COMMONWEALTH of VIRGINIA

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August 15, 2016

VIA ELECTRONIC MAIL
Mr. Jay Stewart
Environmental Manager
BAE Systems, Ordnance Systems, Inc.
Radford Army Ammunition Plant
4050 Pepper's Ferry Road
Radford, Virginia 24141

Re: Second Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning Permit
Radford Army Ammunition Plant, Radford, VA
EPA ID No. VA1210020730

Dear Mr. Stewart:

The Virginia Department of Environmental Quality, Office of Financial Responsibility and Waste Programs (DEQ) has completed the review of the *Response to the First Technical Notice of Deficiency for the Open Burning Ground Renewal Application* (First NOD OBG Response), dated April 29, 2016. The First NOD OBG Response was submitted in response to the First Technical Notice of Deficiency (First NOD), dated February 6, 2016 and subsequent 60 day extension issued on March 6, 2016.

Based on the review of the First NOD OBG Response the DEQ has determined that the majority of the comments raised in the First NOD have been resolved. However, there are deficiencies with the submitted revisions which have been addressed in the attached NOD.

Please review the comments and submit the requested response on a comment by comment basis within 30 days of your receipt of this letter (September 14, 2016). If more time is needed, please contact me at the email address or phone number listed below prior to the expiration of the 30 day deadline.

Please submit the responses to the DEQ in the form of one copy in PDF format and one copy in Microsoft WORD format, electronically attached to an e-mail and submit the responses to the EPA and the DEQ's Blue Ridge Regional Office in the PDF format. Please be advised that the DEQ requires all sections of the application to be in an electronic format, including drawings. The DEQ does not have the capability to copy large drawings, i.e., anything over 11 inches by 17 inches.

If you should have any questions regarding these comments, please contact me at (804) 698-4467 or by email at Ashby.Scott@deq.virginia.gov.

Sincerely,

Ashby R. Scott
Hazardous Waste Permit Writer
Office of Financial Responsibility and
Waste Programs

Attachments:
Notice of Deficiency — Second Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning Permit, Sections 1 through 6

NASA Wallops Appendix D-2 and D-3

QAPP document for the Dominion Virginia Power Ambient Air Monitoring Station

Dominion Virginia Power Air Quality Monitoring Program Quarterly Monitoring Report

cc: Central Hazardous Waste Files
Cassie McGoldrick, EPA, Region III (3LC50)
Rebecca Wright, DEQ, BRRO
Leslie Romanchik, Russ McAvoy, Sonal Iyer, Maria Livaniou, Hasan Keceli, Kurt Kochan, DEQ, CO

Jim McKenna, Radford Army Ammunition Plant

Section 1 of the Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning and Open Detonation Permit, Overall Technical Deficiencies of the Permit Application

General Comments on RAAP OBG Application:

1. Page and section numbers are incorrect across multiple sections. Please reformat the application so that page and section numbers are sequential for easier reference while reviewing.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP acknowledges discrepancies in the numbering of section pages throughout the application. We will correct these discrepancies as revisions are made to each section.

   DEQ Response (1-1) – DEQ will review the revised section numbering when submitted by RAAP. If corrected this will satisfy the comment made.

2. Attachment II.C has had the word "contamination" changed to "impacted or impact to soil". Please provide a justification for this language change.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify Attachment II.C as requested, reverting to the original word of "contamination" in each instance that it was changed to "impacted" or "impact to soil."

   DEQ Response (1-1) – DEQ will review the revised language in Attachment II.C when submitted by RAAP. If corrected according to the comment made this will satisfy the comment made.

Specific Comments for the RAAP Application:

1. **Attachment II.A: Figures II.A-2, II.A-4 and II.A.5 –** Figures II.A-2, II.A-4 and II.A-5 are not at a scale of no more than 200 feet per inch as specified in 40 CFR 270.14(b)(19) and checklist item B-2(a). The facility shall resubmit the figures at the required scale.

   Radford Response (1-1), (Response received on 5/5/2016) – As discussed with the explosive waste incinerator (EWI) permit application, it is not possible (nor practical) to provide one map specifying all of the information required by 40 CFR § 270.14(b)(19). Therefore, this information has been provided on multiple maps. The requirement to provide topographic contours at a scale of no more than 200 feet per inch is satisfied with Figure II.A-3.

   DEQ Response (1-1) – DEQ agrees with the approach to satisfy the regulatory requirement RAAP has made and the comment is now satisfied.

2. **Attachment II.I: Section II.I.1(ii), Page II.I-1 –** The language of Section II.I.1(ii) has been revised to state that no adverse effects to human health or the environment will occur for soils around the OBG in the event of a washout. While Section II.I.4 does describe the procedures to be followed after a washout in the Soil Monitoring Plan (SMP) there is no reference made to this section in Section II.I.1(ii) and simply a blanket statement regarding an assumption of no impact to soils after a washout which cannot be predicted by the facility, only verified by sampling and analysis of the soils after a washout. The language shall be revised to make reference to the requirements of Section II.I.4 or the SMP itself which will be used to verify if an impact to soils has occurred through approved sampling and analysis.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section III.I.1(ii) to make reference to the requirements of Section II.I.4 or the SMP itself, as requested.

   DEQ Response (1-1) – DEQ will review the revised language in Section II.I.1(ii) when submitted by RAAP. If the revised language correct the deficiency noted in the comment it will satisfy the comment made.

3. Attachment II.I: Section II.I.3, Page II.I-2 – Section II.I.3 has been revised to contain the following language:

   "If diesel has already been applied to the pans or if the waste in the pans is considered a Class 1.1 explosive, supervision will evaluate the risks to human health and the environment and will proceed in a manner that will most effectively mitigate these risks."

   The language shall be revised to provide examples of how the supervisor at the OBG will proceed in these specific instances. The examples may be added to Table II.I-1 and the language may be revised to incorporate the reference to the procedures to be used in the Table.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify Section III.I.3 to provide examples of how the supervisor at the OBG will proceed if a precipitation event occurs after diesel has been applied to the pans or in the event that a Class 1.1 explosive has been loaded on the pans. RFAAP will clarify that this is a highly unlikely event but will make sure that procedural considerations have been given to its possible occurrence.

   DEQ Response (1-1) – DEQ will review the revised language in Section III.I.3 when submitted by RAAP. If acceptable the comment will be satisfied.

4. **Attachment II.B, Section II.B.2f, Page II.B-8 –** Section II.B.2f contains the following revision:

"The Group 20 wastes do not ~~It doe not~~ include any listed wastes nor does it ~~exceed any of the limitations on specific constituents set forth in Module III of this permit~~ carry any RCRA codes not authorized by this Permit."

Please provide an explanation as to why the language was modified to describe Group 20 wastes as now being potentially able to include constituents in an amount which will violate the throughput limits on constituents being treated at the OBG. If no satisfactory explanation can be provided to the DEQ the current language in Section II.B.2f will be retained in the condition.

Radford Response (1-1), (Response received on 5/5/2016) – The concentration limits specified in Module III apply on an individual burn basis, not an individual waste group basis. For example, a waste group may have a barium concentration higher than the Module III limit. But, if the total concentration of barium in the burn is less than that specified in Module III, the burn may be performed as configured. Therefore, the statement regarding limitation of Group 20 wastes below the limits specified in Module III is inappropriate.

DEQ Response (1-1) – DEQ accepts the explanation provided by RAAP and the comment is now satisfied.

5. **Attachment II.B, Table 2 –** Table 2, which presented a breakdown of the propellant constituent weight percent's for each waste group, has been removed from the Waste Analysis Plan. The permittee shall revise Section II.B to include Table 2.

Radford Response (1-1), (Response received on 5/5/2016) – Table 2 in Attachment II.B provided a significant level of detail on each waste group that is irrelevant to regulation of that waste group under RCRA. There is no requirement under 40 CFR § 264.13 to provide this level of specification of the waste streams; RCRA only requires that information be obtained that is necessary to store, treat, and dispose of the waste. Examples of this for the OBG would include determination of the waste code and determination of pollutants for which specific permit limits are provided. Furthermore, this analysis need only be maintained in the operating record; it is not required in the waste analysis plan pursuant to 40 CFR § 264.13(b). Therefore, RFAAP does not feel it appropriate to reinstate the table as requested.

In response to DEQ's concern for adequately documenting the expected characterization of each waste stream, RFAAP will develop and maintain onsite a profile of each waste group. Pursuant to Section II.B.5a of Attachment II.B, this profile will identify the hazardous constituents and characteristics necessary for proper designation and management of the waste stream. The profile will also include concentrations of all 40 CFR 261 Appendix VIII (adopted by reference in 9 VAC 20 60 261) constituents in that waste. Every waste profile will be reviewed at least annually in order to confirm that it still accurately represents the waste stream. A waste stream will be re-profiled whenever the Permittees have reason to believe that the process or operation generating the hazardous waste has changed.

DEQ Response (1-1) – DEQ accepts the explanation provided by RAAP and the comment is now satisfied.

6. **Attachment II.B, Tables 3-7 –** Tables 3-7 of Attachment II.B have been removed as they have been replaced by VELAP approved SOPs. Please provide copies of the VELAP certifications and SOPs for these analytical methods for review by DEQ. The certifications and SOPs will not be included in the final permit documents but do need to be reviewed to ensure the methods will satisfy the regulatory requirements for waste analysis.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide copies of the VELAP certifications and SOPs as requested.

   DEQ Response (1-1) – DEQ will review the submitted VELAP and SOP documents when submitted to determine if they satisfy the comment.

7. **Attachment II.B, Section II.B.5a, Page II.B-13 –** Section II.B.5a does not include several metals, and the associated analytical method, from the previous Table 3. The permittee shall revise Section II.B.5a to include the following metals: Antimony, Thallium, Cadmium, Nickel, Silver, Beryllium, Barium, Selenium, Mercury and Arsenic. Please revise the section to include these metals and their associated analytical method.

   Radford Response (1-1), (Response received on 5/5/2016) – The metals specified in Section II.B.5a, Analysis for Compliance, are those metals on which individual concentration limits are established in Module III. The other metals specified in DEQ's comment are only determined for waste profiling analysis. Pursuant to 40 CFR 261, these determinations may be made via either process knowledge or waste analysis. Therefore, analysis for each of the metals specified by DEQ is not necessary. The bulleted list of metals provided in Section II.B.5a, Analysis for Compliance, are determined monthly via waste analysis using the methods specified below the bullet list.

   DEQ Response (1-1) – DEQ accepts the explanation provided but cautions RAAP that the list of metals with established concentration limits in Module III may change depending on the results of the risk assessment and that the list in Section II.B.5a will then need to be updated based on the rationale provided by RAAP.

8. **Attachment II.B, Section II.B.5a, Page II.B-13 –** Please explain the rationale by only reporting Chloride and Perchlorate testing as chloride equivalents instead of reporting them as distinct compounds.

   Radford Response (1-1), (Response received on 5/5/2016) – The waste contains two types of chlorine - inorganic chlorine and organic chlorine as perchlorate. RFAAP has to comply with a concentration limit for total chlorine at the burning ground. Total chlorine (inorganic plus organic) is typically determined by placing a waste in a bomb calorimeter and converting all organic chlorine to chloride prior to performing the chloride analysis via ICP.

Given the nature of RFAAP's wastes, placing a waste sample in a bomb calorimeter is not recommended. Therefore, RFAAP has developed an alternative method to determine total chlorine and comply with the concentration limit presented in our Permit. RFAAP determines inorganic chlorine and perchlorate. The perchlorate measurement is then converted to chloride equivalents to allow comparison with the total concentration limit provided in the Permit. This method of analysis and compliance has been consistent over the life of the Permit.

DEQ Response (1-1) – DEQ accepts the explanation provided by RAAP and the comment is now considered satisfied.

9. **Attachment II.B, Section II.B.4a, Page II.B-10 –** Section II.B.4a regarding waste sampling has been changed to remove the requirement to attach the date the sample was taken from the sampling procedure and instead simply lists the month. This procedure is not adequate to ensure best QA/QC practices as the absence of a date will not allow the permittee to identify the waste which may be out of compliance with the operating limitations in Module III. The language shall be revised to incorporate the labeling of sampling containers with the full date the sample was taken.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP accumulates waste material in satellite accumulation areas and then stores this material on a temporary basis in less than 90 day storage areas. At the time the waste is sent to the area for destruction, it could have been in storage, either via satellite accumulation or temporary storage for over three months. Generally, a sample collection date is assigned to satisfy laboratory holding times. However, as the material is sitting in storage for an extended period of time, any sample date that is assigned to a sample provides an arbitrary representation of the "age" of that sample and is meaningless in determination and evaluation of sample holding time. Furthermore, the sample that is analyzed is reflective of a series of samples collected over the month to form the sample composite, not a single sample collected on a single date. Therefore, RFAAP assigns a sample month to the sample to reflect the month in which the composite sample was collected and allow tracking of the waste that went into each sample. Assigning a date to this composite is not appropriate.

   DEQ Response (1-1) – Please explain how the dating of the waste samples is not appropriate to ensure compliance that the permitted waste groups, with constituents in the ratios dictated by the operating conditions, given there have been violations of the constituent limits for the waste groups treated at the open burning grounds. DEQ requests a more detailed rationale from RAAP and if found unacceptable the previous language will be retained in the permit.

10. **Attachment II.C, Section II.C.1, Page II.C-1 –** Section II.C.1 has been revised to remove the reference to the floodplain standard which requires the removal of hazardous waste from the unit prior to a flood and a comment has been made by RAAP that this citation is incorrect. The DEQ reminds RAAP that the additional language provided in the revised application is applicable to Subpart X units **<u>in addition to</u>** the requirements in the previous

citation of 40 CFR 264.18(b)(1)(i). The language from 40 CFR 264.18(b)(1)(i) shall be restored in a revised submittal of Attachment II.C.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.C.1 as requested.

DEQ Response (1-1) – DEQ will review the revised language in Section II.C.1 when submitted to determine if the comment is satisfied.

11. **Attachment II.C, Section II.C.1, Page II.C-1 –** The language of Section II.C.1 has been revised to the following:

"The analysis of soil samples and subsequent provisions for remediation will, in effect, serve as the way in which the Virginia Department of Environmental Quality (VDEQ) assures that no adverse effects on human health or the environment will result if washout of the area occurs."

This revised language is incorrect as RAAP is the permittee, not DEQ, and is responsible for demonstrating that impacted soils have been removed and remediated according to the plan, which will demonstrate compliance with the floodplain protection standards in event of a washout. The language shall be revised to the previous version or an alternate version which reflects the comment made which will be evaluated for adequacy upon submittal.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise the language in Section II.C.1 as requested.

DEQ Response (1-1) – DEQ will review the revised language in Section II.C.1 when submitted to determine if the comment is satisfied.

12. **Attachment II.C, Section II.C.3.1, Page II.C-3 -** The language of Section II.C.3.1 has been revised to allow for one grab sample instead of the previous two and the combination of NB1 and NB2 into one sampling location. Please either provide a reference to a permit modification which has been approved by the DEQ to allow for this reduced sampling or revise the language to reflect two grab samples will be collected at the two locations NB-1 and NB-2.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP proposed to combine the two sampling locations based on historical data from the many years of soil sampling at the site. RFAAP will prepare a separate submittal that formalizes the request for combining the two site and provides justification necessary to substantiate this request.

DEQ Response (1-1) – DEQ will review the request for combining the two sampling locations, with the proper justification, when submitted to determine if the comment is satisfied.

13. **Attachment II.C, Section II.C.3.2, Page II.C-4 –** Section II.C.3.2 has been revised to remove reference to the Risk Assessment performed upon the initial permit action. While this is not incorrect as a new risk assessment will be performed as part of the permitting process the permittee is reminded that a reference to the new risk assessment will be included in this section and that the COPCs listed in Table II.C-1 may be revised to reflect COPCs identified in the new risk assessment.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP has no objection to incorporating a reference to the new risk assessment once it is completed.

    DEQ Response (1-1) – DEQ will review the revised language in Section II.C.3.2 when submitted after the risk assessment has been completed to determine if the comment is satisfied.

14. **Attachment II.C, Section II.C.3.2, Page II.C-5 –** See Comment 12 regarding reduced grab samples and locations for applicable revised language in Section II.C.3.2.

    Radford Response (1-1), (Response received on 5/5/2016) – As stated in response to Comment 12 above, RFAAP proposed to combine the two sampling locations based on historical data from the many years of soil sampling at the site. RFAAP will prepare a separate submittal that formalizes the request for combining the two site and provides justification necessary to substantiate this request.

    DEQ Response (1-1) – DEQ will review the request for combining the two sampling locations, with the proper justification, when submitted to determine if the comment is satisfied.

15. **Attachment II.C, Section II.C.3.2, Page II.C-6 –** The language of Section II.C.3.2 has been revised as follows:

    "~~Radford AAP~~RFAAP will list each constituent detected above the MDL.~~in soil~~."

    As MDL's can vary by laboratory and analytical procedure, which may not reflect the current achievable MDL for a chemical compound, RAAP will either provide a reference to the permit modification which allows for only constituents reported above the MDL to be reported or will revise the language to the previously permitted version which dictates that all constituents identified in soil sampling will be reported to DEQ.

    Radford Response (1-1), (Response received on 5/5/2016) – The change proposed on Page II.C-6 of Section II.C.3.2 of Attachment II.C was consistent with permit modifications made in 2008 and 2011. The change was made at that time with the intent of clarifying the definition of the word "detected".

DEQ Response (1-1) – DEQ accepts the explanation provided by RAAP and the comment is now satisfied.

16. **Attachment II.C, Section II.C.3.2, Page II.C-6 –** The language of Section II.C.3.2 has been revised to the following:
~~Because~~ 4-~~n~~Nitrophenol has no Region III RSL value., ~~Radford AAP~~RFAAP will analyze for this compound, and if detected above the ~~Reporting Limit~~RL, ~~a site specific risk evaluation will be conducted. The risk evaluation will entail comparing~~the result will be compared to ecological screening level for 4-nitrophenol in soil ~~the result to a~~listed in the June 23, 2000 USEPA memorandum Entitled Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders."

    Please provide the reference to the DEQ approved modification to the current permit which allows for this significantly less stringent screening to be performed in lieu of a site specific risk assessment to be conducted. If no reference can be provided the permittee shall revise the language to the previously approved language which requires the risk assessment.

    Radford Response (1-1), (Response received on 5/5/2016) – The referenced language was not substantially changed from that provided in the prior version of the permit language. The revision provided above was simply made to clarify what was previously a confusing paragraph. Based on conversations with DEQ on March 30, 2016, the language is acceptable as proposed. No additional changes are required.

    DEQ Response (1-1) – DEQ concurs with the explanation provided by RAAP and the comment is now satisfied.

17. **Attachment II.C, Section II.C.3.2, Pages II.C-6 and II.C-7 –** The language of Section II.C.3.2 has been revised to remove the following paragraph and the permittee has added the additional justification language which has been requested to not be included in the final permit:
~~"If ten or more non-carcinogenic COPCs are detected during a single sampling event, the concentrations will be compared to 1/10 of the RBC of those constituents. This comparison is a qualitative evaluation and will have no bearing on the risk evaluation of the site, and will not trigger corrective actions or interim measures at the site.~~

    Justification
    Permit requirements for open burning ground soil sampling, data analysis and response actions are very conservatively set in the existing facility permit and do not reflect several site-specific conditions and realities including the following:

    - *The permit requirements for soil sampling, data evaluation and response actions for the Open Burning Ground OBG assume unprotected site worker exposure to the site soils at EPA and VDEQ default levels of exposure. The reality is that the facility is an active operation and not a closed hazardous waste management unit. As such the* *facility is accessible by authorized personnel only. Authorized personnel are typically site workers who work very limited hours a day on select days a week and not on a regular 40 hour work week schedule. Furthermore, the facility policies and procedures mandate specific personnel exposure limitations (e.g., no eating or drinking in active areas) and require the use of appropriate personal protection equipment that makes routine direct human exposure to site soils practically minimal. The site workers are therefore unlikely to ingest any site soils or have any direct dermal contact, and their removal from the area during pan initiation provide minimal exposure from inhalation. Therefore the very need for an active soil sampling and response actions* ***from the perspective of site worker protection*** *is unnecessary.*

- *Considering the minimal levels of risks to site workers from exposure to site soils,comparison of site soil data to 1/10th action level for non-carcinogens is excessive and unnecessary and provides an unnecessary level of conservatism in the protection of human health and the environment. Furthermore, such comparisons and consequent additional screening and risk assessment of soil data have only one essentially end response action possible, i.e., removal of soil samples. Such action is already required under the permit when any COPC concentration exceeds the actual Action Level.*

~~We therefore~~ RFAAP concludes that the removal of the referenced paragraph from the Permit is well justified and no replacement is necessary. Please remove the above noted justification section if VDEQ concurs."

DEQ does not concur with the removal of the language which requires a site specific risk assessment or the justification RAAP has provided. The fact that the OBG is a currently operating unit, which means the potential for contamination to impact soils and worker health is ongoing, is the very reason why RAAP is required to provide a site specific risk assessment for industrial workers health to ensure the workers are protected at the currently detected levels of contamination in the soils.

Additionally given that the operating conditions in the submitted permit detail that ejected material from the pans will be picked up off the ground and retreated directly refutes RAAP's claim that there is no potential for dermal contact between workers and impacted soils.

The permittee shall revise the section language to include the struck paragraph or DEQ will add in the language while finalizing the draft permit.

Radford Response (1-1), (Response received on 5/5/2016) – During a meeting between the parties on March 31, 2016, several ideas concerning modification of the referenced language were presented. DEQ agreed to evaluate the proposed alternatives and return with a modified request concerning this NOD.

DEQ Response (1-1) – DEQ has reviewed the proposal and drafted alternate language for the condition which addresses RAAP's concerns. The language was sent to RAAP via electronic transmission on May 6, 2016 and no comments have been received by DEQ on the proposed language. Please submit comment on the proposed language with the next response to this comment.

18. **Attachment II.C, Section II.C.4.1, Page II.C-8 –** See Comment 12 regarding revision of NB-1 and NB-2 into one sampling site. Language shall be revised to reflect two distinct sampling locations.

    Radford Response (1-1), (Response received on 5/5/2016) – As stated in response to Comment 12 above, RFAAP proposed to combine the two sampling locations based on historical data from the many years of soil sampling at the site. RFAAP will prepare a separate submittal that formalizes the request for combining the two site and provides justification necessary to substantiate this request.

    DEQ Response (1-1) – DEQ will review the request for combining the two sampling locations, with the proper justification, when submitted to determine if the comment is satisfied.

19. **Attachment II.C, Section II.C.4.2, Pages II.C-8 and II.C-9 –** The language of Section II.C.4.2 has been revised to remove the following paragraph:

    "The contract laboratory will keep a logbook to document the processing steps that are applied to the sample. All sample preparation techniques and instrumental methods must be identified in this logbook. The results of the analysis of all quality control samples should be identified specific to each batch of groundwater samples analyzed. The logbook should also include the time, date, and name of person (and company affiliation if subcontracted) who performed each processing step."

    RAAP has noted in comment RFAAP19 that this condition is covered under the laboratory's VELAP accreditation. Please provide a revised Attachment II.C which includes the current accreditation documents which contains this language for incorporation into the permit.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will reinstate the struck language. However, we request that DEQ recognize that these are minimum requirements and individual laboratory VELAP/QA/QC programs will direct the procedures employed. Clarifying language will be added in this regard.

    DEQ Response (1-1) – DEQ accepts the rational provided by RAAP to satisfy the comment but reminds RAAP that responsibility to ensure contract laboratories are operating at or above the minimum standards in this condition ultimately falls on the facility relying on the laboratory data to ensure compliance with the permit conditions.

20. **Attachment II.C, Section II.C.4.3, Page II.C-9 –** The sampling device referenced in Section II.C.4.3 has been changed from a tulip bulb sampler to a trowel. Please provide a technical justification for this revision.

    Radford Response (1-1), (Response received on 5/5/2016) – The referenced change was made to be consistent with more modern sampling techniques. Based on conversations with DEQ on March 30, 2016, the language is acceptable as proposed. However, for clarification and consistency with the ASTM standard, the sampling device will be changed to reference "a stainless steel sampling device able to collect an undisturbed soil sample."

    DEQ Response (1-1) – DEQ accepts the explanation provided by RAAP and the comment is now satisfied.

21. **Attachment II.C, Section II.C.4.3, Page II.C-9 –** The language has been revised to remove the words "at each burn pad" from the description of the measurement of the sampling locations. The language shall be revised to incorporate these words as it may seem like RAAP is not required to sample at each burn pad otherwise.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise and reinstate "at each burn pad" in Section II.C.4.3 where requested.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.C.4.3 when submitted by RAAP and determine if the comment is satisfied.

22. **Attachment II.C, Section II.C.4.4, Page II.C-10 –** The reference to SW-846 test methods has been removed. The language shall be revised to reflect the inclusion of SW-846 methods and VELAP approved methods for testing.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will make the requested revision to Section II.C.4.4.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.C.4.4 when submitted by RAAP and determine if the comment is satisfied.

23. **Attachment II.C, Section II.C.4.5, Pages II.C-11 through 13 –** The submitted Section II.C.4.5 has been revised to be significantly less stringent in regards to sample COC requirements and analysis reports to be sent and maintained at RAAP for review by inspectors to ensure compliance with the COC requirements of this permit. While RAAP has indicated in Comment RFAAP21 that the revisions were included to reflect the groundwater SAP that does not allow the COC requirements for the SMP to become less restrictive than already permitted. The language shall be revised as follows or the permittee may submit a revision which incorporates all of the current and proposed requirements:

"The soil monitoring program incorporates a COC program to track the custody of the samples from time of collection, to shipment to and receipt at the laboratory. The monitoring of sample possession from field sampling to laboratory analysis is important in the event that unexpected laboratory lab results occur and the documentation of sample possession can be evaluated.
This documentation contains several records and logs that assist in the quality control of the program.

Sample labels are used to prevent misidentification of samples. The labels are completed and affixed to the sample containers prior to field sampling. COC control for all samples will consist of the following:

1. *Labels will be placed on individual sample containers while sampling containing the following information:*
   - *Sample identification number*
   - *Name of sampler (initials)*
   - *Date and time of sample collection*
   - *Sampling location*
   - *Constituents to be analyzed.*

Additionally, sample custody seals affixed over each shipping cooler should be used when a common carrier transports the sample shipment to the laboratory. These seals ensure that the samples have not been disturbed during transportation. The sample custodian sample identification name and date will be included on the custody sample seal.

2. *A custody seal should be placed on the shipping container or on the individual sample bottles. Custody seals provide prevention or easy detection of sample tampering. The custody seal should bear the signature of the collector and the date signed. The custody seal can be placed on the front and back of a cooler, around the opening of a polyethylene overpack bag or on the lid of each sample container.*

3. *No sample should be brought back to the laboratory for preservation. It is recommended that two polyethylene overpack bags be used in shipping.The first will contain the sample bottles, the second the ice needed to keep history of the samples should be maintained as a QC measure. Upon receipt of the shipment, the laboratory should record the temperature on the COC. The method holding time is defined by the analytical method and listed in Table II.C-3. Holding time refers to the period from sample collection to sample extraction and/or analysis.*

4. *A COC record should be completed and should accompany every sample shipment. The COC record should contain enough copies so that each person possessing the shipment receives his/her own and should be designed to allow the Permittee to reconstruct how and under what circumstances a sample was collected, including any problems*

encountered. An example of a COC form that includes the necessary information is included as Attachment II.C-A.

5. *Samples will be packaged and labeled for shipment in compliance with current U.S. Department of Transportation regulations. All samples will be shipped priority/overnight via commercial carrier or hand delivered to the laboratory.*

6. *Samples will arrive at the laboratory via the overnight delivery service or hand delivery. Upon delivery to the laboratory, the ice chests will be checked for intact custody seals and the samples will be unpacked and the information on the accompanying COC records will be examined. If the samples shipped match those described on the COC form, the laboratory sample coordinator will sign the form and assume responsibility for the samples. If problems are found with the sample shipment, the laboratory sample custodian will sign the form and record the problems in the "remarks" section.*

7. *Any missing samples, missing sample tags, broken sample bottles, or unpreserved samples will be noted on the COC record. If there are problems with individual samples, the sample custodian will inform the laboratory coordinator of such problems. The laboratory custodian will then contact the Permittee to determine a viable solution to the problem.*

8. *All information relevant to the sample will be secured at the end of each business day. All samples will be stored in a designated sample storage refrigerator, access to which will be limited to laboratory employees.*

The completed form COC is returned to RFAAP included with the certificate of analyses (i.e., laboratory report package), for each Unit. An example chain-of-custody form is included in Appendix II.C-A. The sample possession is established from time of collection to the time of analysis. This record The COC contains the following information:

- *Sample identification and location*
- *Signature of sampler*
- *Date and time of sampling*
- *Sample type*
- *Identification*
- *Number of containers*
- *Required analysis*
- *Signatures of person(s) involved in possession*
- *Times and dates of possession*
- *Method of transportation*
- *Tracking number from transporter*
- *Statement for packing on ice*
- *Temperature during shipment (min & max)*
- *Internal temperature of shipping cooler (or sample containers) upon arrival at Laboratory*

A sample analysis request sheet can further clarify the samples for each requested constituent. This additional check sheet will be utilized when necessary (i.e., beginning of a new contract with a new laboratory). This sheet sent along with the samples will contain the following information:

- *Name of person receiving samples*
- *Laboratory sample number*
- *Date of sample receipt*
- *Analysis to be performed*
- *Internal temperature during shipping."*

Radford Response (1-1), (Response received on 5/5/2016) – During a meeting between the parties on March 30, 2016, RFAAP explained that the COC requirements may vary depending on the laboratory performing the analysis. However, RFAAP agreed that general COC requirements can be specified that would be required at a minimum for all projects. Therefore, RFAAP will revise the referenced language to incorporate the minimum COC requirements for any sampling event and to reference laboratory VELAP QA/QC programs for further specification of requirements.

DEQ Response (1-1) – DEQ will review the revised language of Section II.C.4.5 when submitted by RAAP and determine if the comment is satisfied.

24. **Attachment II.C, Section II.C.6.2, Pages II.C-15 and II.C-16 –** As noted in Comment 19 please provide the QA/QC documentation required by the VELAP accreditation which is replacing the equivalent language in this section for inclusion into the permit language as an appendix to be referenced in Section II.C.6.2.

    Radford Response (1-1), (Response received on 5/5/2016) – Including specific QA/QC documentation from a specific contract laboratory in the Permit restricts RFAAP to use to that contract laboratory for all future analyses. Given that each VELAP accredited laboratory is required to have a QA/QC plan and that plan is reviewed, approved and deemed adequate for regulatory analysis by DCLS, there should be no need to include the documentation in the Permit. Simply making reference that QA/QC should be performed according to the VELAP-approved QA/QC program for each laboratory should be sufficient.

    DEQ Response (1-1) – DEQ has reviewed RAAP's rationale and requests that language stating the QA/QC plans for each VELAP accredited laboratory be maintained at the facility for review by DEQ inspectors be added to Section II.C.6.2.

25. **Attachment II.C, Section II.C.7.2.2, Page II.C-18 –** Section II.C.7.2.2 has been revised to change the word shall into the word should. The language shall be revised back to include the word shall and remove the word should as should is not a legally enforceable term for a permit condition.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.C.7.2.2 as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section II.C.7.2.2 when submitted by RAAP and determine if the comment is satisfied.

26. **Attachment II.C, Section II.C.7.2.3, Page II.C-18 –** The language of Section II.C.7.2.3 has been revised to significantly modify the procedures to be used to identify data outliers. As data outliers may not just indicate improper sampling and analysis procedures and may indicate a spike in contaminated soil not previously identified this language shall be revised to the previous language included in the Permittee's current permit.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will reinstate struck language as requested.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.C.7.2.3 when submitted by RAAP and determine if the comment is satisfied.

27. **Attachment II.C, Section II.C.7.2.1, Page II.C-19 –** Section II.C.7.2.1 contains language referencing the changes in Section II.C.7.2.3 regarding treatment of outliers. As this language has been found to be deficient by the DEQ the language of Section II.C.7.2.1 shall be revised to the previous language contained in the Permittee's current permit.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will reinstate the previous language as requested.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.C.7.2.1 when submitted by RAAP and determine if the comment is satisfied.

28. **Attachment II.C, Section II.C.7.3.6, Page II.C-19 –** Section II.C.7.3.6 has revised the word possible into practical. The language shall be revised to include the word possible as practical is not a synonym of possible and verification sampling is not to be restricted to when it shall be convenient for the permittee to conduct it.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.C.7.3.6 as requested.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.C.7.3.6 when submitted by RAAP and determine if the comment is satisfied.

29. **Attachment II.C, Section II.C.7.8, Page II.C-17 –** Section II.C.7.8 has been revised to change the deadline to submit a modification request to DEQ from 90 days to "the duration specified by VDEQ". Please note that this duration was previously specified in the permit language and is 90 days. The language of the condition shall be revised to reflect the 90 day deadline requirement.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will reinstate the 90 day requirement in Section II.C.7.8.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.C.7.8 when submitted by RAAP and determine if the comment is satisfied.

30. **Attachment II.C, Table C.II-1 -** There are multiple constituents which have been removed from Table C.II-1. Please provide a reference for the permit modification which has been approved by DEQ to remove these constituents or submit a revised table which includes the struck constituents.

    Radford Response (1-1), (Response received on 5/5/2016) – Attachment II.C.3.3 of the permit allows opportunity to modify the sample locations and/or constituent list. Most of the constituents proposed for removal have not been detected at or above the RL since 2005. RFAAP will provide a separate submittal that summarizes the historical data for each removed pollutant and justifies the basis for removal.

    DEQ Response (1-1) – DEQ will review the separate submittal and make a determination on whether the proposed changes are appropriate based on the justification and supporting sampling data.

31. **Attachment II.C, Table C.II-2 –** The links to the current RSL table used for the TEQ values are not functioning in the footnote of Table C.II-2. Please revise the web addresses to the functional links.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will correct the web addresses for the RSL table in Table C.II-2.

    DEQ Response (1-1) – DEQ will review the revised web address in Table C.II-2 when submitted by RAAP and determine if the comment is satisfied.

32. **Module III, Section III.B.2, Pages III-1 through III-3 –** While RAAP has commented that because of the Human Health and Ecological Risk Assessment the throughput and maximum constituent concentrations in the waste have been removed, the amount of diesel fuel required for a skid burn has also been removed from the submitted language. If the removal of the amount of diesel fuel to be required per burn is anticipated to be adjusted from the results of the risk assessment the removal may stand as a place holder for a revised

throughput limit on diesel per burn. If not then the operating limit must be returned to the permit language.

Radford Response (1-1), (Response received on 5/5/2016) – Diesel fuel is not a hazardous waste and, therefore, regulation of the amount of diesel fuel burned at the facility is not a matter of RCRA limitation. The diesel fuel emissions from the OBG are accounted for and reported to DEQ's Air Division. Implementation of a diesel fuel limit under the RCRA program is not appropriate.

DEQ Response (1-1) – DEQ accepts the explanation provided by RAAP and the comment is now satisfied.

33. **Module III, Section III.D, Page III-5 –** The submitted language of Section III.D has removed references to the analytical test methods which will be performed on the ash residue in order to determine if it is hazardous. The language shall be revised to incorporate the analytical methods which will be performed on the ash to make the determination. RAAP may use the site-specific methods which have been approved by VELAP after they have been reviewed by DEQ for technical adequacy.

    Radford Response (1-1), (Response received on 5/5/2016) – As discussed with DEQ during our March 30, 2016, meeting, the only analytical method removed from Section III.D appears to be the reference to SW846 Method 8330. This method is not being used to determine energetic content of the ash residue. The internal reactivity procedure described in the Waste Analysis Plan (and referenced in this section) is being used to determine whether the waste is hazardous for reactivity. Therefore, inclusion of the Method 8330 reference is not appropriate.

    DEQ Response (1-1) – DEQ concurs with the explanation provided by RAAP and the comment is now satisfied.

34. **Module VII, Pages V.II-1 through V.II-17 –**The submitted groundwater corrective action program does not contain any figures, tables or language which delineates the extent of the contaminant plumes for perchlorate and carbon tetrachloride, identifies the concentrations of the constituents in the plume or delineates the vertical extent of the plume. The section shall be revised to incorporate this information.

    Radford Response (1-1), (Response received on 5/5/2016) – The referenced figures and tables were inadvertently omitted from the permit application. RFAAP will add the information requested.

    DEQ Response (1-1) – DEQ will review the figures and tables when submitted by RAAP and determine if the comment is satisfied.

35. **Module IV, Attachment IV.A, Section II.A, Pages IV.A-12 and IV.A-12 –** Section II.B of Attachment IV.A has been removed and a comment has been made that the QA/QC procedures are no longer applicable since the methods used are all VELAP certified. Please provide the VELAP approved method documentation which specifies the QA/QC procedures to be followed. These QA/QC procedures will then be incorporated into the permit as an appendix to Attachment IV.A and updated as needed by permit modification if the methods are changed.

    Radford Response (1-1), (Response received on 5/5/2016) – Including specific QA/QC documentation from a specific contract laboratory in the Permit restricts RFAAP to use to that contract laboratory for all future analyses. Given that each VELAP accredited laboratory is required to have a QA/QC plan and that plan is reviewed, approved and deemed adequate for regulatory analysis by DCLS, there should be no need to include the documentation in the Permit. Simply making reference that QA/QC should be performed according to the VELAP-approved QA/QC program for each laboratory should be sufficient.

    DEQ Response (1-1) – DEQ has reviewed RAAP's rationale and requests that language stating the QA/QC plans for each VELAP accredited laboratory be maintained at the facility for review by DEQ inspectors be added to Section II.A.

36. **Module IV, Attachment IV.A, Section II.A, Page IV.A-12 –** The language of the permit has been revised to read as follows:

    "All analyses must be conducted by a laboratory that is VELAP accredited for the analytical method, matrix and target analyte (where applicable)."

    The words "as applicable" are not consistent with the VELAP certification requirement for facilities using laboratory data to certify compliance with relevant permit conditions. All methods used must be VELAP certified in order to be considered valid analytical results for compliance with a DEQ issued permit condition. The language shall be revised to remove the words "as applicable" from the statement.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will remove the phrase "where applicable" from Section II.A of Attachment IV.A.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.A when submitted by RAAP and determine if the comment is satisfied.

37. **Module IV, Attachment IV.A, Appendix 6, Section B, Page IV.A-24 –** The last sentence in section B of Appendix 6 has been revised as follows:
    "Any elimination of an outlier ~~must be approved by the Department.shall~~ be properly documented and its basis for exclusion noted."

Exclusion of data outliers without DEQ approval and simply noting the exclusion is not consistent with standard statistical procedures. The language shall be changed to reflect the original statement included in the permit.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will restore the language in Section B of Attachment IV.A, Appendix 6, as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section B of Attachment IV.A, Appendix 6 when submitted by RAAP and determine if the comment is satisfied.

38. **Module II, Attachment II.H, Section II.H.4m Pages II.H-2 and II.H-3 –** Section II.H.4m has been revised to remove the specifications of the fencing which acts as a barrier to control entry into the facility. Please revise the section to include language which references the national security policy which excludes the information from being included in the permit condition.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add the requested information to Section II.D.1.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.D.1 when submitted by RAAP and determine if the comment is satisfied.

39. **Module II, Attachment II.D, Section II.D.1, Page II.D-1 –** Section II.D.1 as submitted has removed language referring to the inspection checklists and the checklists themselves. While the checklists are not required to be included in the final permit document they do need to be submitted for review by the DEQ to determine if they are sufficient to demonstrate compliance with the inspection requirements in this permit. Please submit the checklists with the revised application for review by the DEQ.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide the requested information as confidential business information with the understanding that the checklists will not be incorporated to the Permit.

    DEQ Response (1-1) – DEQ has reviewed the checklists and the comment is now satisfied.

40. **Module II, Attachment II.D, Table II.D.1, Page II.D-5 –** Table II.D.1 has been revised to remove items of Personal Protective Equipment, Respirators, Air Compressors, Portable Pumps, Facility Barricades, Flashing Red Lights and Facility Signs which are required to be inspected by this permit. Please provide a technical justification as to why these items were removed from the inspection schedule other than the one provided in Comment RFAAP4 as this comment is not a sufficient justification for removal of the items.

    Radford Response (1-1), (Response received on 5/5/2016) – The items that were removed from Table II.D.1 were either not necessary for operation of the OBG or were associated with the incinerator area and simply copied into this Permit as a matter of error. The items remaining in Table II.D.1 reflect those necessary to ensure compliant operation of the OBG.

DEQ Response (1-1) – DEQ accepts the rationale provided by RAAP and the comment is now satisfied.

41. **Module II, Attachment II.F, Table II.F-1 -** Table II.F-1 does not contain a reference to the specific policy which requires the names, home phone numbers and home addresses of the emergency coordinators to be withheld. Please revise the notation below the table to include a reference to the specific policy documents which does not allow for this information to be included.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add the requested information to Table II.F-1.

    DEQ Response (1-1) – DEQ will review the revised Table II.F-1 when submitted by RAAP and determine if the comment is satisfied.

42. **Module II, Attachment II.F, Section II.F.6b.ii, Pages II.F-9 through II.F-10 –** The language of Section II.F.6b.ii is not consistent with what is required by 40 CFR 264.56 regarding reporting of an incident which involves the implementation of the contingency plan. The language on Pages II.F-5 and II.F-6 shall be revised to the following:

    "The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within 15 days after the incident, he must submit a written report on the incident to the Regional Administrator. The report must include:

    (1) Name, address, and telephone number of the owner or operator;

    (2) Name, address, and telephone number of the facility;

    (3) Date, time, and type of incident (e.g., fire, explosion);

    (4) Name and quantity of material(s) involved;

    (5) The extent of injuries, if any;

    (6) An assessment of actual or potential hazards to human health or the environment, where this is applicable; and

    (7) Estimated quantity and disposition of recovered material that resulted from the incident."

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.F.6b.ii as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section II.F.6b when submitted by RAAP and determine if the comment is satisfied.

43. **Module II, Attachment II.F, Section II.F.2c, Pages II.F-6 through II.F-8 –** Section II.F.2c of attachment has been revised to remove the waste description and corresponding waste codes from the permit language. As the contingency plan is supposed to be a standalone document the section shall be revised to include the following struck language:

"These wastes include the following:

1. *Wastes which exhibit only the following hazardous characteristic(s):*

   a. *Reactivity (hazardous waste number D003) as specified in 9 VAC 20-60-261; 40 CFR Part 261.23;*

   b. *Reactivity (hazardous waste number D003) as specified in 9 VAC 20-60-261; 40 CFR 261.23 and the characteristic of toxicity, as specified in 9 VAC 20-60-261; 40 CFR 261.24, for one of the following constituents:*

      i. *Lead (hazardous waste number D008);*

      ii. *2,4-Dinitrotoluene (hazardous waste number D030); and/or*

      iii. *Barium (hazardous waste number D005)*

   c. *Ignitability (hazardous waste number D001) as specified in 9 VAC 20-60-261; 40 CFR 261.21. Ignitable wastes are limited to clean up residue of propellant ingredients. Ignitable wastes are mixed with sawdust and are not a liquid when brought to the permitted treatment and storage area.*

2. *Wastes which are not listed pursuant to 9 VAC 20-60-261; 40 CFR 261.31, 32,and 33; and*

3. *Wastes which are one of the following (as identified in the Waste Analysis Plan):*

   a. *Off-specification propellants and propellant intermediates, generated at the facility;*

   b. *Load, assemble and pack waste, consisting of energetic materials from assembling cartridges;*

   c. *Specialty product wastes containing propellant with nitrocellulose, nitrate esters, nitroguanidine, solid explosives, and one of the following combinations of additional materials:*

i. *40 CFR 261 Appendix VIII constituents (D003)*

ii. *40 CFR 261 Appendix VIII constituents, chlorides and/or perchlorates (D003)*

iii. *40 CFR 261 Appendix VIII constituents and/or metals (D003, D004-D010)*

d. *Other miscellaneous waste, described in Module II, Attachment II.B, Appendix II.B-1, Table I, as one of the following:*

i. *Ignitable and reactive liquids in sawdust (D001, D003)*

ii. *Off-specification dinitrotoluene, trinitrotoluene, or Isotriol"*

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.F.2c to include a summary of the managed wastes consistent with the description provided in the Waste Analysis Plan.

DEQ Response (1-1) – DEQ will review the revised language of Section II.F.2c when submitted by RAAP and determine if the comment is satisfied.

44. **Module II, Attachment II.F, Section II.F.5, Page II.F-12 –** Section II.F.5 references safeguards in place to prevent a fire or explosion of the reactive hazardous waste but does not provide any examples of these safeguards. The section shall be revised to incorporate some examples of these safeguards so they may be evaluated for technical adequacy.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.F.5 as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section II.F.5 when submitted by RAAP and determine if the comment is satisfied.

45. **Module II, Attachment II.F, Section II.F.5b, Pages II.F-12 through II.F-13 –** Section II.F.5b references standard operating procedures which guide emergency response staff to prevent the recurrence or spread of fires, explosions and release but does not list any supplemental appendices or attachments which detail these procedures. Table 1 and Appendix A which have been struck out from the submitted application contained the Emergency Procedures and RFAAP Disaster Control Plan and Plant Protection Plan respectively. The permittee shall revise the application to include the applicable portions of these plans as they apply to the OBG operations.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.F.5b as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section II.F.5b when submitted by RAAP and determine if the comment is satisfied.

46. **Module II, Attachment II.F, Section II.F.6d, Page II.F-7 –** The title of Item 7 of Section II.F.6d has been revised from *Storage and Treatment of Release Material* to *Accumulation and Treatment of Release Material.* The permittee shall revise the item title to the previous language to make it consistent with the wording in the regulatory requirements of 40 CFR 264.56(g).

    Radford Response (1-1), (Response received on 5/5/2016) – As no permitted storage areas are provided at the OBG or within the confines of this permit, referencing storage of hazardous waste seemed inappropriate. The title was changed to reflect the activities included in this Permit. RFAAP will add clarifying language to this regard in Section II.F.6d.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.F.6d when submitted by RAAP and determine if the comment is satisfied.

47. **Module II, Attachment II.F, Section II.F.7 –** Section II.F.7 and Table 2 reference the copies of the mutual aid agreement being kept on-site but copies of the agreements were not submitted with the application. The permittee shall submit copies of the agreements for evaluation by DEQ.

    Radford Response (1-1), (Response received on 5/5/2016) – Copies of the agreements will be provided for DEQ's review. However, consistent with the EWI Permit, we do not expect the actual agreements to be included in the Permit.

    DEQ Response (1-1) – DEQ will review the Mutual Aid Agreements when submitted and the comment will be satisfied once a determination of technical adequacy is made.

48. **Module II, Attachment II.F, Section II.F.8 –** Section II.F.8 does not contain a description of the signals to be used to indicate an evacuation of the OBG. The permittee shall revise the section to contain a description of the signals used.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.F.8 as requested.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.F.8 when submitted by RAAP and determine if the comment is satisfied.

49. **Module II, Attachment II.E, Table II.E-1 –** Table II.E.1 does not contain the names of staff which currently hold the job described. The table shall be revised to incorporate this information.

Radford Response (1-1), (Response received on 5/5/2016) – As explained with other sections of the Permit, National Security policy prohibits the inclusion of names of personnel in the Permit to protect the security of the facility and the personnel holding those positions. RFAAP will add a reference to this policy as has been done with other sections of the application.

DEQ Response (1-1) – DEQ accepts the rationale provided by RAAP and will determine if the comment is satisfied once the revised language in Table II.E.1 is submitted.

50. **Module II, Attachment II.E, Section II.E.7 –** Section II.E.7 has been revised to remove the standard operating procedures for the open burning ground operations. The section shall be revised to include the language as it is required to demonstrate the training program is adequate.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.E.7 to include the introductory paragraph regarding standard operating procedures (SOPs). However, inclusion of the bulleted list of procedure sections is overly burdensome, as it would require a permit modification every time the procedure is modified, even in the case that the title of the section is slightly modified or the procedure renumbered. To ensure that the SOP addresses all necessary areas of unit operation, RFAAP will provide DEQ a copy of the SOP to review as part of the permitting process. This copy will be submitted as confidential business information (CBI).

    DEQ Response (1-1) – DEQ accepts the rationale provided by RAAP and will determine if the comment is satisfied once the SOPs have been submitted for review.

51. **Module II, Attachment II.E, Section II.E.9 –** Section II.E.9 does not provide a demonstration that the training director is trained in hazardous waste management procedures. The section shall be revised to incorporate language which provides this demonstration.

    Radford Response (1-1), (Response received on 5/5/2016) – The information provided herein is identical to that provided with and approved for the EWI RCRA permit application. Based on clarifications provided by DEQ during our meeting on March 30, 2016, we will revised the introduction to this section to indicate that the training director ensures that the specified criteria is satisfied.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.E.9 when submitted by RAAP and determine if the comment is satisfied.

52. **Module II, Attachment II.G, Section II.G.4a , Page II.G-10 -** Section II.G.4a subpart (c) contains inapplicable citations for closure of a tank system and an incinerator. While DEQ recognizes the language was most likely mirrored from RAAP's EWI permit the corrected language which follows shall be submitted as a revision by the permittee:

"(c) Complies with the closure requirements of 9 VAC 20-60-264; 40 CFR 264 Subpart G, and 264.601 through 264.603."

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.G.4a as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section II.G.4a when submitted by RAAP and determine if the comment is satisfied.

53. **Module II, Attachment II.G, Section II.G.4b , Pages II.G-11 and II.G-12 -** The text of Section II.G.4b has been revised to reflect that only three closure options are available from the previous four and has combined clean and risk based closure into one option. The permittee is reminded that clean closure and risk based closure are two separate closure standards and that the revised text is technically incorrect in its assumption that these standards are the same. The text shall be revised to reflect there are four distinct closure options for the OBG.

    Radford Response (1-1), (Response received on 5/5/2016) – The language of Section II.G.4b is identical to that provided with and approved for the EWI RCRA permit application. Based on conversations with DEQ during our meeting on March 30, 2016, this section will be modified to be more specific for the OBG since the potential for site contamination is greater. RFAAP will make changes accordingly.

    DEQ Response (1-1) – DEQ will review the revised language of Section II.G.4b when submitted by RAAP and determine if the comment is satisfied.

54. **Module II, Attachment II.G, Section II.G.4b , Pages II.G-11 and II.G-12 -** The language in Section II.G.4b regarding the closure options has been significantly revised from the previous permit language and does not accurately reflect the closure options and required actions which will be necessary to close the OBG. Options for closure are "clean closure" for both solids and groundwater or a "hybrid" where either soils or groundwater meet the "clean closure" standard, but the other media does not. In either of these cases the permittee must perform closure and post-closure care as a landfill and obtain a post-closure care permit. The language shall be revised to remove the closure options and detail the available routes of closure, either clean closure or closure as a landfill with the required monitoring.

    Radford Response (1-1), (Response received on 5/5/2016) – The language of Section II.G.4b was revised to be essentially identical to that provided with and approved for the EWI RCRA permit application. Based on conversations with DEQ during our meeting on March 30, 2016, this section will be modified to be more specific for the OBG since the potential for site contamination is greater. RFAAP will make changes accordingly.

DEQ Response (1-1) – DEQ will review the revised language of Section II.G.4b when submitted by RAAP and determine if the comment is satisfied.

55. **Module II, Attachment II.G, Table II.G-1 –** There are multiple constituents which have been removed from Table II.G-1. Please provide a reference to the permit modification which was approved by the DEQ or revise the table to include the constituents in the previously approved permit.

    Radford Response (1-1), (Response received on 5/5/2016) – Table II.G-1 was revised based upon the multitude of current soil and groundwater monitoring data available on the site, as well as information available on the materials present in or expected to be formed from the combustion of the managed wastes. The original table was developed prior to the availability of this information and, therefore, was highly speculative in nature. To support the proposed removal of each constituent, RFAAP will prepare a summary of this historical data and provide justification for each constituent.

    DEQ Response (1-1) – DEQ will review the justification provided when submitted by RAAP and determine if the rationale provided is acceptable and if comment is satisfied.

56. **Module II, Attachment II.G, Section II.G.5c, Pages II.G-16 through II.G-18 -** The permittee has removed the language in Section II.G.5c which references the evaluation of surface and subsurface impact and has replaced it with a reference to the SMP in Attachment II.C. The permittee is reminded that DEQ has specifically stated that the requirements of the SMP cannot be used as a substitute for sampling for closure of the unit. The permittee shall revise the language in Section II.G.5c to the language of the previously approved permit.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP consolidated the language in the first paragraph of this section, combining two sentences. The previous version of the paragraph also referenced the soil monitoring plan (SMP) in Attachment II.C for the methodologies and procedures that would be employed. The remaining paragraphs were deleted, as they duplicated language provided in the referenced SMP (refer to SMP Section II.C.3.1 - "Sample Locations" and Section II.C.9.1 - "Hot Spot Evaluation and Soil Removal" for similar descriptions). (The original closure plan was developed prior to the SMP. When the SMP was developed, it pulled language from the closure plan). In discussions with DEQ on March 30, 2016, it was agreed that the language can remain as proposed provided that the paragraph beginning with "Prior to…" be added back to the referenced section.

    DEQ Response (1-1) – DEQ accepts the rationale provided by RAAP and will review the revised language in Section II.C.3.1 when submitted to determine if the comment is satisfied.

57. **Module II, Attachment II.G, Section II.G.5e, Page II.G-18 –** The following sentence has been removed from Section II.G.5e*:*

"Additional constituents may be added to the analyses at the time of closure, pending VDEQ approval."

The language shall be revised to include this sentence as it is standard in all closure plans and ensures that additional constituents may be evaluated as needed.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section II.G.5e as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section II.II.G.5 when submitted by RAAP and determine if the comment is satisfied.

Section 2 of the Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning and Open Detonation Permit, Technical Deficiencies of the Groundwater Modules of the Permit Application

1. **Module IV, Section IV.D.3.a, Page IV-5 –** The permittee has revised the following language:

   "Background groundwater quality for a new monitoring parameter or constituent shall be based on data from quarterly sampling of 13MW2 obtained over the course of for one year. Optionally, the facility may collect quarterly background data from 13MW1 at their discretion to obtain a more robust background dataset. In this case, the background dataset would be one year's worth of data from the combination of wells 13MW1 and 13MW2. Existing data may be used to establish background concentrations provided it is of sufficient quality."

   The DEQ concurs with the revisions with the exception of the language which allows the additional background sampling from 13MW1 to be optional, not requiring DEQ approval before sampling proceeds and the frequency of sampling. The language shall be revised as follows:

   "Background groundwater quality for a new monitoring parameter or constituent shall be based on data from quarterly sampling of 13MW2 obtained over the course of for one year. In addition, the facility may collect quarterly background data from 13MW1 following approval from the DEQ, to obtain a more robust background dataset. In this case, the background dataset would be one year's worth of quarterly data from well 13MW1 and supplemental data from 13MW2. ~~Optionally, the facility may collect quarterly background data from 13MW1 at their discretion to obtain a more robust background dataset. In this case, the background dataset would be one year's worth of data from the combination of wells 13MW1 and 13MW2.~~ Existing data may be used to establish background concentrations provided it is of sufficient quality."

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section IV.D.3.a as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section IV.D.3 when submitted by RAAP and determine if the comment is satisfied.

2. **Module V, Section V.B.1, Page V-5 –** The permittee has revised the following language in section V.B.1:

"V.B.1. Groundwater Monitoring System
Groundwater beneath ~~HWMU-13~~OBG shall be monitored with one (1) upgradient background groundwater monitoring well, ~~five~~ three (~~5~~3) downgradient point of compliance wells, and ~~one~~ three (~~1~~3) downgradient plume monitoring well located as specified on the maps presented in Figures V.A.3 and V.A.4 of ***Permit Attachment V.A****. Monitoring well 13MW-2 is located upgradient of the unit and will serve as the background well for the OBG. Monitoring wells 13MW-3, 13MW-4, ~~13MW-5, 13MW-6~~ and 13MW-7 are located downgradient of the unit and will serve as the point of compliance wells. Monitoring wells 13MW5, 13MW6, and 13MW-8 ~~is~~ are the downgradient plume monitoring wells for the unit. In addition, well 13MW-1 will be used as a piezometer to measure static groundwater elevations during each sampling event. Optionally, the facility may collect background data from 13MW1 at their discretion."*

The DEQ concurs with the revisions with the exception of the language which allows the additional background sampling from 13MW1 to be optional and not requiring DEQ approval before sampling proceeds. The language shall be revised as follows:

"V.B.1. Groundwater Monitoring System
Groundwater beneath ~~HWMU-13~~OBG shall be monitored with one (1) upgradient background groundwater monitoring well, ~~five~~ three (~~5~~3) downgradient point of compliance wells, and ~~one~~ three (~~1~~3) downgradient plume monitoring well located as specified on the maps presented in Figures V.A.3 and V.A.4 of ***Permit Attachment V.A****. Monitoring well 13MW-2 is located upgradient of the unit and will serve as the background well for the OBG. Monitoring wells 13MW-3, 13MW-4, ~~13MW-5, 13MW-6~~ and 13MW-7 are located downgradient of the unit and will serve as the point of compliance wells. Monitoring wells 13MW5, 13MW6, and 13MW-8 ~~is~~ are the downgradient plume monitoring wells for the unit. In addition, well 13MW-1 will be used as a piezometer to measure static groundwater elevations during each sampling event. Further, the facility may collect background data from 13MW1 following approval from the Department.~~Optionally, the facility may collect background data from 13MW1 at their discretion"~~*

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section V.B.1 as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section V.B.1 when submitted by RAAP and determine if the comment is satisfied.

3. **Module V, Section V.D.1.c, Page V-7 –** The permittee has revised the following language in section V.D.1.c:

*"c. Background concentrations established at the time of permit issuance are listed in **Permit Attachment V.C**. For any newly detected hazardous constituents, background values shall be established in accordance with 40 CFR 264.97(g) and as specified in **Permit Attachment IV.A, Appendix 6**. ~~Background groundwater quality for a constituent or monitoring parameter shall be based on at least four (4) data points collected at background monitoring well(s) during a period not exceeding one (1) year.~~ Background groundwater quality for a new monitoring parameter or constituent shall be based on data from quarterly sampling of 13MW2 obtained over the course of one year. Optionally, the facility may collect quarterly background data from 13MW1 at their discretion to obtain a more robust background dataset. In this case, the background dataset would be one year's worth of data from the combination of wells 13MW1 and 13MW2. Existing data may be used to establish background concentrations provided it is of sufficient quality."*

The DEQ concurs with the revisions with the exception of the language which allows the additional background sampling from 13MW1 to be optional, not specifying the sampling frequency and not requiring DEQ approval before sampling proceeds. The language shall be revised as follows:

*"c. Background concentrations established at the time of permit issuance are listed in **Permit Attachment V.C**. For any newly detected hazardous constituents, background values shall be established in accordance with 40 CFR 264.97(g) and as specified in **Permit Attachment IV.A, Appendix 6**. ~~Background groundwater quality for a constituent or monitoring parameter shall be based on at least four (4) data points collected at background monitoring well(s) during a period not exceeding one (1) year.~~ Background groundwater quality for a new monitoring parameter or constituent shall be based on data from quarterly sampling of 13MW2 obtained over the course of one year. In addition, the facility may collect quarterly background data from 13MW1 following approval from the DEQ, to obtain a more robust background dataset. In this case, the background dataset would be one year's worth of quarterly data from well 13MW1 and supplemental data from 13MW2. ~~Optionally, the facility may collect quarterly background data from 13MW1 at their discretion to obtain a more robust background dataset. In this case, the background dataset would be one year's worth of data from the combination of wells 13MW1 and 13MW2.~~ Existing data may be used to establish background concentrations provided it is of sufficient quality."*

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section V.D.1.c, as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section V.D.1.c when submitted by RAAP and determine if the comment is satisfied.

4. **Module VII, Section VII.F.1.b, Page VII-7 –** The permittee has revised the following language in section VII.F.1.b:

*"b. Monitoring well 1 13MW2 is located upgradient of the unit and will serve as the background well for the OBG. Monitoring wells 13MW3, 13MW4, ~~13MW5, 13MW6~~ and 13MW7 are located downgradient of the unit and will serve as the point of compliance wells. Monitoring wells 13MW5, 13MW6, and 13MW-8 ~~is~~ are the downgradient plume monitoring wells for the unit. In addition, well 13MW-1 will be used as a piezometer to measure static groundwater elevations during each sampling event. Optionally, the facility may collect background data from 13MW1 at their discretion. Additional monitoring wells, if required ~~as a result of the SAE~~, will serve as plume wells for the monitoring of the HCOCs and daughter products and for the MNA parameters listed in **Permit Attachment VII.B**."*

The DEQ concurs with the revisions with the exception of the language which allows the additional background sampling from 13MW1 to be optional, not specifying the sampling frequency and not requiring DEQ approval before sampling proceeds. The language shall be revised as follows:

*"b. Monitoring well 1 13MW2 is located upgradient of the unit and will serve as the background well for the OBG. Monitoring wells 13MW3, 13MW4, ~~13MW5, 13MW6~~ and 13MW7 are located downgradient of the unit and will serve as the point of compliance wells. Monitoring wells 13MW5, 13MW6, and 13MW-8 ~~is~~ are the downgradient plume monitoring wells for the unit. In addition, well 13MW-1 will be used as a piezometer to measure static groundwater elevations during each sampling event. Further, the facility may collect quarterly background data from 13MW1 following approval from the DEQ, to obtain a more robust background dataset. ~~Optionally, the facility may collect background data from 13MW1 at their discretion.~~ Additional monitoring wells, if required ~~as a result of the SAE~~, will serve as plume wells for the monitoring of the HCOCs and daughter products and for the MNA parameters listed in **Permit Attachment VII.B**."*

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section VII.F.1.b as requested.

DEQ Response (1-1) – DEQ will review the revised language of Section VII.F.1.b when submitted by RAAP and determine if the comment is satisfied.

5. **Module V, Attachment V.B, Compliance Groundwater Monitoring List –** The proposed Constituents of Concern (COC) for removal from the permit are not approved at this time as this is still an operating unit except for pyrene as this constituent is not a COC in soil.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise the COC list as approved by DEQ. Please note that the facility is currently in corrective action monitoring at this time. When the unit returns to Compliance Monitoring, a permit modification will be prepared and additional changes to the COC list will be proposed, with appropriate justification, at that time.

   DEQ Response (1-1) – DEQ will review the revised language of the COC list when submitted by RAAP and determine if the comment is satisfied.

6. **Module V, Attachment V.C, Open Burning Ground Calculated Background Values -** Pyrene should be removed from the list as it is no longer a COC.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Attachment V.C to remove pyrene.

   DEQ Response (1-1) – DEQ will review the revised language of Attachment V.C when submitted by RAAP and determine if the comment is satisfied.

7. **Module V, Attachment V.D, Appendix IX Groundwater Monitoring List -** The proposed Constituents of Concern (COC) for removal from the permit are not approved at this time as this is still an operating unit except for pyrene as this constituent is not a COC in soil.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise the COC list as approved by DEQ. Please note that the facility is currently in corrective action monitoring at this time. When the unit returns to Compliance Monitoring, a permit modification will be prepared and additional changes to the COC list will be proposed, with appropriate justification, at that time.

   DEQ Response (1-1) – DEQ will review the revised language of the COC list when submitted by RAAP and determine if the comment is satisfied.

8. **Module V, Attachment V.E, Groundwater Protection Standards -** The proposed Constituents of Concern (COC) for removal from the permit are approved at this time except Acetonitrile, Acrylonitrile, Sulfide, PCBs, 1,4-Dioxane, Total TCDF, Total PeCDF, Total HxCDD, Total TCDD, 2,3,7,8-TCDD, Total PeCDD, Total HxCDD.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise the COC list as allowed. However, please note that we do not concur with the addition of COCs acetonitrile, acrylonitrile, sulfide, PCBs, 1,4-dioxane, the various total D/F compounds, and 2,3,7,8-TCDD. These COCs were not listed on Attachment V.E previously and we do not understand the basis/justification for their addition. In discussions with DEQ on March 30, 2016, DEQ agreed to revisit this request and determine whether the additional constituents are in fact necessary.

DEQ Response (1-1) –This comment was in response to **table Permit Attachment V.D. APPENDIX IX of 40 CFR Part 264 GROUNDWATER MONITORING LIST**. This was part of confusion during the March 30, 2016 discussion. The following constituents are deemed necessary as they are in part byproducts of combustion or of partial combustion: Total TCDF, Total PeCDF, Total HxCDD, Total TCDD, 2,3,7,8-TCDD, Total PeCDD, Total HxCDD. As for 1,4-dioxane, literature searches indicate the potential for use as a solvent in the processing of crude petroleum, petroleum refining, petrochemicals and explosives and acetonitrile is associated with energetic materials. Based upon the above, DEQ will require the analysis for these constituents unless further justification is provided by the Facility for their removal. PCBs, acrylonitrile and sulfide may be removed.

9. **Module VII, Attachment VII.C, Corrective Action Program - Annual Groundwater Monitoring List for Radford OBG/HWMU-13 -** 2,6-Dinitrotoluene, changed from 0.48 to 0.048 as per VA DEQ Alternate Concentration Limit. January 21, 2015 (effective February 15, 2015).

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify the limit for 2,6-dinitrotoluene in Attachment VII.C from 0.48 to 0.048.

   DEQ Response (1-1) – DEQ will review the revised language of Attachment VII.C when submitted by RAAP and determine if the comment is satisfied.

Section 3 of the Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning and Open Detonation Permit, Technical Deficiencies of the Proposed Statistical Methods Used In the Permit Modules

1. **Module II, Attachment II.C, Section II.C.7.2.3, Page II.C-18 -** Paragraph 1 of the draft permit states that "An outlier refers to a data point which is an inconsistently large or small value." Please note that an outlier test is applicable for background dataset. The facility is advised to include following language; "The facility will check only background data for outliers (unusually high values in the dataset). Facility may re-sample (in an area near the initial sample) if an extreme value is noticed in the compliance dataset. Re-samples will occur during the compliance period of the initial soil sampling event".

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP disagrees that outlier evaluations are only applicable for background data sets. Outliers can occur at any point in time during analysis of either background or compliance data. These outliers may occur due to problems with the sampling technique, analytical difficulties, *etc*. If the sample can be confirmed to be an outlier due to any of these reasons, elimination of it should be permissible regardless of when the outlier occurs. In a meeting between the parties on March 30, 2016, the differences on this issue appeared to relate to the term "background data." DEQ agreed that an outlier could be associated with any data (i.e., historical, background or compliance data). Additionally, with compliance data, typically a verification event would be conducted if a usually high value was observed eliminating the need for an outlier test.

DEQ Response (1-1) – If the facility has sampling problems which results in data not accurately representing the site condition, the facility should re-sample to determine if there was an error in the sampling protocol. If extreme values occur in the background or on-site data without any sampling problem, the facility should collect a re-sample during the compliance period of the initial sampling event. This will enable to the DEQ to distinguish between what may be an extreme value in the sampling location and give an indication of whether the contaminated soil is due to the facility's treatment activities. Please note that background observations which are considered to be outliers should not be in the statistical analysis to preserve the power of the test.

2. **Module II, Attachment II.C, Section II.C.7.2.3, Page II.C-18 –** The draft permit states that "the historical data should be screened for the existence of outliers (USEPA 1992 section 6.2) using the method described by Dixon (1953)." The facility is advised to clearly state that only background data will be screened for the existence of outlier(s).

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP disagrees that outlier evaluations are only applicable for background data sets. Outliers can occur at any point in time during analysis of either background or compliance data. These outliers may occur due to problems with the sampling technique, analytical difficulties, *etc*. If the sample can be confirmed to be an outlier due to any of these reasons, elimination of it should be permissible regardless of when the outlier occurs. In a meeting between the parties on March 30, 2016, the differences on this issue appeared to relate to the term "background data." DEQ agreed that an outlier could be associated with any data (i.e., historical, background or compliance data). Additionally, with compliance data, typically a verification event would be conducted if a usually high value was observed eliminating the need for an outlier test.

   DEQ Response (1-1) – As stated previously in DEQ Response 1-1 to Comment 1, if the facility has sampling problems which results in data not accurately representing the site condition, the facility should re-sample to determine if there was an error in the sampling protocol. If extreme values occur in the background or on-site data without any sampling problem, the facility should collect a re-sample during the compliance period of the initial sampling event. This will enable to the DEQ to distinguish between what may be an extreme value in the sampling location and give an indication of whether the contaminated soil is due to the facility's treatment activities. Please note that background observations which are considered to be outliers should not be in the statistical analysis to preserve the power of the test.

3. **Module II, Attachment II.C, Section II.C.7.2.1, Page II.C-19 –** Section II .C.7.2.1, paragraph 1 of the draft permit states that "Absent the outlier evaluation discussed previously, no statistical manipulation of the data shall be performed prior to this comparison." Please note that outlier evaluation is not applicable to compliance sampling event. The facility is advised to remove above sentence from the draft permit.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP disagrees that outlier evaluations are only applicable for background data sets. Outliers can occur at any point in time during analysis of either background or compliance data. These outliers may occur due to problems with the sampling technique, analytical difficulties, *etc*. If the sample can be confirmed to be an outlier due to any of these reasons, elimination of it should be permissible regardless of when the outlier occurs. In a meeting between the parties on March 30, 2016, the differences on this issue appeared to relate to the term "background data." DEQ agreed that an outlier could be associated with any data (i.e., historical, background or compliance data). Additionally, with compliance data, typically a verification event would be conducted if a usually high value was observed eliminating the need for an outlier test.

   DEQ Response (1-1) – As stated previously in DEQ Response 1-1 to Comment 1, if the facility has sampling problems which results in data not accurately representing the site condition, the facility should re-sample to determine if there was an error in the sampling protocol. If extreme values occur in the background or on-site data without any sampling problem, the facility should collect a re-sample during the compliance period of the initial sampling event. This will enable to the DEQ to distinguish between what may be an extreme value in the sampling location and give an indication of whether the contaminated soil is due to the facility's treatment activities. Please note that background observations which are considered to be outliers should not be in the statistical analysis to preserve the power of the test.

4. **Module IV, Attachment IV, Appendix 6, Section B, Page IV.A-24 –** Appendix 6, Section B (outliers), paragraph 1 of guidance states that "Any elimination of an outlier shall be properly documented and its basis for exclusion noted." The facility is advised to replace above language from the draft permit with the following: Any elimination of an outlier data must be approved by the Department.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Attachment IV, Appendix 6, Section B as requested.

   DEQ Response (1-1) – DEQ will review the revised language of Section B when submitted.

5. **Module IV, Attachment IV, Appendix 6, Section H, Pages IV.A-27 and IV.A-28 –** Appendix 6, Section H, (COMPARISON OF POINT OF COMPLIANCE WELL DATA TO A STANDARDDURING COMPLIANCE OR CORRECTIVE ACTION MONITORING). The facility is advised to replace language of section H with the following: The facility will

initially perform a value -to-value comparison to GPS for all groundwater monitoring data. If a GPS exceedance is noted during the value-to-value comparison for a parameter(s), the facility may collect a verification sample and results from the verification sample will be compared to the GPS in a value-to-value comparison as long as the comparison is completed within 30 days of the initial sampling event. Further, the facility may collect three additional independent groundwater samples during the compliance period for the suspect constituent(s) in order to perform a statistical comparison to GPSs that is based on ACL or MCL. The facility should calculate lower normal confidence limit to compare it to the standard compliance wells data. The facility should calculate upper normal confidence limit to compare it to the standard corrective action monitoring wells data. The level of confidence of the interval should be 80% for a sample size of 4-7 and 90% for a sample size of 8-10.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Module IV, Attachment IV, Appendix 6, Section H with the language suggested.

DEQ Response (1-1) – DEQ will review the revised language of Section H when submitted.

Section 4 of the Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning and Open Detonation Permit, Technical Deficiencies of the Alternative Treatment Technology Review of the Permit Application

General Comments

1. The Alternative Treatment Analysis should provide a detailed description of the waste stream, including chemical composition. This description should include the total quantity of energetic material (EM) produced, a breakdown of what percentage of the waste is considered “non-contaminated” verses EM contaminated with foreign object debris (FOD), and approximate proportions of EM types (single-base, composite, etc.). If possible, an estimation of the proportion of FOD within the contaminated waste stream should also be derived as this could have significant implications for the evaluation of alternative treatments.

   Radford Response (1-1), (Response received on 5/5/2016) – In a meeting between the parties on March 30, 2016, RFAAP questioned what detail on the wastes above that presented in the permit was desired. DEQ clarified that they wanted the Alternative Treatment Technologies Report (ATTR) to be a standalone document. Therefore, additional detail from that provided in the Permit is not necessarily required; the information presented in the Waste Analysis Plan should just be repeated in the ATTR as appropriate.

   As a result of this discussion, RFAAP agreed to add a description of the wastes managed to the ATTR. This description will be similar to that provided in the Waste Analysis Plan. Information on the historical distribution of the various waste groups will also be provided.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

2. In order to provide an adequate baseline for comparison, a full evaluation of the current open burning and incineration processes should be presented prior to the potential alternative treatments. The evaluations should include:

- A detailed description of the process
- Current throughput in kg/month,
- Maximum throughput
- Capability to treat the various propellants produced at the facility
- Characterization of secondary waste streams such as air emissions and residual soil contamination
- Ability to meet applicable regulatory requirements
- Costs
- Requirements for worker safety
- Any limitations associated with the processes

Radford Response (1-1), (Response received on 5/5/2016) – In a meeting between the parties on March 30, 2016, DEQ explained their hopes with the level of detail, walking through the bullets provided above. In response to those discussions, RFAAP offers the following:

- RFAAP will add a description of the current onsite treatment options to the ATTR. These descriptions will be limited to the level of detail already present in permitting materials.
- The throughput for each unit varies significantly due to production changes. Additionally, there are concerns with plant and corporate security in publically documenting waste and production numbers. To satisfy this request, RFAAP will prepare a summary of historical (past three year) waste processing records for both the EWI and the OBG. This summary will be submitted as confidential business information.
- The maximum throughputs for each unit are in their respective permits. We will add this information to the ATTR.
- In the process description for the EWI, RFAAP will include a discussion on the limitations associated with the waste materials that can be processed in the EWI.

(Materials not able to be processed in the EWI are sent to the burning ground for destruction.)

- RFAAP will include general discussions on how each of the waste streams are generated with the waste information requested under Item 4.1 above.
- RFAAP will provide a general discussion on the ability of the OBG and the EWI to meet all current permit limitations. We will discuss discharge streams from each and how they are regulated.
- RFAAP will provide a measure of the overall feasibility of each treatment technology and alternative on a qualitative basis, rather than detailing costs of each option.
- RFAAP will provide a qualitative evaluation on worker safety, providing generally information such as "labor intensive/high exposure technology" versus "limited exposure/limited exposure" technology.
- RFAAP will provide an overall summary for each technology of the evaluations provided in each of the prior bullets.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

3. Please evaluate technologies with potential for the successful treatment of large quantities of EM in the same manner as described in Comment 2 where applicable. At a minimum all technologies that have been demonstrated at the pilot level or above should be included in this analysis. Technologies that do not have the capability to be scaled up (such as the Donovan Chamber) should be screened out of the detailed analysis for clarity. The matrices provided are limited in scope and score technologies on a highly subjective scale. Some of the definitions used for the criteria may not be appropriate or are not intuitive. Please see Comment 15 for more information regarding the criteria used to evaluate alternative treatment technologies**.**

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify the matrix provided with the ATTR based on DEQ's comments provided in the March 30, 2016 meeting. The ATTR will present a hierarchal evaluation of the technologies, ranging from those that are possible but not practical or fully developed to those that may be possible with several modifications, etc.

   DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

4. To what extent is recycling of waste EM utilized? With over 163,000 kg of waste EM produced annually there appears to be significant potential for recycling. Recycling material could result in significant reductions to both operating costs and environmental releases. Processes to safely reintroduce waste EM into the production process (such as foreign object debris (FOD) screening) should be evaluated. Ideally, other methods to reduce the amount of

waste generated should also be considered in the permit, if not in the Alternative Treatment Analysis.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP already utilizes rework material in their production lines where possible. While waste reduction is a primary focus and waste minimization on ongoing goal of RCRA, we believe the current waste load to the EWI and the OBG to be that necessary based on current plant production demands, product quality requirements, and processing limitations. RFAAP will modify the ATTR to include some discussion of the efforts currently being taken to accomplish this goal.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

5. Throughout various portions of the document it is noted that DDESB has not approved several technologies. As noted in the January 23, 2015 Information Paper by Luke Robertson, "Actual AE [ammunition and explosives] demilitarization procedures are established by the Defense Logistics Agency, the DoD Components, or the Single Manager for Conventional Ammunition (SMCA)." DDESB's primary role is to ensure worker and public safety from explosive risks and evaluates situations on a case-by-case basis. By stating that a technology has "not been approved by DDESB," the impression is given that a technology does not meet explosives safety criteria and thus is not viable. Please eliminate DDESB approval as a screening criteria for alternative treatment technologies.

   Radford Response (1-1), (Response received on 5/5/2016) – DDESB approval is critical to ANY explosives management process and cannot be eliminated. The use of non-DDESB approved processes is counter to current DOD policy. RFAAP will provide an overview of this selection matrix and ruling policy documents in the revised ATTR and will explain why a lack of DDESB approval makes any technology a less preferred option.

   DEQ Response (1-1) - DEQ acknowledges that DDESB plays an important role in the explosives management process. However, as DEQ understands this role DDESB reviews processes on a case by case basis and requires a submittal of design and sitting for approval. DDESB does not evaluate the effectiveness of new technologies, only their safety (not including environmental risks). At this preliminary stage, full designs and sitting are not feasible for RFAAP to submit to DDESB. Use of DDESB approval as a screen in the alternative treatment technology evaluation therefore biases the selection process to existing technologies and prevents consideration of newer, potentially more efficient ones. The alternatives evaluation may consider previous DDESB approvals at other sites when evaluating technologies and discuss potential hurdles to eventual DDESB approval within discussions of feasibility. However, lack of DDESB approval alone should not be considered sufficient to eliminate a technology and the evaluation should be clear regarding the role, timing, and submittal requirements for the DDESB process.

6. Please include a brief discussion of the policy framework that the treatment technologies evaluated are subject to. This discussion should include both RCRA and DoD policy requirements such as the Single Manager for Conventional Ammunition's Joint Conventional Ammunition Policies and Procedures, Army Regulation 700-144, and DoD 4145.26-M. The ability of a technology to satisfy these rules, guidance, and regulations should be considered a primary metric used in the evaluation.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP can provide this information to DEQ and in the ATTR, but please note, per our response to NOD 4.5, DDESB is very much part of this process. The role of the DDESB will be further explained and clarified pursuant to this NOD and NOD 4.5.

   DEQ Response (1-1) – Response accepted pending review of submittal, but note that at this stage the requirements of Army Regulation 700-144 and DoD 4145.26.M should be the primary regulatory and policy points of comparison in addition to applicable RCRA laws and regulations.

7. The evaluation makes no mention of the plan to incinerate 95% of RFAAP's explosive waste using a combined EWI and contaminated waste processor facility referenced in a paper dated November 10, 2015 that is available on the facility's website. The paper notes that design for the facility will begin this year. The technology should be evaluated in the alternative treatment analysis, as it appears that RFAAP has already determined it to be a viable treatment option.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP has secured funding to design a combined EWI/CWP facility. At this time, one of the goals is to significantly reduce the waste load going to the OBG. However, a complete elimination of the OBG will not be possible. Furthermore, as this unit has not yet been designed, we cannot guarantee that the goals on waste load to the OBG will be satisfied. There are materials targeted for this facility that may or may not be capable of being treated in it. In addition, while funding for the design has been secured, the actual cost for construction of the facility is unknown and those funds have not been secured. RFAAP will add a discussion and update on this project to the ATTR.

   DEQ Response (1-1) – For clarity, DEQ requests that this technology be evaluated alongside open burning and other potential treatment technologies.

Specific Comments for the Technical Deficiencies of the Alternative Treatment Technology Review of the Permit Application

1. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.1.2, Supercritical Water Oxidation with Pretreatment, Pages 3 and 4 -** The Army study referenced that evaluated Supercritical Water Oxidation was specific to Camp Minden and M6 propellant. It is unclear how applicable this evaluation is to Radford as the EM to be

treated at Camp Minden was considered to be unstable due to improper storage or needed to be treated on a time-critical basis. DDESB did not approve in part because at the time none of the systems evaluated had been tested for large-scale M-6 destruction and the challenges of treating such a large quantity of shock-sensitive material in a short time.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP contends that there are other concerns with the use of SCWO that prevented its use at Camp Minden and, furthermore, that prevents its use at RFAAP. In addition, there are elements of the October 2000 failure that are directly applicable to the RFAAP application. RFAAP will expand this discussion in the ATTR and will include reference to the ongoing SCWO project at the Blue Grass Army Depot.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

2. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.1.2, Neutralization Process for SCWO, Page 3, Last Paragraph -** The October 2000 incident described here should not be considered an inherent failure of the technology. According to the cited report, "The severity of the incident might have been mitigated if consideration had been given to the reaction that was taking place between the propellant and the caustic. Failure to stop the steam trace heating on the recirculation loop helped to sustain the temperature needed for the reaction to continue, and closing the valves at both ends of the segment of the loop below the tank ensured that the gases produced would build up pressure." Please include a description of how and why the incident occurred as well as the corrective actions suggested by NRC such as the use of sound engineering practices and better training for personnel.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP contends that there are other concerns with the use of SCWO that prevented its use at Camp Minden and, furthermore, that prevents its use at RFAAP. In addition, there are elements of the October 2000 failure that are directly applicable to the RFAAP application. RFAAP will expand this discussion in the ATTR and will include reference to the ongoing SCWO project at the Blue Grass Army Depot.

   DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

3. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.1.2, Super Critical Water Oxidation, Pages 3 and 4 -**The 2013 NRC paper cited does not appear to make reference to DDESB approval after a brief review. Additionally, the report is focused on the destruction of chemical weapon munitions (CWM) as opposed to the EM

being evaluated during the Alternative Treatment Analysis. It is unclear from the DDESB memo as to whether or not DDESB has actually evaluated SCWO. Has the Army or BAE requested DDESB review of any SCWO units? It is DEQ's understanding that at least one SCWO unit has been approved and used for large scale use (the Blue Grass Chemical Agent Destruction Pilot Plant). Please provide more information as to the applicability of this technology towards conventional munitions and explosives treatment.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP contends that there are other concerns with the use of SCWO that prevented its use at Camp Minden and, furthermore, that prevents its use at RFAAP. In addition, there are elements of the October 2000 failure that are directly applicable to the RFAAP application. RFAAP will expand this discussion in the ATTR and will include reference to the ongoing SCWO project at the Blue Grass Army Depot.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

4. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.1.6, Pages 5 and 6 –** Section 3.1.6 states that examples of alternative treatment technologies provided by DEQ all require size reduction of the case hardened propellant grain. However RAAP has not provided an explanation as to why the contaminated waste could not be wetted prior to grinding, cut using a hydromilling, or cut using liquid nitrogen. Please provide the reasoning for not adjusting the grinder operation to accommodate the contaminated waste as the current language states that safety issues were identified with hydromilling but does not explicitly state them.

   Radford Response (1-1), (Response received on 5/5/2016) – The size reduction concept and technology was not discussed or further developed in the Army plan. While some combination of potential technologies may present a feasible concept, a large-scale engineering effort such as that which would be required to develop this concept relative to this technology is outside the scope of the ATTR. RFAAP will, however, include a section on size-reduction technologies in the ATTR and provide a discussion on their applicability to the RFAAP wastes.

   DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

5. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.2, Pages 6 through 9 –** The permittee has evaluated several demilitarization technologies which do not seem to have any applicability to the waste stream being discussed. Please provide an explanation as to why these technologies for dismantlement of finished rockets, ammunition and ordinance are being presented when the waste stream being discussed is raw propellant.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP wanted to provide a complete picture of demilitarization technologies that are available to address concerns that the public may have about implementation of this technology for RFAAP materials. However, recognizing DEQ's concern to eliminate the discussion of non-relevant technologies, we will remove these from the ATTR.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

6. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.2.2, Page 7 -** How does this technology differ from the incinerator currently used at the facility? Would it be possible to scale up this technology to deal with the significant waste stream currently produced? If the technology can treat fully assembled ammunition as suggested in the description, how would FOD impact its use?

Radford Response (1-1), (Response received on 5/5/2016) – The deactivation furnace is designed to treat fully loaded ammunition items, not exposed propellant. As DEQ pointed out in their comments, there are considerable differences between treating fully loaded conventional ammunition items and exposed propellant. These units have fed packaged propellant in limited amounts during performance tests. These instances presented serious safety concerns related to premature ignition of the propellant, clogging of the feed chute on the kiln, and fires in the control system due to uncontrolled transfer of packaging materials downstream. (All of which stemmed from the unit not being designed to process raw propellant). In addition, the inner construction of the kiln used in this technology is also not amenable to exposed ignition of propellant. RFAAP provided information to this regard in the ATTR, explaining the material handling, safety, and throughput limitations with this technology.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

7. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.3, Page 9 -** Please include any technologies such as SCWO that have been successfully utilized at the production level in this section.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will include a hierarchal discussion in the ATTR, one category of which eliminates technologies that have not be successfully utilized at the production scale.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

8. **Alternative Treatment Technologies to Open Burning of Propellants, Section 3.3.3, Pages 10 and 11 –** Section 3.3.3 states that the Actodemil process is problematic because of residual metals left in the end product fertilizer. Please explain why the process could not be modified to allow for the metals to be precipitated out of the solution before final processing into the end product?

   Radford Response (1-1), (Response received on 5/5/2016) – While redesigning the Actodemil process is outside the scope of this ATTR, RFAAP was able to further research these limitations. The Actodemil process binds the metals in humic acid and a HUMAXX proprietary reagent similar to Ethylenediamine-tetraacetic acid (EDTA). EDTA is used in chelation therapy for the treatment of acute and chronic lead poisoning. It works by pulling toxins (including heavy metals such as lead, cadmium, and mercury) from the bloodstream., which prevents precipitation of the metals. Unfortunately, the EDTA-like reagent from HUMAXX does not totally precipitate metals and can actually bind to plant components, making those metals available for plant uptake. RFAAP will add a summary of this limitation to the ATTR.

   DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

9. **Alternative Treatment Technologies to Open Burning of Propellants, Section 4.0, Pages 11 and 12 -** Please include expansion of the current explosive waste incinerator (EWI) operations in the assessment of identified alternatives. The submitted Alternative Treatment Analysis provides no information as to why EM contaminated with FOD cannot be treated utilizing this technology. Furthermore, if FOD would impact the EWI please discuss the feasibility of screening the contaminated EM waste stream for FOD as part of this analysis. Federal guidance for ammunition and explosives production appears to require FOD screening within the production process, and it is unclear as to why this screening could not be applied to the contaminated EM waste stream.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add some of this information to the ATTR to the level that information is currently developed. However, please recognize that redesigning the EWI system or the feed system is outside the scope of the ATTR.

   DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

10. **Alternative Treatment Technologies to Open Burning of Propellants, Section 4/Table 1, Pages 11 and 12 -** The criteria and overall evaluation of alternatives needs to be more substantive. The criteria in particular are either evaluating aspects not intuitive to their definitions or only capture a portion of aspects required for evaluation as per Comment 2 of

the General Comments section of Section 4. Comparison of these alternatives to the status quo (which is left largely undefined by the document, see Comment 1) using a subjective rating system does not provide the analysis that would be required for proper evaluation. For instance, a theoretical treatment that would result in zero environmental releases would score exactly the same as a technology that creates a secondary waste stream requiring treatment at a waste-water treatment plant. In addition, many of the technologies carried forward because "pilot or production units are available" are not feasible on a production scale (e.g. Donvan Chambers).

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will assess all technologies consistent with the bulleted list of evaluations provided in NOD 4.2 and will design their evaluation matrix/table based on these bullets, providing information to compare each basis presented in NOD 4.2.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

11. **Alternative Treatment Technologies to Open Burning of Propellants, Table 1, Criteria Definitions -** The definitions for each criterion are poorly defined, and often the analysis provided in the matrix does not match well with the provided definition. In general, quantifiable metrics should be used as criteria whenever possible. Specific issues with criteria definitions and applications are listed below. Before moving forward, DEQ and BAE should have agreement on what and how criteria will be used in the final evaluation.

    - Safety Hazards: The table defines Safety Hazards as "Treatment of energetic and associated pre-treatment, treatment, and post-treatment." This definition is incredibly broad and does not intuitively reflect discussions of safety. The general assumption is that this criterion refers to worker safety. However, statements such as "Requires additional chemicals" or "Two-step process of digesting the propellant and then neutralization-oxidation" have no specific context in regards to worker safety. Prior DDESB approval of a technology should be noted here.

    - Waste Stream Variability: Without the required context of the exact chemical nature of the waste stream this evaluation is of limited used. This criterion should evaluate what percentage of the waste stream has the potential to be treated using the technology and what specific classes of propellants or portions of the waste stream could not be treated. As previously noted, it is unclear how some of the descriptions evaluating technologies for this category are applicable. As an example, "Only one detonation can occur every other day per EDS. Cutting charges are required to treat the chemical munitions" refers not to the capability of the technology to treat various waste streams but the maximum throughput the technology is capable of. This category also limits evaluations to one technology at a time when combinations of technologies may be capable of completely treating the waste stream.

- Environmental Releases: This criterion should provide specifics as to the nature of environmental releases related to each technology. DEQ requires knowledge of what constituents would make up the secondary waste stream and the quantity generated. An effort should be made to provide values from research papers, peer-reviewed literature, or other official documentation whenever possible. If these sources are unavailable estimates can be provided using mass-balance equations or modeling software where applicable. Next to worker safety, this evaluation is the most critical to DEQ's review of the permit regardless of how difficult it is to monitor or model.

- Engineering Controls: No Comments

- Layout Possibilities: I suggest replacing this criterion with "Feasibility" to better incorporate design restrictions, throughput, etc.

- Support: To what degree would this impact the selection of the technology? In theory vendors ought to be able to provide the appropriate technical support for any equipment they provide.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP has multiple concerns with the level of detail requested in this NOD. Several of the requests require effort similar to an engineering design review as opposed to a feasibility study. However, based on our discussions with DEQ on March 30, 2016, we will provide a new table that provides more detail on the ATTR process and technologies evaluated. We will craft this table so that it can standalone for subsequent discussions on alternative treatments to the RFAAP OBG. Furthermore, we will make sure that evaluation provided for each category/definition is appropriate for that definition.

DEQ Response (1-1) – DEQ will review the revised language of the Alternative Treatment Analysis when submitted to determine if the comment is satisfied.

Section 5 of the Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning and Open Detonation Permit, Technical Deficiencies of the Risk Assessment Protocol of the Permit Application

1. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Introduction -** In the introduction section, please add a section that discusses alternate treatment methods and provides reference of the alternate treatment technology evaluation report that is prepared by the facility.

   Radford Response (1-1), (Response received on 5/5/2016) – Considering the significant comments provided on the ATTR, RFAAP will provide a temporary placeholder for this discussion in the RAP and will delay full implementation of this NOD until such time that a final, approved ATTR is available.

   DEQ Response (1-1) –DEQ understands that the alternate treatment method section will change in response to DEQ comments. To ensure that the risk assessment does not need to be updated/delayed due to these changes, please provide a very brief description of what the alternate treatment methods covers and provide a complete reference so that the reader can find this information easily. The purpose of this section is to inform the reader on where to find more information on the alternate treatment methods. DEQ does not believe that adding this information in the RA needs to be delayed till full implementation of NOD.

2. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 1.4. Study Area Description, Pages 1-3 -** In the third paragraph, the protocol mentions that numerous creeks and streams and smaller ponds are ‘generally not used for fishing on a reliable consumption basis.’ Please provide source of this information- e.g., angler survey or other such information. In absence of actual data supporting this assertion, please remove this statement.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP can provide the requested data. However, we wish to clarify that we were not proposing to eliminate these waterbodies from consideration in the fishing scenario, but were merely clarifying that in large, inclusion of these overestimates the risk to the population.

   DEQ Response (1-1) –This response is confusing, DEQ is not asking to include a risk assessment for fish from each pond. DEQ is requesting for RAAP to provide supporting data/basis for RAAP’s assertion that the ponds are not used for fishing.

3. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.1.1. Site-Specific Emissions Sampling, Page 2-2-**

   i. VDEQ understands that this section cannot be completed until flyer testing results are available and therefore the final list of COPCs to be included in quantitative risk assessment (QRA) cannot be developed at this time. However, please include the information about the chemical list for each waste group that can be treated at the OB ground. Please include a table similar to - but appropriately updated with the latest information - tables 2-1 through 2-9 from the previous HHRA report dated 07/27/2015. VDEQ understands that these tables will be refined based on flyer testing data.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide the requested information in the revised RAP from the 2005 HHRA report (note the error provided in the report date in DEQ's comment).

DEQ Response (1-1) – DEQ will review the information provided by RAAP when submitted and determine if the comment is satisfied.

ii. Please use the following guidelines for determining the final COPC list:

- Compounds detected ***in at least one*** or more test run samples and not meeting any of the exclusion criteria below will be included in the MPRA;

- Compounds reported as non-detect in all of the test run samples will be excluded from the COPC list ***provided that the DL is lower than the lowest risk based screening criteria available at the time of testing from EPA RSL table –indoor air;***

- Compounds present in test run samples that are also present in the method blank at greater than 50 percent of the test level will be excluded from the COPC list; ***at 5x concentration for non-common laboratory chemicals and 10x for common laboratory contaminants will be included in the COPC list (please refer to the QAPP for the flyer testing for more details);***

- ***All J and U flagged data will be included as COPC and other laboratory flags will be considered as described in the QAPP and SAP;***

- Compounds without any chemical specific ***emission factor*** fate, transport, and/or toxicity data will be excluded from the COPC list, but will be discussed qualitatively in the MPRA report; ***and***

- ***Any chemical that is present in the waste group, not detected in the test run but based on thermodynamic modeling is reasonably suspected to be present in emissions- these include PICs.***.

Radford Response (2-1), (Response received on 5/5/2016) – In general, RFAAP has no objections to this request. During the meeting, DEQ offered the following clarifications on this NOD:

- The comparison of the DL to the residential indoor air criteria is only to assess the ability of the DL to be used to screen out constituents (i.e., is the detection limit low enough). Absent this, the indoor air criteria will have no use in the risk assessment.

- On the inclusion of blank-detected compounds in the risk assessment - For those compounds that are not common laboratory contaminants, any compound present in the blank sample at a level ≥ 1/5th of the run sample may be excluded. For those compounds that are common laboratory contaminants, any compound present in the blank sample at a level ≥ 1/10th of the run sample may be excluded.

DEQ Response (2-1) – DEQ will review the revised Section 2.1.1 when submitted by RAAP and determine if the comment is satisfied.

4. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.1.2. Supplemental Emission Factors, Page 2-2 -** Please provide a table listing bang box & AP-42 emission factors, and a last column that lists the more conservative value from these two sources. VDEQ understands that the final emission factor chosen for the calculations will depend on the results of flyer testing. Please note that the results of flyer testing will be compared against the last column of the table and the maximum emission rate will be used in HHRA.

   Radford Response (1-1), (Response received on 5/5/2016) – The intent of the flyer testing is to provide site-specific emissions data for the OBG. If this emissions data will not be allowed for use in the risk assessment if it is lower than non-site specific default emission factors, there is no point in collecting the data. Furthermore, the most **recent** data should be used in the assessment, as each iteration of factor reflects an improvement in the ability to collect data or analyze/model emissions from a source. A significant amount of work went into development of the new AP42 emission factors, including an evaluation of the older bang-box data. If, after consideration of all this data, ASTM determined a more appropriate, lower value was representative of OB emissions, than that lower value should be used. Requiring the facility to use the higher of a myriad of emission factors presents an overly conservative and significantly unrepresentative estimate of risk from the facility.

   DEQ Response (1-1) –As discussed at the March 31, 2016 meeting between DEQ and RAAP, data from the flyer sampling test event will be used when available and after a review by DEQ. For chemicals that do not have flyer sampling test data, RAAP will use an emissions rate which represents the worst-case emission scenario using the maximum emissions rate from Bang Box and AP-42 references. While AP-42 represents newer data, the factors for ordinance detonation are marked ‘draft.’ As the FAQ on the EPA website states, *“AP-42 sections designated as 'final' have completed the public comment process and all issues have been resolved. Sections designated as 'draft' reflect the fact that the comment period on these sections has passed, but not all issues have been resolved. EPA might receive additional data or comments that would cause a re-evaluation of the available data and* *possibly open another comment period. Users are encouraged to use factors from finalized sections, if available, but may decide that the draft emissions factors provide better estimates after reviewing the supporting documentation."* Further, the waste stream for OB may or may not be consistent, it also contains items that are not pure ordinance related (e.g. floor sweeps etc.) and exact mixture waste treated at OB ground may not match cartridge size and other categories evaluated in the AP-42 evaluation. Given several unknowns in the air emission estimation and waste group fluctuations, it is prudent to assess human health in a way that reduces the probability of false negative outputs. Therefore, a more conservative approach is deemed the most appropriate.

5. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.2 Discussion of Selected COPCs, Page 2-3 -**

   i. **General comment -** The protocol refers to EPA R6 HHRAP guidance as source for COPCs. This reference is correct. But the list of COPCs, especially groups such as D/F and PAHs, may not be completely reflective of the wastes managed at the OB facility. Further, the thermodynamics of OD process are different than incinerators or similar controlled combustion processes, thus resulting in somewhat different combustion products. Therefore, please consider EPA R 6 guidance as a starting point and add, as necessary, to the COPC list based on facility specific information. This approach also applies to chemical specific parameters (including toxicity values, VOC & mutagenic status) and exposure/input defaults used in human as well as ecological risk assessment. This comment also applies to subsections and other sections of the report as well.

Radford Response (1-1), (Response received on 5/5/2016) – While the COPC lists provided in the HHRAP are written as guidance for hazardous waste combustion facilities, they also reflect general limits on analytical capability and provide those chemicals that can generally be determined via standard stack sampling methods and/or that have fate and transport data available. Including compounds not provided on this list provides little value if they cannot be analytically determined (recognizing the ultimate goal is to provide quantification of OBG emissions via the flyer program) or quantitatively assessed. If DEQ wishes that RFAAP consider additional compounds in the assessment, we request that DEQ provide a specific list of those compounds they feel are necessary. We will then review this list against our waste materials and process knowledge and provide specific feedback on each compound. (Note that during a meeting between the parties on March 31, 2016, DEQ clarified that the referenced sources provided in the HHRAP should be used as the source of fate and transport data. If these sources do not have data available for a certain compound, it need not be included in the quantitative assessment).

DEQ Response (1-1) – HHRAP guidance was developed over 10 years ago and as analytical capabilities have significantly improved since then relying solely on HHRAP guidance may not be the most appropriate approach. As RAAP mentioned at the Mach 31, 2016 meeting, flyer testing will not be able to test for every compound which needs to be included in the risk assessment. Generally speaking as a starting point, all the chemicals that are present in every waste stream, including combustion byproducts of each of these chemicals, are to be included in the COPC list. Additionally, chemicals which can be analyzed by standard EPA analytical methods for VOC, SVOC, Dioxin/Furans, PCBs, energetics, and TAL metals are to be included. The justification for not including specific chemicals (e.g., certain metals) or groups of chemicals (e.g. PCBs) needs to be included in the application by the permittee for DEQ's approval. Please note that as part of the permit application, the permittee is to provide a complete and correct list of COPCs which is reflective of the waste treated at the unit for DEQ's review and approval. Therefore, DEQ will not be able to develop unit-specific COPC list for the permittee but requests the facility to refer to this comment to help develop a complete COPC list that is reflective of the OB unit operations. As discussed at the March 31, 2016 meeting, the chemicals which do not have either F and T/emission factors for air modeling or toxicity data will be discussed qualitatively only.

ii. Please include Hexachlorobenzene & Pentachlorophenol under section 2.2.

Radford Response (2-1), (Response received on 5/5/2016) – The HHRAP specifically states that "these chlorinated compounds are difficult to make even under controlled conditions [and] the combustion properties of these chlorinated compounds indicate that they aren't likely to be formed as PICs if they aren't present in the waste feed stream." As such, USEPA no longer recommends automatically including these compounds in risk assessments. They only recommend their inclusion for waste feeds containing the compounds, wood preservatives, pesticides, or highly variable waste streams, like municipal solid waste. As none of the wastes at the RFAAP contain these compounds, contain a significant amount of chlorine, or meet the other criteria specified by USEPA, inclusion of these compounds is not inappropriate and counter to USEPA guidance.

DEQ Response (2-1) – While the wastes produced by RAAP may not contain chlorine compounds the wastes produced by tenant organizations, which are allowed to be burned at the OBG with proper notification to DEQ, may contain chlorine compounds. Please provide information which demonstrates that no waste produced by tenant organizations contains chlorine compounds.

6. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, General comment -** Please specify if emissions from open burning will be estimated using the POLU13 combustion model that calculates emissions based on propellant material mixing with air then burned to form atmospheric pollutants. If so, which waste streams will be used for the modeling and how are these specific waste streams representative of the worst-case emission scenario?

   Radford Response (1-1), (Response received on 5/5/2016) – The goal of the flyer testing is to eliminate as much modeling as possible. If, in fact, sufficient data is available from the flyer testing, there will be no need to utilize POLU13, as measured values will already represent the actual emissions from the unit. During a meeting between the parties on March 31, 2016, DEQ requested that a brief description of POLU13 be added to the RAP as a backup plan for those constituents not able to be determined via flyer testing. RFAAP will make this addition to the RAP.

DEQ Response (1-1) – DEQ will review the revised RAP when submitted by RAAP and determine if the comment is satisfied.

7. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, General comment -** Please specify if the incinerator trial burn data for combustion byproducts from the burning of propellant wastes at RAAP will be considered since the same waste streams that are burned in the incinerator also will be burned at the Open Burning Ground.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP does not intend to use any test data from the incinerators in application of the OBG risk assessment. Not only is the form of the wastes sent to the incinerator very different from those treated at the OBG, the method of combustion is also considerably different. Therefore, we do not consider the EWI emissions data to be appropriate for use at the OBG.

   DEQ Response (1-1) – The comment is now satisfied.

8. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.2.2. Polynuclear Aromatic Hydrocarbons, Page 2-3 -** In addition to the 7 PAH mentioned in R 6 guidance, please include the remaining 13 PAHs from the RSL table. Please consult latest update of the RSL table for toxicity values.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will consider the inclusion of these PAHs pending their likelihood for formation from the wastes that are treated at the OBG. Assuming that these PAHs are included in the risk assessment, we request DEQ provide appropriate fate and transport data for them, as they are not available from the Region 6 guidance. (Note that during a meeting between the parties on March 31, 2016, DEQ clarified that the referenced sources provided in the HHRAP should be used as the source of fate and transport data. If these sources do not have data available for a certain compound, it need not be included in the quantitative assessment).

   DEQ Response (1-1) – DEQ will review the revised Section 2.2.2 when submitted by RAAP and determine if the comment is satisfied then.

9. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.2.8. Metals, Page 2-5 -** VDEQ understands that the final list will be developed after the flyer test, but please include all TAL (target analyte list) metals (Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tih, V, Zn) and Hg (elemental and divalent) in the initial list of COPCs.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP does not feel it appropriate to include metals in the COPC list that are not present or not expected to be present in the waste materials being combusted at the OBG. Unlike organics, if a metal is not present in the waste feed, it is not possible for it to be present in the emissions. RFAAP will provide a target analyte list for metals that reflects all metals reasonably expected to be present in the waste feed. However, many of those requested by DEQ in this NOD are not expected to be present.

DEQ Response (1-1) – DEQ will review the revised Section 2.2.8 when submitted by RAAP and determine if the comment is satisfied.

10. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.2.8.1. Chromium, Page 2-5 -** The last sentence about recalculating chromium as trivalent chromium is not acceptable as there is no speciation data available. In absence of the speciation data, all chromium will be considered to be in hexavalent form. Please revise.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will initially perform the assessment assuming all emitted chromium is in the hexavalent form (assuming that it is not possible to speciate chromium in the flyer testing). However, the statement provided indicates that, should chromium be a driver in the assessment, RFAAP will consider the potential overestimation of impacts and quantify that potential overestimate by recalculating all risk assuming all chromium is trivalent. We would propose using this recalculation in determining an appropriate safety factor for any permit limitation resulting from chromium risk or hazard.

    DEQ Response (1-1) – RAAP’s response is adequate except for the proposal for recalculation. If hexavalent chromium becomes the risk driver and RAAP wishes to revise the risk assessment, RAAP will need to provide the supporting data and justification to support the assumption of trivalent chromium.

11. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.2.8.2. Lead, Page 2-5 -** In addition to IEUBK, please include ALM.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add ALM modeling to Section 2.2.8.2 of the RAP.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

12. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 2.2.8.3. Mercury –**

i. This section is unclear- mercury species have different toxicity via different routes of exposure and distribution percentages assume elemental, divalent as well as methyl mercury. Will all emissions be treated as 'total' and distribution of various species be done and then each species will be included in QRA? What toxicity values will be used?

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify the text to indicate that mercury speciation will be consistent with recommendations provided in the HHRAP and will further detail this speciation. The toxicity data used will be that for each individual mercury species. Total mercury will only be used to establish the initial emission factor.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

ii. The bullets under mercury mentions some speciation related distribution numbers that seem to be in line with R 6 guidance. For food items, please conservatively assume all mercury to be in methyl mercury form.

Radford Response (2-1), (Response received on 5/5/2016) – RFAAP disagrees with considering all mercury in food items to be in methyl mercury form. The speciation criteria provided in the HHRAP are based on scientific analyses and deviation from them without scientific data to justify such a deviation is inappropriate. Assuming that mercury is in the most hazardous form despite scientific data showing a different distribution is overly conservative. Despite this point, RFAAP will provide an initial assessment of food exposure using the toxicity data for methyl mercury for all types of mercury assessed. However, should this result in significant risk to the receptor, risk will be reassessed using data specific to the mercury congener being evaluated. (Note: All mercury speciation will still be handled according to the recommendations specified in the HHRAP).

DEQ Response (2-1) – RAAP's approach of evaluating all food items using methylmercury and then if needed performing a reassessment using different species is adequate. However, please clarify if this reassessment is done will the mercury species used will reflect the predicted species and phase specific allocations provided in EPA HHRAP?

iii. Please note that based on flyer data, some of the mercury speciation and distribution assumptions may need to be revised.

Radford Response (3-1), (Response received on 5/5/2016) – RFAAP wishes to clarify that there is no intent (nor identified capability) to collect speciated mercury emissions data using the flyer technique. Therefore, we do not expect that the data generated will result in any different distribution than that provided in the RAP.

DEQ Response (3-1) – The comment is now satisfied.

13. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds,** Please include discussion about Nickel in a separate subsection under section 2.2.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add a separate discussion on Nickel to Section 2.2 of the RAP.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

14. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3., Dispersion and Deposition Modeling -** The comments provided in the current section of the NOD, Section 5, relate only to the HHRA and EcoRA. VDEQ's Office of Air Quality Assessments (AQA) will be providing technical and detailed comments on this section and for all the proposed inputs to the model including grid spacing, terrain, use of surrogate compounds, meteorological data and averaging time.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP has reviewed AQA's comments provided with the overall NOD transmittal and has responded to each. DEQ indicated that no separate comments from AQA are being provided as an addendum to the initial NOD letter.

    DEQ Response (1-1) – The comment is now satisfied.

15. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, General comments about Section 3 –**

    i. While *Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities* provides a very detailed discussion about HHRA for combustion facilities, please also refer to EPA Region 3 OB OD permitting guidelines for OB specific requirements to ensure the required information is included in the protocol. This guideline can be found at:

       http://www3.epa.gov/reg3wcmd/ca/pdf/RCRA_OpenBurnOpenDet_Guide.pdf

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will review the EPA Region 3 guidance and incorporate information as appropriate.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

ii. Please provide all input parameters that will be used in the modeling.

Radford Response (2-1), (Response received on 5/5/2016) – As there are a significant number of input parameters utilized in the air emission modeling, the fate and transport assessment, and the final risk calculations, we request further clarification on which input parameters DEQ wants specified.

DEQ Response (2-1) – Please provide a table (or several tables, if needed) of all the air modeling inputs which will be used. If a specific website will be used to obtain certain standard or default values, please provide the web address and name of the source. Except for meteorological data, if any site-specific information is used please provide supporting data/information which justifies the use of site-specific values. This comment also applies to the response for 17.i.

16. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.2.2. Emission Scenario, Pages 3-2 to 3-3** –

i. Please provide some more details and description of the propellant and skid burn procedures and process.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify the descriptions provided in the RAP to be consistent (the same level of detail as) those provided in the 2005 RAR.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

ii. From this section it is unclear exactly how many modeling runs will be performed and using what burn conditions and which waste groups. Please provide a table listing the model runs and conditions it represents.

Radford Response (2-1), (Response received on 5/5/2016) – RFAAP will review Section 3.2.2 and provide clarifying tables as appropriate.

DEQ Response (2-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

iii. This section lists several operational scenarios. Please note that these will have to be included in the permit as explicit operating conditions and the modeling will need to be run using scenarios that represent these conditions. Based on information in section 3.2.2 and Table 3-2 the following conditions are identified:

- Half the pans, i.e., 8 pans are ignited during any burn,
- Total maximum capacity of 8000 lbs for propellant and 2000 lbs for skid burn per day; not more than 292000 lbs per year,
- One burn event per day- either skid or propellant but never both on the same day,
- Conservatively assume 365 burn events per year,
- Burn only during daylight hours,
- Burns only during favorable weather conditions- wind speed between 3-15 mph, no precipitation or thunderstorms occurring or in the vicinity,
- Disposal event restricted during wind speed of 3-15 mph.

Radford Response (3-1), (Response received on 5/5/2016) – RFAAP recognizes that the operating restrictions employed in the modeling may be incorporated as Permit limitations and finds each of them to be reasonable limitations.

DEQ Response (3-1) – The comment is now satisfied.

iv. Skid burn has potential to burn for 7 hours or more but the modeling will be looking at only 1st hour. How will the emissions from the remaining time be included in the air modeling? VDEQ understands that this simmering time will have very different emission properties but may also have a different chemical profile than the one considered in the 1st hour. Please provide a discussion on this aspect and please include this item in the uncertainty analysis as a contributor to potential underestimation of risk.

Radford Response (4-1), (Response received on 5/5/2016) – Note that RFAAP is proposing to model the skid burn in a manner identical to that previously modeled in terms of burn duration versus modeled duration. RFAAP will provide more detail in the RAP on the proposed methodology.

DEQ Response (4-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

v. If burns are not going to be allowed on days when there is a reasonable probability of precipitation (permit condition would need to state this explicitly), the pollutants may be sufficiently dispersed that wet deposition in the study area may be negligible. However the particulates that may be released in air during OB may still be deposited via wet deposition when rain follows the OB event. Since OBODM cannot calculate wet deposition, the uncertainty section must clearly state this limitation which may under predict overall risk.

Radford Response (5-1), (Response received on 5/5/2016) – RFAAP will include a description on OBODM limitations in the uncertainty discussions in the Risk Assessment Report (RAR).

DEQ Response (5-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

vi. Section 3.2.2 provides discussions of the burn and section 3.2.3 lists model runs but it is unclear how the proposed model runs reflect all the discussions provided in Section 3.2.2. Please provide the link between these two sections.

Radford Response (6-1), (Response received on 5/5/2016) – RFAAP will modify Sections 3.2.2 and 3.2.3 to provide the clarity requested by DEQ.

DEQ Response (6-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

17. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.2.3. Material Characteristics, Page 3-5 –**

i. Please provide fugacity coefficient and the phase. Please also provide all the other input parameters, assumptions, and defaults that will be used in the modeling.

Radford Response (1-1), (Response received on 5/5/2016) – As there are a significant number of input parameters utilized in the air emission modeling, the fate and transport assessment, and the final risk calculations, we request further clarification on which input parameters DEQ wants specified.

DEQ Response (1-1) – Please see the response for 15.ii.

ii. It is unclear why the facility wants to use surrogate COPCs when the COPC list, emission factors, results of flyer test, etc. are available. Surrogate compounds are typically used for new facilities for which compound-specific information is not available. Please provide equations that will be used for proposed calculations and also explain why this approach will represent more health-protective air concentrations.

Radford Response (2-1), (Response received on 5/5/2016) – The surrogate COPCs are provided for air modeling purposes only. These surrogate pollutants will be used to provide a unity-type air concentration and deposition parameter based on a 1 g/s emission rate for each type of COPC that the surrogate represents. The modeled concentrations and deposition rates will then be scaled based on the estimated emissions of each and every COPC. Note that RFAAP is not proposing to only assess two COPCs in the risk assessment. We are merely proposing to run the air model for a vapor phase surrogate and a particle phase surrogate to develop the unity-based air concentrations and deposition rates, as is common practice.

DEQ Response (2-1) – DEQ concurs with RAAP's rationale and the comment is now satisfied.

18. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.3. Receptor Grid, Page 3-6 –**

   i. The maximum concentrations at grid level will be the sum of the particulate and vapor phase concentrations, thus representing the maximum theoretical concentration (not counting wet deposition)?

Radford Response (1-1), (Response received on 5/5/2016) – The ground-level pollutant concentrations will be calculated in accordance with the equations provided in Section 5 the HHRAP and the referenced appendices (minus the wet deposition component). The ground-level air concentration will be the modeled air concentration (vapor phase plus particle phase) at the given location. The media concentrations will be a combination of the modeled air concentrations and deposition parameters.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

   ii. Please ensure the following are identified on the grid and the predicted concentrations are available: current schools, daycares, hospitals, nursing homes, hospice and similar elderly care centers.

Radford Response (2-1), (Response received on 5/5/2016) – The specified location of each special subpopulation receptor is provided in Table 4-6. A figure will be provided in the RAR depicting each of these locations on a map. In addition, each of these locations will be included in a discrete receptor grid in the modeling runs.

DEQ Response (2-1) – DEQ will review the figure RAAP will submit to determine if the comment is satisfied.

iii. Please include surface water bodies on the grid and include predicted concentrations at those locations.

Radford Response (3-1), (Response received on 5/5/2016) – RFAAP will include a discrete receptor grid for all waterbodies. In the RAR, RFAAP will provide the predicted concentrations at each of these locations.

DEQ Response (3-1) – DEQ will review the revised Section 3.3 when submitted by RAAP and determine if the comment is satisfied.

19. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.5.1. Averaging Times, Page 3-9 -** The modeling may be carried out for every daylight hour but for risk assessment purposes, please select the 'worst case' operating scenario for averaging time.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP anticipated using the worst-case modeling runs for the risk assessment as explained in Section 3.5.1. In a meeting between the parties on March 31, 2016, DEQ concurred with this approach and indicated that no further action is required.

DEQ Response (1-1) – The comment is now satisfied.

20. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.1.3. Water bodies and Watersheds, Pages 4-4 to 4-6 –**

i. In place of using GPS to identify current receptor, VDEQ strongly recommends that risk assessment be carried out using maximum predicted surface water concentrations based on air modeling results. Once these calculations are done, current receptors etc. may be discussed as additional consideration for risk management decisions.

Radford Response (1-1), (Response received on 5/5/2016) – Recognizing that the location of each waterbody is a fairly well established historical location and that new waterbodies do not generally appear in an assessment area within any reasonable timeframe, RFAAP will model the waterbodies using the actual coordinates for those waterbodies. In addition, each watershed will be modeled based on the sum of the general receptors located within that watershed. Drinking water input locations are also well defined and not subject to new withdraw points without substantial infrastructure modifications or permitting actions. Therefore, these too will be based on actual geographical coordinates.

DEQ Response (1-1) – This response is confusing. Per the meeting on March 31, 2016, the quantitative risk assessment is to be conducted using the worst case waterbody concentration for fishing (and recreational activities). If there is the presence of a waterbody which is used for drinking water, then it will be included in QRA using the predicted concentrations specific to this waterbody. Please make changes to Section 4.1.3 accordingly.

ii. VDEQ understands that there may be fish consumption advisory on several waterbodies within the study area, but the human and ecological risk assessment calculations will not eliminate any exposure pathway based on the advisories.

Radford Response (2-1), (Response received on 5/5/2016) – RFAAP is not proposing to eliminate any exposure pathway based on these advisories. We are merely providing information on the advisories that exist and indicating that these are not in place due to any specific actions by the RFAAP. (We are adding to the description of the exposure setting and may utilize this information in a future uncertainty discussion).

DEQ Response (2-1) – The comment is now satisfied.

21. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.2 Exposure Scenarios, Page 4-7 -**Please also include 'surface water via deposition' in the bulleted list.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise the bulleted list in Section 4.2 as requested.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

22. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.2.1.1. General Receptors, Page 4-7 -** Please also include recreational receptor for direct exposure to surface water.

Radford Response (1-1), (Response received on 5/5/2016) – During a meeting between the parties on March 31, 2016, DEQ clarified that they were referring to a recreational receptor (e.g., someone swimming in the impacted waters, experiencing dermal exposure), not a recreational fisher. DEQ agreed to provide further information on the details for this exposure scenario (e.g., pathways, duration, frequency, etc.). Once this information is provided, RFAAP will add the recreational receptor to the RAP.

DEQ Response (1-1) – Please use the EPA RSL 'Recreator Surface Water Equations' and exposure defaults (where available) to calculate risk/hazard for this receptor. The recreational exposure defaults for surface water are as follows:

Water ingestion rate (L/hr) 0.05

Exposure Time (hr/event) 2

Event frequency (events/day) 1

Skin Surface Area-adult (cm2) 19,652

Skin Surface Area-child (cm2) 6,378

Exposure Frequency (days/years) 195

Exposure Duration -adult (years) 20

Exposure Duration-child (years) 6

Body Weight –adult (kg) 80

Body Weight-child (kg) 15

23. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.2.2.1. General Receptors, Page 4-10** - This section name is repeated. Please correct. This section and several other sections mention that the HHRA will be refined using ‘realistic’ land use and/or food consumptions, etc. Please note that the facility has no control over activities and exposures of off-site receptors therefore ‘site-specific’ consideration cannot be considered. Therefore, please remove such language from this section and elsewhere in the protocol.

Radford Response (1-1), (Response received on 5/5/2016) – While RFAAP has no control over the activities of off-site receptors, local zoning offices do draw jurisdictions and establish areas in which different types of activity are permitted. For example, without extensive re-zoning efforts, an area zoned industrial cannot be used for agricultural farmland or a housing development. In addition, those areas for which extensive clearing of land or existing neighborhoods would be required to conduct subsistence farming, or for which the terrain (e.g., steep grade or cliff) would prohibit subsistence farming, or those areas falling within a transportation line (*e.g.*, railway thoroughfare) would not be considered for the farming scenario. An examination of the exposure scenario map provided in Figure 4-2 reflects these considerations.

DEQ Response (1-1) – DEQ requires further clarification from RAAP to satisfy the comment. DEQ believes RAAP will conduct a QRA using maximum concentrations as described under response 18.i for all the receptors (except fishing/recreational where maximum concentration for a waterbody will be used). In addition, RAAP will make a case for various other locations as described in response 23. Please confirm whether this is an accurate summary of the calculations to be completed for the QRA.

24. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.2.1.2. Special Subpopulations, Page 4-8 -** Schools and day care centers have different exposure scenarios so please separate the two. Please also refer to comments below related to Section 4.3.3. Another section 4.2.2.2 has the same name which is confusing- please either combine the sections or give different names to each section.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will establish a separate exposure scenario for schools and daycare centers. However, recognizing that EPA guidance presents these two locations as having the same exposure assumptions, we request clarification from DEQ on the assumptions they propose we use for each scenario.

    DEQ Response (1-1) – DEQ's comment was related to the information provided in October 2015 report Section 4.2.1.2 and Table 4.4 which listed day care facilities and schools as having separate exposure defaults. Based on the discussion at the March 31, 2016 meeting, a separate line item will be provided in Table 4.4 representing daycare age (0-6 years) and elementary school student age (6-10 years). DEQ remains unclear how the other exposure defaults will be used for the elementary school student as proposed by the facility. Per March 31, 2016 meeting, DEQ is requesting RAAP to provide exposure defaults for this receptor. This comment also applies to response 26.

25. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.2.2. Exposure Pathways, Page 4-8 -** Please add inhalation and dermal pathway of exposure of soil for all receptors. Please also provide all the exposure defaults for *every receptor and each media* that will be used for calculations in a table. Please obtain the exposure from EPA RSL user's guide; for defaults that are not available in the RSL guidance, please refer to EPA's exposure factors handbook and EPA R 6 HHRAP guidance. This comment also applies to section 4.3 and all subsections.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add the requested pathways to each scenario. RFAAP will provide information on the exposure defaults for each exposure scenario in the RAR, as requested during our March 31, 2016, meeting.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

26. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Table 4.4 -** Please specify that inhalation includes vapor and particulates. Further child receptor is counted from 0-6 years, not 1 to 6 years. Schools can have students up to age of 18 years, so please explain why only 10 years is selected.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify Section 4.3.1.1 of the RAP to clarify that the air concentration is a combination of the vapor and particulate concentrations.

During a meeting between the parties on March 31, 2016, RFAAP further explained the age ranges of each receptor that was chosen. DEQ requested several modifications to these child receptors:

- Daycare should be reflective of children from 0 to 6 years old, not 1 to 6 years old.
- School scenario should be clarified as an elementary school scenario.
- Assessment of middle schools and high schools is not necessary at this time, as generally the daycare and elementary school students are more susceptible to risks from exposure.

RFAAP will make the changes requested and will verify the body weights that will be used for each scenario.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time. Please also see the response to Comment 24.

27. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.2.3. Exposure Locations, Page 4-10 -** Please use the maximum deposited concentration (same concentration value) for each receptor for human health and land based ecological receptors for QRA. Information regarding current receptors at the predicted area of maximum deposition and locations of sensitive receptors may be discussed separately for risk management decision making and/or uncertainty analysis.

    Radford Response (1-1), (Response received on 5/5/2016) – In a meeting between the parties on March 31, 2016, RFAAP clarified that they intended to assess risk as the location with the highest modeled air concentration and the location with the highest modeled deposition rates. This will likely result in assessment at multiple locations. (One, worst-case location that includes the highest air concentration and highest deposition rate will not be modeled, as it is overly conservative). DEQ indicated that they found this approach to be acceptable.

    DEQ Response (1-1) – The facility has proposed the following: The maximum modeled air concentration -annual and hourly - will be used for inhalation and acute risk assessment, respectively and highest depositional (volatile and particulate) will be used for soil and all other related media concentrations. Please confirm if this is an accurate summation of what is being proposed.

28. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.3. Quantification of Exposure, Page 4-13 -** Please provide information on what equations, what input assumptions and values, and what algorithms will be used to calculate the exposure point concentration for each media studied. If commercial software is used for this purpose, VDEQ will need to evaluate the software for adequacy review. This comment applies to all the subsections of 4.3.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP indicates in the RAP that the HHRAP Volume III will be used to calculate media concentrations. We are uncertain of what specification is required above and beyond this reference.

    DEQ Response (1-1) – Per the discussions with RAAP on March 31, 2016, RAAP will provide exposure/input values which are different from the ones provided in the RSL table and EPA HHRAP with text justifying the use of these non-default values. For exposure defaults, the EPA RSL values will supersede EPA HHRAP where available. All the input values used in the calculation will be included in the HHRA report. This comment also applies to Response 30.

29. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.3.1.2. Soil Concentrations, Page 4-14 -** There is no screening level evaluation for RCRA permitting related RA. All COPCs that have emission factor and toxicity will be included in the quantitative risk assessment for human health and ecological evaluation. Please remove any references to screening level evaluation throughout the document for both human and ecological risk assessment, including section 4.3.1.3 and section 7.3.

    Radford Response (1-1), (Response received on 5/5/2016) – In regards to the human health risk assessment, the word screening is not applied in this discussion. We consistently refer to the human health risk assessment as the MPRA (multipathway risk assessment).

    The term screening is applied to the ecological assessment and used in Sections 4.3.1.3 and 7.3 based on similar wording and descriptions provided by USEPA in their guidance document (and DEQ's recommended reference) *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities.* Therefore, the use of the word "screening" is consistent with USEPA terminology and DEQ recommendations.

    DEQ Response (1-1) – DEQ concurs with RAAP's rationale and the comment is now satisfied.

30. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.3.1.3. Surface Water and Sediment Concentrations, Page 4-14 -** Please provide the full reference citation for Volume three of HHRAP. Please provide all input variables.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add the requested citation. However, we request DEQ provide further clarification on which input parameters DEQ wants specified as there are a significant number of input parameters utilized in the modeling, fate and transport assessment, and the final risk calculations.

DEQ Response (1-1) – Please see the response to Comment 28.

31. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 4.3.3. Exposure frequency and Duration** - Please refer to Comment 23 above. The facility may use the exposure assumptions and scenarios specified in R 6 guidance and toxicity values which have been developed to account for toxicity to account for sensitive receptors or evaluate sensitive receptor separately as proposed. If the facility chooses to evaluate sensitive receptor separately, please provide references and rationale for selecting exposure values. Exposure at school may be 180 days but daycare may be far greater. Therefore please use 350 days/year. Further, childcare can have infants up to 12 years of age. Please make necessary adjustment. What is the source of the assumption of a 7 day stay in nursing home? How are hospice and longer term facilities accounted for? Also for elderly, how is the immune-compromised status and differential susceptibility to be accommodated in the calculations? Please provide more information on the data source for a nursing home stay of 3 years. Please also provide the equations that will be used to calculate intake concentrations for sensitive populations.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide the requested information in the revised RAP.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

32. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 5.1. Toxicity Information for noncarcinogenic effects, and Section 5.2. Toxicity Information for Carcinogenic Effects, Page 5-1** - Please consult the latest update of the EPA Region 3 RSL table to obtain carcinogenic as well as noncarcinogenic toxicity values. While the RSL table itself obtains toxicity values from several primary sources (IRIS, PPRTV, ATSDR MRLS, CalEPA RELS and cancer potency values and provisional PPRTVs and HEAST), VDEQ recommends using the RSL table so that it is easy to keep a track of updates in relation to the date of report. The RCRA Corrective Action website lists several compounds that are used as surrogate compounds. Please consult this list. Chemicals that have SFO and/or IUR in the RSL table will be considered to be a carcinogen. Chemicals that have a RfD and/or RfC in the RSL table will be considered to be noncarcinogens and chemicals that have both carcinogenic and noncarcinogenic toxicity values, both, risk and hazard will need to be calculated. Please make necessary changes in the text to reflect this information.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section 5.2 accordingly.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

33. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 6.1. Noncarcinogenic Hazard Inde3x Estimate, Page 6-1 –**

i. The TRI report is neither representative of background concentrations, nor does it in any capacity give any indication of background concentrations of any of the constituents. The TRI report simply reports permitted and some fugitive emissions by certain groups of industries that have inventories exceeding a certain quantity. Therefore, please do not use TRI values as background levels. Please remove this entire discussion from the protocol.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP was not using the TRI values as background concentrations, but was using them as a representation of the lack of other facilities that are contributing to the level of regulated constituents in the assessment area. This is necessary and important both when establishing target values for the risk assessment, as well as discussing and evaluating modeled impacts on the surrounding area. We feel the discussion important to document surrounding industrial activities and aide future discussions in the RAR. However, to clarify that the intent of this section is only for information purposes only (and not to base some alternate risk/hazard criteria on), RFAAP will move this discussion to another portion of the RAP.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

ii. Target level HQ for individual noncarcinogens irrespective of target organ (i.e., hazard from one chemical via all exposure media and pathways for a receptor): 0.25. Target level HI for all noncarcinogens irrespective of target organ (i.e., hazard from all COPCs combined via all exposure media and pathways for a receptor): 1.0 The target level for blood lead levels in children is no more than 5% of children exceeding a blood lead level of 10 μg/dL.

Radford Response (2-1), (Response received on 5/5/2016) – RFAAP finds these targets appropriate and will modify the discussion in Section 6.1 of the RAP to reflect this specification.

DEQ Response (2-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

34. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 6.2. Carcinogenic Risk Estimate, Page 6-3 -** Chronic Exposure: Individual risk (i.e., risk from one chemical via all exposure media and pathways for a receptor): at or below 1E-6. Cumulative risk (i.e., risk from all chemicals via all exposure media and pathways for a receptor): at or below 1E-4.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP finds these targets appropriate and will modify the discussion in Section 6.2 of the RAP to reflect this specification.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

35. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 6.3. Acute Hazard Assessment, Page 6-3 -** Please provide a table listing COPC specific acute toxicity value that is proposed to be used and the source of this value. Please use acute exposure Target level AHQ for individual noncarcinogens irrespective of target organ: not to exceed 0.25.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide a table with the requested toxicity values. However, information on the values proposed is provided in the RAP in Section 5.1. Consistent with this discussion, RFAAP will provide the requested table once a final COPC list has been determined.

    The recommended target for the acute hazard assessment seems overly conservative and is not consistent with USEPA guidance. However, since prior applications of the OBG risk assessment at the RFAAP utilized this target criteria, RFAAP will modify the RAP to use the values proposed above.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

36. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 7.2. Ecological COPC selection, Page 7-4 -** The list of COPC and the concentration of COPC must be same for ecological and human health risk assessment. This list may be adjusted based on availability of TRVs, NOELs, and LOELS. Please clarify this in the report.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP agrees that the initial COPC list will be the same for both assessments. However, the actual list of COPCs included in the assessment will vary depending upon human and ecological criteria available on each COPC. We will revise this section to clarify this.

DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

37. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Table 7-1. Habitat Distributions Within the Assessment Area, Page 7-3 and Appendix A - Table 1 in Animal Survey at RAAP by Radford University -** It appears that the habitats listed in these tables needs to be included in the screening level ecological risk assessment using EPA Region 6 SLERA protocol. Please consult this document for further details.

    Radford Response (1-1), (Response received on 5/5/2016) – In the RAP provided, RFAAP proposed to perform an initial screening level ecological assessment that compared modeled concentrations to ecological screening criteria. During a meeting between the parties on March 31, 2016, DEQ indicated that this level of assessment was not acceptable and that a more detailed assessment, consistent with that described in the SLERA must be performed. RFAAP will modify the RAP to provide this revised type of assessment.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

38. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 7.4. Phase II assessment, Page 7-5 -** Please refer to Comment 27 regarding 'Phase I' and rename this section. This section is incomplete as it does not have information regarding habitats, food webs, representative species, assessment endpoints, measurement endpoints, BCFs, BAFs, FCM, TRVs, and other toxicity related information, concentration calculation for each food items, etc. Please include a very detailed discussion of the step-wise process by which ecological risk assessment will be carried out. Please use the following ESQ: For all COPC for a receptor at a given location: acceptable ESQTotal will be at or below 1.

    Radford Response (1-1), (Response received on 5/5/2016) – In the RAP provided, RFAAP proposed to perform an initial screening level ecological assessment that compared modeled concentrations to ecological screening criteria. During a meeting between the parties on March 31, 2016, DEQ indicated that this level of assessment was not acceptable and that a more detailed assessment, consistent with that described in the SLERA must be performed. RFAAP will modify the RAP to provide this revised type of assessment. DEQ indicated that they will provide a series of reference sources of ecological criteria to RFAAP for use in this assessment.

DEQ Response (1-1) – Please see attached hierarchy of references for SLERA (Attachment 1 – NASA Wallops Appendix D-2 and D-3).

39. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 8.1. Types of Uncertainty, Page 8-1 -** Please add the following types of uncertainty: wet deposition is not included thereby underestimating the risk; COCP that do not have either emission factor or toxicity values are not counted in risk/hazard calculation, thus underestimating risk; uncertainties associated with sampling and laboratory based analysis that may under or overestimate risk.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise Section 8.1 accordingly.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

40. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 8.1.1. Assumptions and Variables, Page 8-1 -** For the most part, the exposure defaults are conservative and more likely to result in overestimating than underestimating human risk. This approach ensures protection of the public health as well as scientific validity, and minimizes serious errors in estimating risks and potential liability. This section needs to explain the rationale for selection of conservative defaults. Further, as mentioned previously, 'site-specific' parameters do not apply. Therefore please remove language indicating use of 'site-specific' exposure parameters.

    Radford Response (1-1), (Response received on 5/5/2016) – Many of the considerations that feed the risk assessment are based on site-specific factors, such as waste composition, site location, exposure setting, subpopulation locations, *etc*. However, we recognize that DEQ's intent with this comment was to prevent the use of site-specific exposure factors/consumption practices for individuals within the assessment area. The values proposed for these factors will be consistent with the HHRAP and will be defined in the RAP and RAR.

    DEQ Response (1-1) – The response indicates the detailed information requested by DEQ will be provided at a later date. DEQ will review the new information when available and determine if the comment is satisfied at that time.

Section 6 of the Notice of Deficiency Addressing the Technical Completeness of the Part A and Part B Permit Applications for the Renewal of the Subpart X Open Burning and Open

Detonation Permit, Technical Deficiencies of the Air Modeling of the Risk Assessment Protocol of the Permit Application

General Comments

1. All input and output files (e.g., OBODM, pre-processing and post-processing files), including any spreadsheets and 3rd party software project files (e.g., BEEST, Lakes, Trinity, utility programs) shall be provided to DEQ in electronic format.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide all modeling files in electronic format with the RAR.

   DEQ Response (1-1) – DEQ will review the modeling files upon receipt to determine if the comment is satisfied.

2. The final risk assessment report should include graphics (e.g., contour maps) that show the extent of the air quality impacts and shall utilize a base map that is readily understandable by the general public. DEQ encourages the applicant to also submit Geographic Information System (GIS) shape files of the air quality impacts if available.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide the requested information in the RAR.

   DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

3. A complete copy of all modeling correspondence should be sent to the DEQ Air Division's Office of Air Quality Assessments and the DEQ Land Division.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will provide a copy of all modeling-related correspondence to both the DEQ Air Division and the DEQ Land Division as requested.

   DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

4. Generally speaking, every input parameter that will be used for the modeling will need to be included in this protocol for DEQ's review and approval.

   Radford Response (1-1), (Response received on 5/5/2016) – As there are a significant number of input parameters utilized in the air emission modeling, we request further clarification on which input parameters DEQ wants specified. During a meeting between the parties on March 31, 2016, DEQ indicated that they will provide a specific table of parameters that they wish to have specified in the RAP.

DEQ Response (1-1) – This comment is now rescinded by DEQ. No table is needed and the comment is satisfied.

5. The protocol should provide a justification for the use of OBODM in terms of this model being the best available tool to characterize worst-case exposures. Also, can AERMOD be used in addition to the OBODM model to evaluate wet deposition and particle phase emissions in complex terrain?

   Radford Response (1-1), (Response received on 5/5/2016) – OBODM was selected as the model for this application, as it was the model recommended by DEQ and provided in EPA Region 3's OBOD guidance (reference page 4-9 of EPA's guidance). While AERMOD can be used to model wet deposition from air emission sources, we do not feel it appropriate to do so for this application. EPA specifically recommended the use of OBODM despite its limitations in this area, recognizing that OB activities were not conducted during precipitation events, thereby nullifying the concerns with this deficiency. We do not intend to utilize AERMOD in this effort to supplement the OBODM modeling. RFAAP will prepare a separate submittal providing the necessary justification for this approach.

   DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

Specific Comments for the Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds Air Modeling :

1. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 1.4, Page 1-3 -** The protocol states that *"USEPA guidance indicates that a 10-kilometer (km) radius is usually more appropriate for air dispersion and deposition modeling."* Please provide the reference for this information.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will modify Section 1.4 to include the requested reference.

   DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

2. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.1, Page 3-1 -** The latest version of OBODM is Version 01.3.0024 which was released on February 9, 2010.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will update the OBODM version in Section 3.11.

DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

3. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.2.2, Pages 3-2 through 3-4 -** The applicant has several assumptions in Table 3-2. These include the maximum amount of waste (total), the maximum amount of waste (per pan), the duration of each burn, the hours for each burn, and the conditions for each burn. These assumptions will likely need to be included in enforceable permit conditions.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP recognizes that the assumptions specified in Table 3-2 may be incorporated as Permit limitations and finds each of them to be reasonable limitations.

   DEQ Response (1-1) – DEQ concurs with the applicant's response and the comment is now satisfied.

4. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.2.2, Pages 3-2 through 3-4 -** Consistent with recommendations contained in *40 CFR Part 51, Appendix W - Guideline on Air Quality Models*, the OB modeling should include a range of conditions that ensure that the burn scenario that causes maximum ground-level concentrations is identified. Therefore, a detailed discussion of the possible scenarios, including the model input parameters, should be provided prior to the commencement of the modeling analysis.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP provided a description of the two main burn scenarios (propellant burns and skid burns) in the RAP and provided information on the differences between these two in Section 3.2.2 of the RAP. There are no burn scenarios other than these two scenarios. In a meeting between the parties on March 31, 2016, DEQ clarified that they were simply looking for an increased level of detail in the descriptions provided. RFAAP will make modifications as requested.

   DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

5. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.2.4, Page 3-6 -** We recommend using NAD83 or WGS84 instead of NAD27 in Table 3-4 because the results are more easily translated to Google Earth and other software packages.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise all maps and coordinate descriptions to utilize the NAD83 datum as requested.

DEQ Response (1-1) – DEQ concurs with the applicant's response and the comment is now satisfied.

6. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.2.4, Page 3-6 -** Please provide a graphical representation (i.e., a satellite image) of the coordinates in Table 3-4.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will add a new figure to the RAP that provides a graphical representation of the pan coordinates.

   DEQ Response (1-1) – DEQ concurs with the applicant's response and the comment is now satisfied.

7. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.3, Pages 3-6 through 3-7 –** DEQ recommends the use of a higher resolution receptor grid than what is being proposed by the applicant. Specific guidance is located at:

   http://www.deq.virginia.gov/Portals/0/DEQ/Air/Assessments/dispersion/VA_Modeling_Guideline_03172015.pdf

   Specifically, DEQ and EPA Region III recommend 25-meter receptor spacing along the facility's ambient air boundary (e.g., fenceline). In addition, it is suggested that 50-meter receptor spacing be used within 1 kilometer (km) of the facility, 100-meter spacing from 1 to 3 km, 250-meter spacing from 3 to 10 km, and 500-meter spacing beyond 10 km. Also, it is recommended that refined modeling be conducted using 50-meter receptor spacing to ensure that the maximum impact has been identified in the event that any maximum occurs beyond the initial 50-meter receptor grid.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP notes that the receptor grid proposed is consistent with EPA guidance provided in the HHRAP. However, RFAAP can reduce the receptor spacing within the defined receptor grid as requested. We do not agree with expanding the receptor grid to an extent of 50 kilometers (>30 miles) from the source, especially considering that prior modeling efforts have shown the most impacted locations are less than 3 kilometers from the source. In a meeting between the parties on March 31, 2016, DEQ agreed with this proposed modification.

   DEQ Response (1-1) – DEQ did not specifically recommend using a grid to an extent of 50 kilometers (>30 miles) from this facility. The general DEQ modeling guidelines suggest that AERMOD is valid to a range of 50 kilometers. DEQ concurs that a smaller grid that ensures that the maximum impact is captured is appropriate. A grid extending to 10 kilometers is likely adequate.

8. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.3, Pages 3-6 through 3-7 -** We recommend using NAD83 or WGS84 instead of NAD27 for all receptor locations because the results are more easily translated to Google Earth and other software packages.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise all maps and coordinate descriptions to utilize the NAD83 datum as requested.

   DEQ Response (1-1) – DEQ concurs with the applicant's response and the comment is now satisfied.

9. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.3, Pages 3-6 through 3-7 -** We recommend using the USGS National Elevation Dataset (NED) in lieu of USGS Digital Elevation Models (DEM) because the NED data is generally considered to be more accurate. The applicant should use the highest resolution USGS NED available which is typically 10-meter data.

   Radford Response (1-1), (Response received on 5/5/2016) – RFAAP actually used the NED in establishing the receptor and source elevation data. The description provided in Section 3.3 was incorrect and will be revised accordingly.

   DEQ Response (1-1) – DEQ will review the revised protocol upon receipt to determine if the comment is satisfied.

10. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.4, Pages 3-7 through 3-9 -** Applicants in regulatory modeling analyses are allowed to substitute for up to 10 percent of the data; conversely, the meteorological data base must be 90 percent complete (before substitution) in order to be acceptable for use in regulatory dispersion modeling. Please provide the supporting documentation for purposes of assessing compliance with the 90 percent completeness criteria for the Virginia Tech, Kentland Farm data. The 90 percent requirement applies on a quarterly basis such that 4 consecutive quarters with 90 percent recovery are required for an acceptable one-year data base. The 90 percent requirement applies to each of the variables: wind direction, wind speed, stability, and temperature and to the joint recovery of wind direction, wind speed, and stability.

    Radford Response (1-1), (Response received on 5/5/2016) – The level of effort requested by DEQ in this evaluation is substantial. During a meeting between the parties on March 31, 2016, RFAAP agreed to provide further information on the Kentland Farm data and complete an assessment as to the completeness and availability of it. However, before proceeding with this completeness review, RFAAP will provide an evaluation of the quality of the data consistent with the information requested in NOD 6.12 below.

DEQ Response (1-1) – DEQ will review the RFAAP data quality evaluation, consistent with the information requested in NOD 6.12, and will then determine if additional quality assurance documentation is needed.

11. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.4, Pages 3-7 through 3-9 -** The applicant should use up to 5 years of the Kentland Farm data. EPA guidance (Section 8.3.1.2 of 40 CFR Part 51, Appendix W) stipulates that a <u>minimum</u> of 1 year of onsite data can be used but that additional data up to 5 years should be used if available.

    Radford Response (1-1), (Response received on 5/5/2016) – Recognizing the request for a detailed completeness review for each quarter and each year of data utilized, we believe the requirement to use five years of essentially site-specific data to be overly burdensome. As EPA guidance specifies one year of site-specific data is adequate, we feel that one year of data should be all that is required. DEQ clarified that at least one year of data must be used but more years, up to five, is preferred. DEQ recommended that the quality and completeness assessments be completed before this discussion is finalized.

    DEQ Response (1-1) – DEQ does not concur with the RFAAP's response for several reasons. As previously stated, EPA guidance (Section 8.3.1.2 of 40 CFR Part 51, Appendix W) stipulates that a minimum of 1 year of site-specific data can be used but that additional data up to 5 years should be used if available. There appears to be a significant period of data available for the Kentland Farm site. DEQ does not agree that utilizing 5 years of these data for input to the model represents an "overly burdensome" requirement since all air permit applicants conducting modeling conform to these methods. In addition, Kentland Farm, while in relatively close proximity to the RFAAP, does not constitute "site-specific data" as outlined in Appendix W. Five years of data has also been selected by EPA as an appropriate period of record because it sufficiently represents the year-to-year variability in meteorological conditions.

12. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.4, Pages 3-7 through 3-9 -** Please provide any Quality Assurance Project Plan (QAPP) and supporting documentation that details how the data was collected and how it was quality assured.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will have to work with the Virginia Tech meteorological staff to develop the requested documentation. Recognizing that this will require considerable effort, we request further information from DEQ on what specific information they would like presented on the data and data collection methodologies. During a meeting between the parties on March 31, 2016, DEQ agreed to provide an example QAPP and/or bulleted list of quality evaluations that must be made on the data.

DEQ Response (1-1) – DEQ will provide the example QAPP document for the Dominion Virginia Power Ambient Air Monitoring Station and Dominion Virginia Power Air Quality Monitoring Program Quarterly Monitoring Report to RFAAP for review. Both documents are included as Attachments 2 and 3 of this document.

13. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.4, Pages 3-7 through 3-9 -** The applicant should use upper air data from NWS Station 53829 (Roanoke/Blacksburg) in lieu of data from NWS Station 13723 (Greensboro/High Point/Winston Salem).

    Radford Response (1-1), (Response received on 5/5/2016) – According to the NWS reliability score for the last three months, data from NWS 53829 presents multiple reliability problems. Therefore, we chose NWS 13723, as it presents much more consistent and favorable reliability scores from the NWS. During a meeting between the parties on March 31, 2016, DEQ indicated that they have performed a completeness assessment on the Roanoke data and found the data from the period between 2010 and 2014 to be acceptable. DEQ will provide a copy of this data. (In their assessment of the data, DEQ substituted any missing data from the Roanoke station with data from the Greensboro/Highpoint station). RFAAP will review the data once it is provided by DEQ and provide a final proposal/justification for the source of upper air data.

    DEQ Response (1-1) – DEQ will provide the upper air data to RFAAP for use in the modeling analysis.

14. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.4, Pages 3-7 through 3-9 -** The applicant should also refer to Section 6.8 of EPA's *Meteorological Monitoring Guidance for Regulatory Modeling Applications, February 2000*, for procedures on treatment of missing data and substitution methods.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP will revise the reference in Section 3.4 to indicate that the requested document will be used for missing data substitution.

    DEQ Response (1-1) – DEQ concurs with the applicant's response and the comment is now satisfied.

15. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.5.1, Page 3-9 -** The applicant assumes that *"…only one burn can be conducted per day (due to safety restrictions), the actual maximum number of events per year is 365 events, rather than the 3,285 considered in the annual modeling scenario, which assumes 10 events per day (one event for every hour between 0800 and 1700 hours)."* These assumptions will likely need to be included in enforceable permit conditions.

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP recognizes that the assumptions specified in Section 3.5.1 may be incorporated as Permit limitations and finds each of them to be reasonable limitations.

DEQ Response (1-1) – DEQ concurs with the applicant's response and the comment is now satisfied.

16. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.5.2, Page 3-9 –** Even though the applicant states that the OB operations will not be conducted during precipitation events, it is possible for some of the compounds emitted during a burn to adsorb to atmospheric particulates and gases where they may remain until removed through precipitation (wet deposition). Therefore, please discuss the possibility of using AERMOD for the purposes of quantifying the wet deposition pathway. Omission of wet deposition may underestimate the off-site soil and surface water concentrations.

    Radford Response (1-1), (Response received on 5/5/2016) – While AERMOD can be used to model wet deposition from air emission sources, we do not feel it appropriate to do so for this application. USEPA specifically recommended the use of OBODM despite its limitations in this area, recognizing that OB activities were not conducted during precipitation events, thereby nullifying the concerns with this deficiency. We do not intend to utilize AERMOD in this effort to supplement the OBODM modeling.

    With these considerations, we disagree that omission of wet deposition will underestimate off-site concentrations. If OB operations are not conducted during precipitation events, then the contribution from wet deposition is essentially zero.

    During a meeting between the parties on March 31, 2016, RFAAP agreed to provide a series of comparisons between AERMOD runs and OBODM runs that have been conducted for multiple scenarios as multiple facilities to substantiate our proposal to not supplement the OBODM run with AERMOD runs.

    DEQ Response (1-1) – DEQ will review the modeling comparisons between AERMOD and OBODM upon receipt to determine if the comment is satisfied.

17. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.5.2, Page 3-9 -** If used, the AERMOD wet deposition analyses should be consistent with the latest EPA guidance contained on EPA's Technology Transfer Network Support Center for Regulatory Atmospheric Modeling:

    AERMOD Deposition Algorithms – Science Document (Revised Draft)
    http://www.epa.gov/ttn/scram/7thconf/aermod/aer_scid.pdf

Deposition Parameterizations for the Industrial Source Complex (ISC3) Model, M. L. Wesely, P. V. Doskey, and J. D. Shannon, Environmental Research Division, Argonne National Laboratory, June 2002.
http://www.epa.gov/ttn/scram/7thconf/aermod/driscdep.zip

Radford Response (1-1), (Response received on 5/5/2016) – RFAAP does not intend to utilize AERMOD in the OBG risk assessment process. Additional information justifying this decision will be provided in a separate submittal.

DEQ Response (1-1) – DEQ will review the modeling comparisons between AERMOD and OBODM upon receipt to determine if the comment is satisfied.

18. **Multi-pathway Risk Assessment Protocol for the Radford Army Ammunition Plant Open Burning Grounds, Section 3.5.3, Page 3-10 -** The use of the independent study, *Explosion Dust Particle Size Measurements (Pinnick et. al, 1983)*, is subject to DEQ Land Division approval. Generally, DEQ recommends that the applicant make an effort to develop site-specific particle size distribution data in lieu of national default values.

    Radford Response (1-1), (Response received on 5/5/2016) – RFAAP requests further information on when we can expect DEQ review and comment on the proposed particle size distribution data. We do not expect to be able to collect site-specific particle size distribution data with the flyer study. Therefore, this prior study is the best available data for this effort. Considering this, DEQ agreed in the March 31, 2016, meeting that the proposed particle size distribution provided in the RAP is acceptable.

    DEQ Response (1-1) – DEQ concurs with the applicant's response on the basis that the facility cannot collect site-specific particle size distribution data and the comment is now satisfied.

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Attachment 1
NASA Wallops Appendix D-2 and D-3

APPENDIX D-2

BIOCONCENTRATION FACTORS

BIOCONCENTRATION FACTORS HIERARCHY
RISK ASSESSMENT PROTOCOL FOR OPEN BURNING AREA
NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

Soil to Plants

1. EPA Guidance for Developing Ecological Soil Screening Levels (Eco SSLs), Attachment 4-1 (2007). The BAFs that are based on regression equations were not selected because they cannot be used with the EcoRisk View program.

2. ORNL -Toxicity and Chemical-Specific Factors Database (accessed March 2015).

3. LANL ECORISK Database Release 3.3.

4. The Plant-Soil BCFs for Aboveground Produce (Brag) and Forage (Brforage) from the Human Health Risk Assessment Protocol Companion Database (EPA, 2005). Many of the values in this database are the same as those in the SLERAP, and most of the equations used to develop the values are the same. However, these values were selected before the SLERAP values because they may have used updates Kow values to calculate the BAFs and in some cases, different sources were used for the BAFs.

5. EcoRisk View database (Lakes Environmental). These values are from the SLERAP (EPA, 1999).

6. SLERAP (EPA, 1999). Some of the SLERAP values were not included in the EcoRisk View database so they were hand-entered into EcoRisk View.

Note: The soil to plant BAFs are on a dry weight basis which is the same as what is used in the SLERAP guidance.

Soil to Invertebrates

1. EPA Guidance for Developing Eco SSLs Attachment 4-1 (2007). The BAFs that are based on regression equations were not selected because they cannot be used with the EcoRisk View program. There values were converted to a wet-weight basis by multiplying the BAF from the Eco SSL document by 0.167 (the approximate percent solids in earthworms).

2. LANL ECORISK Database Release 3.3. The values were converted to a wet-weight basis by multiplying the BAF from the Eco SSL document by 0.167 (the approximate percent solids in sediment invertebrates).

3. EcoRisk View database. These values are from the SLERAP (EPA, 1999).

4. SLERAP (EPA, 1999). Some of the SLERAP values were not included in the EcoRisk View database so they were hand-entered into EcoRisk View. Values for some additional parameters were not in SLERAP but were calculated using the equation in the SLERAP guidance.

Note: The ORNL values from Sample et al. (1998) were not used because they were cited in the Eco SSL document.

Sediment to Invertebrates

1. LANL ECORISK Database Release 3.3. The values were converted to a wet-weight basis by multiplying the BAF from the Eco SSL document by 0.167 (the approximate percent solids in sediment invertebrates).

2. EcoRisk View database. These values are from the SLERAP (EPA, 1999).

3. SLERAP (EPA, 1999). Some of the SLERAP values were not included in the EcoRisk View database so they were hand-entered into EcoRisk View. Values for some additional parameters were not in SLERAP but were calculated using the equation in the SLERAP guidance.

4. DOE 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. BJC/OR-112. August. The 90% values will be used from this document. The values were converted to a wet-weight basis by multiplying the BAF from the Eco SSL document by 0.167 (the approximate percent solids in sediment invertebrates).

5. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States (EPA 2004). These are sediment to fish BSAFs so they are used last. The values were converted to a wet-weight basis by multiplying the BAF from the EPA 2004 document by 0.167 (the approximate percent solids in sediment invertebrates).

Water to Fish BCFs

1. Chemical specific Inputs for the 2015 Human Health Ambient Water Quality Criteria (EPA, 2015). Only the bioconcentration factor values were used. The bioaccumulation factors include trophic level factor.

2. EcoRisk View database. These values are from the SLERAP (EPA, 1999). These values were selected first because they account for the trophic level of the test organisms whereas values from other sources do not.

3. SLERAP (EPA, 1999). Some of the SLERAP values were not included in the EcoRisk View database so they were hand-entered into EcoRisk View.

4. ORNL -Toxicity and Chemical-Specific Factors Database (accessed March 2015).

5. LANL ECORISK Database Release 3.3.

6. Human Health Risk Assessment Protocol Companion Database (EPA, 2005).

Water to Invertebrate BCFs

1. EcoRisk View database. These values are from the SLERAP (EPA, 1999). These values were selected first because they account for the trophic level of the test organisms whereas values from other sources do not.

2. SLERAP (EPA, 1999). Some of the SLERAP values were not included in the EcoRisk View database so they were hand-entered into EcoRisk View. Values for some additional parameters were not in SLERAP but were calculated using the equation in the SLERAP guidance.

Water to Algae BCFs

1. EcoRisk View database. These values are from the SLERAP (EPA, 1999). These values were selected first because they account for the trophic level of the test organisms whereas values from other sources do not.

2. SLERAP (EPA, 1999). Some of the SLERAP values were not included in the EcoRisk View database so they were hand-entered into EcoRisk View. Values for some additional parameters were not in SLERAP but were calculated using the equation in the SLERAP guidance.

References

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BIOCONCENTRATION FACTORS FOR THE ECOLOGICAL RISK ASSESSMENT
RISK ASSESSMENT PROTOCOL FOR OPEN BURNING AREA
NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

CAS registry number	Chemical of potential concern	Soil to plant BCF (dry weight)		Soil to invertebrate BCF (wet weight)		Sediment to invertebrate BCF (wet weight)		Water to Fish BCF (wet weight)		Water to Invertebrate BCF		Water to Algae BCF	
71-55-6	1,1,1-Trichloroethane	1.38	ORNL	3.173	LANL	3.173	LANL	16.8	HHRAP	7.97076	Equation	7.97076	Equation
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	0.566	ORNL	27.672	Equation	27.672	Equation	9.92	ORNL	27.672	Equation	27.672	Equation
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzodioxin	0.00068	ORNL	0.019	SLERAP	1.377	(1)	50.8	SLERAP	18.7	SLERAP	39.6	SLERAP
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.00098	ORNL	0.017	SLERAP	0.885	(1)	46.6	EcoRisk	17.2	EcoRisk	36.3	EcoRisk
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00068	ORNL	0.081	SLERAP	1.268	(1)	215.9	EcoRisk	79.6	EcoRisk	168.4	EcoRisk
57117-44-9	1,2,3,6,7,8-hexachlorodibenzofuran	0.00098	ORNL	0.3	SLERAP	0.71	(1)	804.7	EcoRisk	296.4	EcoRisk	627.4	EcoRisk
95-63-6	1,2,4-Trimethylbenzene	0.302	ORNL	2.1042	LANL	2.1042	LANL	24	ORNL	67.1382	Equation	67.1382	Equation
107-06-2	1,2-Dichloroethane	5.33	ORNL	0.45257	LANL	0.45257	LANL	2.85	HHRAP	1.20921	Equation	1.20921	Equation
108-67-8	1,3,5-Trimethylbenzene	0.4	ORNL	45.1835	Equation	45.1835	Equation	85.8	HHRAP	45.1835	Equation	45.1835	Equation
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	0.00373	ORNL	2.54	SLERAP	3	(1)	6776	EcoRisk	2496	SLERAP	5283	EcoRisk
NA	2,3,7,8-TCDD TEQ	0.00438	ORNL	1.5865	LANL	7.45	(1)	3388	EcoRisk	1248	SLERAP	2642	EcoRisk
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	0.00628	ORNL	1.5865	LANL	12	(1)	4235	EcoRisk	1560	EcoRisk	3302	EcoRisk
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-Dioxin	0.00438	ORNL	1.5865	LANL	12	(1)	4235	EcoRisk	1560	EcoRisk	3302	EcoRisk
91-57-6	2-Methylnaphthalene	0.222	ORNL	0.80327	LANL	0.80327	LANL	14.94	ORNL	103.595	Equation	103.595	Equation
83-32-9	Acenaphthene	0.205	ORNL	0.24549	EcoSSL	0.43754	LANL	510	WQC	111.712	Equation	111.712	Equation
208-96-8	Acenaphthylene	0.2	ORNL	3.8243	EcoSSL	0.45925	LANL	54.2	ORNL	111.712	surrogate(2	111.712	surrogate(2
75-07-0	Acetaldehyde	60.6	ORNL	0.04719	Equation	0.04719	Equation	0.632	ORNL	0.04719	Equation	0.04719	Equation
67-64-1	Acetone	53	ORNL	0.52772	LANL	0.52772	LANL	0.1	EcoRisk	0.05	EcoRisk	0.05	EcoRisk
75-05-8	Acetonitrile	60.6	ORNL	0.03763	Equation	0.03763	Equation	0.632	ORNL	0.03763	Equation	0.03763	Equation
98-86-2	Acetophenone	4.67	ORNL	1.40611	Equation	1.40611	Equation	0.48	HHRAP	1.40611	Equation	1.40611	Equation
107-02-8	Acrolein	39	ORNL	0.07011	Equation	0.07011	Equation	0.632	ORNL	0.07011	Equation	0.07011	Equation
107-13-1	Acrylonitrile	27.6	ORNL	0.11449	Equation	0.11449	Equation	0.632	ORNL	0.11449	Equation	0.11449	Equation
7429-90-5	Aluminum	0.004	ORNL	0.00718	LANL	0.00718	LANL	2.7	EcoRisk	4066	EcoRisk	833	EcoRisk
120-12-7	Anthracene	0.101	ORNL	0.40414	EcoSSL	0.37909	LANL	610	WQC	346.338	Equation	346.338	Equation
7440-36-0	Antimony	0.2	ORNL	0.167	EcoSSL	0.00122	LANL	40	EcoRisk	7	EcoRisk	1475	EcoRisk
7440-39-3	Barium	0.156	EcoSSL	0.0152	EcoSSL	0.0152	LANL	633	EcoRisk	200	EcoRisk	260	EcoRisk
100-52-7	Benzaldehyde	5.33	ORNL	1.16445	Equation	1.16445	Equation	0.88	ORNL	1.16445	Equation	1.16445	Equation
71-43-2	Benzene	2.24	ORNL	0.44756	LANL	0.44756	LANL	8.26	HHRAP	3.74887	Equation	3.74887	Equation
56-55-3	Benzo(a)anthracene	0.0176	ORNL	0.26553	EcoSSL	0.03006	LANL	3900	WQC	12299	EcoRisk	5258	EcoRisk
50-32-8	Benzo(a)pyrene	0.0107	ORNL	0.22211	EcoSSL	0.07014	LANL	3900	WQC	4697	EcoRisk	5258	EcoRisk
205-99-2	Benzo(b)fluoranthene	0.31	EcoSSL	0.4342	EcoSSL	0.07014	LANL	3900	WQC	4697	EcoRisk	5258	EcoRisk
191-24-2	Benzo(g,h,i)perylene	0.0055	ORNL	0.49098	EcoSSL	0.22879	LANL	2200	ORNL	19245.1	Equation	19245.1	Equation
207-08-9	Benzo(k)fluroanthene	0.011	ORNL	0.4342	EcoSSL	0.08016	LANL	3900	WQC	13225	EcoRisk	5258	EcoRisk
7440-43-9	Cadmium	0.5	ORNL	2.38147	LANL	2.38147	LANL	907	EcoRisk	3461	EcoRisk	782	EcoRisk
75-15-0	Carbon Disulfide	2.89	ORNL	0.167	LANL	0.167	LANL	9.86	HHRAP	4.52689	Equation	4.52689	Equation
56-23-5	Carbon tetrachloride	0.879	ORNL	12	EcoRisk	12	EcoRisk	30	EcoRisk	12	EcoRisk	300	EcoRisk
7782-50-5	Chlorine	70	ORNL	0.35494	Equation	0.35494	Equation	200	ORNL	0.35494	Equation	0.35494	Equation
74-87-3	Chloromethane	11.4	ORNL	0.43754	LANL	0.43754	LANL	0.632	ORNL	0.39746	Equation	0.39746	Equation
7440-47-3	Chromium	0.041	EcoSSL	0.0511	EcoSSL	0.02684	LANL	19	EcoRisk	3000	EcoRisk	4406	EcoRisk
218-01-9	Chrysene	0.0164	ORNL	0.38243	EcoSSL	0.04008	LANL	3900	WQC	980	EcoRisk	5258	EcoRisk

BIOCONCENTRATION FACTORS FOR THE ECOLOGICAL RISK ASSESSMENT
RISK ASSESSMENT PROTOCOL FOR OPEN BURNING AREA
NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

CAS registry number	Chemical of potential concern	Soil to plant BCF (dry weight)		Soil to invertebrate BCF (wet weight)		Sediment to invertebrate BCF (wet weight)		Water to Fish BCF (wet weight)		Water to Invertebrate BCF		Water to Algae BCF	
7440-50-8	Copper	0.4	ORNL	0.08601	EcoSSL	0.3	EcoRisk	710	EcoRisk	3718	EcoRisk	541	EcoRisk
98-82-8	Cumene	0.29	ORNL	76.6126	Equation	76.6126	Equation	141	HHRAP	76.6126	Equation	76.6126	Equation
53-70-3	Dibenz(a,h)anthracene	0.13	EcoSSL	0.38577	EcoSSL	0.07014	LANL	3900	WQC	710	EcoRisk	5258	EcoRisk
75-71-8	Dichlorodifluoromethane	2.15	ORNL	1.63159	LANL	1.63159	LANL	1.23	ORNL	4.19798	Equation	4.19798	Equation
84-66-2	Diethylphthalate	1.52	ORNL	1.05544	LANL	1.05544	LANL	920	WQC	7.97076	Equation	7.97076	Equation
84-74-2	Di-n-butylphthalate	0.0945	ORNL	5.9452	LANL	5.9452	LANL	2900	WQC	505.01	Equation	505.01	Equation
100-41-4	Ethylbenzene	0.573	ORNL	24.7116	Equation	24.7116	Equation	48.6	HHRAP	24.7116	Equation	24.7116	Equation
206-44-0	Fluoranthene	0.5	EcoSSL	0.50768	EcoSSL	0.45424	LANL	1500	WQC	889.201	Equation	889.201	Equation
86-73-7	Fluorene	0.145	ORNL	1.59819	EcoSSL	0.40247	LANL	342	HHRAP	196.698	Equation	196.698	Equation
50-00-0	Formaldehyde	24.1	ORNL	0.14	EcoRisk	0.14	EcoRisk	0.34	EcoRisk	0.14	EcoRisk	0.14	EcoRisk
110-00-9	Furan	6.43	ORNL	0.89425	Equation	0.89425	Equation	1	ORNL	0.89425	Equation	0.89425	Equation
110-54-3	Hexane	0.211	ORNL	111.712	Equation	111.712	Equation	34.8	ORNL	111.712	Equation	111.712	Equation
18540-29-9	Hexavalent Chromium	0.0075	ORNL	0.01002	LANL	0.01002	LANL	3.16	HHRAP	0.07145	Equation	0.07145	Equation
193-39-5	Indeno(1,2,3-cd)pyrene	0.11	EcoSSL	0.47762	EcoSSL	0.08016	LANL	3900	WQC	4697	EcoRisk	5258	EcoRisk
7439-92-1	Lead	0.045	ORNL	0.03	EcoRisk	0.63	EcoRisk	0.09	EcoRisk	5059	EcoRisk	1706	EcoRisk
7439-96-5	Manganese	0.079	EcoSSL	0.0101	LANL	0.0101	LANL	80	ORNL	4066	[4]		
78-93-3	Methyl Ethyl Ketone	26.1	ORNL	0.54609	LANL	0.54609	LANL	3.16	HHRAP	0.12346	Equation	0.12346	Equation
108-10-1	Methyl Isobutyl Ketone	6.69	ORNL	1.32097	LANL	1.32097	LANL	1.67	HHRAP	0.68675	Equation	0.68675	Equation
80-62-6	Methyl Methacrylate	6.1	ORNL	0.96432	Equation	0.96432	Equation	0.756	ORNL	0.96432	Equation	0.96432	Equation
1634-04-4	Methyl tert-Butyl Ether	11	ORNL	0.42059	Equation	0.42059	Equation	0.302	ORNL	0.42059	Equation	0.42059	Equation
75-09-2	Methylene chloride	7.25	ORNL	0.52772	LANL	0.52772	LANL	2	HHRAP	0.82928	Equation	0.82928	Equation
108-38-3/106-42-3	m-xylene/p-xylene	0.573	ORNL	1.20908	LANL	1.20908	LANL	58.1	HHRAP	29.8401	Equation	29.8401	Equation
91-20-3	Naphthalene	12.2	EcoSSL	0.7348	EcoSSL	0.42084	LANL	69.3	HHRAP	36.033	Equation	36.033	Equation
124-18-5	n-Decane	0.0478	ORNL					7.94	ORNL				
7440-02-0	Nickel	0.06	ORNL	0.12989	LANL	0.12989	LANL	78	EcoRisk	28	EcoRisk	61	EcoRisk
55-63-0	Nitroglycerine	4.42	ORNL	0.05795	LANL	0.05795	LANL	1.088	ORNL	1.51667	Equation	1.51667	Equation
103-65-1	n-Propylbenzene	0.279	ORNL	75.1813	Equation	75.1813	Equation	25.2	ORNL	75.1813	Equation	75.1813	Equation
95-47-6	o-Xylene	0.597	ORNL	1.20908	LANL	1.20908	LANL	48.6	HHRAP	24.7116	Equation	24.7116	Equation
85-01-8	Phenanthrene	0.0997	ORNL	0.28724	EcoSSL	0.38076	LANL	58.2	HHRAP	346.338	Equation	346.338	Equation
108-95-2	Phenol	5.48	ORNL	0.07398	LANL	0.07398	LANL	2.85	HHRAP	1.20921	Equation	1.20921	Equation
7723-14-0	Phosphorus	3.5	ORNL					10000	ORNL				
129-00-0	Pyrene	0.72	EcoSSL	0.29215	EcoSSL	0.2672	LANL	860	WQC	736.377	Equation	736.377	Equation
7440-22-4	Silver	0.014	EcoSSL	0.34152	EcoSSL	0.34152	LANL	87.71	EcoRisk	298	EcoRisk	10696	EcoRisk
100-42-5	Styrene	0.749	ORNL	0.74262	LANL	0.74262	LANL	40.7	HHRAP	20.4644	Equation	20.4644	Equation
127-18-4	Tetrachloroethylene	0.411	ORNL	8.9178	LANL	8.9178	LANL	82.8	HHRAP	43.5111	Equation	43.5111	Equation
108-88-3	Toluene	1	ORNL	0.9352	LANL	0.9352	LANL	23.9	HHRAP	11.6225	Equation	11.6225	Equation
75-69-4	Trichloroflouromethane	1.31	ORNL	3.3901	LANL	3.3901	LANL	16.8	HHRAP	7.97076	Equation	7.97076	Equation
7440-62-2	Vanadium	0.00485	EcoSSL	0.00701	EcoSSL	0.00701	LANL	633	[3]	4066	[4]		
7440-66-6	Zinc	0.99	ORNL	0.63153	LANL	0.63153	LANL	2059	EcoRisk	4578	EcoRisk	2175	EcoRisk

Notes: COPCs are not presented if no TRVs were identified. Blank cells indicate a BCF was not found.

BIOCONCENTRATION FACTORS FOR THE ECOLOGICAL RISK ASSESSMENT
RISK ASSESSMENT PROTOCOL FOR OPEN BURNING AREA
NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

CAS registry number	Chemical of potential concern	Soil to plant BCF (dry weight)	Soil to invertebrate BCF (wet weight)	Sediment to invertebrate BCF (wet weight)	Water to Fish BCF (wet weight)	Water to Invertebrate BCF	Water to Algae BCF

Sources (in order of preference):
Soil to Plants: EcoSSL - EPA Ecological Soil Screening Levels, ORNL - Toxicity and Chemical-Specific Factors Database (accessed March 2015), LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015).
Soil to Invertebrates: EcoSSL - EPA Ecological Soil Screening Levels, LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015), EcoRisk - EcoRisk View database, values are from SLERAP (USEPA, 1999), SLERAP - EPA, 1999 for values not included in EcoRiIsk View database.
Sediment to Invertebrates: LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015), EcoRisk - EcoRisk View database, values are from SLERAP (EPA, 1999), SLERAP - EPA, 1999 for values not included in EcoRisk View database, DOE - BSAFs for Invertebrates (1998), EPA - Fish BSAFs (2004).
Water to Fish: WQC - Human Health Ambient Water Quality Criteria chemical specific inputs (2015), EcoRisk - EcoRisk View database, values are from SLERAP (EPA, 1999), SLERAP - EPA, 1999 for values not included in EcoRisk View database, ORNL - Toxicity and Chemical-Specific Factors Database (accessed March 2015), LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015), HHRAP - Human Health Risk Assessment Protocol Companion Database (EPA, 2005).
Water to Invertebrate and Water to Algae: EcoRisk - EcoRisk View database, values are from SLERAP (EPA, 1999), SLERAP - EPA, 1999 for values not included in EcoRisk View database

Equation - Calculated BCF using equation from SLERAP guidance (EPA, 1999).

Footnotes:
1 - Maximum BCF from United States Army Corps of Engineers database: The US Army Engineer Research and Development Center, Waterways Experiment Station, Environmental Laboratory (CEERD-EP-R). Biota-Sediment Accumulation Factor Database Last update: May 3, 2006. http://el.erdc.usace.army.mil/bsaf/bsaf.html
2 - Value for Acenaphthene used as surrogate.
3- The bioconcentration of vanadium is expected to be lower than it is for most of the other metals so the BCF for barium was used as a surrogate. The BCF for barium is the arithmetic mean of the recommended values for 14 inorganics with laboratory data available (aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc).
4- The bioconcentration of manganese and vanadium is expected to be lower than it is for most of the other metals so the BCF for aluminum was used as a surrogate. The BCF for aluminum is the arithmetic mean of the recommended values for 14 inorganics with laboratory data available (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc).

APPENDIX D-3

TOXICITY REFERENCE VALUES

TOXICITY REFERENCE VALUES HIERARCHY
RISK ASSESSMENT PROTOCOL FOR OPEN BURNING AREA
NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

Plants

1. EPA Eco SSLs (EPA, 2005). The Eco SSLs are presented in the individual documents for each chemical (2003-2008).

2. LANL ECORISK Database Release 3.3 (October 2015).

3. ORNL Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymson et al., 1997a).

4. Canadian Soil Quality Guidelines (SQGs) (CCME, 1999). The SQGs are presented in the individual documents for each chemical (1999-2010).

Note: EPA Region 4 guidance (August 2015) was not included in the TRV hierarchy as all sources evaluated in Region 4 guidance are presented above. In the EPA Region 4 Ecological Risk Assessment Supplemental Guidance, Interim Draft, the order of preference is the EPA Eco SSLs, the Los Alamos National Laboratory (LANL) ECORISK Database Release 3.2, and the ORNL Plant Benchmarks. Because the LANL were recently updated in 2015 with Version 3.3, that source was used after the Eco SSLs followed by the ORNL Plant benchmarks as listed above.

Note: Region 5 ESLS were not used because the majority of them are based on risks to mammals and they do not present the basis of the plant and invertebrate values.

Soil Invertebrates

1. EPA Ecological Soil Screening levels (Eco SSLs) (EPA, 2005). The Eco SSLs are presented in the individual documents for each chemical (2003-2008).

2. Los Alamos National Laboratory (LANL) ECORISK Database Release 3.3 (October 2015).

3. ORNL Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process 1997 Revision (Efroymson et al., 1997a).

4. EPA Region 4 Ecological Risk Assessment Supplemental Guidance, Interim Draft (August 2015) utilized the EPA Eco SSLs, the Los Alamos National Laboratory (LANL) ECORISK Database Release 3.2, and the ORNL Plant Benchmarks in order of preference. Therefore, these documents (using the 3.3 version of LANL ECORISK database) were listed in the hierarchy before the Region 4 document. The

equilibrium partitioning (EqP) modeled values for organic chemicals listed in the Region 4 Guidance were used if there were no values for the other three sources.

5. Canadian Soil Quality Guidelines (SQGs) (CCME, 1999). The SQGs are presented in the individual documents for each chemical (1999-2010).

Surface Water

1. EPA Region 3 Biological Technical Assistance Group (BTAG) Screening Benchmark (2006).

2. EPA National Recommended Water Quality Criteria (NRWQC) (updated 2013). Note that there will be very few, if any chemicals that have NRWQC that are not already included in the Region 3 BTAG screening benchmarks.

3. Virginia Water Quality Standards (VA WQS) (updated 2011). Note that there will be very few, if any chemicals that have VA WQS that are not already included in the Region 3 BTAG screening benchmarks.

4. EPA Region 4 Ecological Risk Assessment Supplemental Guidance, Interim Draft (August 2015). Saltwater values will be use first in order of preference. For some chemicals, the Region 4 saltwater screening values are actually freshwater values. Therefore, Region 4 saltwater values were not used for these chemicals and saltwater values from the sources in the order of preference listed below were considered next.

5. NOAA Screening Quick Reference Tables (SquiRT) (Buchman, 2008).

6. Conducting Ecological Risk Assessments at Remediation Sites in Texas, Revised Draft (TCEQ, 2014). These benchmarks are more current than the Region 5 ecological screening levels (ESLs). Earlier versions of this document were cited in the Region 3 BTAG benchmarks.

7. EPA Region 5 Ecological Screening Levels (2003). These are only freshwater values.

Note: All the sources were first reviewed for saltwater values in the order of preference. If saltwater values were not available in any of these documents, the documents were reviewed in the listed hierarchy for freshwater values.

Note: The ORNL Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision (Suter et al., 1996) were already included in the Region 3 benchmarks when applicable so they were not considered in the hierarchy.

Sediment

1. EPA Region 3 BTAG Screening Benchmark (2006).

2. EPA Region 4 Ecological Risk Assessment Supplemental Guidance, Interim Draft (August 2015).

3. NOAA Screening Quick Reference Tables (SquiRT) (Buchman, 2008). Note that the Dutch target numbers were not used because those values have since been rescinded by the Dutch Soil Remediation Circular 2006, as amended on 1 October 2008.

4. Conducting Ecological Risk Assessments at Remediation Sites in Texas, Revised Draft (TCEQ, 2014). These benchmarks are more current than the Region 5 ESLs.

5. EPA Region 5 Ecological Screening Levels (2003). These are only freshwater values.

Note: All the sources were first reviewed for saltwater values in the order of preference. If saltwater values were not available in any of these documents, the documents were reviewed in the listed hierarchy for freshwater values.

Note: The ORNL Sediment Benchmarks (Jones et al., 1997) were already included in the Region 3 benchmarks when applicable so they were not considered in the hierarchy.

Birds and Mammals

1. EPA Eco SSLs (EPA, 2005). The Eco SSLs are presented in the individual documents for each chemical (2003-2008).

2. ORNL Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996)

3. LANL ECORISK Database Release 3.3 (October 2015).

Note: If TRVS are not found in the above sources, values from SLERAP (EPA, 1999) were used, if available. Also, the Region 5 ESLs (EPA, 2003) were not used because these are screening levels in mg/kg while the TRVs for mammals and birds need to be in units of mg/kg body weight-day.

References

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TRVS FOR THE ECOLOGICAL RISK ASSESSMENT
RISK ASSESSMENT PROTOCOL FOR OPEN BURNING AREA
NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

CAS registry number	Chemical of potential concern	Quantitatively evaluated(1)	Plant		Soil invertebrate		Surface Water		Sediment		Mammal		Bird	
			TRV basis:		TRV basis:		TRV basis:		TRV basis: concentration		TRV basis: ingested dose		TRV basis: ingested dose	
			mg/kg	Source	mg/kg	Source	mg/L	Source	mg/kg	Source	mg/kg BW-day	Source	mg/kg BW-day	Source
71-55-6	1,1,1-Trichloroethane	Yes					0.312	Reg 3 SW	0.856	Reg 3 SW	1000	ORNL		
76-13-1	1,1,2-trichloro-1,2,2-trifluoroethane	Yes					0.207	Texas FW	2.78	Texas FW				
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzodioxin	Yes					2.78E-10	Reg 5 FW			0.003333333	TEF(2)	0.1	TEF(2)
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	Yes									0.0001	TEF(2)	0.001	TEF(2)
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	Yes					2.78E-10	Reg 5 FW			0.0001	TEF(2)	0.01	TEF(2)
57117-44-9	1,2,3,6,7,8-hexachlorodibenzofuran	Yes									0.00001	TEF(2)	0.0001	TEF(2)
95-63-6	1,2,4-Trimethylbenzene	Yes					0.019	Reg 3 SW	0.645	Reg 4 SW				
107-06-2	1,2-Dichloroethane	Yes					1.13	Reg 3 SW	0.175	Reg 4 SW	50	ORNL	17.2	ORNL
108-67-8	1,3,5-Trimethylbenzene	Yes					0.071	Reg 3 FW	0.638	Reg 4 SW				
106-99-0	1,3-Butadiene	No												
106-98-9	1-Butene	No												
592-41-6	1-Hexene	No												
109-67-1	1-Pentene	No												
16747-26-5	2,2,4-Trimethylhexane	No												
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	Yes									3.33333E-06	TEF(2)	0.00001	TEF(2)
NA	2,3,7,8-TCDD TEQ	Yes			5	LANL	3.1E-12	Reg 3 FW	0.00041	SLERAP	0.000001	SLERAP	0.00001	SLERAP
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	Yes									0.00001	TEF(2)	0.00001	TEF(2)
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-Dioxin	Yes			5	LANL	3.1E-12	Reg 3 FW	0.0000025	Reg 4 SW	0.000001	SLERAP	0.00001	SLERAP
79-29-8	2,3-Dimethylbutane	No												
584-94-1	2,3-Dimethylhexane	No												
565-59-3	2,3-Dimethylpentane	No												
108-08-7	2,4-Dimethylpentane	No												
98-01-1	2-Furaldehyde	No												
563-46-2	2-Methyl-1-butene	No												
513-35-9	2-Methyl-2-butene	No												
625-27-4	2-Methyl-2-pentene	No												
592-27-8	2-Methylheptane	No												
591-76-4	2-Methylhexane	No												
91-57-6	2-Methylnaphthalene	Yes			29	EcoSSL	0.0042	Reg 3 SW	0.0202	Reg 3 SW	65.6	EcoSSL		
107-87-9	2-Pentanone	No												
563-45-1	3-Methyl-1-butene	No												
96-14-0	3-Methylpentane	No												
83-32-9	Acenaphthene	Yes	0.25	LANL	29	EcoSSL	0.0066	Reg 3 SW	0.00671	Reg 3 SW	65.6	EcoSSL	2	Trust(3)
208-96-8	Acenaphthylene	Yes	0.25	surrogate(4)	29	EcoSSL	0.307	Reg 4 SW	0.00587	Reg 3 SW	65.6	EcoSSL	2	Trust(3)
75-07-0	Acetaldehyde	Yes					1.4	Reg 4 SW	0.342	Reg 4 SW				
64-19-7	Acetic Acid	No												
67-64-1	Acetone	Yes					564	Reg 3 SW	0.036	Reg 4 SW	10	ORNL	200.89	LANL
75-05-8	Acetonitrile	Yes					12	Reg 3 FW	5.144	Reg 4 SW				
98-86-2	Acetophenone	No												
74-86-2	Acetylene	No												
107-02-8	Acrolein	Yes					0.00055	Reg 3 SW	0.00033	Reg 4 FW				
107-13-1	Acrylonitrile	Yes			1000	ORNL	0.581	Reg 3 SW	0.17	Texas SW	0.46	SLERAP		
7429-90-5	Aluminum	Yes	50	ORNL	600	ORNL	0.087	Reg 3 FW(5)	18000	NOAA SW	1.93	ORNL	109.7	ORNL
120-12-7	Anthracene	Yes	6.8	LANL	29	EcoSSL	0.00018	Reg 3 SW	0.0469	Reg 3 SW	65.6	EcoSSL	2	Trust(3)
7440-36-0	Antimony	Yes	11	LANL	78	EcoSSL	0.5	Reg 3 SW	2	Reg 4 SW	0.059	EcoSSL		
7440-39-3	Barium	Yes	110	LANL	330	EcoSSL	0.2	NOAA SW	48	NOAA SW	51.8	EcoSSL	20.8	ORNL
100-52-7	Benzaldehyde	Yes					0.057	Reg 4 FW	0.456	Reg 4 FW				
71-43-2	Benzene	Yes	31	CCME	31	CCME	0.11	Reg 3 SW	0.137	Reg 3 SW	26.36	LANL		
56-55-3	Benzo(a)anthracene	Yes	18	LANL	18	EcoSSL	0.000018	Reg 3 FW(5)	0.0748	Reg 3 SW	0.615	EcoSSL	0.107	LANL
50-32-8	Benzo(a)pyrene	Yes	20	CCME	18	EcoSSL	0.000015	Reg 3 FW(5)	0.0888	Reg 3 SW	0.615	EcoSSL	2	Trust(3)
205-99-2	Benzo(b)fluoranthene	Yes	18	LANL	18	EcoSSL	0.00068	Reg 4 SW	0.13	NOAA SW	0.615	EcoSSL	2	Trust(3)
191-24-2	Benzo(g,h,i)perylene	Yes			18	EcoSSL	0.00044	Reg 4 SW	0.067	NOAA SW	0.615	EcoSSL	2	Trust(3)
207-08-9	Benzo(k)fluoranthene	Yes	1.2	SLERAP	18	EcoSSL	0.00064	Reg 4 SW	0.07	NOAA SW	0.615	EcoSSL	2	Trust(3)
100-47-0	Benzonitrile	No												
123-72-8	Butanal	No												

TRVS FOR THE ECOLOGICAL RISK ASSESSMENT
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NASA WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

CAS registry number	Chemical of potential concern	Quantitatively evaluated[1]	Plant TRV basis:		Soil invertebrate TRV basis:		Surface Water TRV basis:		Sediment TRV basis: concentration		Mammal TRV basis: ingested dose		Bird TRV basis: ingested dose	
			mg/kg	Source	mg/kg	Source	mg/L	Source	mg/kg	Source	mg/kg BW-day	Source	mg/kg BW-day	Source
7440-43-9	Cadmium	Yes	32	EcoSSL	140	EcoSSL	0.00012	Reg 3 SW	0.68	Reg 3 SW	0.77	EcoSSL	1.47	EcoSSL
124-38-9	Carbon dioxide	No												
75-15-0	Carbon Disulfide	Yes					0.00092	Reg 4 SW	0.0005	Reg 4 SW	0.25	LANL		
630-08-0	Carbon monoxide	No												
56-23-5	Carbon tetrachloride	Yes			1000	ORNL	1.5	Reg 3 SW	7.24	Reg 3 SW	16	ORNL		
463-58-1	Carbonyl sulfide	No												
7782-50-5	Chlorine	Yes					0.0075	Reg 3 SW						
74-87-3	Chloromethane	Yes					2.7	Reg 3 SW	8.74	Texas SW				
7440-47-3	Chromium	Yes	78	CCME	78	CCME	0.0575	Reg 3 SW	52.3	Reg 3 SW	2.4	EcoSSL	2.66	EcoSSL
218-01-9	Chrysene	Yes	1.2	SLERAP	18	EcoSSL	0.002	Reg 4 SW	0.108	Reg 3 SW	0.615	EcoSSL	2	Trust[3]
590-18-1	cis-2-Butene	No												
7688-21-3	cis-2-Hexene	No												
627-20-3	cis-2-Pentene	No												
7440-50-8	Copper	Yes	70	EcoSSL	80	EcoSSL	0.0031	Reg 3 SW	18.7	Reg 3 SW	5.6	EcoSSL	4.05	EcoSSL
98-82-8	Cumene	Yes					0.0026	Reg 3 FW	0.984	Reg 4 SW				
120-92-3	Cyclopentanone	No												
112-31-2	Decanal	No												
53-70-3	Dibenz(a,h)anthracene	Yes	1.2	SLERAP	18	EcoSSL	0.00028	Reg 4 SW	0.00622	Reg 3 SW	0.615	EcoSSL	2	Trust[3]
75-71-8	Dichlorodifluoromethane	Yes					1.963	Texas FW	3.68	Texas FW				
84-66-2	Diethylphthalate	Yes	100	LANL			0.0759	Reg 3 SW	0.218	Reg 3 SW	4583	ORNL		
84-74-2	Di-n-butylphthalate	Yes	160	LANL			0.0034	Reg 3 SW	1.16	Reg 3 SW	550	ORNL	0.14	LANL
74-84-0	Ethane	No												
100-41-4	Ethylbenzene	Yes	55	CCME	55	CCME	0.025	Reg 3 SW	0.305	Reg 3 SW	2.91	CCME		
74-85-1	Ethylene	No												
206-44-0	Fluoranthene	Yes	50	CCME	29	EcoSSL	0.0016	Reg 3 SW	0.113	Reg 3 SW	65.6	EcoSSL	2	Trust[3]
86-73-7	Fluorene	Yes			29	EcoSSL	0.0025	Reg 3 SW	0.0212	Reg 3 SW	65.6	EcoSSL	2	Trust[3]
50-00-0	Formaldehyde	Yes					0.074	Reg 4 FW	0.0052	SLERAP	9.4	ORNL		
110-00-9	Furan	Yes	600	ORNL										
111-71-7	Heptanal	No												
66-25-1	Hexanal	No												
110-54-3	Hexane	Yes					0.00058	Reg 3 FW[5]	0.0396	Reg 3 FW				
18540-29-9	Hexavalent Chromium	Yes	1	ORNL	0.4	ORNL	0.0015	Reg 3 SW			9.24	EcoSSL	11	LANL
7647-01-0	Hydrogen Chloride	No												
74-90-8	Hydrogen Cyanide	No												
7664-39-3	Hydrogen Fluoride	No												
193-39-5	Indeno(1,2,3-cd)pyrene	Yes	1.2	SLERAP	18	EcoSSL	0.00028	Reg 4 SW	0.068	NOAA SW	0.615	EcoSSL	2	Trust[3]
75-28-5	Isobutane	No												
115-11-7	Isobutene	No												
7439-92-1	Lead	Yes	120	EcoSSL	1700	EcoSSL	0.0081	Reg 3 SW	30.2	Reg 3 SW	4.7	EcoSSL	1.63	EcoSSL
7439-96-5	Manganese	Yes	220	EcoSSL	450	EcoSSL	0.12	Reg 3 FW[5]	260	NOAA SW	51.5	EcoSSL	179	EcoSSL
74-82-8	Methane	No												
78-93-3	Methyl Ethyl Ketone	Yes					14	Reg 4 SW	0.631	Reg 4 SW	1771	ORNL		
108-10-1	Methyl Isobutyl Ketone	Yes					123	Reg 3 SW	0.022	Reg 4 SW	25	ORNL		
80-62-6	Methyl Methacrylate	Yes					2.8	Reg 3 FW	9.5	Texas FW				
1634-04-4	Methyl tert-Butyl Ether	Yes					18	Reg 4 SW	2.911	Reg 4 SW				
96-37-7	Methylcyclopentane	No												
75-09-2	Methylene chloride	Yes	1600	LANL			2.56	Reg 3 SW	0.268	Reg 4 SW	5.85	ORNL		
624-91-9	Methylnitrite	No												
620-14-4	m-ethyltoluene	No												
108-38-3/106-42-3	m-xylene/p-xylene	Yes	100	LANL	95	CCME	0.019	Reg 3 SW	0.0252	Reg 3 FW	2.1	LANL	106.7	LANL

CAS registry number	Chemical of potential concern	Quantitatively evaluated[1]	Plant		Soil invertebrate		Surface Water		Sediment		Mammal		Bird	
			TRV basis:		TRV basis:		TRV basis:		TRV basis: concentration		TRV basis: ingested dose		TRV basis: ingested dose	
			mg/kg	Source	mg/kg	Source	mg/L	Source	mg/kg	Source	mg/kg BW-day	Source	mg/kg BW-day	Source
91-20-3	Naphthalene	Yes	1	LANL	29	EcoSSL	0.0014	Reg 3 SW	0.0346	Reg 3 SW	65.6	EcoSSL	15	LANL
106-97-8	n-Butane	No												
124-18-5	n-Decane	Yes					0.049	Reg 4 SW	0.308	Reg 4 SW				
7440-02-0	Nickel	Yes	38	EcoSSL	280	EcoSSL	0.0082	Reg 3 SW	15.9	Reg 3 SW	1.7	EcoSSL	6.71	EcoSSL
7697-37-2	Nitric Acid	No												
10102-44-0	Nitrogen dioxide	No												
NA	Nitrogen oxide	No												
55-63-0	Nitroglycerine	Yes	21	LANL			0.138	Reg 3 FW	0.0049	Reg 4 FW	96.4	LANL		
75-52-5	Nitromethane	No												
111-84-2	n-Nonane	No												
111-65-9	n-Octane	No												
124-19-6	Nonanal	No												
109-66-0	n-Pentane	No												
103-65-1	n-Propylbenzene	Yes					0.128	Reg 3 FW	0.72	Texas FW				
124-13-0	Octanal	No												
611-14-3	o-Ethyltoluene	No												
NA	Oxides of Nitrogen	No												
7782-44-7	Oxygen	No												
95-47-6	o-Xylene	Yes	100	LANL	95	CCME	0.019	Reg 3 SW	0.0252	Reg 3 FW	2.1	ORNL	106.7	LANL
110-62-3	Pentanal	No												
622-96-8	p-Ethyltoluene	No												
85-01-8	Phenanthrene	Yes			29	EcoSSL	0.0015	Reg 3 SW	0.0867	Reg 3 SW	65.6	EcoSSL	2	Trust[3]
108-95-2	Phenol	Yes	0.79	LANL	1.8	LANL	0.058	Reg 3 SW	0.42	Reg 4 SW	60	LANL		
7723-14-0	Phosphorus	Yes					0.0001	Reg 3 SW						
NA	PM-10	No												
NA	PM-2.5	No												
74-98-6	Propane	No												
115-07-1	Propene	No												
123-38-6	Proprionaldehyde	No												
129-00-0	Pyrene	Yes			18	EcoSSL	0.00024	Reg 3 SW	0.153	Reg 3 SW	0.615	EcoSSL	20.5	LANL
7440-22-4	Silver	Yes	560	EcoSSL	50	ORNL	0.00023	Reg 3 SW	0.73	Reg 3 SW	6.02	EcoSSL	2.02	EcoSSL
100-42-5	Styrene	Yes	3.2	LANL	1.2	LANL	0.91	Reg 3 SW	7.07	Reg 3 SW				
7446 09-5	Sulfur Dioxide (SO2)+	No												
7664-93-9	Sulfuric Acid	No												
75-65-0	tert-Butyl Alcohol	No												
127-18-4	Tetrachloroethylene	Yes	10	LANL	3.8	CCME	0.045	Reg 3 SW	0.19	Reg 3 SW	2	LANL		
110-02-1	Thiophene	No												
108-88-3	Toluene	Yes	200	LANL	75	CCME	0.215	Reg 3 SW	1.09	Reg 3 SW	26	ORNL		
NA	Total dioxin/furan compounds	No												
624-64-6	trans-2-Butene	No												
4050-45-7	trans-2-Hexene	No												
646-04-8	trans-2-Pentene	No												
75-69-4	Trichlorofluoromethane	Yes					6.4	NOAA SW	1.69	Texas FW	212	LANL		
12789-66-1	TSP	No												
7440-62-2	Vanadium	Yes	60	LANL	20	ORNL	0.02	Reg 3 FW[5]	57	NOAA SW	4.16	EcoSSL	0.344	EcoSSL
7440-66-6	Zinc	Yes	160	EcoSSL	120	EcoSSL	0.081	Reg 3 SW	124	Reg 3 SW	75.4	EcoSSL	66.1	EcoSSL

Notes: Blank cells indicates TRV not found.

CAS registry number	Chemical of potential concern	Quantitatively evaluated(1)	Plant		Soil invertebrate		Surface Water		Sediment		Mammal		Bird	
			TRV basis:		TRV basis:		TRV basis:		TRV basis: concentration		TRV basis: ingested dose		TRV basis: ingested dose	
			mg/kg	Source	mg/kg	Source	mg/L	Source	mg/kg	Source	mg/kg BW-day	Source	mg/kg BW-day	Source

Sources (in order of preference):

Plants: EcoSSL - EPA Ecological Soil Screening Levels, LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015), ORNL - Oak Ridge National Laboratory Toxicological Benchmarks for plants (Efroymson et al., 1997a), CCME - Canadian Council and Ministers of Environment Soil Screening Levels

Invertebrates: EcoSSL - EPA Ecological Soil Screening Levels, LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015), ORNL - Oak Ridge National Laboratory Toxicological Benchmarks for invertebrates (Efroymson et al., 1997b), Reg 4 - EPA Region 4 Ecological Screening Values (EPA, 2015), CCME - Canadian Council and Ministers of Environment Soil Screening Levels

Surface water: Reg 3 - EPA Region 3 Biological Technical Assistance Group screening benchmarks (EPA, 2006a), NRWQC - National Recommended Water Quality Criteria (EPA, 2013), VA WQS - Virginia Water Quality Standards (VDEQ, 2011), Reg 4 - EPA Region 4 Ecological Screening Values (EPA, 2015), NOAA - Screening Quick Reference Tables (Buchman, 2008), Texas - Aquatic Life Surface Water Risk-Based Exposure Limits (TCEQ, 2014), Reg 5 - EPA Region 5 Ecological Screening Levels (EPA, 2003).

Sediment: Reg 3 - EPA Region 3 Biological Technical Assistance Group, freshwater sediment screening benchmarks (EPA, 2006b), Reg 4 - EPA Region 4 Ecological Screening Values (EPA, 2015), NOAA - Screening Quick Reference Tables (Buchman, 2008), Texas - Ecological Benchmarks for Sediment (TCEQ, 2014), Reg 5 - EPA Region 5 Ecological Screening Levels (USEPA, 2003).

Bird and Mammals: EcoSSL - EPA ecological soil screening levels, ORNL -Toxicological Benchmarks for Wildlife (Sample et al, 1996), LANL - Los Alamos National Laboratory 3.3 database (LANL, 2015)

For water and sediment, saltwater (SW) values were selected first in order of preference. If saltwater values were not available in any of the documents, the documents were reviewed for freshwater (FW) values in the same order of preference.
If a TRV was not found in the above sources, values from SLERAP (EPA, 1999) were used, if available.

Footnotes:
1 - A chemical was quantitatively evaluated in the ecological risk assessment if there was current toxicity criteria available or if an appropriate surrogate could be identified.
2 - TRVs estimated using Toxicity equivalency factors (TEFs) developed by the World Health Organization (WHO) based on the TRV for 2,3,7,8-TCDD.
3 - The TRVs for the PAHs for birds were based on 7,12-dimethylbenz(a)anthracene (Trust et al., 1994). Trust, Kimberly A., Anne Fairbrother, and Michael J. Hooper. 1994. “Effects of 7,12-Dimethylbenz[a]anthracene on Immune Function and Mixed-Function Oxygenase Activity in the European Starling.” Env. Toxicol. Chem. 13: 821-830.
4 - Value for Acenaphthene used as surrogate.
5 - Although Region 4 saltwater screening values are listed for these chemicals, the values are actually freshwater values. Therefore, Region 4 saltwater values were not used for these chemicals and saltwater values from the sources in the order of preference listed above were considered next.

Attachment 2
QAPP document for the Dominion Virginia Power Ambient Air Monitoring Station

DOMINION VIRGINIA POWER
Brunswick County, Virginia

QUALITY ASSURANCE PROJECT PLAN (QAPP)
Ambient Air Quality Monitoring Station
Particulate Matter (PM_{10}/$PM_{2.5}$), Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Ozone (O_3), and Nitrogen Dioxide (NO_2)

Prepared by

TRC

TRC Companies, Inc.
Gainesville, Florida

October, 2013

A) PROJECT MANAGEMENT ELEMENTS

A1) QA PROJECT PLAN IDENTIFICATION AND APPROVAL

Title: Dominion Virginia Power

Dominion Virginia Power	
1. Signature:	Date: 10/29/2013
Mr. Laurence Labrie, Environmental Consultant	

TRC Environmental	
A) Signature:	Date: 10/29/2013
Miss. Melita Lihzis, Project Manager	
B) Signature:	Date: 10/29/2013
Mr. Edward MacKinnon, QA Manager	
C) Signature:	Date: 10/29/2013
Mr. Jonathan Bowser, Principal in Charge	

A2) TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

A3) DISTRIBUTION LIST

A hard copy of this QAPP has been distributed to the individuals in the table below. The document is also available upon request.

Distribution List		
Name	**Position**	**Affiliation**
Virginia Department of Environmental Quality		
Dominion Virginia Power		
TRC Environmental Corporation		

A4) PROJECT ORGANIZATION

A4.1) Roles and Responsibilities

The Virginia Department of Environmental Quality (VDEQ), Dominion Virginia Power (Dominion) and TRC Environmental Corp. (TRC) will all play vital roles in the implementation of this project. The role of each entity is summarized below and described in Table A.1. A project flow chart is provided as Figure A4.1.

A4.1.(1) Virginia Department of Environmental Quality

A Technical Systems Audit of the network if requested by the agency will be accommodated.

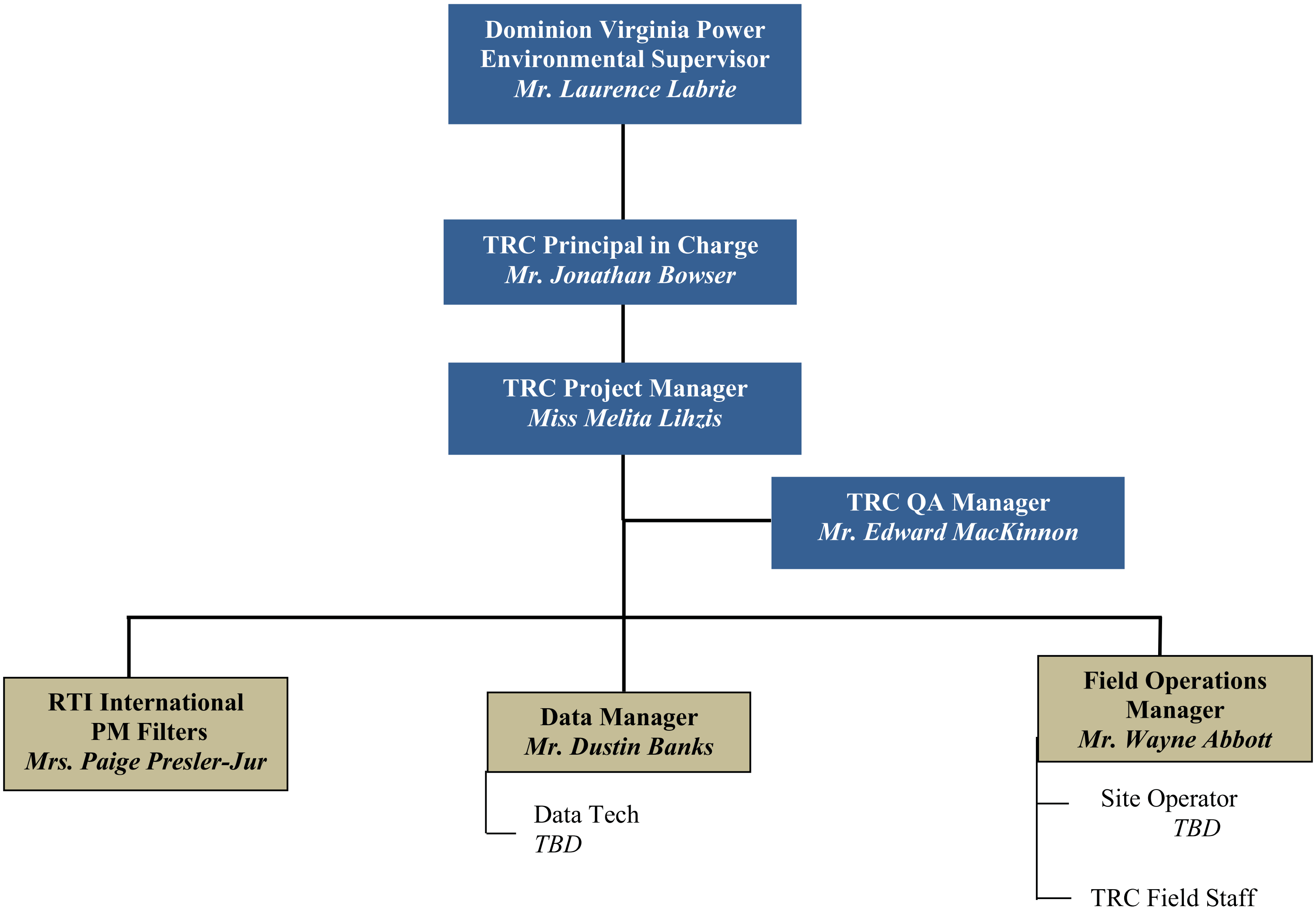
A4.1.(2) Dominion Virginia Power

Dominion will be responsible for assisting in the selection of sites, securing use of the site locations, installing monitoring shelters, site security and installation of utilities. Dominion will review all data reports prepared by TRC.

A4.1.(3) TRC Environmental Corporation

TRC has been contracted by Dominion and will be responsible for network installation, operation, data collection and reporting. TRC will assist in the site selection, provide the equipment, instrumentation and personnel necessary to ensure that the data are of sufficient quantity and quality to meet the objectives of the program. TRC will ensure that quality control (QC) and standard operating procedures (SOPs) are followed in accordance with EPA and VDEQ requirements such that the quality assurance (QA) objectives of this plan are met.

Figure A4.1. Project Organizational Chart



A5) PROBLEM DEFINITION AND BACKGROUND

A5.1) Problem Statement and Background

A5.1.(1) Background

Dominion Virginia Power (DVP) is proposing to construct a new power generation facility in or near Brunswick County, Virginia. The project's equipment will include three combustion turbine generators three each heat recovery steam generators, a steam turbine generator, an air cooled condenser and associated balance-of-plant equipment. The net electrical output of the project is expected to be a nominal 1,400 MW with duct firing and inlet chilling. The ambient air monitoring will be conducted in the vicinity of Brunswick County, Virginia to measure concentrations of particle matter (PM) with aerodynamic diameters less than or equal to 10 and 2.5 micrometers (PM_{10} and $PM_{2.5}$, respectively), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and nitrogen dioxide (NO_2). The meteorological measurements will include wind speed and direction (WS and WD, respectively), standard deviation of wind direction (σθ), vertical wind speed (w), standard deviation of vertical wind speed (σw), calculated standard deviation of elevation angle (σE), temperature (T), relative humidity (RH), and solar radiation (SR).

A5.1.(2) Ambient Monitoring- Purpose and Objectives

The purpose of this program is to conduct at least one year of air quality and meteorological monitoring in the vicinity of the planned construction for the new power generation facility at a single location. The station will be operated following prevention of significant deterioration (PSD) guidelines. This air quality and meteorological monitoring program has been designed to provide valid, reliable and regulatory compliant ambient measurement data from a single monitoring station located in the vicinity the proposed generating station.

The Ambient Air Quality Monitoring program will be performed in accordance with the applicable requirements of 40 CFR Parts 50, 53, 58 and other requirements specified by VDEQ. The air monitoring data will be used to:

- Establish a baseline of pollutant concentrations in the area prior to development/construction of a new power generating facility.
- Provide air quality and meteorological data for future permit application(s).

A6) PROJECT DESCRIPTION

A6.1) Project Overview

As previously stated, the purpose of this monitoring program is to install and operate, for at least one year, ambient air quality and meteorological monitoring at one site in the vicinity of the proposed construction of a new power generating facility. This air quality and meteorological monitoring program has been designed to provide valid, reliable and regulatory compliant ambient measurement data from the single monitoring station located in Brunswick County, Virginia.

The parameters selected for the air quality monitoring program are as follows:

- Particulate Matter – including PM_{10} and $PM_{2.5}$.
  - PM_{10} and $PM_{2.5}$ will be measured following the National one in six day schedule (see http://www.epa.gov/ttnamti1/calendar.html).
- Sulfur Dioxide (SO_2)
  - SO_2 will be monitored on a continuous basis. Five minute and hourly averages will be recorded. The highest hourly 5-minute average will be reported in compliance with SO_2 reporting requirements.
- Carbon Monoxide(CO)
  - CO will be monitored on a continuous basis. Hourly averages will be recorded.
- Ozone (O_3)
  - O_3 will be monitored on a continuous basis. Hourly averages will be recorded.
- Nitrogen Oxide/Nitrogen Dioxide (NO/NO_2)
  - NO/NO_2 will be monitored on a continuous basis. Hourly averages will be recorded.

In addition, the following meteorological parameters will be measured:

- Horizontal wind speed (WS or u), wind direction (WD) and standard deviation of wind direction ($\sigma\theta$) at a height of 30 meters (m),
- Vertical wind speed (w), and standard deviation of vertical wind (σw) at 30 m (Note: standard deviation of elevation angle, σE, will be calculated as $\sigma w/\bar{u}$),
- Temperature (T) and relative humidity (RH) at 2 m, and
- Global solar radiation (SR).

A6.2) Project Schedule

The tentative project implementation schedule is outlined in Table A.4. Project activities ranging from installation of the monitoring network to demobilization are identified.

A6.3) Scheduled Field Activities

Federal regulation provides for the implementation of a number of qualitative and quantitative checks to ensure that data will meet the Data Quality Objectives (DQOs) for the project. Each of the checks attempts to evaluate phases of measurement uncertainty.

TRC will have primary responsibility for implementation of all monitoring program QC measures. The following is a summary of QC activities that will be implemented to ensure that measurement uncertainty is maintained within established acceptance criteria for the attainment of the program DQOs. QC activities will include, but not be limited to, the following:

- SO_2, CO, O_3, and NO/NO_2
    - Multipoint calibrations,
    - Weekly automated calibration and QC checks
    - Daily review of instrument measurements and diagnostics,
    - Weekly operational checks by site operator,
    - Routine maintenance as specified in TRC's Standard Operating Procedure (SOP), and
    - Quarterly independent performance audits.

- $PM_{10/2.5}$
    - Weekly review of instrument measurements and diagnostics,
    - Monthly flow and leak checks,
    - Routine maintenance as specified in TRC's SOP, and
    - Quarterly performance audits.

- Meteorological Measurements
    - Semiannual calibrations,
    - Weekly reasonableness checks by site operator
        - Verification that wind sensors are operational and show no sign of damage,
        - Wind speed, wind direction and temperature measurements represent actual conditions, and
    - Semi-annual performance audits.

A6.4) Project Records

TRC will provide monthly summary reports to Dominion Virginia Power that contain information to evaluate the attainment of the Data Quality Objectives. Monthly reports will be submitted within 30 days after the end of each calendar month. Each report will be comprised of the following:

- Executive Summary;
- Hourly values for SO_2, CO, O_3, and NO/NO_2
- Hourly values for WS, WD, temperature, relative humidity and global solar radiation;
- Highest 5-minute SO_2 concentration in each hour;
- 24-hour values for PM_{10} and $PM_{2.5}$ (one sample every six days);
- Results of instrument QC checks;
- QA/QC and equipment maintenance documentation;
- Monthly and cumulative data capture statistics;

In addition, TRC will prepare and provide DVP with quarterly and annual data reports. The contents of the quarterly and annual reports are discussed in greater detail in Section C.2 of this QAPP.

A7) QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

A7.1) Data Quality Objectives (DQOs)

A7.1.(1) DQO Process

The Data Quality Objectives (DQOs) of this project are to provide valid data that satisfy the regulating authority's requirements. Monitoring is performed in accordance with TRC Standard Operating Procedures (SOPs) and EPA regulations and guidance documents.

The Brunswick County Ambient Air Monitoring Program is designed to achieve program DQOs and meet or exceed the minimum standard requirements for field monitoring and analytical methods. The overall QA objective is to develop and implement procedures for continuous air quality and meteorological monitoring, data validation and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet program DQOs.

A7.1.(2) Measurement Quality Objectives (MQOs)

Measurement Quality Objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. MQOs can be defined in terms of the following data quality indicators:

- *Precision* – a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error.
- *Bias* – the systematic or persistent distortion of a measurement process which causes error in one direction.
- *Accuracy* – a measure of the overall agreement of a measurement to a known value; includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.
- *Representativeness* – a qualitative term that expresses "the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition."
- *Completeness* – a measure of the amount of valid data needed to be obtained from a measurement system.
- *Comparability* – a qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.
- *Detectability* – the determination of the low range critical value of a characteristic that a method specific procedure can reliably discern.

Tables A.4 and A.5 summarize the MQOs for the pollutant monitors and the meteorological station, respectively.

A7.2) Data Quality Assessment

Methods for calculating precision, accuracy and bias are conducted following the procedures specified in Appendix A of 40 CFR Part 58 and guidance provided in the Quality Assurance Handbook for Air Pollutions Measurement Systems, Volume II. These procedures are summarized below. A comprehensive discussion is presented in TRC's Data Management and Reporting SOP.

A7.2.(1) Precision

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. Simply stated, precision is a measure of the variability of an instrument.

The precision of automated analyzers is evaluated by making multiple comparisons of the sample's known concentration against the instrument's response and calculating the upper bound of the coefficient of variation (CV). The precision of manual PM samplers is determined by collocated sampling (i.e. the simultaneous operation of two identical samplers placed side by side). The difference in the results of the two samplers is used to estimate the precision of the entire measurement process (i.e., both field and laboratory precision) by calculating the CV of the relative percent differences (d_i).

A7.2.(2) Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error. The accuracy of automated methods is assessed through field performance audits. Performance audits are conducted by sampling an independent standard (i.e. a standard not used for instrument calibration). Accuracy is evaluated by comparing the measured response to the known value. Performance audits are conducted quarterly using standards at several different concentrations. Performance audits are conducted semi-annually for meteorological measurements.

A7.2.(3) Bias Estimate

For continuous gaseous pollutant measurements (SO_2, NO, NO_2, CO, and O_3), the bias estimate is calculated using the one-point QC checks as described in Section 3.2.1 of 40 CFR Part 58 Appendix A. The bias estimator is an upper bound on the mean absolute value of the percent differences calculated on a quarterly basis.

The bias for $PM_{2.5}$ measurements can be estimated following the same procedure as continuous SO_2, using the paired concentration values. PM_{10} bias is estimated by calculating the upper bound of the mean absolute value of the one-point flow percent differences.

A8) SPECIAL TRAINING REQUIREMENT/CERTIFICATION

Appropriate training will be provided to employees supporting the Brunswick County Ambient Air Quality Monitoring Program, commensurate with their duties. No special training or certifications are required for this monitoring project. Field technicians and scientists, data analysts and the QA manager are all either meteorologists or environmental scientists with expertise in operation of monitoring instrumentation, data management and data QC procedures as they apply to meteorological and ambient air quality monitoring programs.

On-site personnel will receive training on station and instrumentation operation, maintenance and QC procedures. Additional training will be provided, as appropriate, throughout the entire term of the project as deemed necessary by the TRC project manager.

Documents relevant to adhering to this QAPP will be made available to all site personnel and located in the field office for accessibility. Such documents include, but are not limited to:

- Brunswick County Air Monitoring Plan
- TRC SOPs
- Brunswick County Quality Assurance Project Plan
- Instrument manuals

Most of the on-site activities described in this QAPP constitute routine sampling and analyses for which no special training requirements or certifications are needed. However, all TRC staff working on-site will comply with the Dominion Health and Safety Plan in effect at the time. All health and safety training records are maintained in the TRC files. Prior to the start of the on-site work, all field personnel will be given instruction specific to the project, covering the following areas:

- Organization and lines of communication and authority,
- Overview of the QAPP, including sample collection, handling, and labeling procedures,
- QA/QC requirements,
- Documentation requirements, and
- Health and safety requirements.

Instructions will be provided by the TRC Field Operations Manager and TRC Project QA Officer.

A9) DOCUMENTATION AND RECORDS

Table A.9 indicates the categories and types of records and documents which are kept relating to this project. Current copies of all documents are maintained at the specified locations. At the conclusion of the project, copies of documents will be archived at TRC's regional office in Raleigh, NC for a period of not less than five years.

Examples of quality assurance documents and forms are attached in Appendix B.

A9.1) Data Reporting

The documents and records that will be produced during this air monitoring program include, but are not limited to, the following types:

- Interim progress reports
- Quarterly data reports
- Audit reports
- Annual Data Reports
- Revisions to this QAPP

QA reports will be submitted to the TRC Project Manager to ensure that any problems identified during the sampling and analysis program are investigated and the proper corrective measures taken in response. The QA reports may include:

- All results of field and laboratory audits,
- Problems noted during data validation and assessment, and
- Significant QA/QC problems, recommended corrective actions, and the outcome of corrective actions.

QA reports will be prepared and submitted on an as-needed basis.

B) MEASUREMENT AND DATA ACQUISITION

B1) SAMPLING PROCESS DESIGN

Refer to Section A6 for the monitoring design of this project. This section discusses the areas being sampled, what is being tested, and how often. The Air Monitoring Plan that was prepared for this program goes into greater detail regarding the design of the monitoring system. Table B.1 summarizes the measurement methodologies that will be employed during this monitoring program. Table B.2 is a list of the equipment manufacturers along with their address, web address and phone number.

B2) SAMPLING METHODS AND REQUIREMENTS

B2.1) Ambient Air Quality Monitoring

B2.1.(1) Meteorological Data Collection

Meteorological (met) parameters will be measured with new RMYoung and LI-COR sensors. Horizontal wind speed and direction will be determined with an RMYoung Wind Monitor AQ. Vertical wind speed will be measured with a Young 27106 Gill propeller anemometer. Temperature and humidity will be determined with a Young 41382VC probe housed in a model 43502 aspirated radiation shield. Global solar radiation will be measured with a LI-COR LI-200 Pyranometer. Met data will be recorded, calculated ($\sigma\theta$, σw and σE) and displayed using a Model 26800 translator. Horizontal and vertical wind sensors will be mounted on an existing tower at a height of 30 meters. Temperature, relative humidity and sensors will be monitored at a height of two meters, above a grassy location outside the monitor shelter. The solar radiation sensor will be mounted on the roof of the monitoring shelter. All met data collected from this station will be transmitted to the central server location on a 15-minute basis. Fifteen minute and hourly averaged data will be stored in separate data tables. Standard deviation of wind direction will be calculated following equation 9-9 of EPA QA Handbook Volume IV (EPA-454/B-08-002, March 2008).

B2.1.(2) Gas Analyzers

Continuous monitoring of SO_2 concentrations will be conducted using Teledyne-Advanced Pollution Instrumentation (TAPI) model T100 UV Fluorescent SO2 Analyzers. The T100 is designated as a Federal Equivalent Method (FEM), designation EQSA-0495-100.

Continuous monitoring of CO concentrations will be conducted using a Thermo Scientific Model 48i Gas Filter Correlation (GFC) CO analyzer. The 48i is designated as a Federal Reference Method (FRM), designation RFCA-0981-054. Hourly averaged concentrations of CO will be calculated to comply with reporting requirements established for CO.

Continuous monitoring of O_3 concentrations will be conducted using a TAPI T400 UV Absorption analyzer. The T400 photometric ozone analyzer is designated as a Federal Equivalent Method, designation EQOA-0992-087. Hourly averaged concentrations of O_3 will be calculated to comply with reporting requirements established for O_3.

Continuous monitoring of NO/NO_2 concentrations will be conducted using a Thermo Environmental Model 42i Chemiluminescence analyzer. The 42i is designated as a Federal Reference Method (FRM), designation RFNA-1289-074. Hourly averaged concentrations of NO/NO_2 will be calculated to comply with reporting requirements established for NO/NO2.

All gas analyzers will be calibrated with a TAPI Model T700 dynamic dilution calibrator configured with gas phase titration and an internal photometer certified as an ozone transfer standard. Calibration dilution gas will be generated using a TAPI Model 701 zero air system.

The instruments will be installed in a temperature controlled shelter (EKTO 868 or similar) fitted with a borosilicate glass and/or FEP Teflon® sample inlet and manifold. All continuous data (SO_2, CO, O_3, and NO_2) will be recorded on a PC-based data acquisition system with local backup. Data will be transmitted to a central server and accessible via a restricted access website.

B2.1.(3) Particulate Matter Monitors

PM_{10} and $PM_{2.5}$ mass concentrations will be determined using collocated filter based BGI PQ200 samplers operated on the national 6-day sampling schedule. The BGI PQ200 samplers are designated as Federal Reference Methods. The $PM_{2.5}$ sampler will employ the BGI designed Very Sharp Cut Cyclone (VSCC), designation RFPS-0498-116. The Reference Method for PM_{10} sampling is designated RFPS-1298-125. Filters will be shipped to a Virginia Environmental Laboratory Accreditation Program (VELAP) accredited laboratory for PM_{10} and $PM_{2.5}$ gravimetric analysis in accordance with 40 CFR Part 50, Appendix J (PM_{10}) and Appendix L ($PM_{2.5}$).

B2.1.(4) Site Operation and Configuration

TRC personnel will visit this station, as necessary to conduct routine operations as described above. This station will be powered by line voltage obtained from an adjacent source. All instrumentation will be housed within a new EKTO shelter equipped with an industrial heating and air conditioning system. The shelter will be a fixed, semi-permanent system and not readily mobile. Normal spare parts and consumable items will be stored on-site for instrument maintenance.

B3) SAMPLE HANDLING AND CUSTODY REQUIREMENTS

PM samples collected using the BGI PQ-200 units will be shipped to the laboratory for gravimetric analysis. RTI International in Raleigh, North Carolina has been enlisted to perform the gravimetric analysis of these samples. This section describes the sample handling and custody requirements for the PM_{10} and $PM_{2.5}$ samples collected following the EPA FRM.

Summaries of sample media, required sample volumes, preservation, and holding time requirements for all samples are presented in Table B.3.

B3.1) Sample Custody

Sample custody is addressed in two parts: field sample collection and laboratory analysis.

A sample is considered to be under a person's custody if

- the item is in the actual possession of a person;
- the item is in the view of the person after being in actual possession of the person;
- the item was in the actual physical possession of the person but is locked up to prevent tampering; and,
- the item is in a designated and identified secure area.

B3.1.(1) Field Sample Custody

Sample handling is an important part of the field investigation program since samples that are incorrectly handled can affect the quality of data. Sample handling begins at the collection of the samples and continues until the sample has been analyzed. An over-riding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of sample tracking from collection to shipment, laboratory receipt, and laboratory custody (until proper sample disposal and the introduction of field investigation results as evidence in legal proceedings when pertinent) must be documented.

Sample chain-of-custody and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory, with the chain-of-custody, intact. The TRC Field Sampling Coordinator (or designee) is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field and up until the samples have been transferred to a courier. The chain-of-custody procedures are initiated in the field immediately following sample collection. The procedures consist of: (1) preparing and attaching a unique sample label to each sample collected, (2) completing the chain-of-custody form, and (3) preparing and packing the samples for shipment.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.

- All media will be identified by the use of pre-printed adhesive sample labels with site name and location, sample locations, date/time of collection, type of preservation, type of analysis, and sampler's initials. Figure B.1 provides an example sample label. In most cases, sample labels will be generated prior to the sampling event.

- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage location.

- Chain-of-custody records are initiated by the samplers in the field. The field portion of the custody documentation should include: (1) the project name; (2) signatures of samplers; (3) the sample number, date and time of collection; (4) signatures of individuals involved in sampling; (5) identification number of media associated with each sample; and (6) if applicable, air bill or other shipping number. To the extent possible, this information will be entered prior to the sampling event.

- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files. An example chain-of-custody is included in Figure B.2.

- Samples will be properly packaged for shipment and dispatched to the laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured for shipment to the laboratory. If an authorized laboratory courier does not pick up the samples from the project site, custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by field personnel. An example of a cooler custody seal is provided in Figure B.3. Subsequently, the cooler will be strapped shut with strapping tape in at least two locations.

- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained by the laboratory as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.

- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature of the laboratory sample custodian on the chain-of-custody document as receiving the samples and signature of sampler as relinquishing samples.

B3.1.(2) Laboratory Sample Custody

Samples will be received and logged in by a designated sample custodian or his/her designee. Upon sample receipt, the sample custodian will

- Examine the shipping containers to verify that the custody tape is intact,

- Examine all sample containers for damage,

- Compare samples received against those listed on the chain-of-custody,

- Examine all shipping records for accuracy and completeness,

- Sign and date the chain-of-custody immediately (if shipment is accepted) and attach the air bill,

- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the Laboratory Project Manager, who will be responsible for contacting the TRC Project QA Officer,

- Attach laboratory sample container labels with unique laboratory identification and test, and

- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field identification provided by field personnel.

- The Laboratory Project Manager will be notified of sample arrival.

- The completed chain-of-custody, air bills, and any additional documentation will be placed in the final file.

Figure B.1. Sample Label

CLIENT/SOURCE	☐ GRAB ☐ COMPOSITE OTHER
SITE NAME	DATE
SAMPLE #	TIME
ANALYSIS	PRESERVATIVE
	COLL. BY

Figure B.2. Chain-of-Custody

RTI Chain of Custody
PM2.5 Gravimetric Analyses

Client Name: ____________________ Project No.: ____________________

Contact Name: ____________________ Phone: ____________________

If you have any questions for RTI, please contact Paige Presler-Jur (919.541.6813 or pjur@rti.org)

Part I. Weighing Laboratory

Packaged By: ____________________ Date: ____________________

Shipped Via: ____________________ Airbill No.: ____________________

Filter ID No.	Cassette No.	Weighing Date	Expiration Date	*Date Sampled**	*Average Flow Rate**	*Total Elapsed Time**	*Sample Volume**

* To be completed by field scientist.

Part II: Client

Field Scientist: ____________________ Date Rec'd: ____________________

Shipment Integrity OK?: Yes _____ No _____ (describe below)

Comments: ____________________

Part III: Shipment from Field to RTI

Packaged By: ____________________ Date: ____________________

Shipped Via: ____________________ Airbill No.: ____________________

Part IV: Receipt at RTI

Received By: ____________________ Date Rec'd: ____________________

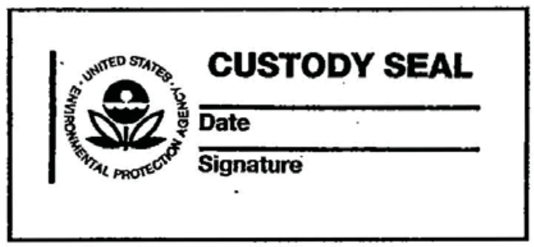
Shipment Integrity OK?: Yes _____ No _____ (describe below)

Shipment Max. Temperature: ____________________

Comments: ____________________

Figure B.3. Chain-of-Custody Seal

Custody Seal



B4) ANALYTICAL METHODS REQUIREMENTS

RTI International, located in Raleigh, North Carolina, will be performing the gravimetric analysis required for this air monitoring program. The lab will perform the analysis in accordance with their SOPs (see Appendix D of this document) as well as with 40 CFR Part 50, Appendices J and L.

B4.1) PM_{10} – 40 CFR Part 50, Appendix J

This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}) in ambient air over a 24-hour period. Concentrations of PM_{10} will be compared to National Ambient Air Quality Standards as specified in Section A5.1. The measurement process is nondestructive, and the PM_{10} sample can be subjected to subsequent physical or chemical analyses. Quality assurance procedures and guidance are provided in 40 CFR Part 58, Appendices A and B.

Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (298 °K, 760 mmHg), is determined from the measured flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter ($\mu g/m^3$).

The analytical balance must be suitable for weighing the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weights and mass loadings. Typically, an analytical balance with a sensitivity of 0.1 µg is required for lo-volume samplers (~1 m^3 /hr).

B4.2) $PM_{2.5}$ – 40 CFR Part 50, Appendix L

This method provides for the measurement of the mass concentration of fine particulate matter having an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) in ambient air over a 24-hour period. Concentrations of $PM_{2.5}$ will be compared to National Ambient Air Quality Standards as specified in Section A5.1. The measurement process is considered to be nondestructive, and the $PM_{2.5}$ sample obtained can be subjected to subsequent physical or chemical analyses. Quality assessment procedures are provided in 40 CFR Part 58, Appendix A.

Each filter is weighed (after moisture and temperature conditioning) before and after sample collection to determine the net gain due to collected $PM_{2.5}$. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure and the sampling time. The mass concentration of $PM_{2.5}$in the ambient air is computed as the total mass of collected particles in the $PM_{2.5}$ size range divided by the actual volume of air sampled, and is expressed in micrograms per cubic meter of air ($\mu g/m^3$).

The analytical balance used to weigh filters must be suitable for weighing the type and size of filters specified, under section 6.0 of 40 CFR Part 50, Appendix L, and have a readability of ±1 µg. The balance shall be calibrated as specified by the manufacturer at installation and recalibrated immediately prior to each weighing session.

B5) QUALITY CONTROL REQUIREMENTS

QC, as it applies to an air quality monitoring program, is the overall system of technical activities and procedures developed to measure the attributes and performance of the sampling program against defined standards to verify that they meet the stated requirements established by the program. Quality control includes:

- Establishing specifications or acceptance criteria for each quality characteristic of the monitoring/analytical process,
- Assessing procedures used in the monitoring/analytical process to determine conformance to these specifications, and
- Taking any necessary corrective actions to bring them into conformance.

The overall goal of QC is to minimize loss of data through invalidation by establishing a reasonable level of checking at various stages of the data collection process. QC procedures determine if field and lab procedures are producing acceptable data and are used to initiate appropriate corrective actions; therefore QC is both proactive and corrective.

TRC will have primary responsibility for implementation of all monitoring program QC measures. The following is a summary of QC activities that will be implemented to ensure that measurement uncertainty is maintained within established acceptance criteria for the attainment of the program DQOs. QC activities will include, but not be limited to, the following:

Sulfur Dioxide, Carbon Monoxide, Ozone and Nitrogen Dioxide

- Quarterly multipoint calibration checks,
- Weekly automated calibration checks (zero/span and precision)
- Daily review of instrument measurements and diagnostics,
- Weekly operational checks by site operator, and
- Routine maintenance as specified in TRC's Standard Operating Procedure (SOP).
- Quarterly independent performance audits.

Particulate Matter – including PM_{10} and $PM_{2.5}$

- Weekly review of instrument measurements and diagnostics,
- Monthly flow and leak checks,
- Collocated sampling for precision determination,
- Routine maintenance as specified in TRC's SOP, and
- Quarterly performance audits.

Meteorological Measurements

- Semiannual calibrations,
- Weekly reasonableness checks by site operator
- Verification that wind sensors are operational and show no sign of damage,
- Wind speed, wind direction and temperature measurements represent actual conditions, and
- Semi-annual performance audits.

Detailed MQOs as well as corresponding accuracy goals are presented in the tables included in Appendix E. These tables were directly reproduced from Appendix D of the Quality Assurance Handbook, Volume II.

Quality control activities for each measurement system are conducted according to the schedule in Table B.4. Refer to the identified TRC SOPs for detailed procedures.

B6) INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

All monitoring equipment will be tested during the pre-operational phase of the program. All instruments and sensors will receive a cursory calibration check to verify operation prior to deployment. All calibration standards will be inspected for current calibrations and traceability to NIST or the appropriate authority. For this monitoring program, TRC has purchased new gas monitors, gas calibrators, meteorological instruments and PM monitors. In addition, data acquisition PCs and hardware have also been purchased new. Manufacturer's warranties will be in place for the majority of the program.

The following is a summary of activities and procedures TRC will follow to ensure all instrumentation and equipment will operate at acceptable performance levels throughout the duration of the program.

- SO_2, CO, O_3, and NO/NO_2
  - Daily review of instrument measurements and diagnostics,
  - Weekly operational checks by site operator, and
  - Routine maintenance as specified in TRC's Standard Operating Procedure (SOP).
  - Quarterly independent performance audits.

- $PM_{10/2.5}$
  - Daily review of instrument measurements and diagnostics,
  - Monthly flow and leak checks,
  - Routine maintenance as specified in TRC's SOP, and
  - Quarterly performance audits.

- Meteorological Measurements
  - Weekly reasonableness checks by site operator
    - Verification that wind sensors are operational and show no sign of damage,
    - Wind speed, wind direction and temperature measurements represent actual conditions, and
  - Semi-annual performance audits.
  - Routine maintenance as specified in TRC SOPs.

Documentation of all site activities will be provided through the use of multiple forms including the site log books, site visit check sheets, maintenance and repair activities as well as calibration records. Inventory of spare parts and a schedule of routine activities will be maintained at the station. Copies of these forms are included in the appropriate TRC SOP. Table B.4 summarizes the scheduled field activities

Table B.5 presents an inventory of spare parts and expendable items that will be maintained on site for the duration of this monitoring program.

B7) INSTRUMENT CALIBRATION AND FREQUENCY

- SO_2, CO, O_3, and NO/NO_2
  - Quarterly multipoint calibrations, if determined necessary,
  - Weekly automated calibration checks (zero/span and precision point in the range of 10-100 ppb),

- $PM_{10/2.5}$
  - Quarterly flow, temperature and pressure calibrations,

- Meteorological Measurements
  - Semiannual calibrations.

Calibrations will be performed according to TRC SOPs. All calibration equipment will be in current certification and traceable to the National Institute of Standards and Technology (NIST) or the appropriate authoritative standard. Certification records will be maintained at the site location and in TRC's Raleigh office. Calibrations and certifications will be performed by trained and experienced field scientists and technicians. Calibration equipment, as required, may be sent to the manufacturer or a facility equipped and qualified to perform traceable calibrations.

Calibrations, calibration checks and certifications will be performed according to the schedule in Table B.6.

B8) INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES

TRC has purchased new equipment for this project to minimize the potential for instrument failure and data loss. In addition, consumables and spare parts for a minimum of 13 months have been purchased for this monitoring location. These parts and consumables were obtained from the original equipment manufacturer and will be located at the site. TRC's field scientists and site operator will be responsible for maintaining an inventory of these items. In the event additional parts or supplies are needed, they will be procured from the instrument manufacturer through TRC's Raleigh Office where they will be inspected prior to deployment. On a weekly basis, the local site operator will communicate to the project manager the status of all spare parts and consumable items. The PM will be responsible for ordering all parts, supplies and materials, as required, to meet the requirements of this program. The PM will also be responsible for ensuring that these parts and supplies meet the specifications of the instrument manufacturer allowing all instrumentation to be operated in compliance with this QAPP.

B9) NON-DIRECT MEASUREMENTS

The site was located using global positioning systems (GPS). Maps from both Google Maps and Google Earth were used for locating and siting the monitoring station location for this project.

B10) DATA MANAGEMENT

Data management involves the collection, storage, transmittal, validation, reporting and archiving of measurements taken from continuous and time integrated samplers, sensors and instruments. The primary data collection systems will be comprised of an on-site PC running software developed to acquire data digitally from the instrumentation operating at the monitoring station. All continuous measurement instrumentation has built in data averaging and storage capabilities, as well as the ability to transmit those data digitally (e.g. USB, RS-485 or LAN interface). The data acquisition software (DAS) requests data from the instruments and populates a locally stored database containing multiple averaging intervals of each parameter. This database is the primary source of data.

For this monitoring program, the local (site) database will be comprised of 5 minute and hourly tables. Meteorological parameters and gas concentrations (along with instrument QC checks) will be stored in 15-minute and hourly tables.

At 5-minute intervals, data are transferred via TCP/IP to a central server hosted by TRCAir.com. This server maintains TRC's central air monitoring database and hosts a limited access/secure website to allow for data display, review and editing. Software running on the central server performs a diagnostic check on incoming data and generates error reports based on screening criteria. These reports are emailed to project personnel. For QC purposes, data will also be stored on a local USB memory device and transferred to a server located in TRC's Raleigh, NC office.

Data analysts will review measurement data on a daily basis as a first level of validation. If any data are determined to be missing, the DAS software will attempt to retrieve these data from the instruments and place them in the local database. These values will be transferred to and populated in the central server. In the event data are not retrieved automatically, the data analyst can connect to the instrument directly, retrieve data manually and load those data in to the central database.

The central database is structured with duplicate tables. The original data tables are protected, so they cannot be altered. A duplicate set of tables are identified as 'edited.' All data validation activities are stored in the edited tables.

Review and validation activities will be documented to ensure integrity and traceability of the measurement data. Edits will be independently verified by a second analyst, the project manager or other project staff. Status codes will be entered into the database indicating the action taken and validity of the datum.

Hard copy data (station logs, sample chain of custody forms, QC checks sheets, etc.) will be sent to the Raleigh office on a monthly basis. Site documentation will be reviewed as part of the data validation process and data from manual samplers will be loaded into the central database.

All data management activities will be performed in a manner consistent with TRC SOPs, as applicable.

C) ASSESSMENTS AND OVERSIGHT

C1) ASSESSMENTS AND RESPONSE ACTIONS

Assessment activities take place throughout the project to ensure that the QAPP is being implemented as approved.

C1.1) Performance Audits

Performance audits, while intended to determine data accuracy, are used to ensure that other aspects of the QAPP are being implemented. These audits will be conducted by an independent audit team in the actual field setting, if possible. The equipment for the audit will not be the same equipment used for field operations. The audit equipment will also be documented and traceable to applicable standards. Performance audits will be performed on a semi-annual basis.

C1.1.(1) Meteorological Sensors

Audits of the meteorological data collection systems will be conducted in accordance with the 2008 version of the US EPA's *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV - Meteorological Measurements* and *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA-454/B-08-002).

Acceptable limits of accuracy for the meteorological sensors are identified in Table C.1. In the event that any of the limits are exceeded calibration checks will be performed immediately after the audit.

C1.1.(2) Air Quality Analyzers

Audits of the continuous ambient air quality data collection systems will be conducted in accordance with the schedule presented in Table C.2. Audits will be conducted in accordance with the 2008 version of USEPA's *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II – Ambient Air Quality Monitoring Program* (EPA-454/B-08-003).

Acceptable limits of accuracy for air quality instruments are identified in Table C.3. In the event that any of the limits are exceeded calibration checks will be performed immediately after the audit.

Continuous Gas Analyzers

All monitors will be audited by introducing three known concentrations through as much of the inlet system as practicable. Audit procedures will be conducted in accordance with 40 CFR 58, Appendix A requirements at concentration levels specified in this part and Table C.4. Audit concentration levels will be selected based on the ambient concentrations expected at this location. The instrument responses compared to the known input concentrations of the audit gases, as a percent difference, will be used to assess accuracy of the measurement data. The percent difference (d_i) is calculated as

d_i = (measured-audit)/audit x 100

At each level, d_i must be less than or equal to 15% to achieve the MQO as summarized in Table C.3 (refer also to the Validation Templates in Appendix E). All data used for the assessment of measurement accuracy will be submitted quarterly as specified in 40 CFR 58, Appendix A section 5.2.

Particulate Matter Instrumentation

Audits will be performed of the BGI PQ-200 units in conformance with the manufacturer recommendations as well as 40 CFR 50 Appendix L. Audits will consist of checks of all instrument parameters listed below, also summarized in Table C.3:

- Flow rate
- Leak check
- Verify temperature and pressure

The percent difference between the actual parameter value reported by the independent audit standard and the value indicated by the particulate monitoring instrument will be used to assess data accuracy. The digital output of the instrument will be compared to the known value using the validation criteria in Table C.3. Accuracy data compiled from the audit results will be submitted as part of the quarterly report.

C1.2) Technical System Audits

A system audit of field activities including sampling and field measurements may be conducted and documented by the TRC Project QA Officer (or designee) at the start of sampling. The purpose of this audit is to verify that all established procedures are being followed as planned and documented and to allow for timely corrective action, reducing the impact of any nonconformance. The audit will ensure that all personnel have read the QAPP. The audit will cover field sampling records, field measurement results, field instrument operation and calibration records, sample collection, preservation, handling, and packaging procedures, adherence to QA procedures, personnel training, sampling procedures, review of sampling design versus the sampling plan, corrective action procedures, and chain-of-custody, etc. Follow-up surveillance will be conducted by the TRC Field Operations Manager to verify that QA procedures are maintained throughout the investigation.

Prior to performing the audit, the auditor will review the QAPP and assure that the audit equipment is certified and is up to date with calibrations.

Upon completion of the audit, the TRC Project QA Officer will prepare a written audit report, which summarizes the audit findings, identifies deficiencies and recommends corrective actions. In addition, a verbal debriefing will also be given to the TRC Field Operations Manager and TRC Project Manager at the time of the audit. The written report will be submitted to the TRC Project Manager, who will be responsible for ensuring that corrective measures are implemented.

C1.3) Field Systems Audit

The following tasks will be performed during the audit:

Station Location:

- Instrument shelter and surrounding area inspections
- Inventory of air monitoring equipment
- Review of calibration records – NIST traceable
- Review SOPs – ensure they are being followed
- Review site logs and documentation – ensure procedures are followed
- Ensure site personnel are knowledgeable about the project and procedures by interviews

Meteorological Station (semi-annual):

- Ensure heights and exposures are in accordance with USEPA regulations
- Check for accuracy of sensors as required by manufacturer as well as USEPA regulations

Air Quality Monitoring Station:

- Ensure inlet heights and exposures are in accordance with USEPA regulations
- Visually inspect sampling lines
- Manually calculate flow rates, if possible. Ensure flow rates meets guidelines
- Review documentation to ensure instruments meet Federal Reference Methods equivalent specifications.

C1.4) Data Quality Systems Audits

The data quality audit will consist of an evaluation of the project management organization, field operations, personnel qualifications and training, data management and processing procedures, QA program, and data reporting methods. The intent of the data quality audit is to ensure traceability of data from point of collection to reporting.

C1.5) Regulatory Audits

The state regulatory agency may choose to perform a systems audit, which would provide an assessment of adherence to the QAPP. The Dominion Environmental Supervisor will coordinate access to the sites for any audits needed.

C1.6) QAPP Revisions

It may be necessary for sections of this QAPP to be updated in the event that: additional information is received; changes in any system or procedure; changes in conditions at the site. Any revisions to this QAPP will be made by a written and approved amendment, which will become a permanent part of this plan.

C1.7) Field Non-Conformances

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the QAPP), or when sampling procedures and/or field procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The TRC Field Operations Manager will approve the corrective action and notify the TRC Project Manager and TRC QA Officer. The TRC Project Manager, in consultation with the VDEQ, if necessary, will approve the corrective action. The TRC Field Operatoions Manager will ensure that the corrective action is implemented by the field team. Corrective actions will be implemented and documented in the field logbook. Documentation will include:

- A description of the circumstances that initiated the corrective action,
- The action taken in response,
- The final resolution, and
- Any necessary approvals.

No staff member will initiate corrective action without prior communication of findings through the proper channels as described above. All corrective actions will take into account the possible effect on the data. If necessary, a problem resolution audit will be conducted.

C2) REPORTS TO MANAGEMENT

C2.1) Performance and Technical Systems Audit Reports

Within 45 days of the independent audits the auditor will prepare and submit audit report(s) to the Project Manager and Quality Assurance Manager. Performance and Technical Systems Audits will be conducted of the ambient air monitors on a quarterly basis. Performance Audits of the Meteorological sensors will be conducted on a semi-annual basis.

C2.2) Quarterly Data Reports

The Project Manager (PM) is routinely kept informed of project oversight and assessment activities and findings via meetings with the Field Operations Manager. Additionally, the PM receives the quarterly report, which contains the following elements: quarterly data summary including any violation of standards, completeness achieved, explanation of any missing or invalidated data, hourly pollutant and calibration and audit forms. The Data Manager is responsible for compiling the quarterly report. Quarterly electronic data submittals will include pollutant concentrations along with measurement quality checks (as specified in section 1.3 of 40 CFR 58, App. A).
Each quarterly report will be comprised of the following:

- Executive Summary;
- Hourly values for SO_2, CO, O_3, NO/NO_2
- WS, WD, temperature, relative humidity and global solar radiation;
- Highest 5-minute SO_2 concentration in each hour;
- 24-hour values for PM_{10} and $PM_{2.5}$ (one every six days);
- Summary of highest concentrations recorded;
- Results of instrument QC checks;
- QA/QC and equipment maintenance documentation;
- Results of performance audits;
- Quarterly and cumulative data capture statistics by parameter;
- Precision and bias estimates, including calculations;

After internal approval, the report is forwarded to Dominion, who is responsible for submitting the information to VDEQ with the appropriate certification form. The reports are to be submitted to VDEQ within 30 days of the end of each monitoring quarter.

C2.3) Annual Data Reports

The data manager also prepares the annual report, which provides a summary of overall results. The report compares the results to the required project standards and objectives.

- Annual data capture statistics;
- Annual frequency distribution of WS and WD; and,
- Annual pollution rose diagrams.

An Annual Report will be submitted within 30 days after the end of the program monitoring year. The annual report will include the 4^{th} quarter of monitoring along with an annual summary of all quarterly report elements.

C2.4) Corrective Action Reports

The need for corrective action may be identified during audits, data validation, or data assessment. Potential types of corrective action may include data qualification or reanalysis of samples by the laboratory. These actions are dependent upon whether the data to be collected is necessary to meet the required QA objectives. If the data validator or data assessor identifies a corrective action situation, the TRC Project Manager will be responsible for informing the appropriate personnel. All corrective actions of this type will be documented by the TRC Project Manager and maintained in the project files.

D) DATA VALIDATION AND USABILITY

D1) DATA REVIEW, VERIFICATION AND VALIDATION

Data review, validation and verification procedures are used to accept, reject or qualify air quality and meteorological measurement data in an objective and consistent manner. Criteria used to review and validate measurement data are defined in this section. The degree to which data comply with the quality requirements addressed in Section B of this QAPP is determined by these criteria. Ambient air quality data will be validated, invalidated or qualified by comparing measurements with criteria established in the Data Validation Tables as presented in EPA QA Handbook Volume II, Appendix D. These tables are reproduced and presented in Appendix E of this document. These tables establish three levels of criteria where each table has a different degree of implication about the quality of the data. Criteria that are deemed **critical** to maintaining the data integrity are shown in the first section of the tables. Observations that do not meet all criterion on the Critical Criteria Table should be invalidated unless there are compelling reason and justification otherwise. Criteria that are important for maintaining and evaluating data quality are included in the second section of the table. Violation of an **Operational** criterion or a number of operational criteria may be cause for invalidation. Detailed review of quality control results and operational information may or may not indicate data are acceptable for the parameter being evaluated. If one or more of these criteria are not met data are considered suspect unless other quality control information demonstrates otherwise. **Systematic** criteria which are important for the correct interpretation of the data but may not impact the validity are shown in the third section of the Tables.

Meteorological data will be evaluated based on criteria presented in Table C.1.

Overall, in order for data to be considered valid, each data point must be identifiable in terms of parameter, date, time and units. Instruments and sensors must be calibrated and operated according to applicable TRC SOPs and must be bracketed by acceptable calibrations, QC checks and audits to support determination of validity. All documentation, including site logs, check lists and maintenance records must be sufficient to support validity of the data.

D2) VALIDATION AND VERIFICATION METHODS

Verification can be defined as confirmation that specified operational requirements have been fulfilled by providing objective evidence. Data verification involves the inspection, analysis, and acceptance of measurement data or samples. Data validation is a routine process designed to ensure that reported values meet the DQOs of the measurement program. The data validation process should examination the collected evidence, in the form QC data and operation documentation, to determine if measurement data meets the requirements for the specific intended use. The purpose of data validation is to detect and then verify any data values that may not represent actual air quality conditions at the sampling station.

During this monitoring program at least one hour of data will need to be invalidated every other week. The owner of the existing cell tower is required to test the backup power generators located at the site location once every two weeks. The two generators will be run the same day and time every other week for at least 45 minutes. The schedule of these tests will be communicated with the PM so that TRC can invalidate the data from that time period.

D2.1) Data Validation Process

TRC will employ a 3 tiered approach to data validation; Level 0, Preliminary (sometimes referred to as Level 1) and Final (Level 2). This process will assure that data collected for this air quality monitoring program are of sufficient quality to meet the project objectives. Records of QC activities, to be described in the QAPP, will be reviewed on an on-going basis and used for determination of data validity. Calibrations, flow audits, automated QC checks, sample data sheets and operator log entries will also be used in the validation process. Daily review will be conducted by staff in Raleigh. Visual data inspection as well as results of screening software will be used for validation on a daily basis.
Detailed data validation criteria and data validation protocol will be described in detail in the QAPP. Following is an overview of TRC's data validation procedure:

<u>Level 0 Validation (Daily)</u>

- Review for completeness and acquire missing data if available
- Review for anomalies and reasonableness
- Visually review graphed data
- Evaluate automated QC checks (zero/span/precision, etc.)

<u>Preliminary Validation (Level 1)</u>

- Review site records (i.e. operator logbook and sample data sheets)
- Review operator QC checks (i.e. sampler flow rate checks)
- Evaluate any noted anomalies to other data sources (i.e. meteorological conditions compared to nearest National Weather Station (NWS) or other verifiable measurements)
- Review instrument calibration records
- Review performance audit results
- Edit/enter validation codes

<u>Final (Level 2) Validation</u>

Data are considered final when it can be demonstrated that they meet the data quality objectives of the program and are a true representation of the air quality and meteorological conditions in the region. Data must pass Final Validation criteria before submittal to VDEQ. Activities for Final Validation include:

- Generation of monthly data summaries
- Review of monthly data by TRC Program Manager, Data Manager and QA

- Resolution of any inconsistencies
- Update validation codes to final

D3) RECONCILIATION WITH USER REQUIREMENTS

The objectives of this monitoring program are described in Section A.5. TRC and Dominion have established this air monitoring program to measure the levels of gaseous and particulate PM pollution. Gaseous, PM and meteorological monitoring systems are installed to provide scientifically defensible air quality data to characterize the extent, frequency of occurrence, and magnitude of pollutant concentrations in the region. Data are expected to provide a true representation of air quality in the vicinity.

TRC will conduct quarterly and annual review of the monitoring program to ensure all data considered valid meet the defined network acceptance criteria and monitoring objectives by verifying that quality assurance procedures and documentation are reviewed and evaluated in the data validation process. Performance audits, calibrations, automated and manual precision and accuracy tests, technical systems audits, as well as all other methods used to ensure data quality are considered as part of this review. If, at any time, the review process indicates objectives of the monitoring program are not being met, the project and QA managers will reassess this QAPP.

TABLES

Table A.1 Program Responsibilities	
Position	**Role**
Virginia Department of Environmental Quality	Assist in data review and System Audit, if requested
Dominion Virginia Power Environmental Manager	Overall program management and coordination. Reviews data prepared by TRC and submits the information to VDEQ. Responsible for site acquisition and response to SO_2, PM_{10} and $PM_{2.5}$ action levels.
TRC Project Manager (PM)	The Project Manager is responsible for ensuring successful outcomes and managing all aspects of the project. All contract personnel report to the Project Manager.
TRC QA Manager	Coordination of performance and system audits and data quality assessments.
TRC Field Operations Manager (FOM)	Has the overall responsibility of field operations, field activities, and the operation of the monitoring sites.
TRC site operator and Field Scientist(s)	Responsible for site set-up, deploying monitoring equipment, quality control checks and retrieving data from the monitoring sites. Site Operators report to the FOM.
TRC Data Manager	Responsible for database management, data validation and the preparation of periodic reports.

Table A.3 Summary of Monitoring Program Parameters		
Parameter	**Measurement Units**	**Reporting Interval**
SO_2	Parts per billion (ppb)	Hourly (highest 5-min)
O_3	ppb	Hourly
CO	Parts Per Million (ppm)	Hourly
NO_2	ppb	Hourly
PM_{10}	Micrograms per cubic meter ($\mu g/m^{3}$)	Daily (24 hour; 1 in 6 day schedule)
$PM_{2.5}$	$\mu g/m^3$	Daily (24 hour; 1 in 6 day schedule)
WS	Meters per second (m/s)	Hourly
WD	Directional degrees (°)	Hourly
σθ	°	Hourly
w	m/s	Hourly
σw	Radians	Hourly
T	Degrees Celsius (°C)	Hourly
RH	Percent (%)	Hourly
SR	Watts per square meter (w/m^2)	Hourly

Table A.4 Project Schedule – Based on Start Date of April 1, 2012		
Activity	**Frequency**	**Date Due**
Installation	Once	September 2013
Calibrations	Quarterly or as required	September 2013, End/Beginning of Quarter Thereafter.
Station/Equipment Checks	Weekly	n/a
Begin Data Collection		September 2013
Audits	Quarterly/Semi-Annual	Based on Initiation Date
Reports	Quarterly	Draft 30 Days After Quarter End. Final Due 45 Days After Quarter End.
Complete Data Collection		September 30, 2014
Final Calibration	Once	October 10, 2014
Demobilization	Once	October 10, 2014

Table A.5 Summary of Measurement Quality Objectives - Pollutant Parameters						
Parameter	**Reporting Units**	**Operating Range**	**Precision**	**Bias**	**Completeness**	**Reference**
$PM_{2.5}$ FRM Sampler	$\mu g/m^3$	n/a	n/a	n/a	90% of valid samples per monitoring quarter	
PM_{10} FRM Sampler	$\mu g/m^3$	n/a	n/a	n/a	90% of valid samples per monitoring quarter	
SO_2	ppb	0 - 500	90% CL CV ≤ 10% based on precision checks	95% CL ≤± 10% based on precision	90% of hourly values per monitoring quarter	40 CFR 58 A 4.1.2 and 4.1.3
CO	ppm	0 - 50	90% CL CV ≤ 10% based on precision checks	95% CL ≤± 10% based on precision	90% of hourly values per monitoring quarter	40 CFR 58 A 4.1.2 and 4.1.3
O_3	ppb	0 -500	90% CL CV ≤ 7% based on precision checks	95% CL ≤± 7% based on precision	90% of hourly values per monitoring quarter	40 CFR 58 A 4.1.2 and 4.1.3
NO/NO_2	ppb	0 - 500	90% CL CV ≤ 15% based on precision checks	95% CL ≤± 15% based on precision	90% of hourly values per monitoring quarter	40 CFR 58 A 4.1.2 and 4.1.3

CL – Confidence Level
CV – Coefficient of Variation

Table A.6 Meteorological Data Measurement Quality Objectives								
Measurement	**Method**	**Reporting Units**	**Operating Range**	**Resolution**	**Minimum Sample Frequency**	**Accuracy**	**Raw Data Collection Frequency**	**Completeness**
Ambient Temperature	Thermistor	ºC	-50 – 50	0.1	Hourly	± 0.5	1 second	90%
Relative Humidity	Capacitive Sensor	%	0 - 100	0.1	Hourly	± 7%	1 second	90%
Horizontal Wind Speed	Propeller Anemometer	m/sec	0.5 – 50.0	0.1	Hourly	±0.2 m/s ≤ 5 ±5 % > 5 m/s	1 second	90%
Wind Direction	Vane anemometer	Degrees	0 – 360	1	Hourly	± 5 Degrees	1 second	90%
Vertical Wind Speed	Propeller Anemometer	m/sec	-25 – 25 m/s	0.1	Hourly	± 0.2 m/s	1 second	90%
Solar Radiation	Pyranometer	Watts/m^2	0 – 1,396	1	Hourly	± 5%	1 second	90%

Table A.7 Location of Air Monitoring Stations			
Site Location	**Elevation**	**Latitude (^oN)**	**Longitude (^oW)**
Route 58 in Brunswick County, Virginia	80 meters	36.769104^o	-77.72743^o

Table A.8 Project Documentation and Records		
Record/Document Type		**Location**
Management & Organization	Client Contract	Project Files - RAL
	Correspondence	Project Files - RAL
	Staff Training/Certifications	Project Files - RAL
Site Information	Siting Criteria Checklists	Project Files - RAL
	Site Maps and Photos	Project Files – RAL & DVP
Field Operations	QAPP	Project Files – RAL & DVP
	Standard Operating Procedures	Project Files – RAL & DVP
	Site Logbooks	Project Files - DVP
	Quality control documents	Project Files - DVP
	Standard/Calibration Certs.	Project Files – RAL & DVP
Raw Data	Electronic Data	RAL File Server
	Hardcopy Data	Project Files - RAL
Data Reporting	Monthly data/summary reports	Project Files - RAL
	Annual data/summary reports	Project Files - RAL
	Electronic format reports	RAL File Server
	QA Assessments and Reports	Project Files - RAL
Data Management	Hardware and software manuals	Project Files – RAL
	Data Validation Procedures	Project Files - RAL
Quality Assurance	Audit results	Project Files - RAL
	QA Assessments and Reports	Project Files - RAL

Table B.1 Methodology				
Parameter	**Method**	**Manufacturer**	**Model**	**Reference**
SO_2	Pulsed UV Fluorescence	Teledyne-API	T-100	FEM
CO	Gas Filter Correlation	Thermo Scientific	48i	FRM
O_3	UV Absorption	Teledyne-API	T-400	FEM
NO/NO_2	Chemiluminescence	Thermo Scientific	42i	FRM
PM_{10}	Filter	BGI	PQ-200	FRM
$PM_{2.5}$	Filter	BGI	PQ-200	FRM
WS	Prop/AC Pulses	R.M. Young	05305	Meets EPA PSD
WD	Vane/Potentiometer	R.M. Young	05305	Meets EPA PSD
w	Prop/AC Pulses	R.M. Young	27106	
T	Pt RTD/Aspirated Shield	R.M. Young	41342	
RH	Capactive	Young/Rotronic	41382	
SR	Pyranometer	Li-Cor	LI-200	

Table B.2 Equipment Suppliers	
Manufacturer/Supplier	**Equipment**
R.M. Young Company 2801 Aero Park Drive Traverse City, MI 49686 (231)946-3980 Youngusa.com	Wind Sensors, Temperature Sensors, Translator
Teledyne API 9480 Carroll Park Drive San Diego, CA 92121 (858)657-9800 Teledyne-api.com	T100 SO_2 Monitors, T400 O_3 Monitors, T700 Gas Dilution Calibrators and 701 Zero Air Supplies.
Thermo Fisher Scientific Inc. 81 Wyman Street Waltham, MA 02454 (781)622-1000 and (800)678-5599 thermoscientific.com	48i CO Monitors and 42i NO/NO_2 Monitors
EKTO Manufacturing Corp. Eagle Drive Sanford, ME 04073 (207)324-4427 Ekto.com	Shelters
BGI 58 Guinan Street Waltham, MA 02451 (781)891-9380 Bgiusa.com	PQ-200 FRM PM_{10} and $PM_{2.5}$ Samplers

Table B.3. Summary of Media, Preservation, and Holding Time Requirements					
Analytical Parameter	**Analytical Method**	**Estimated Sample Volume**	**Media**	**Preservation Requirements**	**Maximum Holding Time**
Particulate PM_{10}	40 CFR Part 50, Appendix J	24.0 m^3 (16.7 L/min for 24 hours)	47 mm Teflon filters	None	None
Particulate $PM_{2.5}$	40 CFR Part 50, Appendix L	24.05 m^3 (16.7 L/min for 24 hours)	47 mm Teflon filters	None	None

Table B.4 Scheduled Field Activities

Field Activity	Every Visit	Weekly	Bi-weekly	Monthly	Quarterly	Semi-Annually
Communication with Project Manager	X	X				
Change inlet filter			X			
Verify Instrument/Sensor Readings	X	X				
Inspect/Clean sample manifold	X	X				
Inspect/Clean PM sampling system inlets (VSCC & PM_{10} Impactor)				X		
PM Filter Blanks (10%)				Bi-Monthly		
PM Flow Verifications/Leak Checks				X		
Visually Inspect Meteorological sensors/cables	X	X				
Site operator checks/inspections, logbook entries	X	X				
$PM_{10/2.5}$ FRM Samples *		X				
Zero/Spam checks (auto)			X			
Perform & record analyzer calibrations.					X	
Perform & record meteorological calibrations.						X
Pollutant Instrument Calibrations					X	
Filter Shipments			X			
Audit pollutant analyzers (independent)					X	
Met systems Audit (independent)						X
Certify SO_2 tank standards						
Certify SO_2 dilution calibrator					X	
Ship Documentation to TRC			X			

* Every sixth day

Table B.5 Inventory of Spare Parts and Expendables	
Item	**Inventory at Site**
R.M. Young Wind Monitor - Complete	1
Prop for Vertical Wind Speed	1
T100, T400, T700, 43i and 48i Expendables Kits, 1 Year Supply	3
701 Zero Air Expendables, 1 Year Supply	3

Table C.1 PSD Calibration and Accuracy Criteria – Meteorological Measurements						
Measurement	**Calibration**			**Accuracy**		
	Type	**Acceptance Criteria**	**Frequency**	**Type**	**Acceptance Criteria**	**Frequency**
Ambient Temperature	3 pt. Water Bath with NIST traceable RTD or thermometer	± 0.5 ^{o}C	Quarterly	3 pt. Water Bath with NIST traceable RTD or thermometer	± 0.5 ^{o}C	Within 60 days of startup and 6 month intervals
Relative Humidity	NIST-traceable Psychrometer, chamber or standard solutions	±7% RH	Quarterly	NIST-traceable Psychrometer, chamber or standard solutions	±7% RH	Within 60 days of startup and 6 month intervals
Horizontal Wind Speed	NIST-traceable Synchronous Motor	±0.2 m/s < 5 m/s, ±5%. 5 m/s	Quarterly	NIST-traceable Synchronous Motor	±0.2 m/s < 5 m/s, ±5%. 5 m/s	Within 60 days of startup and 6 month intervals
Wind Direction	Magnetic Compass or GPS	±5 degrees Including orientation error	Quarterly	Magnetic Compass or GPS	±5 degrees including orientation error	Within 60 days of startup and 6 months thereafter
Solar Radiation	NIST-traceable Pyranometer	5% of mean observed interval	Quarterly	NIST-traceable Pyranometer	5% of mean observed interval	Within 60 days of startup and 6 month intervals
Vertical Wind Speed	NIST-traceable Synchronous Motor	±0.2 m/s	Quarterly	NIST-traceable Synchronous Motor	±0.2 m/s	Within 60 days of startup and 6 month intervals

Table C.2 Audit Schedule 1	
Performance Audit Schedule	**Parameters to be Audited**
45 days after startup	All Gas Analyzers, $PM_{10/2.5}$ samplers, Met Sensors, DAS
Quarterly	All Gas Analyzers, $PM_{10/2.5}$ samplers and DAS
Semi-Annual	Meteorological Sensors

Table C.3 Accuracy Limits and Validation Criteria for Pollutant Measurements					
Parameter	**Criteria**	**Samples Evaluated**	**Acceptable Range**	**Frequency of Evaluation**	**Reference**
PM_{10} / $PM_{2.5}$ FRM	Flow Rate Accuracy	Single point flow rate check	± 4% of reference flow standard and ± 5% of nominal flow of $1m^3$/hr	Quarterly	EPA QA Handbook, Volume II, Sec. 2.12 PQ200 Operation Manual Sec. 2.2.3
PM_{10} / $PM_{2.5}$ FRM	Ambient temperature	Single point check	± 2º C of actual	Quarterly	40 CFR 50 App. L, Sec. 7.4.8 ($PM_{2.5}$) Same for PM_{10}
PM_{10} / $PM_{2.5}$ FRM	Ambient pressure	Single point check	± 10 mm Hg of actual	Quarterly	40 CFR 50 App. L, Sec. 7.4.8 ($PM_{2.5}$) Same for PM_{10}
PM_{10} / $PM_{2.5}$ FRM	Filter temperature	Single point calibration check	± 1º C of actual	Quarterly	40 CFR 50 App. L, Sec. 7.4.8 ($PM_{2.5}$) Same for PM_{10}
SO_2	3 consecutive audit levels	Test atmosphere generated from Certified Standard	≤15% difference for each audit level	Quarterly	40 CFR 58 App. A Section 3.2.2
CO	3 consecutive audit levels	Test atmosphere generated from Certified Standard	≤15% difference for each audit level	Quarterly	40 CFR 58 App. A Section 3.2.2
O_3	3 consecutive audit levels	Certified Transfer Standard Photometer	≤15% difference for each audit level	Quarterly	40 CFR 58 App. A Section 3.2.2
NO/NO_2	3 consecutive audit levels	Test atmosphere generated from Certified Standard	≤15% difference for each audit level	Quarterly	40 CFR 58 App. A Section 3.2.2

Table C.4 Pollutant Audit Levels – 40 CFR 58 App. A 3.2.2				
Audit Level	**Concentration Range**			
	SO_2(ppb)	**CO (ppm)**	**O_3 (ppb)**	**NO_2 (ppb)**
1	0.3 – 5.0	0.08 – 0.1	20 - 50	0.2 – 2.0
2	6.0 - 10	0.5 – 1.0	60 - 100	3.0 – 5.0
3	20 - 100	1.5 – 4.0	110 - 200	6.0 – 100
4	110 - 400	5.0 – 15	210 - 300	110 - 300
5	410 - 900	20 - 50	310 - 900	310 - 600

APPENDIX A

Brunswick County Air Monitoring Plan

Air Quality Monitoring Plan for the Dominion Energy Brunswick County Site

August 9, 2013

(TRC Project 204046.0000.0000)

Prepared for:

Dominion Resources, Inc.

Prepared by:

TRC Companies, Inc.
Gainesville, FL

Table of Contents

1 Introduction

Dominion Virginia Power (DVP) is proposing to construct a new power generation facility in or near Brunswick County, Virginia. The project's equipment will include three combustion turbine generators three each heat recovery steam generators, a steam turbine generator, an air cooled condenser and associated balance-of-plant equipment. The net electrical output of the project is expected to be a nominal 1,400 MW with duct firing and inlet chilling.

The purpose of this program is to conduct at least one year of pre-construction prevention of significant deterioration (PSD) air quality monitoring in the vicinity of the planned construction for the new power generation facility at a single location. The monitoring will include measurements of particle matter (PM) with aerodynamic diameters less than or equal to10 and 2.5 micrometers (PM_{10} and $PM_{2.5}$, respectively), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and nitrogen dioxide (NO_2). Meteorological measurements for wind speed and direction (WS and WD, respectively), standard deviation of wind direction (σθ), vertical wind speed (w), standard deviation of vertical wind speed (σw), calculated standard deviation of elevation angle (σE), temperature (T), relative humidity (RH), and solar radiation (SR) will be recorded at the selected monitoring location.

This Air Monitoring Plan is organized into six sections as follows: Section 1 Introduction, Section 2 presents the objectives of the air quality monitoring program, Section 3 outlines the monitoring station locations and the site selection process, Section 4 describes the air sampling and meteorological monitoring methodologies, Section 5 presents planned Quality Assurance and Quality Control measures, and Section 6 presents a discussion of data processing, validation and reporting requirements.

2 Objectives

As previously stated, the purpose of this monitoring program is to install and operate, for at least one year, ambient air quality and meteorological monitoring at one site in the vicinity of the proposed construction of a new power generating facility. This Air Monitoring Plan has been developed in accordance with applicable PSD regulations and guidelines. This air quality and meteorological monitoring program has been designed to provide valid, reliable and regulatory compliant ambient measurement data from the single monitoring station located in Brunswick County, Virginia.

Monitoring will commence in September 2013 and will continue for at least one year. The goal of this Air Monitoring Plan is to describe the operations of the monitoring program and ensure compliance with applicable requirements of 40 CFR Parts 50, 53, 58 and other requirements specified by the Virginia Department of Environmental Quality (VDEQ). The air monitoring data will be used to:

- Establish a baseline of pollutant concentrations in the area prior to development/construction of a new power generating facility.
- Provide air quality and meteorological data for future permit application(s).

The air quality monitoring program described in this Plan is designed to produce data that meets the data quality objectives (DQOs) including, but not limited to, precision, accuracy, comparability, and data capture. These DQOs and acceptance criteria, as found in the Quality Assurance Handbook for Air Pollution Measurement Systems Volumes II, will be addressed in the Quality Assurance Project Plan (QAPP).

3 Number, Type and Location of Monitoring Site

3.1 Site Selection Process

TRC, in concert with DVP, assessed two potential site locations in Brunswick County, Virginia. Both sites were identified as candidates based upon their proximity to the proposed future construction as well as the presence of pre-existing cell towers with the infrastructure (power, communications, and security) to support air quality and meteorological monitoring. The site surveys of these two locations were conducted to ensure that these locations meet instrument siting requirements (CFR 40, Part 58, Appendices D and E), have power available within a reasonable distance and present no restrictions to access. The location of the monitoring station being proposed is shown in Figure 1. The monitoring location is less than 5 miles from the potential power generation facility sites.

3.2 Site Parameters

All parameters (PM_{10}, $PM_{2.5}$, SO_2, CO, O_3, NO_2 and meteorology) will be monitored at the selected location. Concentrations of PM_{10}, $PM_{2.5}$, SO_2, CO, O_3, and NO_2 will serve as baseline concentrations in the region. A single tower with wind instrumentation installed at 30 meters will allow for compliance with the general siting requirements specified in the Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV: Meteorological Measurements Version 2.0 (Final).

3.3 Site Location

The site is located along Route 58 (Governor Harrison Parkway) in Brunswick County, Virginia. The exact coordinates of this location are:

- Longitude: -77.72743^{o}
- Latitude: 36.769104^{o}
- Elevation: 80 meters

Figure 1 Brunswick County Site Location

4 Air Quality Monitoring Methodology

The methods used to monitor the parameters selected for this air quality monitoring program and the reporting requirements are described below.

Continuous monitoring of SO_2 concentrations will be conducted using Teledyne-Advanced Pollution Instrumentation (TAPI) model T100 UV Fluorescent SO_2 Analyzers. The T100 is designated as a Federal Equivalent Method (FEM), designation EQSA-0495-100. Five minute and hourly averaged concentrations of SO_2 will be calculated to comply with reporting requirements established for SO_2.

Continuous monitoring of CO concentrations will be conducted using a Thermo Scientific Model 48i Gas Filter Correlation (GFC) CO analyzer. The 48i is designated as a Federal Reference Method (FRM), designation RFCA-0981-054. Hourly averaged concentrations of CO will be calculated to comply with reporting requirements established for CO.

Continuous monitoring of O_3 concentrations will be conducted using a TAPI T400 UV Absorption analyzer. The T400 photometric ozone analyzer is designated as a Federal Equivalent Method, designation EQOA-0992-087. Hourly averaged concentrations of O_3 will be calculated to comply with reporting requirements established for O_3.

Continuous monitoring of NO/NO_2 concentrations will be conducted using a Thermo Environmental Model 42i Chemiluminescence analyzer. The 42i is designated as a Federal Reference Method (FRM), designation RFNA-1289-074. Hourly averaged concentrations of NO/NO_2 will be calculated to comply with reporting requirements established for NO/NO_2.

All gas analyzers will be calibrated with a TAPI Model T700 dynamic dilution calibrator configured with gas phase titration and an internal photometer certified as an ozone transfer standard. Calibration dilution gas will be generated using a TAPI Model 701 zero air system.

The instruments will be installed in a temperature controlled shelter (EKTO 868 or similar) fitted with a borosilicate glass and/or FEP Teflon® sample inlet and manifold. All continuous data (SO_2, CO, O_3, and NO_2) will be recorded on a PC-based data acquisition system with local backup. Data will be transmitted to a central server and accessible via a restricted access website.

PM_{10} and $PM_{2.5}$ mass concentrations will be determined using collocated filter based BGI PQ200 samplers operated on the national 6-day sampling schedule. The BGI PQ200 samplers are designated as Federal Reference Methods. The $PM_{2.5}$ sampler will employ the BGI designed Very Sharp Cut Cyclone (VSCC), designation RFPS-0498-116. The Reference Method for PM_{10} sampling is designated RFPS-1298-125. Filters will be shipped to a Virginia Environmental Laboratory Accreditation Program (VELAP) accredited laboratory for PM_{10} and $PM_{2.5}$ gravimetric analysis in accordance with 40 CFR Part 50, Appendix J (PM_{10}) and Appendix L ($PM_{2.5}$).

Meteorological (met) parameters will be measured with new R.M. Young and LI-COR sensors. Horizontal wind speed and direction will be determined with an R.M. Young Wind Monitor AQ. Vertical wind speed will be measured with a Young 27106 Gill propeller anemometer. Temperature and humidity will be determined with a Young 41382VC probe housed in a model 43502 aspirated radiation shield. Global solar radiation will be measured with a LI-COR LI-200 Pyranometer. Met data will be recorded, calculated ($\sigma\theta$, σw and σE) and displayed using a Model 26800 translator. Horizontal and vertical wind sensors will be mounted on an existing tower at a height of 30 meters. Temperature, relative humidity and solar radiation sensors will be monitored at a height of two meters. . All met data collected from this station will be transmitted to the central server location on a 15-minute basis. Fifteen minute and hourly averaged data will be stored in separate data tables. Standard deviation of wind direction will be calculated following equation 9-9 of EPA QA Handbook Volume IV.

Table 1 summarizes the parameters to be measured for the Brunswick County monitoring program.

Table 1 Monitoring Program Parameters

Parameter	**Measurement Units**	**Reporting Interval**
SO_2	Parts Per Billion (ppb)	Hourly (and highest 5-minute)
PM_{10}	Micrograms per cubic meter ($\mu g/m^3$)	Every 6^{th} day (24-hour)
$PM_{2.5}$	$\mu g/m^3$	Every 6^{th} day (24-hour)
CO	Parts Per Million (ppm)	Hourly
NO_2	ppb	Hourly
WS (*u*)	Meters per Second (m/s)	Hourly
WD	Directional Degrees (°)	Hourly
$\sigma\theta$	Directional Degrees (°)	Hourly
w	m/s	Hourly
σw	m/s	Hourly
σE	Radians	Hourly
T	Degrees Celsius (°C)	Hourly
RH	Percent (%)	Hourly
SR	Watts per Square Meter (w/m^2)	Hourly

TRC personnel will visit the station as necessary to conduct routine operations as described above. This station will be powered by line voltage obtained from an adjacent source. All instrumentation will be housed within an EKTO shelter equipped with an industrial heating and air conditioning system. The shelter will be a fixed, semi-permanent system and not readily mobile. Normal spare parts and consumable items will be stored on-site for instrument maintenance.

5 Quality Assurance and Quality Control Procedures

The Ambient Air Monitoring Program is designed to achieve program DQOs and meet or exceed the minimum standard requirements for field monitoring and analytical methods. The overall QA objective is to develop and implement procedures for continuous air quality and meteorological monitoring, data validation and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet program DQOs. Specific procedures for field instrument calibrations, reporting of data, internal quality control, preventative maintenance of field equipment, and corrective action, as applicable, will be described in a comprehensive QAPP. The QAPP will describe, in detail, the necessary QA/QC and other technical activities that must be implemented to ensure that the results of work performed will satisfy the program DQOs. The Monitoring Program QAPP will be implemented prior to commencement of any monitoring activities.

TRC will have primary responsibility for implementation of all monitoring program QC measures. The following is a summary of QC activities that will be implemented to ensure that measurement uncertainty is maintained within established acceptance criteria for the attainment of the program DQOs. QC activities will include, but not be limited to, the following:

Sulfur Dioxide, Carbon Monoxide, Ozone and Nitrogen Dioxide

- Quarterly multipoint calibration checks,
- Weekly automated calibration checks (zero/span and precision)
- Daily review of instrument measurements and diagnostics,
- Weekly operational checks by site operator, and
- Routine maintenance as specified in TRC's Standard Operating Procedure (SOP).
- Quarterly independent performance audit.

Particulate Matter – including PM_{10} and $PM_{2.5}$

- Weekly review of instrument measurements and diagnostics,
- Monthly flow and leak checks,
- Collocated sampling for precision determination,
- Routine maintenance as specified in TRC's SOP, and
- Quarterly performance audit

Meteorological Measurements

- Quarterly calibrations,
- Weekly reasonableness checks by site operator
- Verification that wind sensors are operational and show no sign of damage,
- Wind speed, wind direction and temperature measurements represent actual conditions, and
- Semi-annual performance audits.

Specific Guidance to be followed will include:

- 40 CFR 58, Appendix A. Quality Assurance Requirements for SLAMS, SPMs, and PSD Air

Monitoring

- Quality Assurance Handbook for Air Pollution Measurement Systems Volumes II: Ambient Air Quality Monitoring Program and Volume IV: Meteorological Measurements Version 2.0 (Final)
- Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA-454/R-99-005)

Quarterly Performance Audits will be performed by Environmental, Engineering & Measurement Services, Inc. (EEMS). EEMS is an environmental consulting firm providing clients with a wide range of environmental services, with emphasis in all aspects of ambient air quality monitoring and Clean Air Act compliance.

6 Data Processing, Data Validation and Reporting

6.1 Data Processing

Data processing begins with acquisition (electronic and manual) at the monitoring station. TRC will install a computer-based data acquisition system that will record 1-minute and hourly averaged data from the continuous gas analyzers (SO_2, CO, O_3, and NO_2) and 15-minute and hourly averaged data from the meteorological instrumentation in a local database. These systems will be connected to the internet and transfer data to a local server at TRC's office in Raleigh, NC. Data will be transmitted at 5-minute and hourly intervals. TRC will host a secure, limited access website that will display data updated every 5 minutes as well as hourly and daily summaries. Parameters to be recorded will include SO_2 concentrations (ppb), CO concentrations (ppm), NO_2 concentrations (ppb), O_3 concentrations (ppb), PM concentrations ($\mu g/m^3$), scalar averaged wind speed (m/s), vector averaged wind speed (m/s), vector averaged wind direction (deg), standard deviation of wind direction (deg), temperature (°C), relative humidity (%), and solar radiation (watts/m^2). In addition, automated QC checks will be recorded in the database.

Automated error checking software will send email alerts to TRC staff should a fault be detected with any of the continuous monitoring instruments or if a QC check is out of tolerance.

6.2 Data Validation

Detailed data validation criteria and data validation protocol will be described in detail in the QAPP.

Records of QC activities, as described in the QAPP, will be reviewed on an on-going basis and used for determination of data validity. Calibrations, flow audits, automated QC checks, sample data sheets and operator log entries will also be used in the validation process. Daily review will be conducted by staff in Raleigh. Visual data inspection as well as results of screening software will be used for validation on a daily basis.

Data are considered final when it can be demonstrated that they meet the data quality objectives of the program and are a true representation of the air quality and meteorological conditions in the region. Data must pass Final validation criteria before submittal. Activities for Final Validation include:

- Generation of monthly data summaries
- Review of monthly data by TRC Program Manager, Data Manager and QA
- Resolution of any inconsistencies
- Update validation codes to final

6.3 Data Reporting

Monthly Summary Reports will be submitted within 30 days after the end of each calendar month. Each report will be comprised of the following:

- Executive Summary;
- Hourly Values for SO_2, NO_2, CO, $O_3$and meteorological parameters;

- 5-minute maximum concentrations for SO_2
- 24-Hour Values for PM_{10} and $PM_{2.5}$;
- Monthly data capture statistics;
- Comparison relative to NAAQS;

Quarterly Reports will be submitted within 30 days after the end of each monitoring quarter. Each report will be comprised of the following:

- Executive Summary;
- Hourly Values for SO_2, NO_2, CO, O_3 and meteorological parameters;
- 24-Hour Values for PM_{10} and $PM_{2.5}$;
- QA and equipment maintenance documentation;
- Monthly and cumulative data capture statistics;
- Comparison relative to NAAQS;
- Frequency distribution of WS and WD; and,
- Pollution roses of SO_2, NO_2, CO and O_3 concentrations.

An Annual Report will be submitted within 30 days after the end of the calendar year. Each report will be comprised of the following:

- Annual data capture statistics;
- Comparison relative to NAAQS;
- Annual frequency distribution of WS and WD; and,
- Annual pollution rose diagrams.

APPENDIX B

Project Forms

PQ-200 Calibration Form

Project Name	Project Number	Site ID	Audit Date	Start Time	End Time	Operator

Sensor Information		Flow Standard		Temp Standard		Pressure Standard	
Make:		Make:		Make:		Make:	
Model:		Model:		Model:		Model:	
S/N:		S/N:		S/N:		S/N:	
Inlet Height:		Cal Date:		Cal Date:		Cal Date:	
Last Cal Date:							
PM_{10} or $PM_{2.5}$							

As-Found Check

Actual Flow V. Indicated Flow

Inlet Temp (°C) ______ Reference Device Temp (°C) ______

Target Flow (lpm)	Reference Flow (lpm)	Corrected Refrence Flow (lpm)	ent Flow (lpm)	Percent Difference %	Required Accuracy %	Pass/Fail
15.00						
18.30						
16.70						

Temperature and Pressure Sensor Verification

Standard Temp °C	Sensor Temp °C	Error °C	Required Accuracy °C	Pass/ Fail
Standard Pressure mm Hg	**Indicated Pressure mm Hg**	**Error mmHg**	**Required Accuracy mmHg**	**Pass/ Fail**

Leak Check

Leak Check Value lpm	Tolerance lpm	Pass/ Fail

Standard Flow V. Nominal Flow

Nominal Flow lpm	Reference Flow lpm	Percent Diff. %	Required Accuracy %	Pass/ Fail

Notes:

Checked by:_______________________________ (Project Manager or QA Manager -Sign and Date)

Filter Collection Data
PQ200

Project Name: ____________________ Project Number: ____________________
Client Name: ____________________ Site Operator: ____________________
City/State: ____________________

Location ID: __________ Monitor ID: __________ Vaucuum Pump ID: __________
Filter Collected: __________ Filter Installed: ____________________

	Monitor	**Standard**
Date		
Time		

PAST SAMPLE

Total Volume (m^3) :

Est. Run Time:		Start Time :		Stop Time :	
Q(VLpm):		Q(VLpm) avg:		CV:	
Tmax (°C) :		Tmin (°C) :		Tavg (°C) :	
Pbar max (mmHg) :		Pbar min (mmHg) :		Pbar avg (mmHg) :	

Relative Humidity Calibration Form

Project Name	Project Number	Site Name	Calibrator	Calibration Date	Data Logger

Operator	

	RH Sensor	
	As Found	As Left
ID #		
Description		
Manufacturer		
Model		
ranslator ID #		
Manufacurer		
Zero		
Span		

Transfer Standard

ID # ____________

Manufacturer ____________

Model ____________

Date of Last Cert ____________

Correction Factors					
10%	30%	50%	70%	85%	95%

As Found Data Logger Relative Humidity Output				
Prtable hygrometer	Correction Factor	Equivalent Relative	Datalogger Output	
			% Relative Humidity	Difference

Notes:

Checked by:__________________________________ (Project Manager or QA Manager -Sign and Date)

Site Status Report Form

Client: ________ Site ID: ________ Job Number: ________

	Parameter		Standard		Criteria	Error	Pass/Fail
BAM1020 PM_{10}	Date				± 0 days		
	Time				± 3 minutes		
	Flow (ACTUAL)	lpm	**16.7**	lpm	± 2%		
	LAST m	mg/cm^2	0.108	mg/cm^2	± 5%		
	STATUS		**ON**		ON		
	Tamb	°C		°C	± 2°C		
	Pamb	mmHg		mmHg	± 10 mmHg		
	Filter Tape Change Date	2/15/2012	Don't Change Tape		Filter Tape Changed?		Yes No
	Collection Jar Empty?	Yes No	Clean the collection jar		Cleaned Jar?		Yes No
BAM1020 $PM_{2.5}$	Date				± 0 days		
	Time				± 3 minutes		
	Flow (ACTUAL)	lpm	**16.7**	lpm	± 2%		
	LAST m	mg/cm^2	0.107	mg/cm^2	± 5%		
	STATUS		**ON**		ON		
	Tamb	°C		°C	± 2°C		
	Pamb	mmHg		mmHg	± 10 mmHg		
	Filter Tape Change Date	1/9/2012	Don't Change Tape		Filter Tape Changed?		Yes No
	Collection Jar Empty?	Yes No	Clean the collection jar		Cleaned Jar?		Yes No
T100	Date				± 0 days		
	Time				± 3 minutes		
	Current Concentration	ppb					
	Sample Flow	cc/min	**650**	cc/min	± 10%		
	T_{BOX}	°C		T_{amb}°C	T_{amb} + ~ 5°C		
	P_{amb}	mmHg		mmHg	± 10 mmHg		
	Filters Clean?	Yes No	Clean the collection jar		Filter Replaced?		Yes No
	Intake Manifold Clean?	Yes No	Clean the intake manifold		Manifold Cleaned?		Yes No
	Manifold Ventilation Fan Clean?	Yes No	Clean the ventilation fan		Fan Cleaned?		Yes No
T700	Date				± 0 days		
	Time				± 3 minutes		
	Cylinder Pressure	psi			> 500 psi		
	T_{BOX}	°C		T_{amb}°C	T_{amb} + ~ 5°C		
	Filters Clean?	Yes No	Replace the filter		Filter Replaced?		Yes No

DAS System	Date	Time
Monitor		
Standard		
Pass/Fail		

System Response Check

- BAM 1020 PM_{10} : Yes No
- BAM 1020 $PM_{2.5}$: Yes No
- T100: Yes No
- T700: Yes No
- Meterological Intruments: Yes No

Site Conditions

- BAM inlets free of debris? Yes No
- BAM pump exhaust fan clear? Yes No
- Teledyne inlet free of debris? Yes No
- Inlets are free of damage? Yes No
- Building sturucture sound? Yes No

Meteorological Intstruments	Equipment Name	Inspection	Signal	Pass/Fail
	Wind Monitor AQ	Yes No	Yes No	Contact TRC
	Temperature Sensors	Yes No	Yes No	Contact TRC
	Solar Radiation	Yes No	Yes No	Contact TRC
	Relative Humidity	Yes No	Yes No	Contact TRC
	Date	12/15/2012	12/15/2012	Pass
	Time	13:30	13:30	Pass

Site Operator: ________

Signature: ________
(Sign and Date)

RESET SHEET

Checked by:________ (Project Manager or QA Manager -Sign and Date)

Solar Radiation Calibration Form

Project Name	Project Number	Site Name	Calibrator	Calibration Date	Data Logger	Operator

RH Sensor	As Found	As Left
ID #		
Description		
Manufacturer		
Model		
Translator ID #		
Manufacurer		
Zero		
Span		

Transfer Standard	
ID #	
Manufacturer	
Model	
Date of Last Cert	
Slope	
Intercept	
Translator ID	

As Found								
Time	Transfer W/m^2	Sensor W/m^2	Time	Transfer W/m^2	Sensor W/m^2	Time	Transfer W/m^2	Sensor W/m^2

As Found					As Left				
Transfer		Sensor		% Diff	Transfer		Sensor		% Diff
Total		Total			Total		Total		
Adj. Max		Max			Adj, Max		Max		
Adj. Average		Average			Adj. Average		Average		

Notes:

Checked by:_________________________________ (Project Manager or QA Manager -Sign and Date)

Station Log

Client: ____________________ Site ID: __________ Job Number: ________________________

Operator	Instrument	S/N	Date/Time	Comments

T100 Calibration Sheet

Project Name	Project Number	Site ID	Audit Date	Start Time	End Time	Operator

Sulfur Dioxide Analyzer:

Make	Model	S/N	Range	Inlet Height	Flow, cc/min	Last Calibrated	Inline Filter?

Calibration Equipment:

	Make	Model	S/N	Calibration Date
MFC Dilution System				
Compressed Gas Cyl.	Manufacturer	Concentration	Cyl Expiration	Cylinder S/N

As-Found Verification Check

	T700 Dilution Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
	Mean Absolute Errors :			

Linear Regression Results

Zero ≤ ±3% of full scale		Correlation Coef. r
Span error within ±15% of full scale		
One-point QC check %diff ≤ 10%		
All points withn ±2% of best fit line		
slope		
intercept		

As-Left Calibrated Values

	T700 Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
	Mean:			

Linear Regression Results

Zero ≤ ±3% of full scale	
Span error within ±15% of full scale	
One-point QC check %diff ≤ 10%	
All points withn ±2% of best fit line	
slope	
intercept	

Notes:

Checked by:__________________________________ (Project Manager or QA Manager -Sign and Date)

T400 Calibration Sheet

Project Name	Project Number	Site ID	Audit Date	Start Time	End Time	Operator

Ozone (O3) Analyzer:

Make	Model	S/N	Range	Inlet Height	Flow, cc/min	Last Calibrated	Inline Filter?

Calibration Equipment:

	Make	Model	S/N	Calibration Date
MFC Dilution System				
Compressed Gas Cyl.	Manufacturer	Concentration	Cyl Expiration	Cylinder S/N

As-Found Verification Check

	T700 Dilution Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
		Mean Absolute Errors :		

Linear Regression Results

Zero ≤ ±3% of full scale		Correlation Coef. r
Span error within ±15% of full scale		
One-point QC check %diff ≤ 10%		
All points withn ±2% of best fit line		
slope		
intercept		

As-Left Calibrated Values

	T700 Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
		Mean:		

Linear Regression Results

Zero ≤ ±3% of full scale	
Span error within ±15% of full scale	
One-point QC check %diff ≤ 10%	
All points withn ±2% of best fit line	
slope	
intercept	

Notes:

Checked by:________________________________ (Project Manager or QA Manager -Sign and Date)

48i Calibration Sheet

Project Name	Project Number	Site ID	Audit Date	Start Time	End Time	Operator

Carbon Monoxide (CO) Analyzer:

Make	Model	S/N	Range	Inlet Height	Flow, cc/min	Last Calibrated	Inline Filter?

Calibration Equipment:

	Make	Model	S/N	Calibration Date
MFC Dilution System				
Compressed Gas Cyl.	Manufacturer	Concentration	Cyl Expiration	Cylinder S/N

As-Found Verification Check

	T700 Dilution Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
		Mean Absolute Errors :		

Linear Regression Results

Zero ≤ ±3% of full scale		Correlation Coef. r
Span error within ±15% of full scale		
One-point QC check %diff ≤ 10%		
All points withn ±2% of best fit line		
slope		
intercept		

As-Left Calibrated Values

	T700 Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
		Mean:		

Linear Regression Results

Zero ≤ ±3% of full scale	
Span error within ±15% of full scale	
One-point QC check %diff ≤ 10%	
All points withn ±2% of best fit line	
slope	
intercept	

Notes:

Checked by:__________________________________ (Project Manager or QA Manager -Sign and Date)

42i Calibration Sheet

Project Name	Project Number	Site ID	Audit Date	Start Time	End Time	Operator

Nitrogen Oxides (NO, NO2, NOx) Analyzer:

Make	Model	S/N	Range	Inlet Height	Flow, cc/min	Last Calibrated	Inline Filter?

Calibration Equipment:

	Make	Model	S/N	Calibration Date
MFC Dilution System				
Compressed Gas Cyl.	Manufacturer	Concentration	Cyl Expiration	Cylinder S/N

As-Found Verification Check

	T700 Dilution Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
	Mean Absolute Errors :			

Linear Regression Results

Zero ≤ ±3% of full scale		Correlation Coef. r
Span error within ±15% of full scale		
One-point QC check %diff ≤ 10%		
All points withn ±2% of best fit line		
slope		
intercept		

As-Left Calibrated Values

	T700 Calibrator Output ppb	Analyzer Response ppb	Error ppb	Error %
Zero				
Precision				
2				
3				
4				
Span				
	Mean:			

Linear Regression Results

Zero ≤ ±3% of full scale	
Span error within ±15% of full scale	
One-point QC check %diff ≤ 10%	
All points withn ±2% of best fit line	
slope	
intercept	

Notes:

Checked by:________________________________ (Project Manager or QA Manager -Sign and Date)

TRC

T700 Dynamic Dilution Calibrator Calibration

Project Name	Project Number	Site ID	Audit Date	Start Time	End Time	Operator

Dilution Calibrator Information		Reference Flow Standard Info.		Current Environmental Cond.		EPA Environmental Cond.		Calibrator Settings	
Make:		Make:	Bios	Temp (°C) :	0	Temp (°C) :		Gas Flow Slope:	
Model:		Model:	Definer 220 Low	Pressure (mmHg) :	760	Pressure (mmHg) :		Gas Flow Intercept:	
S/N:		S/N:		Teledyne Std. Cond				Dilution Flow Slope:	
Last Cal. Date:		Model:	Definer220 High	Temp (°C) :	0			Dilution Flow Intercept:	
Firmware:		S/N:		Pressure (mmHg) :	760				

Mass Flow Controller As-Found Verification

Parameter	ACT CAL	TARG CAL	ACT DIL	TARG DIL	03 GEN REF	O3 FLOW	O3 GEN DRIVE	O3 LAMP TEMP	CAL PRESSURE
Value									
Parameter	DIL PRESSURE	ACT=	TARG=	BOX TEMP	PHOTOMEASURE	PHOTO REFERENCE		PHOTO FLOW	PHOTO LAMP TEMP
Value									
Parameter	PHOTO SPRESS	PHOTO STEMP		PHOTO SLOPE	PHOTO OFFSET	DARK OFFSET		PERM FLOW	PERM TEMP
Value									

Recorded Measurements							**Indicated Flow**		**Estimated Uncertainty**	
Ref. Flow 1 SCCM ___ gas	Ref. Flow 2 SCCM	Ref. Flow 3 SCCM	Avg. Flow SCCM air	Temp °C °C	Pressure mmHg	STD Flow SCCM air	Output VDC	Flow SCCM	% FS	%PT

Recorded Measurements							**Indicated Flow**		**Estimated Uncertainty**	
Ref. Flow 1 SCCM ___ gas	Ref. Flow 2 SCCM	Ref. Flow 3 SCCM	Avg. Flow SCCM air	Temp °C °C	Pressure mmHg	STD Flow SCCM air	Output VDC	Flow SCCM	% FS	%PT

Notes: ____

Checked by:________________________________ (Project Manager or QA Manager -Sign and Date)

Temperature Sensor Calibration

Project Name	Project Number	Site Name	Calibrator	Calibration Date	Data Logger

Operator

	Temprature Probe	
	As Found	As Left
ID #		
Description		
Manufacturer		
Model		
Ro		
Alpha		
Translator type		

Transfer Standard	
ID #	
Manufacturer	
Model	
Date of Last Cert	

Correction Factors					
0°	10°	20°	30°	40°	50°

As Found Data Logger Temprature Output										
Transfer Standard			**Temprature Probe**					**Shelter Temp.**	
Uncorrected Temp(°C)	Correction Factor	Corrected Temp (°C)	Raw Temp. (°C)	Corrected Temp (°C)	Raw Diff (°C)	Corrected Diff (°C)		Temp. °C	Diff (°C)

Notes:

Checked by:__________________________________ (Project Manager or QA Manager -Sign and Date)

APPENDIX C

TRC Standard Operating Procedures (SOPs)

Title: Teledyne Advanced Pollution Instrumentation Model T100 Operation and Maintenance	Procedure Number: AM-450A
	Revision Number: 00
Supersedes: Not Applicable	Issued Date: 01/31/12
Reason for Revision: Not Applicable	Effective Date: 01/31/11

Authorization Signatures		
G. Connelly	J. Bowser	
Author Date	Functional Area Manager Date	Quality Assurance Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes instruction for on-site technicians and TRC field technicians concerning routine maintenance and operation of the Teledyne Advanced Pollution Instrumentation Model T100 UV Fluorescence SO2 Analyzer, also referred to as the T100. This SOP is applicable to all TRC air measurements programs using the T100 UV Fluorescence SO2 Analyzer for the collection and analysis of continuous real-time monitoring of SO2 concentrations in ambient air.

2.0 SAFETY CONSIDERATIONS

The field team leader, project manager, or the National Safety Director can address any questions or safety concerns. All employees operating the T100 SO_2 analyzer must follow these guidelines to prevent personal injury:

1. Always use a third ground wire on all instruments.
2. Unplug the instrumentation when servicing or replacing parts.
3. If it is mandatory to work inside an instrument while it is in operation, use extreme caution to avoid contact with high voltages. The analyzer has a 110 volt Volts Alternating Current (VAC) power supply. Refer to the manufacturer’s instruction manual and know the precise locations of the VAC components before working on the instrument.
4. Avoid electrical contact with jewelry. Remove rings, watches, bracelets, and necklaces to prevent electrical burns.
5. If working at heights follow TRC and client specific safety plans. On-site personnel should only attempt to climb a tower if they have been properly trained and have mandatory fall protection equipment. A tower should never be climbed without an additional person on-site.

All employees servicing instrumentation should follow these precautions to avoid damaging internal components.

6. Wear an anti-static wrist strap that is properly connected to an earth ground. (note when the analyzer is unplugged, the chassis is not at earth ground)

7. If an anti-static wrist strap is not available be sure to touch a grounded metal object before touching any internal components;
8. Handle all printed circuit boards by the edge;

Carefully observe the instructions in each procedure specified in the Instructions manual;

3.0 ROUTINE CHECKS

These checks must be performed during each site visit. The visit is documented using the *Site Status Report Form* (*SSRF)*.

1. The front display should be in "SAMPLE" mode as seen below. If an error is displayed make note of it and press "EXIT" to return to "SAMPLE" mode.

T100 Display Screen and Touch Control

2. Record the current concentration on the *SSRF*.
3. Toggle through the "TST" functions making note of each parameter listed below on the *SSRF*.
   - Time displayed on the analyzer and the Standard Time
   - Sample Flow Rate
   - T_{box} and the ambient temperature near the instrument, taken with a NIST traceable thermometer.
   - P_{amb} and the ambient pressure near the instrument, taken with a NIST traceable barometer.
4. Check the Date setting. Press "SETUP" > "CLK" > "DATE"
   DO NOT change the date setting! Once documented press "EXIT" until the "SAMPLE" mode screen is displayed.
5. The filter attached to the inlet manifold should be changed monthly, adjusting for environmental conditions if necessary. The filter located in the front panel of the T100. Should be inspected on a regular basis. Document your findings and actions on the *SSRF*.
6. If the intake manifold has dirt buildup it must be cleaned. Document your findings and actions on the *SSRF*.

Ensure that the manifold ventilation fan is clean and operating properly. Document your findings and actions on the *SSRF*.

4.0 PREVENTATIVE MAINTENANCE

The maintenance schedule is listed in Table 6-2. Maintenance should be performed per recommendations found in section 8 of the T100 manual. Note that the environment the T100 is in effects the time schedule of maintenance needed. All maintenance must be noted in the *Station Log*.

ITEM	ACTION	FREQUENCY	CAL CHECK	MANUAL SECTION
Particulate filter	Change Particulate filter	Monthly	No	8.3.1
Verify test functions	Review and evaluate	Weekly	No	8.2; Appendix C
Zero/Span Check	Evaluate offset and slope	Weekly	--	6.3, 6.6, 6.9
Zero/Span Calibration	Zero and span calibration	Every 3 Months	--	6.2, 6.4, 6.5, 6.7, 6.8
External zero air scrubber (optional)	Exchange chemical	Every 3 Months	No	8.3.3
Perform Flow check	Check flow	Every 6 Months	No	8.3.7
Internal IZS Permeation Tube	Replace	Annually	YES	8.3.2
Perform pneumatic leak check	Verify Leak Tight	Annually or after repairs involving pneumatics	YES	8.3.6
pump diaphragm	Replace	Annually	YES	Refer to diaphragm kit instructions
calibrate UV Lamp Output	Perform **LAMP CAL**	Prior to zero/span calibration or PMT hardware calibration	--	4.8.7 & 10.7.2.5
PMT Sensor hardware calibration	Low-level hardware calibration	On PMT/ preamp changes if 0.7 < **SLOPE** or **SLPOE** > 1.3	YES	10.7.2.8
Sample chamber optics	Clean chamber, windows and filters	As necessary	YES	10.7.2.2 & 10.7.2.3
Critical Flow orifice and Sintered filters	Replace	As necessary	YES	8.3.4

Table 6-2 T100 Preventative Maintenance Schedule

5.0 SPARE PARTS AND SERVICE TOOLS

A record of all consumables will be kept onsite in the *Spare Parts Inventory*. This will be updated during each site visit. Necessary spare parts, calibration and service tools for the T100 are listed in Appendix B of the T100 Operation Manual.

6.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project specific QAPP.

- Documents necessary for completion of this SOP include:
  - *Site Status Report Form (SSRF)*
  - *Station Log*
  - *Spare Parts Inventory*
- One copy of the completed *Site Status Report Form* and the *Station Log* must be signed and remain onsite in the Station Log Book.
- An electronic copy of the complete *Site Status Report Form* and the *Station Log* must be submitted to the project specific database.
- The *Spare Parts Inventory* is project specific. It is an electronic document that will be updated during each site visit.

7.0 REFERENCES

These documents should be available for consultation during operation and routine maintenance procedures. The T100 manual must be available for details not included in this SOP.

TRC SOP AM-005: *Air Measurements Practice Software Control*

Teledyne Advanced Pollution Instrumentation Operation Manual Model T100 UV Florescence SO_2 Analyzer

40 CFR 53.23c: *Code of Federal Regulations*, Volume 40, Part 53.23c

40 CFR 58 Appendix A: *Code of Federal Regulations,* Volume 40, Appendix A

40 CFR 58 Appendix E: *Code of Federal Regulations,* Volume 40, Appendix E

Title: **Teledyne Advanced Pollution Instrumentation Model T700 Dynamic Dilution Calibrator Operation and Maintenance**	Procedure Number: **AM-459A**
	Revision Number: 00
Supersedes: Not Applicable	Issued Date: 01/31/11
Reason for Revision: Not Applicable	Effective Date: 01/31/11

Authorization Signatures

G. Connelly	J. Bowser	
Author Date	Functional Area Manager Date	Quality Assurance Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes instruction for on-site technicians and TRC field technicians concerning routine maintenance and operation of the Teledyne Advanced Pollution Instrumentation Model T700 Dynamic Dilution Calibrator, also referred to as the T700. This SOP is applicable to all TRC air measurements programs using the T700 Dynamic Dilution Calibrator to supply calibration standard gases for multipoint span and zero checks.

2.0 SAFETY CONSIDERATIONS

The field team leader, project manager, or the National Safety Director can address any questions or safety concerns. All employees operating the T700 SO_2 analyzer must follow these guidelines to prevent personal injury:

1. Always use a third ground wire on all instruments.
2. Unplug the instrumentation when servicing or replacing parts.
3. If it is mandatory to work inside an instrument while it is in operation, use extreme caution to avoid contact with high voltages. The analyzer has a 110 volt Volts Alternating Current (VAC) power supply. Refer to the manufacturer's instruction manual and know the precise locations of the VAC components before working on the instrument.
4. Avoid electrical contact with jewelry. Remove rings, watches, bracelets, and necklaces to prevent electrical burns.
5. If working at heights follow TRC and client specific safety plans. On-site personnel should only attempt to climb a tower if they have been properly trained and have mandatory fall protection equipment. A tower should never be climbed without an additional person on-site.

All employees servicing instrumentation should follow these precautions to avoid damaging internal components.

6. Wear an anti-static wrist strap that is properly connected to an earth ground. (note when the analyzer is unplugged, the chassis is not at earth ground)
7. If an anti-static wrist strap is not available be sure to touch a grounded metal object before touching any internal components;

8. Handle all printed circuit boards by the edge;

Carefully observe the instructions in each procedure specified in the Instructions manual;

3.0 ROUTINE CHECKS

These checks must be performed during each site visit. The visit is documented using the *Site Status Report Form* (*SSRF)*.

1. The front display should be in "STANDBY" mode as seen below. If an error is displayed make note of it and press "EXIT" to return to "STANDBY" mode.

T700 Display Screen and Touch Control

2. Toggle through the "TST" functions making note of each parameter listed below on the *SSRF*.
   - Time displayed on the analyzer and the Standard Time
   - T_{box} and the ambient temperature near the instrument, taken with a NIST traceable thermometer.
3. Check the Date setting. Press "SETUP" > "CLK" > "DATE"
   DO NOT change the date setting! Once documented press "EXIT" until the "STANDBY" mode screen is displayed.
4. Record the calibration gas cylinder pressure on the *SSRF*.

4.0 PREVENTATIVE MAINTENANCE

The maintenance schedule is listed in Table 6-2. Maintenance should be performed per recommendations found in section 10 of the T700 manual. Note that the environment the T700 is in effects the time schedule of maintenance needed.

ITEM	ACTION	FREQUENCY	CAL CHECK	MANUAL SECTION
Verify test functions	Record and Analyze	Weekly or after any Maintenance or Repair	No	8.2; Appendix C
Preform Flow Check	Verify flow of MFCs	Annually or any time the T700s internal DAC is recalibrated	No	8.1 & 8.2
Preform Leak Check	Verify Leak Tight	Annually or after any Maintenance or Repair	Yes	10.2.1
Pneumatic lines	Examine and Clean	As needed	Yes if cleaned	-

Table 6-2 T700 Preventative Maintenance Schedule

5.0 SPARE PARTS AND SERVICE TOOLS

A record of all consumables will be kept onsite in the *Spare Parts Inventory*. This will be updated during each site visit. Necessary spare parts, calibration and service tools for the T700 are listed in Appendix B of the T700 Operation Manual.

6.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project specific QAPP.
- Documents necessary for completion of this SOP include:
  - *Site Status Report Form (SSRF)*
  - *Station Log*
  - *Spare Parts Inventory*
- One copy of the completed *Site Status Report Form* and the *Station Log* must be signed and remain onsite in the Station Log Book.
- An electronic copy of the complete *Site Status Report Form* and the *Station Log* must be submitted to the project specific database.
- The *Spare Parts Inventory* is project specific. It is an electronic document that will be updated during each site visit.

7.0 REFERENCES

These documents should be available for consultation during operation and routine maintenance procedures. The T700 manual must be available for details not included in this SOP.

TRC SOP AM-005: *Air Measurements Practice Software Control*

Teledyne Advanced Pollution Instrumentation Operation Manual Model T700 Dynamic Dilution Calibrator

40 CFR 53.23c: *Code of Federal Regulations*, Volume 40, Part 53.23c

40 CFR 58 Appendix A: *Code of Federal Regulations,* Volume 40, Appendix A

40 CFR 58 Appendix E: *Code of Federal Regulations,* Volume 40, Appendix E

Title: BGI PQ200 PM_{10} Air Sampler Operation and Maintenance		Procedure Number: AM-470B
		Revision Number: 00
Supersedes: Not Applicable		Issued Date: 01/31/2012
Reason for Revision: Not Applicable		Effective Date: 01/31/2012

Authorization Signatures		
B. Porembski/G. Connelly	J. Bowser	
Authors Date	Functional Area Manager Date	Quality Assurance Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes instruction for on-site technicians and TRC field technicians concerning routine maintenance and operation of the PQ200A Air Sampler as an audit sampler. This procedure will discuss all equipment, forms and spreadsheets needed to complete maintenance and operation tasks

This SOP is applicable to all TRC air measurements programs using BGI's PQ200 air sampler as a reference or portable audit sampler for the measurement of PM_{10} mass concentrations in ambient air. This SOP will discuss the most current, to issue date, hardware and firmware version of BGI's PQ-200. The current firmware version is 5.62.

2.0 SAFETY CONSIDERATIONS AND CAUTION

Only checks in this operation and maintenance procedure should be made. If these checks are outside of acceptable limits, the appropriate manager should be contacted immediately. Do not make any adjustments to the monitor without specific instructions from the appropriate manager.

3.0 PROCEDURE

Documentation forms for these procedures will be listed in the forms, records and documentations section of the SOP, the filed technician will print and sign these documents after each visit for onsite records and submit a digital copy to the project's database.

3.1 Checks Preformed Each Weekly Visit (every six days)

The BGI PQ200 is a standalone sampling system meeting the Federal Reference Method (FRM) standards for single day sampling of $PM_{2.5}$ or PM_{10}. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations. (Document No. PQ200 & PQ200A Air Sampler Instruction Manual version 1.82)

The following steps should be followed for installing and removing the filter cassettes from the BGI system. NOTE: 47 mm diameter Teflon filters will be supplied and pre-weighed by the analytical laboratory.

1. The filter cassette should only be removed from the system when a sampling event is not in progress.
2. Open the filter mechanism by turning the T-handle in the counter-clockwise direction. The assembly will drop down.
3. Install a cap to cover the top of the filter cassette. This will help prevent contamination.
4. Remove the filter from the sampler and attach a second cap to cover the bottom of the filter cassette.
5. Install a new filter cassette. Be sure that the caps have been removed prior to installation.
6. Rotate the T-handle clockwise, which will raise the filter assembly. Turn the handle until an audible click is heard and the handle will not rotate any further.
7. Collect any data associated with the filter being removed at this time on the *PQ-200 collection sheet*. (i.e., serial number, sample volume, etc.)
8. Inspect the drip jar, if debris or fluids have collected in the drip jar empty it. Replace the jar when finished, do not over tighten. Note any maintenance on the *PQ-200 Collection Sheet.*
9. Note any site conditions that have been addressed or need to be addressed in the future on the *Site Status Report Form*.

3.2 Leak Tests

External Leak Test

- Insert an unused filter into the filter holder. (Do not use this filter for $PM_{2.5}$ sampling following the leak test; however it may be used for other flow calibration checks.)
- Remove the inlet from the down tube and place the flow audit adapter on the top of the down tube. Close the valve on the adapter to prevent air flow.
- From the Main Menu, use the arrow keys until ***Test Menu** flashes. Press **SELECT** to enter the Test Menu.
- From the Test Menu, press the down arrow until ***Leak Test** flashes. Press **SELECT**. The **PQ200 LEAK TEST: In Progress!** Screen will be displayed. Ensure that the flow path is sealed (i.e., the valve on the flow audit adapter is closed) and press **SELECT** to begin evacuating the system.
- The PQ200 will automatically evaluate the performance of the system and report whether the system has passed or failed the leak test. This is a 2 minute test. The initial (locked) pressure is displayed on the left side of the screen. This will be a number in excess of 75 cm of water column. In order to pass the test, the actively displayed pressure (shown on the right side of the screen) must not drop by more than 5 cm of water column during the 2 minute time interval.
- If the leak test passes, the sampler is operating properly. If the leak test fails, investigate and correct any malfunction:
  - Make sure the audit adapter is securely seated on the down tube and that the valve is completely closed.
  - Make sure the VSCC and Filter Assembly are securely closed.
  - Make sure the filter cassette was securely closed and placed in the filter housing during the leak test.
  - Visually inspect tubing for cracks or loose connections.

- Visually check O-rings in the flow audit adapter, WINS, and filter holder for cracks, deformation, or improper seating.

  If all of these items appear normal and the sampler continues to fail the leak check, contact the manufacturer.

- Turn off the sampler, remove the flow audit adapter and put the inlet back in the down tube.
- Remove the filter. Discard the filter or retain it for further leak tests or flow calibration checks.

Internal Leak Test

The purpose of the internal leak test is to determine if there is bypass leakage in the filter cassette. This test is performed exactly as above with two changes.

- The flow audit adapter is NOT installed on the end of the down tube.
- An impermeable membrane is placed in the filter cassette below the filter. Use BGI part KT006, cassette fitted with membrane, or part RD006, pack of six membranes.

4.0 MAINTENANCE

Cleaning, at least monthly, is required for the PQ-200 inlet PM_{10} size selective inlet head. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations.

Prior to any maintenance an as-found leak check must be performed and documented.

PM_{10} Inlet Maintenance

1. Remove the PM_{10} Size selective inlet from the inlet tube.

2. Access the particle trap by unscrewing the upper assembly from the lower assembly. Inspect the O-rings condition.

3. Thoroughly clean the inside of the particle tap and nozzle down the three collection tubes. Cotton tipped applicators and alcohol, water or a multipurpose cleaner may be used as a solvent.

4. Wearing nitrile gloves for protection lubricate the large O-ring on the upper assembly, and the two smaller O-rings at the base of the lower assembly with Dow-Corning 111 valve lubricant. Replace any hard, cracked or damaged O-rings immediately!

5. Lubricate the threads and O-ring seat on the upper assembly with white lithium grease.

6. Remove the four screws on the top of the PM_{10} inlet. And remove the top plate assembly. Clean all surfaces with a rag or paper towel with clean water or a multi-purpose cleaner. Clean all spun aluminum surfaces to prevent corrosion.

7. Clean the drip jar and ensure the fiber seal is good.

8. Reassemble the PM_{10} inlet head taking care not the cross thread the union between the upper and lower assemblies.

9. Record a detailed note of any maintenance, including changing O-rings, in the *Station Log*.

10. Complete an as left-leak check, documenting it appropriately.

5.0 ADDITIONAL INFORMATION

A more detailed equipment manual is available from BGI Incorporated and is located in the site office for any other questions about the PQ200 Operation Manual.

6.0 QUALITY CONTROL PROCEDURES

The following list is a summary of the quality control procedures used to ensure measurement accuracy and completeness:

- The entire sampling system must be audited on a quarterly basis.
- All field-entered data will be reviewed by another member of the field team to ensure the correctness of the data entry.

7.0 TRAINING AND/OR QUALIFICATIONS

TRC personnel operating the BGI PQ200 must have received proper training and be familiar with collecting air samples on filter media. Additionally, personnel must be familiar with and have experience operating flow, temperature and pressure calibration equipment. Anyone working with this instrument must have received authorization from the Project Manager.

8.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project specific QAPP.
- Documents necessary for completion of this SOP include:
  - *PQ200 Routine Checklist*
  - *Station Log*
  - *Spare Parts Inventory*
- One copy of the completed *PQ200 Routine Checklist* and the *Station Log* must be signed and remain onsite in the Station Log Book.
- An electronic copy of the complete *PQ200 Routine Checklist* and the *Station Log* must be submitted to the project specific database.

9.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The PQ200 instruction manual must be available at all times for details not include in this SOP.

These documents should be available for consultation during setup, operation and routine maintenance procedures. The PQ200 instruction manual must be available at all times for details not included in this SOP.

40 *CFR* part 58 Appendix A, "Quality Assurance Requirements for SLAMS, SPMs and PSD Air Monitoring." *Code of Federal Regulations* Title 40, Pt. 58 appendix A, January 2012

PQ-200 Instruction Manual. Version 1.85. BGI Incorporated.

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Ambient Air Quality Monitoring Program Quality System Development. EPA-454/B-08-003, December 2008

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks EPA-454/R-98-0012, May, 1998

Title: BGI PQ200 $PM_{2.5}$ Air Sampler Operation and Maintenance			Procedure Number: AM-471B
			Revision Number: 00
Supersedes: Not Applicable			Issued Date: 11 / 11 /11
Reason for Revision: Original			Effective Date: 11 / 11 /11
Authorization Signatures			
Author Date	Functional Area Manager Date	Quality Assurance Date	

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes instruction for on-site technicians and TRC field technicians concerning routine maintenance and operation of the PQ200A Air Sampler as an audit sampler. This procedure will discuss all equipment, forms and spreadsheets needed to complete maintenance and operation tasks

This SOP is applicable to all TRC air measurements programs using BGI's PQ-200 air sampler as a reference or portable audit sampler for the measurement of $PM_{2.5}$ mass concentrations in ambient air. This SOP will discuss the most current, to issue date, hardware and firmware version of BGI's PQ-200. The current firmware version is 5.62.

2.0 SAFETY CONSIDERATIONS AND CAUTION

Only checks in this operation and maintenance procedure should be made. If these checks are outside of acceptable limits, the appropriate manager should be contacted immediately. Do not make any adjustments to the monitor without specific instructions from the appropriate manager.

3.0 PROCEDURE

Documentation forms for these procedures will be listed in the forms, records and documentations section of the SOP, the filed technician will print and sign these documents after each visit for onsite records and submit a digital copy to the project's database.

3.1 Checks Preformed Each Weekly Visit

The BGI PQ200 is a standalone sampling system meeting the Federal Reference Method (FRM) standards for single day sampling of $PM_{2.5}$ or PM_{10}. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations. (Document No. PQ200 & PQ200A Air Sampler Instruction Manual version 1.82)

The following steps should be followed for installing and removing the filter cassettes from the BGI system. NOTE: 47 mm diameter Teflon filters will be supplied and pre-weighed by the analytical laboratory.

1. The filter cassette should only be removed from the system when a sampling event is not in progress.
2. Open the filter mechanism by turning the T-handle in the counter-clockwise direction. The assembly will drop down.
3. Install a cap to cover the top of the filter cassette. This will help prevent contamination.
4. Remove the filter from the sampler and attach a second cap to cover the bottom of the filter cassette.
5. Install a new filter cassette. Be sure that the caps have been removed prior to installation.
6. Rotate the T-handle clockwise, which will raise the filter assembly. Turn the handle until an audible click is heard and the handle will not rotate any further.
7. Collect any data associated with the filter being removed at this time on the *PQ-200 collection sheet*. (i.e., serial number, sample volume, etc.)
8. Inspect the drip jar, if debris or fluids have collected in the drip jar empty it. Replace the jar when finished, do not over tighten. Note any maintenance on the *PQ-200 Collection Sheet.*
9. Note any site conditions that have been addressed or need to be addressed in the future on the *Site Status Report Form*.

3.2 Leak Tests

External Leak Test

1. Insert an unused filter into the filter holder. (Do not use this filter for $PM_{2.5}$ sampling following the leak test; however it may be used for other flow calibration checks.)
2. Remove the inlet from the downtube and place the flow audit adapter on the top of the downtube. Close the valve on the adapter to prevent air flow.
3. From the Main Menu, use the arrow keys until ***Test Menu** flashes. Press **SELECT** to enter the Test Menu.
4. From the Test Menu, press the down arrow until ***Leak Test** flashes. Press **SELECT**. The **PQ200 LEAK TEST: In Progress!** Screen will be displayed. Ensure that the flow path is sealed (i.e., the valve on the flow audit adapter is closed) and press **SELECT** to begin evacuating the system.
5. The PQ200 will automatically evaluate the performance of the system and report whether the system has passed or failed the leak test. This is a 2 minute test. The initial (locked) pressure is displayed on the left side of the screen. This will be a number in excess of 75 cm of water column. In order to pass the test, the actively displayed pressure (shown on the right side of the screen) must not drop by more than 5 cm of water column during the 2 minute time interval.
6. If the leak test passes, the sampler is operating properly. If the leak test fails, investigate and correct any malfunction:
    - Make sure the audit adapter is securely seated on the downtube and that the valve is completely closed.
    - Make sure the VSCC and Filter Assembly are securely closed.
    - Make sure the filter cassette was securely closed and placed in the filter housing during the leak test.
    - Visually inspect tubing for cracks or loose connections.

- Visually check o-rings in the flow audit adapter, WINS, and filter holder for cracks, deformation, or improper seating.

  If all of these items appear normal and the sampler continues to fail the leak check, contact the manufacturer.

7. Turn off the sampler, remove the flow audit adapter and put the inlet back in the downtube.
8. Remove the filter. Discard the filter or retain it for further leak tests or flow calibration checks.

Internal Leak Test

The purpose of the internal leak test is to determine if there is bypass leakage in the filter cassette. This test is performed exactly as above with two changes.

- The flow audit adapter is NOT installed on the end of the downtube.
- An impermeable membrane is placed in the filter cassette below the filter. Use BGI part KT006, cassette fitted with membrane, or part RD006, pack of six membranes.

4.0 MAINTENANCE

Cleaning, at least monthly, is required for the PQ-200 inlet PM_{10} size selective inlet head. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations.

Prior to any maintenance an as-found leak check must be performed and documented.

PM_{10} Inlet Maintenance

1. Remove the PM_{10} Size selective inlet from the inlet tube.

2. Access the particle trap by unscrewing the upper assembly from the lower assembly. Inspect the O-rings condition.

3. Thoroughly clean the inside of the particle tap and nozzle down the three collection tubes. Cotton tipped applicators and alcohol, water or a multipurpose cleaner may be used as a solvent.

4. Wearing nitrile gloves for protection lubricate the large O-ring on the upper assembly, and the two smaller O-rings at the base of the lower assembly with Dow-Corning 111 valve lubricant. Replace any hard, cracked or damaged O-rings immediately!

5. Lubricate the threads and O-ring seat on the upper assembly with white lithium grease.

6. Remove the four screws on the top of the PM_{10} inlet. And remove the top plate assembly. Clean all surfaces with a rag or paper towel with clean water or a multi-purpose cleaner. Clean all spun aluminum surfaces to prevent corrosion.

7. Clean the drip jar and ensure the fiber seal is good.

8. Reassemble the PM_{10} inlet head taking care not the cross thread the union between the upper and lower assemblies.

9. Record a detailed note of any maintenance, including changing O-rings, in the *Station Log*.

10. Complete an as left-leak check, documenting it appropriately.

5.0 ADDITIONAL INFORMATION

A more detailed equipment manual is available from BGI Incorporated and is located in the site office for any other questions about the PQ200 Operation Manual.

6.0 QUALITY CONTROL PROCEDURES

The following list is a summary of the quality control procedures used to ensure measurement accuracy and completeness:

- The entire sampling system must be audited on a quarterly basis.
- All field-entered data will be reviewed by another member of the field team to ensure the correctness of the data entry.

7.0 8.0 TRAINING AND/OR QUALIFICATIONS

TRC personnel operating the BGI PQ200 must have received proper training and be familiar with collecting air samples on filter media. Additionally, personnel must be familiar with and have experience operating flow, temperature and pressure calibration equipment. Anyone working with this instrument must have received authorization from the Project Manager.

8.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project specific QAPP.
- Documents necessary for completion of this SOP include:
  - *PQ200 Routine Checklist*
  - *Station Log*
  - *Spare Parts Inventory*
- One copy of the completed *PQ200 Routine Checklist* and the *Station Log* must be signed and remain onsite in the Station Log Book.
- An electronic copy of the complete *PQ200 Routine Checklist* and the *Station Log* must be submitted to the project specific database.

9.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The PQ200 instruction manual must be available at all times for details not include in this SOP.

These documents should be available for consultation during setup, operation and routine maintenance procedures. The PQ200 instruction manual must be available at all times for details not included in this SOP.

40 *CFR* part 58 Appendix A, “Quality Assurance Requirements for SLAMS, SPMs and PSD Air Monitoring.” *Code of Federal Regulations* Title 40, Pt. 58 appendix A, January 2012

PQ-200 Instruction Manual. Version 1.85. BGI Incorporated.

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Ambient Air Quality Monitoring Program Quality System Development.
EPA-454/B-08-003, December 2008

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks
EPA-454/R-98-0012, May, 1998

Title: R. M. Young Meteorological Monitoring Instrumentation Operation and Maintenance			Procedure Number: AM-480Y
			Revision Number: 00
Supersedes: Not Applicable			Issued Date: 1/24/12
Reason for Revision: Original			Effective Date: 1 /24/12
Authorization Signatures			
G. Connelly Author Date	J. Bowser Functional Area Manager Date	Quality Assurance Date	

1.0 PURPOSE, SCOPE, AND APPLICABILITY

The purpose of this SOP is to provide instructions and guidance for the routine operation and maintenance of R. M. Young meteorological monitoring instrumentation and is applicable to all TRC air measurements programs utilizing R. M. Young Meteorological Monitoring equipment.

1.1 Summary of Method

Meteorological monitoring stations typically measure wind speed, wind direction and temperature. Other parameters may include relative humidity, solar radiation, precipitation, barometric pressure and vertical wind speed. This SOP provides guidance to TRC field personnel for operating sensors for all of these parameters.

2.0 SUMMARY OF RESPONSIBILITIES

Functional Area Managers (e.g., Practice Leader, Group Manager, Project Manager) are responsible for ensuring implementation of the SOP.

Quality Assurance personnel are responsible for:

- Review and approval of SOP.
- Auditing, under the direction of a Functional Area Manager, to verify implementation of SOP.

TRC Air Measurements employees are responsible for performing tasks in accordance to this SOP.

TRC field personnel, (i.e., the on-site technician) are responsible for performing tasks in accordance to this SOP and contacting the TRC Project of QA Manager if any checks are outside of acceptable limits.

3.0 REQUIRED SUPPLIES

- Manuals:

- R.M. Young Wind Monitor AQ, Model 05505
- R.M. Young Wind System Calibration Manual, Model 18860-90
- R.M. Young Meteorological Translator, Model, 26800
- R.M. Young Anemometer Model 27106
- R.M. Young Multi-Plate Radiation Shield, Model 41003
- R.M. Young Platinum Temperature Probe, Model 41342VC/VF
- R.M. Young Relative Humidity/ Temperature Probe, Model 41382VC
- R.M. Young Solar Radiation , Model 70092

- Project QAPP
- Laptop with appropriate data logger software and hardware

4.0 SAFETY CONSIDERATIONS

The field team leader, project manager, or the National Safety Director can address any questions or safety concerns. All employees operating the T100 SO_2 analyzer must follow these guidelines to prevent personal injury:

1. Always use a third ground wire on all instruments.
2. Unplug the instrumentation when servicing or replacing parts.
3. If it is mandatory to work inside an instrument while it is in operation, use extreme caution to avoid contact with high voltages. The analyzer has a 110 volt Volts Alternating Current (VAC) power supply. Refer to the manufacturer's instruction manual and know the precise locations of the VAC components before working on the instrument.
4. Avoid electrical contact with jewelry. Remove rings, watches, bracelets, and necklaces to prevent electrical burns.
5. If working at heights follow TRC and client specific safety plans. On-site personnel should only attempt to climb a tower if they have been properly trained and have mandatory fall protection equipment. A tower should never be climbed without an additional person on-site.

All employees servicing instrumentation should follow these precautions to avoid damaging internal components.

6. Wear an anti-static wrist strap that is properly connected to an earth ground. (note when the analyzer is unplugged, the chassis is not at earth ground)
7. If an anti-static wrist strap is not available be sure to touch a grounded metal object before touching any internal components;
8. Handle all printed circuit boards by the edge;
9. Carefully observe the instructions in each procedure specified in the Instructions manual;

5.0 PROCEDURES

Upon arrival at the site, the station operator should note the time and date in the Station Log and the Site Operational Status (SOS) form. The following checks are to be performed and results recorded on the SOS form:

1. Horizontal Wind Speed and Direction – Wind Monitor AQ 05305

   a. Visually inspect the propeller and tail of the Wind Monitor AQ. Ensure that the propeller and vane are moving freely and there is no sign of damage. If both appear to be in good condition, check "Yes" on the SOS form.

   b. Check the instantaneous display on the 26800 Translator while observing the Wind Monitor AQ. If the readings seem reasonable based on visual observations, indicate agreement by checking "Yes.

   c. If either box above is checked "No," make a note in the Station Log and in the "Comments" section of the SOS form. Contact the Project Manager or his designated alternate should there be any doubt about the operational status of the Wind Monitor.

2. Vertical Wind Speed – Gill Propeller Anemometer 27106

   a. Visually inspect the propeller to make sure the blades are intact and it is rotating freely. View the sensor from a distance to ensure that the shaft is in a vertical position. If the sensor appears to be in good condition and functioning properly, indicate this on the SOS form. If the "No"

   b. Check the display of the 26800 Translator to confirm that the data being recorded seem reasonable based on current conditions. Check the appropriate box on the SOS and make an entry in the Site Logbook, if necessary.

3. Temperature Sensors – 41342 Pt RTD mounted in 43502 Aspirated Shield

   a. Visually inspect the aspirated shield to ensure that it is clean and free of any debris that may interfere with air flow through the shield. For sensors mounted at 2 meters, listen for the aspirator motor and confirm that it is running. It is sometimes possible to feel air movement at the shield inlet. Vegetation below the sensor should be maintained at a height of less than 30 cm (1 ft). Inspect the cables coming to the sensor/shield for signs of weathering or damage. If the sensor, shield and cabling appear to be in good condition, check the "yes" box. If any concerns are identified, check "No" and make a notation in the Site Logbook.

   b. Observe the temperature reading being displayed on the 26800 Translator and indicate on the SOS if it seems reasonable for the current conditions.

4. Solar Radiation – 70092 (Li-Cor L-2000)

a. Visually inspect the sensor to ensure that there is no dirt on the white acrylic diffuser head. If dirt is present, wipe carefully with a damp paper towel. Check that the sensor is level by observing the bubble indicator. Adjust the leveling screws, if necessary. Check the appropriate box on the SOS and make any necessary notations in the Site Log.

b. Observe the values being displayed on the 26800 Translator and indicate on the SOS if the readings represent the current conditions.

5. Relative Humidity – 41382 Probe Mounted in Multi-Plate Shield 41003

   a. Visually inspect the multi-plate shield to make sure it is clean and free of debris that may block air flow through the plate spacing. If dirt is present, the plates should be wiped with a damp cloth or paper towel. Indicate the condition of the shield on the SOS form. Observe readings for RH on the 26800 translator and confirm that they are reasonable for the current conditions.

6. Barometric Pressure – N/A

7. Precipitation – N/A

6.0 PREVENTIVE MAINTENANCE AND SPARE PARTS

The following is a summary of routine, preventive maintenance to be performed by TRC field personnel. All activities must be properly documented on the appropriate forms and in the site logbook. Note that sensor calibration checks must be performed prior to and after maintenance (refer to TRC Meteorological Sensor Calibration SOPs).

1. Quarterly Maintenance

   a. Inspect wind speed propellers for cracks or other signs of wear or damage. Replace if necessary. Always replace the foam propeller on the model 27106 Gill Propeller anemometer.

   b. Inspect the tail of the Wind Monitor AQ for signs of damage. Replace if necessary.

   c. Inspect the temperature and humidity sensor shields for proper operation and cleanliness. Remove sensors and clean shields.

   d. Ensure that the solar radiation sensor is level and adjust, if necessary, using the leveling screws on the mounting bracket.

   e. Inspect all sensor mounts and adjust, tighten or replace as necessary.

   f. Inspect all sensor signal and power cables for signs of weathering, cracks or other damage. Replace as necessary.

   g. Inspect tower hardware for signs of corrosion and/or damage. Replace as necessary.

2. Annual Maintenance

a. Replace wind speed and direction sensor bearings.

b. Replace humidity sensor element screen if cleaning in ineffective.

The following spare parts inventory must be maintained on-site or at TRC's regional office responsible for the project operations.

* One vertical wind speed propeller (part number 08274)
* One wind speed propeller (CFT)
* One complete Wind Monitor AQ
* One set of bearings for vertical wind speed sensor
* One set of bearings for Wind Monitor AQ
* One blower fan for aspirated shield
* One humidity sensor element screen
* Spare signal cable (100')

7.0 TRAINING AND/OR QUALIFICATIONS

To ensure that reliable results are obtained, all TRC Field Personnel must have read this SOP and have an understanding of the contents. In addition, proper training and experience with meteorological monitoring instrumentation is required. All site activities must be performed by individuals authorized by the Project Manager.

8.0 FORMS RECORDS AND DOCUMENTATIONS

The required forms for this SOP are:

- Site Operation Status (SOS) Form
- Site Logbook
- Instrument Manuals

9.0 REFERENCES

These documents should be available for consultation during operation and routine maintenance procedures. The R. M. Young Instructions Manual must be available for details not included in this SOP.

TRC SOP AM-005: *Air Measurements Practice Software Control*

Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, February 2000.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements Version 2.0 (Final), EPA-454/B-08-002, March 2008

R. M. Young Instructions Manuals for the following:

- Wind Monitor-AQ Model 05305
- Meteorological Translator Model 26800

- Platinum Temperature Probe Model 41342VC
- Aspirated Radiation Shield Model 43502
- Relative Humidity Probe Model 41382VC
- Gill Propeller Anemometer Model 27106
- Solar Radiation Sensor Model 70092

Title: **Air Quality and Meteorological Data Management, Validation and Reporting**			Procedure Number: **AM-700**
			Revision Number: 00
Supersedes: Not Applicable			Issued Date: 1/24/12
Reason for Revision: Style = Normal			Effective Date: 1 /24/12
Authorization Signatures			
G. Connelly Author Date	J. Bowser Functional Area Manager Date	Quality Assurance Date	

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This standard operating procedure (SOP) describes the process for ambient air quality and meteorological monitoring data validation, to assure quality data and to ensure these data are validated to meet U. S. Environmental Protection Agency (EPA) guidelines for successful submission to the EPA Air Quality System (AQS) database. These procedures apply to all ambient air quality and meteorological parameters that are measured and managed within TRC's central database.

The validation process consists of the following major steps:

- Review of raw data on a daily basis for completeness and instrument/sensor performance.
- Process data through Level 0 validation to ensure that all possible data have been collected and are correctly transmitted to the raw data table on the central server.
- Process data through Preliminary (Level 1) validation to identify values that do not meet acceptance criteria.
- Process data through Final (Level 2) validation that includes input from air quality specialists, field specialists, and site operators to resolve all questionable validation issues.

2.0 SUMMARY OF RESPONSIBILITIES

Staff positions that have data validation responsibilities are:

- Air Monitoring Data Manager
- Data analyst

- Field Personnel
- Site operator
- Technical Assistant
- Project/Program Manager

The project manager is responsible for assigning qualified individuals to perform data validation. The site operator, having first-hand knowledge of site conditions and activities is critical to data validation. The site operator's supervisor, along with field staff, is responsible for reviewing filed documentation and activities to ensure compliance with procedures and QC requirements.

3.0 PROCEDURES

Ambient air pollution data and meteorological data are linked; therefore they should be validated and verified at the same time. This SOP addresses validation of data from both continuous air quality monitors and meteorological instrumentation.

The validation process consists of a series of review procedures designed to establish the "level" of validation. EPA describes four levels of validation in the Quality Assurance Handbook Volume IV. TRC employs a 3 tiered approach to data validation; Level 0, Preliminary (Level 1) and Final (Level 2). This process ensures that data collected from air quality monitoring programs are of sufficient quality to meet the project objectives. Records of QC activities are reviewed on an on-going basis and used for determination of data validity. Calibrations, flow audits, automated QC checks, sample data sheets and operator log entries will are used in the validation process. Daily review is conducted by staff in Raleigh and Gainesville. Visual data inspections as well as results of screening software are used for validation on a daily basis.

3.1 Level 0 Validation (Daily)

- Review for completeness and acquire missing data if available
- Review for anomalies and reasonableness
- Visually review graphed data
- Evaluate automated QC checks (zero/span/precision, etc.)

1. Using the project specific Data Review Spreadsheet, generate a daily report by completing the information in the table similar to the following:

	Report Format		**Report Dates**			
Report Period	Data	QA				
Daily			Report Date	7/13/2011		
Monthly	x	x	Report Month	11	Report Year	2011
Custom			Start Date	6/1/2011	End Date	6/10/2011

2. From the Monthly Report Tab, review the previous day's (or longer period) data for completeness. If data are missing, attempt to retrieve from the local database on the site PC. If data cannot be retrieved, contact the Project Manager.
3. Visually review data using the Monthly Graphs sheet. Screen data as follows:
    a. All Parameters:
        i. Ensure there is a data value for each parameter for every period.
        ii. Determine whether measured values make sense considering the current and past weather conditions.
        iii. Compare data from multiple stations, if available.
        iv. If data analyst determines values are suspect, determine if questionable data are related to site activities (e.g. maintenance, calibrations, or audits). If questionable data coincide with a site visit, contact the site operator of field personnel to discuss what may have caused erroneous values.
        v. If questionable values are determined to be a result of faulty or inoperable equipment, contact the Project Manager immediately.
        vi. If a definitive determination cannot be made as to why a value or values are suspect, consult the Project Manager.
        vii. Record the date and time of all parameters that are determined to be suspect or invalid in the data validation log and/or the data validation form, as appropriate.
    b. Air Quality Parameters
        i. Review auto calibration results using the Monthly Cal Graphs. Refer to QAPP or Monitoring Plan for acceptance criteria.
    c. Meteorological Parameters
        i. The following table is a general guide for screening meteorological data. Please refer to QA Handbook Vol. IV for guidance.

Parameter	**Min**	**Max**	**Min. Δ**	**Max. Δ**	**Comments**
WS (m/s)	0	20	±0.1/3 hr	±5/hr	> Change during frontal passage
SWS (m/s)	0	20	±0.1/3 hr	±5/hr	> Change during frontal passage
WD (°)	0	360	±1/hr	±45/3 hr	> Change during frontal passage
Sigma (°)	0	99	±1/3 hr		Rarely > 50 except light winds
Temp (C)	-30	40	±0.1/hr	±/hr	> Change during frontal passage
SR (w/m^2)	0	1,200			Zero at night
Pressure (mb)	850	1020		6/3 hr	> Change during frontal passage
Precip (in/hr)	0	1		1.00/hr	
Humidity (%)	10	100	±5/3 hr	±20/hr	> During precip events

3.2 Preliminary (Level 1)Validation (Monthly)

The following tasks are to be completed on a routine basis after a complete months' worth of data has been collected. All validation activities are to be recorded either in a data validation log book, or a data validation form (project specific).

- Review site records (i.e. operator logbook and sample data sheets)

- Review operator QC checks (i.e. sampler flow rate checks)
- Evaluate any noted anomalies to other data sources (i.e. meteorological conditions compared to nearest NWS or other verifiable measurements)
- Review instrument calibration records
- Review performance audit results
- Edit/enter validation codes

When the above tasks are complete, data are ready to be moved to the Level 2 (edited) database tables. The spreadsheet application that loads edited data to these tables is password protected and requires supervisor (Project Manager or Data Manager) approval.

3.3 Final (Level 2) Validation (Quarterly)

Data are considered final when it can be demonstrated that they meet the data quality objectives of the program and are a true representation of the air quality and meteorological conditions in the region. Data must pass Final Validation criteria before submittal to client or AQS. Activities for Final Validation include:

- Generation of monthly data summaries.
- Review of monthly data by TRC Program, Data and QA Managers.
- Resolution of any inconsistencies.
- Update validation codes to final.

Air quality and Meteorological monitoring data must meet the following criteria to be deemed valid:

- All measurement systems must be demonstrated to be operating properly, according to the manufacturer's requirements and/or TRC SOPs.
- Entire sampling period must be bracketed by valid calibrations and calibration checks,
- All calibration standards must have current traceability to NIST or another approved standard authority,
- All QC checks must be within the accuracy goals as stated in the QAPP and or Monitoring Plan.
- Data are considered valid if no conclusive evidence to the contrary are found.

4.0 TRAINING AND/OR QUALIFICATIONS

To ensure that reliable results are obtained, all TRC Field Personnel must have read this SOP and have an understanding of the contents. In addition, proper training and knowledge of air pollution meteorology is a necessity.

5.0 FORMS, RECORDS AND DOCUMENTATIONS

The required forms for this SOP are:

- Site Status Report Forms

- Site Logbook
- Instrument Manuals
- Calibration and Maintenance Records
- Continuous Data Validation Forms

6.0 REFERENCES

These documents should be available for consultation during all phases of the data validation process.

TRC SOP AM-005: *Air Measurements Practice Software Control.*

TRC SOP AM-006: *Air Measurements Data Review and Validation.*

Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, February 2000.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements Version 2.0 (Final), EPA-454/B-08-002, March 2008.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, EPA-454/B-08-003, December, 2008.

Title: Teledyne Advanced Pollution Instrumentation Model T100 UV Fluorescence SO_2 Analyzer Calibration	Procedure Number: AM-150A Revision Number: 00
Supersedes: Not Applicable	Issued Date: 01/31/12
Reason for Revision:	Effective Date: 01/31/12

Authorization Signatures		
G. Connelly Author Date	J. Bowser Functional Area Manager Date	Quality Assurance Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes standardized calibration procedures for the Teledyne Advanced Pollution Instrumentation (TAPI) Model T100 UV Fluorescence SO2 Analyzer, also referred to as the T100. This procedure will discuss all equipment, forms and spreadsheets needed to calibrate and process data collected.

This SOP is applicable to all TRC air measurements programs using TAPI's T100 SO_2 analyzer for the collection and analysis of continuous real time monitoring of SO_2 in ambient air.

2.0 SUMMARY OF RESPONSIBILITIES

Functional Area Managers (e.g., Practice Leader, Group Manager, Project Manager) are responsible for ensuring implementation of the SOP.

Quality Assurance personnel are responsible for:

- Review and approval of SOP
- Auditing, under the direction of a Functional Area Manager, to verify implementation of SOP

The Project Manager is responsible for:

- Calibrations occurring at the proper intervals
- Ensuring calibration documents are reviewed, accurate and complete within an appropriate timeframe

The Field Operations Manager is responsible for:

- Directing the activities of the Field Technician
- Ensuring that all the calibration equipment is available and properly certified
- Reviewing all documentation related to calibration activities for accuracy and completeness

The Field Technician is responsible for:

- Reading and understanding the appropriate calibration SOPs, calibration forms and project QAPP
- Performing calibrations in accordance with the appropriate calibration SOPs, project QAPP and relevant USEPA quality assurance guidance
- Reviewing documentation for accuracy and completeness
- Contacting the appropriate Field Operations Manager or Project Manager if any checks are outside of acceptable limits.

3.0 REQUIRED SUPPLIES

- TAPI T100 Operation Manual
- Project QAPP
- Laptop with appropriate data logger hardware and software
- Calibration Spreadsheet
- NIST traceable certified items:
  - T700 Dynamic Dilution Calibrator
  - T701 Zero Air Generator
  - Barometer
  - Temperature Sensor
  - Relative humidity sensor
  - SO_2 mixed gas cylinder, as close to 10ppm as possible, but no lower
- Current Calibration Certifications for all Standards and equipment current within the last12 months

4.0 CALIBRATION FREQUENCY

The analyzer requires calibration in the following circumstances:

- At installation
- Prior to takedown
- Weekly, at least, automated calibration checks.
- Prior to any instrument modification or removal, given that the analyzer is operational.

- Following any modifications to the instrument.

5.0 AUTOMATED CALIBRATION CHECKS

The computer DAS system performs automated calibration checks throughout a testing program. The concentration of calibration and calibration frequency are included in the project specific QAPP. The order of calibration points and acceptance criteria remain consistent across all projects.

6.0 AS-FOUND CALIBRATION CHECKS

1. Complete the T100 and T700 sections of the *Site Status Report Form*, See AM-450A and 459A for detailed instruction.
2. Note the Standard Start Date, Start Time and other header parameters on the *Teledyne API T100 Calibration Form*.
3. Ensure that the zero air and span gas connections are complete to the back of the T100 analyzer.
4. On the front panel of the T700, Dynamic Dilution Calibrator, toggle to GEN > AUTO generate a ZERO gas, setting the flow rate to value that will appropriately flood the manifold.
5. Once the T700 is supplying calibration gas, wait for a minimum of two minutes for the response of the T100 to stabilize.
6. Document the analyzers stable response on the *Teledyne T100 Calibration Form.*
7. On the front panel of the T700, Dynamic Dilution Calibrator, toggle to GEN > AUTO generate a calibration span value documented in the project specific QAPP.
8. Set the flow rate to a value that sufficient to flood the manifold.
9. Once the T700 is supplying calibration gas, wait for a minimum of two minutes for the response of the T100 to stabilize.
10. Document the analyzers stable response on the *Teledyne T100 Calibration Form*
11. Repeat the same procedure for a precision point be sure to note the T100's response on the *Teledyne API T100 Calibration Form*
12. To form an accurate calibration correlation, other points can be assessed along the range of the analyzer and documented on the *Teledyne API T100 Calibration form.*

7.0 QUARTERLY MULTI POINT CALIBRATION PROCEDURE

This section will cover the procedures for performing a multipoint calibration of the T100 analyzer. For greater detail please refer to section 6.4 of the T100 manual.

1. On the front panel of the T700, Dynamic Dilution Calibrator, toggle to GEN > AUTO generate a ZERO gas, setting the flow rate to value that will appropriately flood the manifold.
2. Once the T700 is supplying calibration gas, wait for a minimum of two minutes for the response of the T100 to stabilize.
3. Once stable press "CAL" on the front panel of the T100. Enter the password , "101."

4. If the reading is stable press the “ZERO” button on the front of the T100.
5. Note your actions on the *Teledyne T100 Calibration Form*
6. On the front panel of the T700, Dynamic Dilution Calibrator, toggle to GEN > AUTO generate a calibration span value documented in the project specific QAPP.
7. Set the flow rate to a value sufficient to flood the manifold.
8. Once the T700 is supplying calibration gas, wait for a minimum of two minutes for the response of the T100 to stabilize.
9. Once stable press “CAL” on the front panel of the T100. Enter the password , “101.”
10. If the reading is stable press the “SPAN” button on the front of the T100.
11. Note your actions on the *Teledyne T100 Calibration Form.*
12. Check that the system’s response readings fall within the tolerances on the *T100 Calibration Form*.
13. If the monitor fails notify the appropriate manager. .
14. Following the calibration return the system to ambient conditions. Check all connections and ensure the data being logged is appropriate for current conditions.
15. Ensure all entries on the calibration form are complete and correct. Include the end time sign a copy of the *T100 Calibration Form* and add it to the station log book. Submit a copy to the online database. Note any Comments on the *Station Log*.

8.0 FORMS RECORDS AND DOCUMENTATIONS

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project of the project specific QAPP.
- Documents necessary for completion of this SOP include
  - *T100 Calibration Form*
  - *Station Log*
  - *Site Status Report Form*
- One copy of the competed *T100 Calibration Form* and the *Station Log* must be signed and remain onsite in the Station Log Book
- An electronic copy of the complete *T100 Calibration Form* and the *Station Log* must be submitted to the project specific database

9.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The T100 manual must be available for details not included in this SOP.

TRC SOP AM-005: *Air Measurements Practice Software Control*

Teledyne Advanced Pollution Instrumentation Operation Manual Model T100 UV Florescence SO_2 Analyzer

40 CFR 53.23c: *Code of Federal Regulations*, Volume 40, Part 53.23c

40 CFR 58 Appendix A: *Code of Federal Regulations,* Volume 40, Part 58, Appendix A

40 CFR 58 Appendix E: *Code of Federal Regulations,* Volume 40, Part 58, Appendix E

40 CFR 50 Appendix A: *Code of Federal Regulations,* Volume 40, Part 50, Appendix A

Title: **Teledyne Advanced Pollution Instrumentation Model T700 UV Fluorescence SO_2 Analyzer Calibration**	Procedure Number: **AM-159A**
	Revision Number: 00
Supersedes: Not Applicable	Issued Date: 01/31/12
Reason for Revision:	Effective Date: 01/31/12

Authorization Signatures		
G. Connelly	J. Bowser	
Author Date	Functional Area Manager Date	Quality Assurance Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes standardized calibration procedures for the Teledyne Advanced Pollution Instrumentation (TAPI) Model T700 Dynamic Dilution Calibrator, here after referred to as the T700. This SOP will discuss procedures, equipment, forms and spreadsheets required to calibrate each component of the T700.

The accuracy of the three components of the T700 is intrinsic to achieving accurate calibration concentrations. Verification and calibration guidance for the, T700's, mass flow controllers (MFC), and optional O_3 Photometer and O_3 Generator will be provided in this document.

This SOP is applicable to all TRC air measurements programs using TAPI's T100 SO_2 analyzer for the collection and analysis of continuous real time monitoring of SO_2 in ambient air.

2.0 SUMMARY OF RESPONSIBILITIES

Functional Area Managers (e.g., Practice Leader, Group Manager, Project Manager) are responsible for ensuring implementation of the SOP.

Quality Assurance personnel are responsible for:

- Review and approval of SOP
- Auditing, under the direction of a Functional Area Manager, to verify implementation of SOP

The Project Manager is responsible for:

- Calibrations occurring at the proper intervals
- Ensuring calibration documents are reviewed, accurate and complete within an appropriate timeframe

The Field Operations Manager is responsible for:

- Directing the activities of the Field Technician

- Ensuring that all the calibration equipment is available and properly certified
- Reviewing all documentation related to calibration activities for accuracy and completeness

The Field Technician is responsible for:

- Reading and understanding the appropriate calibration SOPs, calibration forms and project QAPP
- Performing calibrations in accordance with the appropriate calibration SOPs, project QAPP and relevant USEPA quality assurance guidance
- Reviewing documentation for accuracy and completeness
- Contacting the appropriate Field Operations Manager or Project Manager if any checks are outside of acceptable limits.

3.0 REQUIRED SUPPLIES

- TAPI T700 Operation Manual
- Project QAPP
- Calibration Spreadsheet
- NIST traceable certified items:
  - Flow Meter Standard (BIOS)
  - Barometer
  - Temperature Sensor
  - Relative humidity sensor
  - SO_2 mixed gas cylinder, as close to 10ppm as possible, but not lower
  - Reference Photometer, when applicable
  - External source of zero air, when applicable
  - External source for O_3, when applicable
- Current Calibration Certifications for all Standards and equipment current within the last12 months

4.0 CALIBRATION FREQUENCY

The analyzer requires calibration in the following circumstances:

- At installation

- Prior to takedown
- Once quarterly
- Prior to any instrument modification or removal, given that the analyzer is operational.
- Following any modifications to the instrument.

5.0 AS-FOUND VERIFICATION CHECKS

1. Complete the T100 and T700 sections of the *Site Status Report Form*, See AM-450A and 459A for detailed instruction.
2. Note the time you start in standard time Start Date, Start Time and other header parameters on the *Teledyne API T700 Calibration Form*. Be sure to document the current ambient conditions on the calibration form.

6.0 QUARTERLY MASS FLOW CONTROLLER CALIBRATION PROCEDURE

This section will cover the procedures for performing a multipoint calibration for the calibration gas and dilution gas mass flow controllers. If further detail is necessary consult section 8.1 of the T700 manual.

1. Ensure all connections are complete from the gas cylinder and the T701, zero air generator, to the back of the T700.
2. Remove the Teflon line from one of the mass flow controllers. Complete a leak tight connection from the outlet of the MFC to the appropriate flow meter. Typically, the calibration gas requires a low flow meter, the dilution gas requires a high flow meter. (BIOS definers)
3. Using the T700 front panel toggle to DIAG > MFC.
4. The T700 memory contains a table, table 6.1, populated with a range of flows and the corresponding voltages for the various mass flow controllers.

CAL POINT	DRIVE VOLTAGE (mV)	MFC FULL SCALE			
		1.0 LPM	3.0 LPM	5.0 LPM	10.0 LPM
		MFC TARGET OUTPUT			
0	000	0.000	0.000	0.000	0.000
1	250	0.050	0.150	0.250	0.500
2	500	0.100	0.300	0.500	1.000
3	750	0.150	0.450	0.750	1.500
4	1000	0.200	0.600	1.000	2.000
5	1250	0.250	0.750	1.250	2.500
6	1500	0.300	0.900	1.500	3.000
7	1750	0.350	1.050	1.750	3.500
8	2000	0.400	1.200	2.000	4.000
9	2250	0.450	1.350	2.250	4.500
10	2500	0.500	1.500	2.500	5.000
11	2750	0.550	1.650	2.750	5.500
12	3000	0.600	1.800	3.000	6.000
13	3250	0.650	1.950	3.250	6.500
14	3500	0.700	2.100	3.500	7.000
15	3750	0.750	2.250	3.750	7.500
16	4000	0.800	2.400	4.000	8.000
17	4250	0.850	2.550	4.250	8.500

18	4500	0.900	2.700	4.500	9.000
19	4750	0.950	2.850	4.750	9.500
20	5000	1.000	3.000	5.000	10.000

Table 6.1

5. Within the MFC menu toggle to the first flow rate for verification and select "ON" to start airflow.
6. When using the BIOS flow meters take single readings at 15 second intervals. This will reduce interference between readings.
7. Record three individual readings on the *Teledyne API T700 Calibration Form.*
8. Repeat this process for each flow rate indicated on the *Teledyne API T700 Calibration Form.*
9. Repeat this process for each MFC installed in the T700.
10. Ensure proper calculation of the flow rates utilizing the calibration conditions from the original MFC calibration. These are found in the original paperwork from Teledyne. All volumetric flow rates should be corrected to the same reference temperature and pressure by utilizing the formula

$$F_c = F_m \frac{298.15\, P_m}{760(T_m + 273.15)}$$

    Where: F_c is the corrected flow rate (L/m at 25°C and 706 mmHg); F_m represents the measured flow rate (at temperature T_m and pressure P_m); P_m is the measured pressure in mmHg (absolute), and the temperature measured in degrees Celsius is represented by T_m.

11. If the flow readings are greater than 2% from the standard flow meter reading contact the project manager for further guidance and instruction.

7.0 QUARTERLY O_3 PHOTOMETER CALIBRATION PROCEDURE

This section will cover the procedure for assessing the accuracy of the O_3 photometers performance. If further detail is necessary consult section 8.3 of the T700 manual.

1. Utilizing the image 7.1 directly connect the reference photometer to the T700.

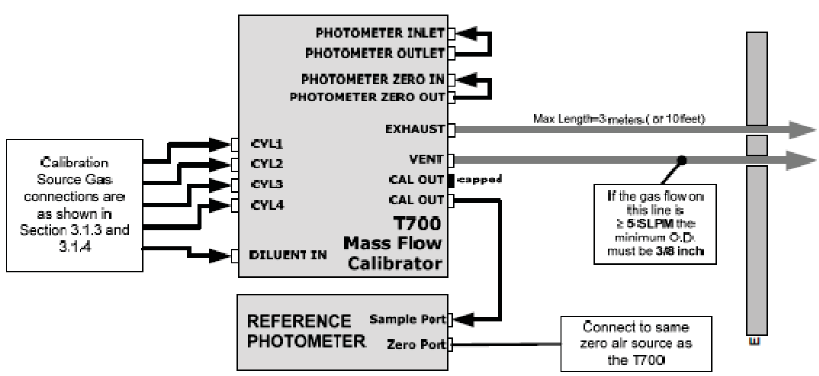


Figure 7.1

2. Ensure the T700 is in standby mode.
3. Using the T700 front panel toggle to GEN > AUTO

4. Toggle through the gas selections until you find the gas appropriate for your application. Input the appropriate concentration and units then input the total flow desired.
5. Once the T700 is generating a gas flow, toggle through the display "SET" values until the actual concentration "ACT" test function is displayed.
6. Wait a minimum of 10 minutes or until the ACT reading settles down.
7. Record the O_3 "ACT" concentration reading displayed by both the T700 and by the reference Photometer on the *Teledyne API T700 Calibration Form*.
8. Repeat this procedure for as many reference points along the performance range of the T700 as required by the project specific QAPP.
9. If the "ACT" concentration readings are more than greater than 1% from the reference photometer's reading contact the project manager for further guidance and instruction.

8.0 O_3 GENERATOR CALIBRATION PROCEDURE

This segment addresses procedures to calibrate the T700's optional internal photometer. For further detail consult section 8.3 of the T700 manual.

1. The T700's internal photometer can be calibrated by direct connection or though the calibration manifold. If connection through the calibration manifold is desired consult section 8.3 of the T700 manual.
2. Directly connect the T700 to the to the reference photometer, external zero air source and external O_3 Source as illustrated in Figure 8.1

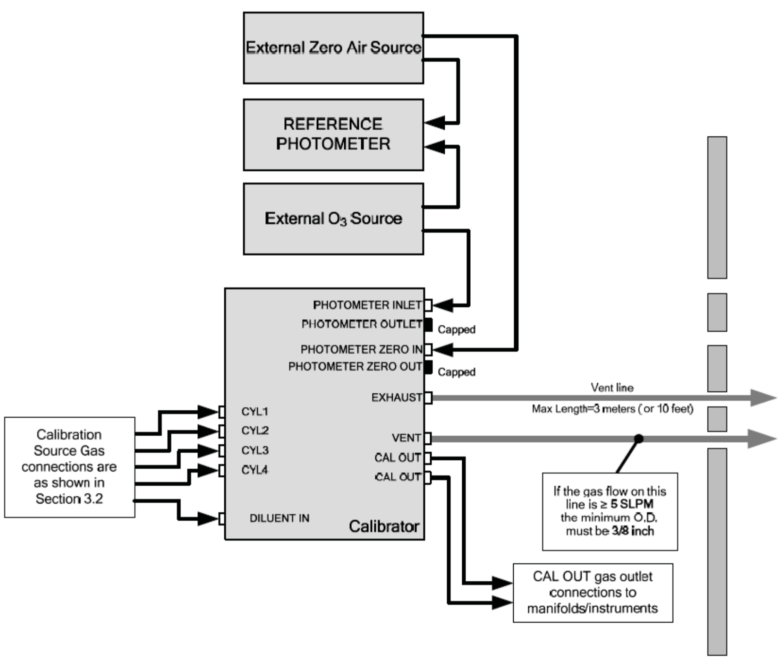


Figure 8.1

3. To set the zero point offset for the T700 toggle the front panel to SETUP > GAS > O3 > PHOT > BCAL

4. Enter the password "717" then continue to "CAL"

5. If utilizing an internal O_3 generator press the "ZERO" button, if utilizing an external O_3 generator press the "XZRO" button, press enter to continue.

6. Allow the zero air to enter the "photometer in" port at the rear of the calibrator, wait a minimum of 10 minutes to allow the values to settle.

7. Once settled select the "ZERO" button. There will be another screen by which you will be required to confirm your selection press yes to change the offset and slope values for the O_3 measurement.

8. Repeat to calibrate the span value, ensuring that the exact span calibration value as measured by the reference photometer is entered prior to confirming the selection in step seven.

9. Document any changes in the appropriate station log.

9.0 FORMS RECORDS AND DOCUMENTATIONS

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project of the project specific QAPP.

- Documents necessary for completion of this SOP include

  - *T700 Calibration Form*

  - *Station Log*

  - *Site Status Report Form*

- One copy of the competed *T700 Calibration Form* and the *Station Log* must be signed and remain onsite in the Station Log Book

- An electronic copy of the complete *T700 Calibration Form* and the *Station Log* must be submitted to the project specific database

10.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The T700 manual must be available for details not included in this SOP.

TRC SOP AM-005: *Air Measurements Practice Software Control*

Teledyne Advanced Pollution Instrumentation Operation Manual Model T100 UV Florescence SO_2 Analyzer

Teledyne Advanced Pollution Instrumentation Operation Manual Model T700 Dynamic Dilution Calibrator

40 CFR 53.23c: *Code of Federal Regulations*, Volume 40, Part 53.23c

40 CFR 58 Appendix A: *Code of Federal Regulations,* Volume 40, Part 58, Appendix A

40 CFR 58 Appendix E: *Code of Federal Regulations,* Volume 40, Part 58, Appendix E

40 CFR 50 Appendix A: *Code of Federal Regulations,* Volume 40, Part 50, Appendix A

Title: BGI PQ200 PM_{10} Air Sampler Calibration	Procedure Number: AM-170B
	Revision Number: 00
Supersedes: Not Applicable	Issued Date: 01/27/12
Reason for Revision: Original	Effective Date: 01/27/12

Authorization Signatures					
Grace Connelly	1/27/12	J. Bowser	1/27/12		
Author	Date	Functional Area Manager	Date	Quality Assurance	Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes standardized calibration procedures for the PQ200. This procedure will discuss all equipment, forms and spreadsheets needed to calibrate the monitor.

This SOP is applicable to all TRC air measurements programs using BGI's PQ200 air sampler as a reference or portable audit sampler for the measurement of PM_{10}, mass concentrations in ambient air.

2.0 SUMMARY OF RESPONSIBILITIES

Functional Area Managers (e.g., Practice Leader, Group Manager, Project Manager) are responsible for ensuring the implementation of the SOP

Quality Assurance personnel are responsible for:

- Review and approval of SOP
- Auditing, under the direction of a Functional Area Manager, to verify implementation of SOP

The Project Manager is responsible for:

- Calibrations occurring at the proper intervals
- Ensuring calibration documents are reviewed, accurate and complete within an appropriate timeframe

The Field Operations Manager is responsible for:

- Directing the activities of the Field Technician
- Ensuring that all calibration equipment is available and properly certified
- Reviewing all documentation related to calibration activities for accuracy and completeness

The Field Technician is responsible for:

- Reading and understanding the appropriate calibration SOPs, calibration forms and project QAPP
- Performing calibrations in accordance with the appropriate calibration SOPs, project QAPP and relevant USEPA quality assurance guidance
- Reviewing documentation for accuracy and completeness
- Contacting the appropriate Field Operations Manager or Project Manager if any checks are outside of acceptable limits

3.0 REQUIRED SUPPLIES

- PQ200 Instruction Manual
- Project QAPP
- Calibration Spreadsheet
- NIST traceable certified items:
  - Flow meter (ex. Delta Cal)
  - Barometer
  - Temperature Sensor
- Current Calibration certifications for all standards and equipment current within the last 12 months

4.0 CALIBRATION FREQUENCY

The sampler requires calibration in the following circumstances:

- At installation
- Prior to take down
- Once per quarter
- Annually
- Immediately prior to removal, repair, or replacement of the monitor or any of its components.

5.0 AS FOUND-VERIFICATION CHECK

1. Record the Samplers start time of the calibration in the Station Log. Fill out the heading information on the *PQ200 Calibration Form.*

2. The "as-found" check must be documented prior to calibrating the monitor. Follow the order shown below. For further detail see section 2.2 of the manual.

5.1 Temperature and Pressure

1. Position a reference standard thermometer and barometer near the PQ200 ambient temperature and barometric pressure sensors.
2. Allow ample time for the collocated sensors to stabilize. Record both the reference standard values and the actual readings from the PQ200 on the Document the PQ-200's temperature and pressure readings on the *PQ200 Calibration Form.*

5.2 Leak Check

1. Insert an unused filter into the filter holder.
2. Remove the PM_{10} or $PM_{2.5}$ head from the inlet tube and attach the audit flow adapter onto the inlet tube. Close the valve on the flow adapter.
3. Go to ***Test Menu** > ***Leak Test**, press SELECT. The **PQ200 LEAK TEST: In Progress!** screen will be displayed. Press SELECT to evacuate the system.
4. The PQ200 will evaluate the performance of the system for two minutes and will report whether the system has passed or failed the leak check.
5. If the system passed, the sampler is operating properly. If the leak test failed see section 3.2.1 of the PQ200 manual to trouble shoot the malfunction.
6. Record the leak check results on the *PQ200 Calibration Form*

5.3 Flow

1. Attach the reference flow meter onto the inlet tube. Turn the refrerence flow meter on.
2. Go to the ***Test & Calibration Menu > Verify Flow Calibration**, press SELECT. The "**Check Flow Now!"** screen will appear. The sampler will pump air at the current selected flow rate.
3. Allow the reference flow meter to stabilize; this should take at least 20 seconds.
4. Record the average flow value of the reference flow meter on the *PQ200 Calibration Form.*
5. Record the flow reading from the PQ200 display onto the *PQ200 Calibration Form.*

5.4 Comparison and Completion

1. Check that each response from the system falls within the tolerance of the project specific QAPP.
2. If the monitor fails, notify the appropriate manager.
3. If the temperature, pressure, or flow rate error is greater than one half of the acceptable tolerance. Then the appropriate calibration and an as-left calibration check should be performed, see section 6 of this document.
4. If all responses are in compliance then adjustments are required.
5. Following the calibration check or as-left calibration check, return the system to ambient conditions. Check all connections and ensure the data being logged is appropriate for current conditions.

6. Ensure all entries on the calibration form are complete and correct. Include the end time sign a copy of the *PQ200 Calibration form* and add it to the station log book. Submit a copy to the online database. Note any Comments on the *Station Log*, updating both the station log book and the online database.

6.0 CALIBRATION PROCEDURE

This calibration procedure will provide guidance to adjusting the output readings of the BGI PQ200, correcting the values to be within a specified range of the traceable standard values. This procedure describes the use of BGI's Delta Cal, TRC's most commonly used field audit calibrator. Assuring the temperature and barometric pressure are accurate prior to calibrating the flow rate of the PQ200 is recommended.

1. The flow rate tolerance for the delta Cal to calibrate a sampler is ±2%. The flow rate must be calibrated at three points. The standard operational flow rate and ±10% of the operational flow rate
2. Utilize the instruction in section 3.1 of the PQ200 user's manual.
3. Once the calibration is complete, preform an as-left calibration check following the as-found verification checks.
4. Return to step 20 of section five and to complete the appropriate documentation.

7.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project specific QAPP.
- Documents Necessary for completion of this SOP include:
  - *PQ200 Calibration Form*
  - *Station Log*
- One copy of the completed *PQ200 Calibration Form* and the *Station Log* must be signed and remain onsite in the Station Log Book.
- An electronic copy of the complete *PQ200 Calibration Form* and the *Station Log* must be submitted to the project specific database.

8.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The PQ200 instruction manual must be available at all times for details not included in this SOP.

40 *CFR* part 58 Appendix A, "Quality Assurance Requirements for SLAMS, SPMs and PSD Air Monitoring." *Code of Federal Regulations* Title 40, Pt. 58 appendix A, January 2012

PQ200 Instruction Manual. Version 1.85. BGI Incorporated.

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Ambient Air Quality Monitoring Program Quality System Development.
EPA-454/B-08-003, December 2008

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks
EPA-454/R-98-0012, May, 1998

Title: BGI PQ200 $PM_{2.5}$ Air Sampler Calibration	Procedure Number: AM-171B
	Revision Number: 00
Supersedes: Not Applicable	Issued Date: 01/31/12
Reason for Revision: Original	Effective Date: 01/31/12

Authorization Signatures		
Grace Connelly	J. Bowser	
Author Date	Functional Area Manager Date	Quality Assurance Date

1.0 PURPOSE, SCOPE, AND APPLICABILITY

This procedure establishes standardized calibration procedures for the PQ200. This procedure will discuss all equipment, forms and spreadsheets needed to calibrate the monitor.

This SOP is applicable to all TRC air measurements programs using BGI's PQ200 air sampler as a reference or portable audit sampler for the measurement of $PM_{2.5}$ mass concentrations in ambient air.

2.0 SUMMARY OF RESPONSIBILITIES

Functional Area Managers (e.g., Practice Leader, Group Manager, Project Manager) are responsible for ensuring the implementation of the SOP

Quality Assurance personnel are responsible for:

- Review and approval of SOP
- Auditing, under the direction of a Functional Area Manager, to verify implementation of SOP

The Project Manager is responsible for:

- Calibrations occurring at the proper intervals
- Ensuring calibration documents are reviewed, accurate and complete within an appropriate timeframe

The Field Operations Manager is responsible for:

- Directing the activities of the Field Technician
- Ensuring that all calibration equipment is available and properly certified
- Reviewing all documentation related to calibration activities for accuracy and completeness

The Field Technician is responsible for:

- Reading and understanding the appropriate calibration SOPs, calibration forms and project QAPP
- Performing calibrations in accordance with the appropriate calibration SOPs, project QAPP and relevant USEPA quality assurance guidance
- Reviewing documentation for accuracy and completeness
- Contacting the appropriate Field Operations Manager or Project Manager if any checks are outside of acceptable limits

3.0 REQUIRED SUPPLIES

- PQ200 Instruction Manual
- Project QAPP
- Calibration Spreadsheet
- NIST traceable Certified items:
  - Flow meter (ex. DeltaCal)
  - Barometer
  - Temperature Sensor
- Current Calibration certifications for all standards and equipment current within the last 12 months

4.0 CALIBRATION FREQUENCY

The sampler requires calibration in the following circumstances:

- At installation
- Prior to take down
- Once per quarter
- Annually
- Immediately prior to removal, repair, or replacement of the monitor or any of its components.

5.0 AS FOUND-VERIFICATION CHECK

1. Record the Samplers start time of the calibration in the Station Log. Fill out the heading information on the *PQ200 Calibration Form.*

2. The “as-found” check must be documented prior to calibrating the monitor. Follow the order shown below. For further detail see section 2.2 of the manual.

5.1 Temperature and Pressure

1. Position a reference standard thermometer and barometer near the PQ200 ambient temperature and barometric pressure sensors.
2. Record both the reference standard values and the actual readings from the PQ200 on the Document the PQ-200’s temperature and pressure readings on the *PQ200 Calibration Form*.

5.2 Leak Check

1. Insert an unused filter into the filter holder.
2. Remove the PM_{10} or $PM_{2.5}$ head from the inlet tube and attach the audit flow adapter onto the inlet tube. Close the valve on the flow adapter.
3. Go to ***Test Menu** > ***Leak Test**, press SELECT. The **PQ200 LEAK TEST: In Progress!** screen will be displayed. Press SELECT to evacuate the system.
4. The PQ200 will evaluate the performance of the system for two minutes and will report whether the system has passed or failed the leak check.
5. If the system passed, the sampler is operating properly. If the leak test failed see section 3.2.1 of the PQ200 manual to trouble shoot the malfunction.
6. Record the leak check results on the *PQ200 Calibration Form*

5.3 Flow

1. Attach the reference flow meter onto the inlet tube.
2. Go to the ***Test & Calibration Menu > Verify Flow Calibration**, press SELECT. The **Check Flow Now!** screen will appear. The sampler will pump air at the current selected flow rate.
3. Allow the reference flow meter to stabilize; this should take at least 20 seconds.
4. Record the average flow values on the *PQ200 Calibration Form.*
5. Record the flow reading from the PQ200 display onto the *PQ200 Calibration Form.*

5.4 Comparison and Completion

1. Check that each response from the system falls within the tolerance of the project specific QAPP.
2. If the monitor fails, notify the appropriate manager.
3. If the temperature, pressure, or flow rate error is greater than one half of the acceptable tolerance. Then the appropriate calibration and an as-left calibration check should be performed, see section 6 of this document.
4. If all responses are in compliance then no further tests are required.
5. Following the calibration check or as-left calibration check, return the system to ambient conditions. Check all connections and ensure the data being logged is appropriate for current conditions.

6. Ensure all entries on the calibration form are complete and correct. Include the end time sign a copy of the *PQ200 Calibration form* and add it to the station log book. Submit a copy to the online database. Note any Comments on the *Station Log*, updating both the station log book and the online database.

6.0 CALIBRATION PROCEDURE

This calibration procedure will provide guidance to adjusting the output readings of the BGI PQ200, correcting the values to be within a specified range of the traceable standard values. This procedure describes the use of BGI's Delta Cal, TRC's most commonly used field audit calibrator. Assuring the temperature and barometric pressure are accurate prior to calibrating the flow rate of the PQ200 is recommended.

1. The flow rate tolerance for the delta Cal to calibrate a sampler is ±2%. The flow rate must be calibrated at three points. The standard operational flow rate and ±10% of the operational flow rate
2. Utilize the instruction in section 3.1 of the PQ200 user's manual.
3. Once the calibration is complete, preform an as-left calibration check following the as-found verification checks.
4. Return to step 20 of section five and to complete the appropriate documentation.

7.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in the Forms section of the project specific QAPP.
- Documents Necessary for completion of this SOP include:
  - *PQ200 Calibration Form*
  - *Station Log*
- One copy of the completed *PQ200 Calibration Form* and the *Station Log* must be signed and remain onsite in the Station Log Book.
- An electronic copy of the complete *PQ200 Calibration Form* and the *Station Log* must be submitted to the project specific database.

8.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The PQ200 instruction manual must be available at all times for details not included in this SOP.

40 *CFR* part 58 Appendix A, "Quality Assurance Requirements for SLAMS, SPMs and PSD Air Monitoring." *Code of Federal Regulations* Title 40, Pt. 58 appendix A, January 2012

PQ200 Instruction Manual. Version 1.85. BGI Incorporated.

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Ambient Air Quality Monitoring Program Quality System Development.
EPA-454/B-08-003, December 2008

Quality Assurance Handbook for Air Pollution Measurement systems Volume II: Part 1 Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks
EPA-454/R-98-0012, May, 1998

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Revision Number:
00</td></tr>
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<tr><td>G. Connelly
Author — Date</td><td>J. Bowser
Functional Area Manager — Date</td><td colspan="2">Quality Assurance — Date</td></tr>
</table>

1.0 PURPOSE, SCOPE, AND APPLICABILITY

The purpose of this SOP is to provide instructions and guidance for the calibration of R. M. Young meteorological monitoring instrumentation and is applicable to all TRC air measurements programs utilizing R. M. Young Meteorological Monitoring equipment.

2.0 SUMMARY OF RESPONSIBILITIES

Functional Area Managers (e.g., Practice Leader, Group Manager, Project Manager) are responsible for ensuring the implementation of the SOP

Quality Assurance personnel are responsible for:

- Review and approval of SOP
- Auditing, under the direction of a Functional Area Manager, to verify implementation of the SOP

The Project Manager is responsible for:

- Calibrations occurring at the proper intervals
- Ensuring calibration documents are reviewed, accurate and complete within an appropriate timeframe

The Field Personnel:

- Ensuring that all calibration equipment is available and properly certified
- Reviewing all documentation related to calibration activities for accuracy and completeness
- Reading and understanding the appropriate calibration SOPs, calibration forms and project QAPP

- Performing calibrations in accordance with the appropriate calibration SOPs, project QAPP and relevant USEPA quality assurance guidance
- Reviewing documentation for accuracy and completeness
- Contacting the appropriate Field Operations Manager or Project Manager if any checks are outside of acceptable limits

3.0 REQUIRED SUPPLIES

- Manuals:
  - R.M. Young Wind Monitor AQ, Model 05505
  - R.M. Young Wind System Calibration Manual, Model 18860-90
  - R.M. Young Meteorological Translator, Model, 26800
  - R.M. Young Anemometer Model 27106
  - R.M. Young Multi-Plate Radiation Shield, Model 41003
  - R.M. Young Platinum Temperature Probe, Model 41342VC/VF
  - R.M. Young Relative Humidity/ Temperature Probe, Model 41382VC
  - R.M. Young Solar Radiation , Model 70092
- Project QAPP
- Laptop with appropriate data logger software and hardware
- Calibration Spreadsheet
- R.M. Young Anemometer Drive, Model 18802
- R.M. Young Vane Angle Fixture, Model 18112
- R.M. Young Torque Drive, Model 18310
- R.M. Young Vane Torque Drive, Model 18331
- R.M. Young Anemometer Drive, Model 18802
- R.M. Young Torque Disk, Model 18310
- Digital Multi-meter
- NIST traceable Certified items:
  - Barometer
  - Temperature Sensor that can be read to an accuracy of

  - Relative Humidity Sensor
- Reference Pyranometer
- Calibration Certifications for all calibration standards and equipment current within the last 12 months.

4.0 CALIBRATION FREQUENCY

The monitor requires calibration in the following circumstances:

- At installation
- Prior to uninstalling
- At Least Bi-Annually
- Prior to and after the instrument is removed or installed for repair or if any sensor is replaced. This assumes the sensor is operational.

5.0 CALIBRATION VERIFICATION

1. Record the time listed on the R.M. Young data translator. Fill out the other header information listed on the *R.M. Young Calibration Form.*
2. Down the Meteorological sensors in the TRC Logger Software.

5.1 Wind Monitor AQ

1. Inspect the condition of the Wind Monitor, note any issues in the *Station Log* and contact the TRC manager for further details. Identify any damage; cracks and breaks in tail assembly, damaged wires, loose connections. Ensure the tail is securely coupled to the sensor shaft.
2. Recognize at least two appropriate landmarks approximately 90 degrees apart and their associated angles from true North from the sensor. Landmarks within 10° of true north should be avoided.
3. Point the wind monitor directly towards landmark one by sighting down the centerline to the landmark. Record the 26800 Meteorological Translator output on the calibration form.
4. Rotate the wind monitor 180° and sight backwards down the centerline towards landmark one. Record the 26800 Meteorological Translator output on the calibration form.
5. Repeat steps five and six for landmark two.
6. Ensure that the screw attaching the alignment collar to the wind sensor is tight. Remove the sensor from the mast in order to perform linearity, bearing torque, and crossover tests.
7. Bearing Torque Test:
   - The bearing torque test should be performed indoors to mitigate interference from light winds.
   - Attach the 18331 torque gauge to the sensor, see page 11 of the R.M. Young Manual.

- Document the starting torque of the sensor in both the clockwise and counterclockwise direction over the entire azimuth of the sensor. Document the maximum torque on the calibration form. The threshold is 11g·cm.

8. Linearity Test:
   - Attach the 18212 vane angle test fixture to the wind monitor. Install the sensor in the test stand or tower
   - Rotate the tail 30° clockwise on the linearity disk until the output reading of the 26800 output reads 350°. Record the results on the *R.M. Young Calibration Form*
   - Repeat in the counterclockwise direction.
9. Crossover Test:
   - Leave the 18212 vane angle test fixture attached to the wind monitor.
   - Rotate the vane slowly past the 350° and continue towards 360° the output should switch cleanly from near 360 ± 3° to near 0 ± 3°. Record the results on the *R.M. Young Calibration Form*
   - Repeat in the counter clockwise direction
10. When all wind Monitor AQ tests have been completed, verify the system preforms within the QAPP specifications, typically ± 3°.
11. If the wind monitor does not fall within these specifications adjustments must be completed. Contact the appropriate manger and see the corresponding calibration procedure in Section 6.0 of this document.

5.2 Wind Speed Sensor

1. If necessary, remove the wind speed sensor from the mount.
2. Inspect the condition of the Wind Speed Sensor, note any issues in the *Station Log* and contact the TRC manager for further details. Identify any damage; cracks and breaks in propeller blades, damaged wires, or loose connections. Ensure the wind speed tail is securely coupled to the coupled to the sensor shaft.
3. Remove the propeller by loosening the propeller set screw. And attach the R.M. Young Torque Drive.
4. Speed Test:
   - Test the sensor output encompassing the full range of the sensor, 0 to 50 m/s. A minimum of five points is required. Typically, speeds of 2, 5, 10, 25, and 45 m/s demonstrate and suitable range.
   - For each point, rotate the sensor and document the 26800 Meteorological Translator output as well as the motor output (RPM). Convert the motor output, M_o , in rpm to motor speed, M_s , in m/s using the conversion below:

$$M_s = 0.00512 \times M_o$$

5. Bearing Torque Test:
   - Attach the torque disk to the sensor shaft.
   - Determine the starting torque of the sensor is less than the threshold of 1.0 g·cm, for further details consult page 9 of the Wind System Calibration Manual.

6. If all measurements were within the accuracy limits specified in the QAPP or the R.M. Young manual, no further tests are required.
7. If the speed sensor does not fall within these specifications adjustments must be completed. Contact the appropriate manger and see the corresponding calibration procedure in Section 6.0 of this document.

5.3 Solar Radiation Sensor

1. Inspect the condition of the Solar Radiation Sensor, note any issues in the *Station Log* and contact the TRC manager for further details. Identify any damage; cracks and breaks on the radiation sensor, damaged wires, or loose connections.
2. Solar radiation measurements should be taken over as much of a diurnal cycle as possible, at a minimum, 6 hours including solar noon. Record hourly averages for the sets period on the calibration form. Calculate interval averages.
3. Verify that the site sensor is within tolerances specified in the QAPP. EPA PSD guidance is ±5% of interval average. If all measurements are within the specified accuracy limits, no further.
4. If all responses are in compliance then no further tests are required.
5. If the solar radiation sensor does not fall within these specifications adjustments must be completed. Contact the appropriate manger and see the corresponding calibration procedure in Section 6.0 of this document.

5.4 Temperature Sensor

1. Inspect the condition of the sensor. Note any issues in the *Station Log* and contact the TRC manager for further details. Identify any damage, cracks or breaks in the aspirator shield, damaged wires, or loose connections. Verify the distance between the tip of the temperature probe and the probe shield opening is between 1.5 – 2 inches. Check that the sensor lead is properly grounded. If any problems are found, note them in the Station Log and contact the manger. If no other issues arise, continue.
2. Remove the probe(s) from the aspirator housing and set aside. Temperature probes can be damaged by rough handling, always handle them with care.
3. The temperature probes must be tested at 3 points spanning the expected range, or as specified in the QAPP.
4. Use a thermos to and ice or warm water to prepare a temperature bath. Add ice or hot water until the desired temperature is reached.
5. Place the reference temperature thermometer and the temperature probe 3 inches deep in the bath. It is important that the two be close together. The water should be constantly agitated; this can be accomplished with a stir plate and magnet. Use caution to avoid damaging the probes during the verification process.
6. Once the temperature output has stabilized, record the temperature indicated by the temperature reference device and the data acquisition system on the calibration form
7. Repeat steps 29 to 31 for each test point.
8. If all responses are in compliance then no further tests are required. Clean the aspirator shield and ensure all components are clean and reinstalled properly and securely.

9. If the sensor does not fall within these specifications adjustments must be completed. Contact the appropriate manger and see the corresponding calibration procedure in Section 6.0 of this document.

5.5 Relative Humidity

1. Inspect the condition of the sensor. Note any issues in the *Station Log* and contact the TRC manager for further details. Identify any damage, cracks or breaks in the aspirator shield, damaged wires, or loose connections. Verify the distance between the tip of the temperature probe and the probe shield opening is between 1.5 – 2 inches. Check that the sensor lead is properly grounded. If any problems are found, note them in the Station Log and contact the manger. If no issues arise, continue.
2. Position the reference standard Relative Humidity sensor near the sensor to be calibrated.
3. Once both readings have stabilized document the relative humidity reading from both sensors on the calibration form.
4. Three readings should be taken throughout the day in an attempt to cover a range of values
5. If all responses are in compliance then no further tests are required. Clean the aspirator shield and ensure all components are clean and reinstalled properly and securely.
6. If the speed sensor does not fall within these specifications adjustments must be completed. Contact the appropriate manger and see the corresponding calibration procedure in Section 6.0 of this document.

5.6 Vertical Wind Speed

1. Check the vertical wind speed output for proper operation.
2. Inspect the condition of the Vertical Wind Speed Sensor, note any issues in the *Station Log* and contact the TRC manager for further details. Identify any damage; cracks and breaks in propeller blades, damaged wires, or loose connections. Ensure the wind speed tail is securely coupled to the coupled to the sensor shaft.
3. Remove the propeller by loosening the propeller set screws. And attach the R.M. Young Torque Drive.
4. Speed Test:
   - The propeller must be tested in the clockwise and counter clockwise direction at all levels specified in the project QAPP.
   - Test the sensor output encompassing the full range of the sensor. Test the vertical wind speed sensor using the values listed in the table.
   - For each point, rotate the sensor and document the 26800 Meteorological Translator output as well as the motor output (RPM). Convert the motor output, M_o , in rpm to motor speed, M_s , in m/s using the conversion below:

$$M_s = 0.0049 \times M_o$$

Point	Motor Output M_o rpm	Motor Speed M_s m/s
1	0	0

2	100	0.49
3	500	2.45
4	1000	4.9
5	5000	24.5

5. Bearing Torque Test:
   - Attach the torque disk to the sensor shaft.
   - Determine the starting torque of the sensor is less than the threshold of 1.0 g·cm, for further details consult page 9 of the Wind System Calibration Manual.
6. If all measurements were within the accuracy limits specified in the QAPP or the R.M. Young manual, no further tests are required.
7. If the speed sensor does not fall within these specifications adjustments must be completed. Contact the appropriate manger and see the corresponding calibration procedure in Section 6.0 of this document.

5.7 Comparison and Completion

1. If any component of the meteorological equipment fails, notify the appropriate manager! The manager will instruct you to perform the appropriate adjustments listed in section 6.0 of this document. An as left calibration verification must be performed. See Section 6.0 of this document.
2. Following the calibration check or as-left calibration check, resume logging of the Meteorological equipment values in the TRC Logger Software. Document the time the system goes back online. Ensure all connections are secure and the data being logged is appropriate for current conditions.
3. Ensure all entries on the calibration form are complete and correct. Include the end time sign a copy of the BAM 1020 Calibration Form and add it to the station log book. Submit a copy to the online database. Note any Comments on the *Station Log*.

6.0 ADJUSTMENT PROCEDURES

The following procedures address instrument specific adjustment procedures. Whenever any adjustment it must be properly documented and recorded on the calibration form. An additional calibration check must be performed and documented following completion of the adjustments.

6.1 Wind Monitor

1. Realignment of the sensor is completed by loosening the screw that secures the alignment collar to the wind sensor.
2. The wind vane is then aligned with one of the predefined landmarks.
3. The sensor body should be rotated until the direction indicated by the data logger matches the true direction of the landmark.
4. Tighten the set screw.
5. Complete an as-left calibration verification and complete the comparison and completion section, both found in section 5.0 of this manual.

6.2 *Wind Speed Sensor*

1. Replacement of the wind speed sensor bearings is completed according to page 3 of the R.M. Young Wind Monitor –AQ, Model 05305 manual.
2. Complete an as-left calibration verification and complete the comparison and completion section, both found in section 5.0 of this manual.

6.3 *Solar Radiation Sensor*

1. Adjustment of the sensor interface gain will be necessary. The sensor must be recalibrated following and adjustment.
2. The sensor voltage output is adjusted with the gain potentiometer located inside the 70101 interface. Adjust the gain until the site sensor output matches the references or transfer standard, the Eppley PSP is recommended.
3. Complete an as-left calibration verification and complete the comparison and completion section, both found in section 5.0 of this manual.

6.4 *Temperature Sensor*

1. Place the sensor in an ice bath along with the reference device. When a stable reading is achieved adjust the “offset” potentiometer of the 41341 sensor to match the reference. Place both sensors in a water bath in the range of 10-45°C. Once a stable reading is achieved adjust the “gain” potentiometer until the sensor matches the references.
2. Complete an as-left calibration verification and complete the comparison and completion section, both found in section 5.0 of this manual.

6.5 *Relative Humidity*

1. No adjustments can be made to the Relative Humidity Sensor. If it is out of specification it must be returned to the manufacturer. Contact the project manager for further instruction.
2. If any replacements are made, complete an as-left calibration verification and complete the comparison and completion section, both found in section 5.0 of this manual.

6.6 *Vertical Wind Speed*

1. If the output becomes erratic, the tach-generator assembly must be replaced. See the sensor manual for instructions.
2. No adjustments can be made to the Relative Humidity Sensor. If it is out of specification it must be returned to the manufacturer. Contact the project manager for further instruction.
3. If any replacements are made, complete an as-left calibration verification and complete the comparison and completion section, both found in section 5.0 of this manual.

7.0 FORMS, RECORDS, AND DOCUMENTATION

- Forms and spreadsheets are supplied electronically. Printed copies of these forms can be found in forms section of the project specific QAPP.
- Documents necessary for completion of this SOP include:
  - *Wind Monitor AQ Calibration Form*

- *Station Log*

- One copy of each of the completed calibration forms and the *Station Log* must remain onsite in the Station Log Book

- An electronic copy of each of the completed calibration forms and the *Station Log* must be submitted to the TRC database.

8.0 REFERENCES

These documents should be available for consultation during setup, operation and routine maintenance procedures. The BAM 1020 manual must be available for details not included in this SOP.

United States Environmental Protection Agency (USEPA). 2008. Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV: Meteorological Measurements Version 2.0 (Final). EPA-454/B-08-002. March 2008

United States Environmental Protection Agency (USEPA). 2000. Meteorological Monitoring Guidance for Regulatory Modeling Applications. EPA-454/R-99-005. February 2000

Wind Monitor – AQ Model 05305 Instructions. RM Young Company, Revision: S110210

Wind System Calibration Instructions. R.M. Young Company, Revision: B062309

APPENDIX D

RTI International Standard Operating Procedures

Standard Operating Procedure for Particulate Matter (PM) Gravimetric Analysis

Environmental and Industrial Sciences Division
RTI International*
Research Triangle Park, North Carolina

Prepared by: Lisa C. Greene Date: 7-9-2008

Reviewed by: James C. Flanagan Date: 7/11/08

Approved by: RKM Jayanty Date: 7-10-08

RTI INTERNATIONAL

* RTI International is a trade name of Research Triangle Institute.

Contents

Standard Operating Procedure for Particulate Matter (PM) Gravimetric Analysis

1.0 Procedural Section

1.1 Scope and Applicability

This standard operating procedure (SOP) describes filter preparation and gravimetric analysis operations in the RTI International (RTI) Environmental and Industrial Sciences Division (EISD) Gravimetry Laboratory (Grav Lab). This SOP applies to particulate matter (PM) samples collected on Teflon® filters and includes the performance of the Federal Reference Method (FRM) for the determination of $PM_{2.5}$ in ambient air. Filter conditioning and weighing currently take place in a dedicated laboratory for weighing PM filters. The laboratory consists of two weighing chambers, which have computer-controlled temperature and relative humidity (RH) that meet the requirements of 40 CFR Part 50, Appendix L, and the U.S. Environmental Protection Agency's (EPA's) *Quality Assurance Guidance Document 2.12*.

- **Analyte**: PM, including $PM_{2.5}$ and $PM_{10\text{-}2.5}$
- **Matrix**: Ambient air
- **Analytical Method**: Reference Method for the Determination of Fine PM as $PM_{2.5}$ in the Atmosphere, 40 CFR 50, Appendix L, July 1997
- **Calculated Laboratory MDL**: 7 µg per 46.2 mm Teflon® filter.

1.2 Summary of Method

This SOP describes the processes used by RTI for performing PM filter gravimetric analyses by the $PM_{2.5}$ FRM (Reference Method for the Determination of Fine PM as $PM_{2.5}$ in the Atmosphere), 40 CFR 50, Appendix L. The major steps in the process for handling the filters are as follows:

- Obtaining filters from the manufacturer and characterizing each lot
- Conditioning and pre-weighing each filter
- Packaging and sending the filters to the client for use in their PM monitoring program
- Receiving, conditioning, and post-weighing each filter
- Calculating and reporting results
- Archiving the filters.

The individual procedures are described in this SOP and related SOPs. This SOP concentrates on filter weighing operations, and other SOPs are referenced as necessary.

1.3 Definitions

- Gravimetric Analysis—Determination of particulate concentration based on weight difference
- $PM_{2.5}$ — PM with an aerodynamic diameter less than or equal to 2.5 microns
- $PM_{10\text{-}2.5}$ — PM with an aerodynamic diameter between 10 and 2.5 microns, also known as PM_{Coarse}
- Filter Lot — Units of filters from a single type, grade, class, size, and composition, manufactured under essentially the same conditions and time by the same manufacturer
- Filter Batch — Units of unsampled filters inspected and equilibrated under essentially the same conditions and time in the RTI EISD Grav Lab for use in one given shipment (or hand delivery, if appropriate) of tared filters to the client
- Weighing Session — Period of time in which filters for one client are weighed by one Laboratory Analyst on one balance on one date, interrupted only by brief breaks of no more than 15 minutes' duration.

1.4 Health and Safety Warnings

The PM weighing operations do not involve unusual risks from electrical equipment or chemical exposures. Standard RTI laboratory health and safety precautions must be followed.

RTI personnel must exercise caution when using antistatic devices containing radioactive polonium sources, must keep an inventory of the location and size of antistatic devices, and must dispose of the devices in accordance with manufacturers' specifications, RTI safety and health guidelines, and state and local regulations.

1.5 Cautions

Laboratory personnel will always wear clean clothes and wash thoroughly all parts of their bodies that are exposed during weighing, especially their hands, arms, face, and hair, using adequate soap and water to remove loose skin and hair, as close as possible in time to the weighing activity. Laboratory coats and gloves are required and will minimize the potential for laboratory contamination. Laboratory coats must be taken off before leaving the weighing facility to minimize contamination from the external environment.

RH is a particularly difficult parameter to control; even if total moisture content stays constant, if temperature changes, RH will also change. Gravimetric laboratory personnel must be aware of the potential for unacceptable RH excursions during seasonal extremes (e.g., high heat and humidity in the summer). Corrective measures must be taken whenever environmental controls are out of specification.

1.6 Interferences

PM gravimetric results are highly sensitive to certain interfering factors and conditions. The following list describes common precautions to be taken against interferences:

- Ensure proper handling procedures humidity and temperature control of the filter and particulate sample during weighing, and promptness in, and consistency of, the weighing method prior to and following collection to control weighing artifacts due to environmental conditions.
- Minimize or standardize weight losses by keeping the filters cool during transport to the weighing laboratory and by conditioning and weighing the filters promptly after their receipt in the laboratory. Weight losses can occur due to thermal or chemical decomposition or evaporation of compounds like ammonium nitrate (NH4 NO3), which releases ammonia and nitric acid as gases. Semivolatile organic compounds (SVOCs) may be part of the PM on the filters; if so, they may evaporate and cause sample weight losses.
- Check for weight loss in any new lot of filters that is received. Filters must not be used until their weights have stabilized. Some new blank Teflon® filters have been found to exhibit a weight loss of up to 150 micrograms (µg) over a period of time up to 6 weeks after being removed from their original shipping containers.
- Minimize weight loss due to mechanical removal of particles and/or filter material by careful handling during removal of the filter from its cassette, filter conditioning, neutralization of electrostatic charge buildup on the filter, and all other filter-handling tasks before weighing.
- Neutralize electrostatic to prevent biases due to electrostatic attraction or repulsion during the weighing process.

1.7 Personnel Qualifications

Personnel employed to perform weighing operations must have a minimum of a high school diploma with at least 6 months' experience in computer applications, including spreadsheet and word processing software and laboratory sample handling and record-keeping practices. Lead analysts must have a minimum of a bachelor's degree in a laboratory science and at least 6 months' additional experience in the RTI EISD Grav Lab. All personnel employed to perform weighing operations will be trained by a supervisor before being allowed to process client samples for the PM program. RTI Laboratory Supervisors helped to devise the written examination and the hands-on practical examination for the laboratory component of EPA's $PM_{2.5}$ FRM Performance Evaluation (PE) program. All RTI analysts will be trained to a competency level that is equivalent to the FRM PE certification before they are allowed to perform weighing operations.

1.8 Apparatus and Materials

Mention of specific suppliers or trade names does not constitute endorsement by RTI.

- Mettler Toledo UMT2 or UMX2 balance
- U-electrode (ionizer)
- Marble balance table
- Filters, 46.2 mm, Teflon®
- Millipore Petrislides®, appropriately sized for 46.2 mm filters
- Filter cassettes of the correct type and make
- Filter cassette holders, protective containers
- Nonmetallic forceps to handle weights
- Nonmetallic forceps to handle filters
- Staticide®
- Kimwipes®
- Three sets of National Institute of Standards and Technology (NIST)–traceable standards used for working mass reference standards
- At least one set of NIST–traceable standards used for primary mass reference standards
- Millipore Petrislides®
- Powderfree gloves
- Labcoats
- Shoecovers
- Sticky floor mats
- Computer
- Balance Link® or equivalent data acquisition software
- Laboratory notebook or database.

1.9 Calibration

The microbalance will be certified upon initial set-up by an authorized microbalance service representative. Thereafter, the microbalance will be serviced at least annually, and on an as needed basis, by an authorized microbalance service representative. Records kept by RTI will include service dates and calibration results. NIST–traceable standards will be tracked by a control chart to determine if any bias is entering into the system. These standards will be recertified annually.

Temperature and RH sensors will be calibrated annually.

The microbalance will be internally calibrated using its internal standards and “Autocalibrate” function each time it is brought up from “Standby” mode.

If the microbalance is found to be out of calibration during routine weighing operations, it must be recalibrated by the analyst using the microbalance’s internal standards and “Autocalibrate” function. If the microbalance cannot be autocalibrated, it must be serviced only by an authorized microbalance service representative.

1.10 Sample Collection

Sample collection is not applicable to this SOP because samples are acquired by the state or federal agencies responsible for exposing the filters.

1.11 Sample Handling

Note: The information in this section pertains to EISD Grav Lab handling of both speciation and compliance samples. Additional information on this topic that is specific to the speciation network can be found in the SOP, *Standard Operating Procedure for the Sample Handling and Archiving Laboratory (SHAL)*, Research Triangle Institute, 2005. The SHAL SOP is the default SOP for the handling of speciation samples.

RTI will provide Chain-of-Custody documentation with all sample shipments to track and ensure the following: samples are collected, transferred, stored, and analyzed by authorized personnel; sample integrity is maintained during all phases of sample handling and analysis; and an accurate written record is maintained of sample handling and treatment from the time of its collection, through the laboratory analytical process, to the eventual relinquishing of all data to the client.

Upon initial receipt of new filters, RTI will prepare a “Filter Inventory and Inspection” spreadsheet containing the manufacturer’s lot number, box numbers, filter identification numbers, and date received by the RTI EISD Grav Lab. This form will allow laboratory personnel to select and use the filter boxes in the proper sequence.

If the filters are from a manufacturer’s lot that has not previously been used in the RTI EISD Grav Lab, then an Initial Lot Stability Test must be performed on randomly selected filters to determine and document the minimum length of time required to condition filters from that lot. The Initial Lot Stability Test is explained fully in Section 1.12.1 (Initial Lot Stability Test).

Filters must be inspected and conditioned before use. Inspection and conditioning must be performed in the weighing environment. The inspection date, analyst’s initials, number of filters rejected, and reasons for rejection must be noted on the hard copy “Pre-sampling Batch Inspection and Stability Form” in the RTI EISD Grav Lab and will be entered into the “Filter Inventory and Inspection” spreadsheet as soon as is practicable. Conditioned filters must be sequentially weighed and packaged for shipment to the designated receiving address(es) in order of filter identification number. Additional information on this topic can be found in Section 1.12.3 (Filter Inspection and Conditioning).

Filters will be shipped to the designated address(es) or hand delivered to the designated SHAL contact within 5 days of preweighing to ensure that the 30-day window for using the filters is met. If a filter expires without being used, the filter will be returned to RTI to be reconditioned and weighed again only if a system for the return of unsampled filters to RTI has been established with the client. The decision to recondition filters will be made on a case-by-case basis by the Laboratory Supervisor in coordination with the Project Manager and client.

Chain-of-Custody forms will accompany each sample shipment and will contain the filter identification numbers, accompanying cassettes' identification, pre-sampling weighing date, and date shipped to the designated site operator. Chain-of-Custody forms will be completed by site operators to provide tracking information from receipt in the field, through sample collection, to return sample shipment to RTI.

Upon receipt of loaded filters, RTI will complete the receipt portion of the "Chain-of-Custody" form, including the date and maximum temperature, if specified.

RTI will implement, as a matter of standard practice, a sample turnaround time of 10 calendar days from the date of receipt from the field. Shipping and maintaining the filters at or below 4°C provides a 30-day window from sampling for RTI to condition and weigh filters. The designated site operators are responsible for shipping filters and cassettes, and cassette containers, to RTI at a temperature at or below 4°C. All custody information will be entered into and maintained in the project database.

Once the filters have been weighed and the appropriate internal quality control (QC) procedures have been completed, the filters must be returned to their Petrislides®, and the lids must be securely replaced. The Petrislides® must be placed in numerical order in the Millipore® slide tray. Each tray must be labeled with the client's name and the range of filter ID numbers archived in that tray and then sealed in a plastic bag. Two sealed trays will be placed in each outer cardboard Millipore® box. The outer box must then be labeled with the appropriate archival information, including the client's name, RTI contact name and telephone extension, filter ID range, and archival date. The box must be placed in a cold storage facility to be maintained at or below 4°C. The archival date must be entered into the appropriate Microsoft (MS) Excel® spreadsheet beside each filter ID number.

1.12 Sample Preparation and Analysis

Note: Additional information on this topic for the laboratory's support of the Speciation Trends Network is found in the SOP, *Standard Operating Procedures for Procurement and Acceptance Testing of Teflon, Nylon, and Quartz Filters*, Research Triangle Institute, 2005.

1.12.1 Initial Lot Stability Test

Information derived from the Lot Stability Test must be used to determine the average length of time required to equilibrate filters from a given lot. All Lot Stability Test information must be recorded in the laboratory notebook. The Lot Stability Test must be performed as follows:

1. Randomly select six filter boxes from the same filter lot.
2. Randomly select 2 filters from each box.
3. Weigh the 12 filters and then place the filters in Petrislides®.
4. Allow the filters to equilibrate for at least 24 hours in the weighing environment.
5. Weigh the 12 filters, return them to their Petrislides®, allow them to equilibrate for another 24 hours in the weighing environment, and reweigh the filters.
6. Continue the 24-hour equilibration and weighing process for up to 7 days (5 days minimum) and plot the trend of weight loss. If the trend is still decreasing after 5 days, continue the 24-hour schedule of equilibration and weighing.
7. The filters are considered equilibrated when they no longer exhibit a consistent downward weight trend.
8. Record the length of time it took the filters to equilibrate. This will be the minimum time that all filters from this lot must equilibrate prior to performing a Batch Stability Test. (described in Section 1.12.4).

1.12.2 Filter Storage

After successful completion of the Initial Lot Stability Test, the numbered boxes of unused filters will be stored until needed. After the manufacturer's lot number, box numbers, filter identification numbers, and date received by the RTI EISD Grav Lab are recorded in the "Filter Inventory and Inspection" spreadsheet, the numbered boxes will be placed on the designated laboratory shelf in numerical order so that the next box to be used can be easily obtained. The boxes must be used in numerical order, with the lowest number being used first.

1.12.3 Filter Inspection and Conditioning

An initial screening inspection of each lot of filters must be performed prior to their use for the program. Randomly select 10% of the total quantity of filters received from the vendor. Transport these filters to the Optical Microscopy Laboratory and examine each filter with the aid of a stereo microscope and enhanced lighting (e.g., fiberoptic illuminators, tensor lamps). Record observations of filter appearance, including, but not limited to, extraneous debris or loose pieces of extra filter membrane, filter damage, uniformity of color, clarity of identification number, overspray of filter identification number, or crimping or irregularities in the thickness of the reinforcing ring. Provide the appropriate Task Leader and the program's Quality Assurance Officer (QAO) with a copy of the inspection notes. The lot will be rejected and returned to the manufacturer for replacement if more than 1/4 of the filters inspected (2.5% of the total lot) exhibit defects that are judged by the Task Leader and QAO to adversely impact sample collection or data quality.

In addition to the initial screening, filters must be individually inspected in groups of 25 before they are conditioned for taring. A filter must be rejected if it exhibits any of the following defects:

- Pinhole
- Separation of ring
- Chaff or flashing
- Loose material
- Discoloration
- Filter nonuniformity
- Others: see Laboratory Supervisor.

If a filter is rejected, the analyst must make a note of the rejection on the hard copy "Pre-sampling Batch Inspection and Stability Form" and in the MS Excel "Filter Inventory and Inspection" spreadsheet and must discard the filter. If the filter is accepted, the analyst must place it in a Petrislide for equilibration. The analyst must place the Petrislide lid slightly ajar over the well so that it covers approximately 3/4 of the filter surface. This placement of the lid allows for outgassing of the filter and offers some protection from particle deposition. The analyst must inspect and equilibrate a sufficient number of filters to allow for unforeseen filter problems or rejection during weighing. The number of filters equilibrated will consist, at a minimum, of the number of filters required for shipment to the client plus an additional 5 filters. Filters must equilibrate for at least the period of time determined in the Initial Lot Stability Test.

1.12.4 Pre-sampling Batch Stability Test

The Batch Stability Test is used to verify that filters from a particular batch have achieved weight stability and are not losing weight due to outgassing or another process. The Batch Stability Test must be performed after the filters have equilibrated for at least the period of time determined in the Initial Lot Stability Test. Only stable filter batches will be used for PM sampling. The following procedure must be performed each time a batch of filters that has been equilibrated in the RTI EISD Grav Lab for less than 60 hours is prepared for analysis:

1. Randomly select 3 filters from the batch of equilibrated filters.
2. Weigh each of the 3 filters and record their weights in the laboratory notebook.
3. Allow the filters to equilibrate overnight and reweigh.
4. If the average weight loss for the 3 filters is less than 5 μg, they are ready to be weighed for shipment to the client.
5. If the average weight loss for the 3 filters exceeds 5 μg, repeat the 24-hour schedule of equilibration and weighing until the average weight loss for the 3 filters is less than 5 μg.

1.12.5 Pre-sampling Weighing Procedure

The following procedure must be performed each time PM filters are tare-weighed in the RTI EISD Grav Lab:

1. The laboratory's Dickson® RH and temperature data logger is routinely set to collect 5-minute grab samples. Twenty-four hours prior to a weighing session, verify that this logger setting has not been changed.
2. The microbalance must be left plugged in and turned on at all times to avoid lengthy warm-up periods. If the microbalance has been left in "Standby" mode, the LCD screen display must be turned on by pressing the tare (Zero) button once. ***Note: Do not press the On/Off button.***
3. Verify that the microbalance is level by observing the level indicator bubble at the rear of the sample chamber. If the microbalance is level, the air bubble will be positioned in the center of the indicator circle. If the air bubble is not centered, level the microbalance by turning the two leveling feet at the rear of the sample chamber until the bubble is in the middle of the indicator circle. **Note**: The microbalance must be releveled each time it is moved. Releveling will not normally be necessary because the microbalance is not routinely moved. If observation of the level bubble indicates that the microbalance has been moved, notify the Laboratory Supervisor immediately. Always calibrate the microbalance after releveling.
4. Internally calibrate the microbalance with its "Autocalibrate" function. The microbalance must be internally calibrated each time it is brought up from "Standby" mode. **Note:** Do not lean on or place weight on the stone balance table or open the laboratory door while the internal calibration is in progress. Minimize movement in the laboratory during the internal calibration.
5. Turn on the computer, if necessary, and download the humidity and temperature data from the data logger to the computer.
6. Pull the data into an MS Excel spreadsheet and calculate the 24-hour mean and standard deviation for temperature and RH. Report temperature to 3 significant digits.
7. Verify that the weighing chamber's mean temperature and RH for the previous 24 hours have met the following specifications: temperature maintained between 20–23 °C with a standard deviation less than 2, and 24-hour mean RH maintained between 30–40% with a standard deviation less than 5.
8. Lightly spray a low-lint disposable cloth (Kimwipe®) with Staticide®. Do not direct the spray toward the data logger, microbalance, reference weights, filters, or area around the microbalance and computer. Use the moistened cloth to wipe both sets of forceps and the work area around the microbalance and computer. Allow the forceps and work area to air-dry before proceeding. The computer and monitor will be routinely cleaned with products designed for that purpose.

9. Open the weighing template spreadsheet in the client's folder or the Grav Lab speciation database application, each where appropriate, and create a filename or initial weighing session consisting of the first and last filter ID numbers in the range to be weighed (e.g., *9021884_9021920*).
10. Complete the QC data worksheet or initial weighing session setup form with analyst initials, weigh date, start time, client/RTI project number, filter lot, initial RH (%), and initial temperature (°C, to 3 significant digits).
11. Complete the database worksheet or Grav database initial weighings form with filter ID number, weighing type, and any other specified information.
12. Begin the weighing session by weighing reference standards that bracket the typical weight of a filter. Using nonmetallic forceps, place either the 100 mg or 200 mg working mass standard on the microbalance weigh pan and close the microbalance door. Take care not to drop, bend, or otherwise mar the standard.
13. Wait for the microbalance to display a stable reading for at least 20 seconds.
14. Press either the "print" button on the microbalance or the "print screen" button on the computer keyboard to enter the displayed weight directly to the cursor position in the spreadsheet or database form.
15. Repeat this process with a second working mass standard to bracket the weight of a typical Teflon® PM filter.
16. Compare the weights of the working mass standards to the QC weight acceptance limits posted near the microbalance. If a mass standard varies from its verified weight by more than 3 μg, autocalibrate the microbalance and reweigh the working mass standard. If the mass standard still varies by more than 3 μg, contact the Laboratory Supervisor.
17. Reposition the cursor (if necessary) in the first filter weight cell. Using the filter handling forceps, pick up the first filter to be weighed and pass it through the U-electrode to neutralize static charge and place the filter on the weigh pan and close the microbalance door. Wait for the microbalance to display a stable reading for at least 20 seconds
18. Press the "print" or "print screen" button to enter the weight directly into the database worksheet or data entry form.
19. Open the automatic microbalance door, remove the filter from the weigh pan, and reclose the microbalance door. The microbalance must return to zero on its own. If, after 20 seconds, the microbalance has not returned to zero, press the "tare" key. It should not be necessary to press the "tare" key after every filter. If it proves necessary to press the "tare" key after every filter, troubleshoot the system as outlined in this procedure.
20. Repeat the process for all the filters. After every tenth filter, reweigh working mass standards that bracket the weight of a typical filter (e.g., 100 mg and 200 mg) and record the weight in the QC data worksheet. Compare the weights of the working mass standards to the QC weight acceptance limits for the working mass standards.

21. If the number of tared filters needed for shipment or hand delivery to the client can be weighed in one weighing session, then weigh the number of filters needed for shipment or delivery plus 1 additional filter to be used as a laboratory (lab) blank. If the client requires a quantity of filters too large to be weighed in one weighing session, then weigh the number of filters that can be safely weighed in the time available and select 1 filter to be used as a lab blank for that weighing session. In each case, the lab blank must be placed in a Petrislide® and labeled with the client name, RTI project number, weigh date, and the filter ID range that it represents. In each case, the lab blank must also be identified as a lab blank in the weighing spreadsheet.
22. Reweigh every filter and record the initial and final weights in the appropriate spaces on the database or Excel form used for the weighing session.. If replicate filter weights vary by more 5 µg, weigh the filter a third time to confirm the weight. If replicate filter weights vary by more than 15 μg, contact the Laboratory Supervisor. The Laboratory Supervisor will troubleshoot the system and direct the analyst to troubleshoot the microbalance system and/or to allow the filters to equilibrate an additional length of time before reweighing all the filters in the batch.
23. If replicate filter weights are within 15 μg, then reweigh the 100 mg and 200 mg working mass standards. If the working mass standards are within 3 μg of their verified weight, then the weighing session is complete. All changes to the spreadsheet or weighing session must be saved.
24. If the purpose of the weighing session is to tare filters to complete the batch started previously, then a lab blank must be included in the weighing session. This practice will result in multiple lab blanks covering all weighing sessions for the batch of filters shipped or delivered to the client.

1.12.6 Preparing the Filters for Shipment

Shipping and receiving of filters for the PM Chemical Speciation Program will be performed in the SHAL. These procedures are discussed in the SOPs for the SHAL.

1.12.7 Receipt of Filters from the Field

Shipping and receiving of filters for the PM Chemical Speciation Program will be performed in the SHAL. These procedures are discussed in the SOPs for the SHAL.

1.12.8 Receipt of Filters from the SHAL and Post-sampling Batch Stability Test

The following procedure must be performed each time PM filters are received from the SHAL:

1. Review and complete all Chain-of-Custody forms submitted with the filters. Return one completed carbonless copy of the form to SHAL and retain the other copies.

2. Log the filter identification information in the PM Sample Receipt Notebook. Include filter ID numbers, date received from the SHAL, receiver's initials, pertinent information concerning shipment integrity communicated by the SHAL, and any observations about obvious filter damage.
3. Transfer the copies of the "Chain of Custody" form(s) with the filters to the weighing chamber in RTI Building 11. If the filters are not received from the SHAL in Petrislides®, place each filter in a clean Petrislide®. Label each Petrislide® with client name, date received from the SHAL, and filter ID number.
4. Place the Petrislides® containing the filters in numerical order on a tray. Verify the filter ID numbers against the ID numbers recorded on the "Chain of Custody" form(s).
5. Place the filter tray on the appropriate shelves in the weighing chamber to equilibrate. Place the Petrislide® lid slightly ajar over the slide well so that it covers approximately 3/4 of the filter surface.
6. Allow the filters to equilibrate in the weighing chamber for at least 24 hours.
7. Randomly select 3 of the sampled filters, weigh them, and then replace them on the shelf to equilibrate at least 24 additional hours.
8. Reweigh the 3 sampled filters. If the average weight loss for the 3 filters is less than 5 μg, the batch of filters can be weighed. If the average weight loss for the 3 filters exceeds 5 μg, repeat the 24-hour equilibration and weighing process.

1.12.9 Post-sampling Filter Weighing

Open the appropriate MS Excel® spreadsheet(s) or database final weighing session forms to perform post-sampling weighing of PM filters. Post-sampling weighing is performed as outlined in the pre-sampling weighing section (see 1.12.5). All internal QC procedures described in the pre-sampling filter weighing section must be followed during post-sampling weighing. Different or additional QC data that must be recorded are as follows:

1. Perform replicate weighing of post-sampling filters at a frequency of every third filter rather than reweighing every filter. In addition to incremental reweighing, reweigh any filter for which a negative net mass is noted. Reweigh any field or trip blank for which a negative net mass or a net mass greater than 30 µg is noted.
2. Identify field or trip blanks, if known, in the "Blanks" column of each spreadsheet.
3. Reweigh the lab blank for each tare session with filters in the post-sampling batch and enter these weights in the appropriate field of the QC data worksheet or database final weighings form. It is imperative that all lab blanks for the batch be reweighed in each post-sampling weighing session. Initial and final lab blank weights must not differ by more than 15 μg. A weight gain of more than 15 μg (positive weight change) indicates potential contamination in the weighing chamber. A weight loss of more than 15 μg (negative weight change) indicates either that the filters were not adequately equilibrated before shipment to the sampling sites or that the filters were contaminated before shipment with

particulate that was dislodged prior to post-sampling weighing. If the lab blank does not meet the appropriate criterion, notify the Laboratory Supervisor and QAO immediately. Anomalies that cannot be traced to issues in the laboratory will be noted as such by the Laboratory Supervisor.

4. Record field and trip blank weighings in the appropriate section of the QC data worksheet or database final weighings form. The initial and final field blank weights must not differ by more than 30 μg. A weight gain of more than 30 μg indicates possible field contamination of the filters or that tare or post-sampling weights were not correctly recorded. A weight loss of more than 30 μg indicates possible inadequate equilibration of the filters before shipment to the sampling sites, or that tare weights were not correctly recorded. If initial and final field blank weights differ by more than 30 μg, notify the Laboratory Supervisor so that the issue can be investigated in the laboratory and the client can be notified of possible field-related problems.
5. All post-sampling filter weights must be recorded. Note any problems observed during post-sampling filter weighing (e.g., filter damage, incomplete documentation) in the “Comments” field of the database worksheet or database final weighings form. Data flags will notify quality assurance (QA) and SHAL personnel, and, if necessary, the client, that these data must be reviewed to be deemed valid or invalid.

1.12.10 Filter Archival

After post-sampling weighing, filters must be archived according to the procedure outlined in Section 1.11 (Sample Handling). The “Archival Date” column must be completed in the appropriate MS Excel® spreadsheet.

1.12.11 Troubleshooting

Problems in meeting the various QC requirements during a pre-sampling or post-sampling weighing session can be related to the filter conditioning environment, a malfunctioning microbalance, or the filters themselves (e.g., exposed filters). Analysts must take the appropriate corrective action or call the matter to the attention of the Laboratory Supervisor if serious problems are observed. All problems that affect reportable data must be brought to the attention of the Laboratory Supervisor and must be documented for use during data validation. Serious, systematic, or chronic problems must be dealt with using the Corrective Action Procedures described in the laboratory's QA Project Plan (QAPP).

The following list describes common troubleshooting situations and recommended solutions:

- If filter weights are unstable, ensure that temperature and RH are within the acceptance criteria and that levels do not fluctuate excessively. Also, check temperature and RH monitoring devices with independent devices.

- If unexplained weight gains are observed on laboratory blanks, or if visual contamination is observed, laboratory contamination is present. In this case, more frequent cleaning is required.
- If there are measurement uncertainties and fluctuations associated with electrical charge, samples must be charge-neutralized prior to weighing using Polonium 210 alpha sources or an ionizing electrode. Since the radioactive half-life of Polonium 210 is approximately 6 months, Polonium charge neutralizers, if used in the lab, must be replaced at least annually.
- If a power failure has occurred, the user must manually reset the microbalance's electronics and run the internal recalibration procedure. Recovery time may be required for the microbalance to stabilize after a power outage. Refer to the instrument's operating manual for recommendations.
- If blank or working standard weighing discrepancies are observed between sessions, recertify the working standards against the laboratory primary standards and/or calibrate the microbalance using an external laboratory primary standard.
- If microbalance repairs or significant internal adjustments are necessary, a qualified service technician must be called. Unqualified personnel must not attempt to adjust or repair the microbalance. **Note:** Additional information on this topic can be found in Section 2.2.2 (Removing a Microbalance from Service).
- If certain exposed filters appear to be losing weight systematically over time, the PM may be composed of nitrates or other semivolatile species. Notify the QAO and expedite final weighing as much as possible within the confines of the reference method.
- If any unused filter is found to have a weight outside the normal range (i.e., 110 to 160 mg), an investigation is warranted. Examine other filters from the same lot for defects.
- If there is a consistent negative replication (>15 µg) for laboratory blank filters, it is a sign that the filters have not equilibrated long enough and are off-gassing semivolatiles from the manufacturing process. Monitor other filters from the same lot; additional conditioning time is required before filters from that lot can be used for sampling.

1.13 Data Acquisition Hardware and Software

Note: See the SOP, *Data Handling Procedures for the Speciation Analysis Program*, for detailed procedures on this topic. The referenced SOP will provide details about the data acquisition software to be used in the chemical speciation program.

The three major programs currently used to process RTI EISD Grav Lab data are MS Access®, MS Excel®, and Mettler BalanceLink®. Spreadsheets used for managing state client compliance data are created in MS Excel®. Speciation data are managed with custom RTI–written MS

Access® routines to facilitate compliance with Good Automated Laboratory Practices requirements. Speciation data are recorded on the program's dedicated server maintained by RTI's Ragland Computer Center staff.

IBM-PC compatible computers will be used in the weighing laboratory. These will be networked via RTI's internal computer network. Password security will be used to validate users. Full or incremental backups of the data will be performed daily.

1.14 Calculations and Data Reduction

The calculations relevant to the gravimetric procedures are listed in the following table.

Parameter	Units	Type of Conversion	Equation
Filter Volume (V_a)	m^3	Calculated from average flow rate (Q_{ave}) in L/min, and total elapsed time (t) in minutes	$V_a = Q_{ave} \times t \times 10^{-3}$
Mass on Filter (M_{PM})	μg	Calculated from the filter post-weight (M_f) in mg and filter pre-weight (M_i) in mg, multiplied by the unit conversion ($\mu g/mg$)	$M_{PM} = (M_f - M_i) \times 10^3$
PM Concentration (C_{PM})	$\mu g/m^3$	Calculated from laboratory data and sampler volume	$PM = M_{PM} / V_a$

1.15 Records Management

Note: See the SOP, *Data Handling Procedures for the Speciation Analysis Program*, for detailed procedures on this topic. The following discussion outlines the records management procedures to be implemented for the gravimetric filters. The referenced SOP will provide the detailed records management protocols for all filter and sample types that are used on the chemical speciation program.

As outlined in Section 1.11 (Sample Handling), RTI will prepare a "Filter Inventory and Inspection" spreadsheet upon initial receipt of new filters. This form will be completed with filter ID numbers, box numbers, date received, date inspected, number of filters rejected, and reason(s) for rejection. The form will allow laboratory personnel to select and use the filter boxes in the proper sequence.

RTI will provide Chain-of-Custody documentation with all sample shipments to track and ensure the following:

- Samples are collected, transferred, stored, and analyzed by authorized personnel.
- Sample integrity is maintained during all phases of sample handling and analysis.

- An accurate written record is maintained of sample handling and treatment from the time of its collection, through the laboratory analytical process, to the eventual relinquishing of all data to the client.

Chain-of-Custody forms will include filter ID numbers, accompanying cassette identification, pre-sampling weighing date, and date shipped to the designated site operator. One copy of the Chain-of-Custody form will be retained by the site operator. A second copy of the form will accompany return shipments to RTI. Upon receipt of loaded filters from the field, RTI will complete the final portion of the Chain-of-Custody form, including date received at RTI and maximum temperature during shipment. The designated site operators are responsible for shipping filters and cassettes, and cassette containers to RTI at a temperature at or below 4°C.

The filter database will be completed with the information described above and with filter archiving information. Filters will be archived, following the procedures outlined in Sections 1.11 (Sample Handling) and 1.12.8 (Filter Archival), until 1 year after termination of the contract or until the client requests return of such materials. Boxes of archived filters will be labeled with the appropriate archiving information, including client name, RTI contact name and telephone extension, filter ID range, and archive date, and the boxes will be placed in a secure cold storage facility. The archival date for each filter ID number will be completed in all pertinent MS Excel® spreadsheets.

2.0 Quality Control and Quality Assurance

2.1 Determination of Working Standard QC Weight

The following procedure must be performed each time the working mass reference standards are recertified by the North Carolina Department of Agriculture Standards Laboratory, or a similar NIST–traceable standards laboratory, and each time the working mass reference standards exceed the PM acceptance limits.

1. Using clean weight forceps, weigh the working mass reference standard daily for five days.
2. Record the weights and calculate the mean (i.e., The mean will be the weight used for comparison during each subsequent weighing session).

If the mean weight determined for the working mass reference standard differs from the certified value by more than 20 μg, verify the primary standards and then either call the microbalance manufacturer's service representative to calibrate the microbalance or return the working mass standard for recertification.

2.2 Monitoring Microbalance Performance

2.2.1 Quality Control Checks of the Microbalance

Routine checks of the microbalance using certified mass standards must be performed to detect any appreciable changes in instrument response over time. Since fine particulate mass concentrations are calculated based on the measured difference between loaded filters and clean filters, the absolute response of the microbalance is less critical than long-term stability and repeatability. Internal QC checks are recorded during each weighing session on the session's QC data worksheet. The following internal QC checks designed to monitor appreciable changes in microbalance response are performed at the beginning and end of every weighing session:

1. Measure and record the temperature, RH, operator's initials, date, and time on the weighing session's QC data worksheet.
2. Zero and autocalibrate the microbalance.
3. Weigh the NIST Class 1 100 mg mass standard. Record the weight on the QC data worksheet for that weighing session and compare this weight to those previously determined for the 100 mg standard.
4. Weigh the NIST Class 1 200 mg calibration weight. Record the weight on the QC data worksheet for that weighing session and compare this weight to those previously determined for the 200 mg standard.

2.2.2 Removing a Microbalance from Service

If the weights recorded for the certified mass standards used to perform systematic checks of the microbalance differ by more than 20 μg from their certified value or by more than 5 μg from their last recorded weight, the microbalance must be examined to verify that it is level, that the weigh pan and sample chamber are free of visible contamination, and that the chamber door mechanism is free of visible contamination that would prevent the door from sealing properly. These conditions must be corrected, if necessary. The microbalance must be internally calibrated and the certified mass standards must be weighed again. If the weights recorded for the certified mass standards still differ by more than 20 μg from their certified value or by more than 5 μg from their last recorded weight, 3 laboratory blanks must be randomly selected from the laboratory blanks exposed in the laboratory. The3 laboratory blanks will be weighed and their weights will be recorded on the QC data worksheet for the weighing session. If the weight recorded for any 1 of the laboratory blanks differs by more than 15 μg from its initial weight, the microbalance will be removed from service pending repair and calibration by an authorized microbalance service representative.

The procedure for removing a microbalance from service in the RTI EISD Grav Lab is as follows:

1. Leave the microbalance in "Standby" mode.
2. Notify the Laboratory Supervisor that a routine check of the microbalance as described above has indicated that the microbalance is out of compliance.
3. Place a clearly written notice on the stone weighing table that states, "THIS

MICROBALANCE WAS REMOVED FROM SERVICE ON (MM/DD/YY) PENDING REPAIR AND CALIBRATION BY AN AUTHORIZED MICROBALANCE SERVICE REPRESENTATIVE." Sign and date the notice.

4. Print the pertinent weighing session QC data worksheet. Paste this worksheet into the microbalance log. Write a brief summary of the microbalance checks and corrective actions in the microbalance log and initial and date the summary.
5. The Laboratory Supervisor will contact Mettler Toledo to schedule a service appointment, notify the QAO, and contact clients and the SHAL, as deemed necessary and appropriate, to discuss rescheduled delivery of tared filters.
6. If sampled filters must be weighed to avoid expiration in the RTI EISD Grav Lab, notify the Laboratory Supervisor. Weigh the sampled filters on the laboratory's second microbalance. Flag any filter with an explanatory comment where the post-sampling weighing is performed on a microbalance other than the microbalance on which its initial (tare) weighing was performed.
7. After the microbalance has been repaired, calibrated, and certified by an authorized microbalance service representative, remove the written notice from the stone weighing table. Write a brief summary of the microbalance repair in the microbalance log and initial and date the summary.
8. Verify the microbalance performance with the certified working mass standards as described in Section 2.2.1 and document this verification in the microbalance log.

2.3 QC Filter Samples

The following table summarizes the recommended frequency of QC filters for the PM program:

Type of QC Filter	Description	Acceptance Criteria
Lot Stability Test Filters	Twelve (12) filters are repeatedly weighed to determine the minimum necessary equilibration time for filters from the same manufacturing lot.	Weight trend approaches zero
Batch Stability Test Filters	Three (3) filters from a batch are repeatedly weighed during equilibration to verify the stability of the filter shipment batch.	Weight loss < 5 µg
Laboratory Blank Filters	One (1) laboratory blank filter is weighed for every weighing session.	Weight loss < 15 µg
Field Blank Filters	Unexposed filters from each shipment batch are designated as field blanks by the client.	Weight difference < 30 µg
Replicate Filter Weighings	Every filter (pre-weighing) or every third filter (post-weighing) is reweighed.	Weight difference < 15 µg

2.4 Cleaning the Laboratory

The laboratory will be cleaned monthly or as needed to minimize contamination in the weighing environment. The laboratory will be cleaned after any renovation, maintenance, or repair activity in the vicinity of the weighing chambers (RTI Bldg 11, Bay 6). Cleaning will be performed by Laboratory Analysts who are familiar with the laboratory equipment, systems, and gravimetric analysis operations. Ultraviolet (UV) fluorescent inspection of surfaces in the weighing chambers will be performed annually to detect particulate microcontamination in the controlled environment to aid the analysts in identifying problem areas and refining their cleaning strategy. In this inspection, a UV hand lamp will be used to highlight contamination on surfaces in the illumination area. At a minimum, the following procedure will be followed when cleaning the laboratory:

1. Don shoe covers, disposable lab coats, and powder-free gloves prior to cleaning the laboratory.
2. After donning protective garments and gloves, replace all Petrislide® lids securely on open Petrislides® in which unsampled and sampled filters are conditioning. Closing the Petrislides® protects filter surfaces from contamination due to fall-out of settled particulate that is resuspended during cleaning.
3. Place all balances in “Standby” mode.
4. Verify that all working mass standards (reference weights) are stored in tightly closed boxes to protect them from contamination during cleaning.
5. Shut down all computers.
6. Remove all auxiliary supplies (e.g., unopened boxes of filters, FRM magazines and cassettes, mouse pads) from the chamber.
7. Invert all ionizing units and tap them gently on a table top to dislodge particulates. **Note:** Do not tamper with or touch the foil-covered Polonium strips if any are in use.
8. Damp-wipe all vertical and horizontal surfaces with a low-lint disposable cloth moistened with deionized (DI) water. Disposable cloths should be damp, not wet. Add a small amount (approximately 50 μL) of Staticide® to the DI water used to wipe items, including walls, shelves, table tops, and network junction boxes. **Note:** Do not wipe the floor with a Staticide® solution; Staticide® may make the floor slippery. Discard disposable cloths after use.
9. When damp-wiping vertical and horizontal surfaces, pay particular attention to cables and cords, corners, ledges, network/telephone junction boxes, telephones, computer components, computer mouse, the shelf racks on which trays of filters are placed, the work area around the balances, and the balances themselves. Gently wipe the top of the balance’s power supply, data acquisition component, and chamber component. Do not place pressure on the microbalance.
10. Gently clean the balance’s sample chamber and weigh the pan with the brush provided by the manufacturer. The brush is located in a small drawer on the side of the chamber component. Pay particular attention to the groove in which the automatic chamber door moves as it opens and closes.

11. Using a low-lint sponge mop, damp-mop the floor with DI water. Rinse the mop frequently and change the water frequently. Use a textured scrubber as needed to remove visible staining. As noted previously, Staticide® must not be added to the water used to mop the floor.
12. Exit the chamber, changing the adhesive mats inside and outside the chamber door.
13. Allow surfaces to air dry. Wait at least 1 hour for the chamber's air circulation system to pull air through the plenum's course filters.
14. Pre-clean auxiliary supplies before returning them to the chamber.
15. After donning protective garments and gloves, remove Petrislide® lids from the Petrislides® that were closed prior to cleaning and place each lid slightly ajar over the Petrislide® well so that it covers approximately 3/4 of the filter surface. As noted previously in this SOP, such a placement of the lid allows for outgassing of the filter and offers some protection from particle deposition.
16. Reboot computers.
17. Bring balances up from "Standby" mode and internally calibrate them using the "Autocalibrate" function.

3.0 References

40 Code of Federal Regulations, Parts 50 (Appendix L), 53, and 58. *Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for Particulate; Final Rule* (referred to herein as 40 CFR Parts 50/53/58) as published in the *Federal Register*, Volume 62, Number 138, Friday, July 18, 1997.

U.S. EPA (Environmental Protection Agency) *The U.S. EPA Quality Assurance Handbook*. Monitoring $PM_{2.5}$ in ambient air using designated reference or class 1 equivalent methods. Volume II, Part II, Section 2.12., November 1998

Mettler UMT2/UMX2 Microbalance Operations Manuals

Related SOPs:

- *Sample Receiving, Shipping, and Archiving Procedures for the $PM_{2.5}$ Chemical Speciation Program*, RTI, 2005.
- *Standard Operating Procedures for Procurement and Acceptance Testing of Teflon, Nylon, and Quartz Filters*, RTI, 2005.
- *Data Handling Procedures for the Speciation Analysis Program*, RTI, 2005.

APPENDIX E

Tables as Replicated from the QA Handbook Volume II, Appendix D

Ozone Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action	
CRITICAL CRITERIA-Ozone				
One Point QC Check Single analyzer	1/ 2 weeks	≤ ±7% (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2	
Zero/span check	1/ 2 weeks	Zero drift ≤ ± 2% of full scale Span drift ≤ ± 7 %		
OPERATIONAL CRITERIA - Ozone				
Shelter Temperature				
Temperature range	**Daily** (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance	
Temperature Control	Daily (hourly values)	≤ ± 2° C SD over 24 hours		
Temperature Device Check	2/year	± 2°C of standard		
Precision(using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV ≤ 7%	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2	
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL ≤ ± 7%	95% Confidence Limit of absolute bias estimate. 40 CFR Part 58 App A sec 4.1.3	
Annual Performance Evaluation				
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level ≤ 15%	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2	
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4	
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference ≤ 10%	40 CFR Part 58 App A sec 2.4	
State audits	1/year	State requirements		
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within ± 2 % of full scale of best-fit straight line Linearity error <5%	Multi-point calibration (0 and 4 upscale points) 40 CFR Part 50 App D sec 5.2.3	
Zero Air		Concentrations below LDL		
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	40 CFR Part 58 App A sec 2.6.1	
Zero Air Check	1/year	Concentrations below LDL		

Requirement	Frequency	Acceptance Criteria	Information /Action	
Ozone Local primary standard				
Certification/recertification to Standard Reference Photometer	1/year	single point difference ≤ ± 3%	Primary Standards usually transported to EPA Regions SRP for comparison	
(if recertified via a transfer standard)	1/year	Regression slopes = 1.00 ± 0.03 and two intercepts are 0 ± 3 ppb		
Ozone Transfer standard				
Qualification	Upon receipt of transfer standard	±4% or ±4 ppb (whichever greater)	Transfer Standard Doc EPA 600/4-79-056 Section 6.4	
Certification	After qualification and upon receipt/adjustment/repair	RSD of six slopes ≤ 3.7% Std. Dev. of 6 intercepts 1.5	Transfer Standard Doc EPA 600/4-79-056 Section 6.6	
Recertification to local primary standard	Beginning and end of O3 season or 1/6 months whichever less	New slope = ± 0.05 of previous and RSD of six slopes ≤ 3.7% Std. Dev. of 6 intercepts 1.5	1 recertification test that then gets added to most recent 5 tests. If does not meet acceptability certification fails	
Lower detectable level	1/year	0.003 ppm		
SYSTEMATIC CRITERIA- Ozone				
Requirement	**Frequency**	**Acceptance Criteria**	**Information /Action**	
Standard Reporting Units	All data	ppm (final units in AQS)		
Completeness (seasonal)	Daily	75% of hourly averages for the 8-hour period	8-Hour Average	
Sample Residence Times		< 20 seconds		
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E	
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E	
EPA Standard Ozone Reference Photometer (SRP) Recertification	1/year	Regression slope = 1.00 ± 0.01 and intercept < 3 ppb	This is usually at a Regional Office and is compared against the traveling SRP	

CO Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action	
CRITICAL CRITERIA-CO				
One Point QC Check Single analyzer	1/ 2 weeks	$\leq \pm$10% (percent difference)	1 - 10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2	
Zero/span check	1/ 2 weeks	Zero drift $\leq \pm$ 2% of full scale Span drift $\leq \pm$ 10 %		
OPERATIONAL CRITERIA-CO				
Shelter Temperature				
Temperature range	**Daily** (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance	
Temperature Control	Daily (hourly values)	$\leq \pm$ 2° C SD over 24 hours		
Temperature Device Check	2/year	$\pm$ 2°C of standard		
Precision(using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV $\leq$ 10%	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2	
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL $\leq \pm$ 10%	95% Confidence Limit of absolute bias estimate 40 CFR Part 58 App A sec 4.1.3	
Annual Performance Evaluation				
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level $\leq$ 15%	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2	
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4	
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference $\leq$ 15%	40 CFR Part 58 App A sec 2.4	
State audits	1/year	State requirements		
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within $\pm$ 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points)	
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	Vendor must participate in EPA Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1	
Zero Air/Zero Air Check	1/year	Concentrations below LDL		

Requirement	Frequency	Acceptance Criteria	Information /Action	
Gas Dilution Systems	1/3 months	Accuracy ± 2 %		
Detection				
Noise	NA	0.50 ppm	40 CFR Part 53.20	
Lower detectable level	1/year	1.0 ppm	40 CFR Part 53.20	
SYSTEMATIC CRITERIA-CO				
Standard Reporting Units	All data	ppm (final units in AQS)		
Completeness (seasonal)	Hourly	75% of hourly averages for the 8-hour period	8-Hour average	
Sample Residence Times		< 20 seconds		
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E	
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E	

NO_2 Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action	
CRITICAL CRITERIA- NO_2				
One Point QC Check Single analyzer	1/ 2 weeks	$\leq \pm 10\%$ (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2	
Zero/span check	1/ 2 weeks	Zero drift $\leq \pm$ 3% of full scale Span drift $\leq \pm$ 10 %		
OPERATIONAL CRITERIA- NO_2				
Shelter Temperature				
Temperature range	**Daily** (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance	
Temperature Control	Daily (hourly values)	$\leq \pm$ 2° C SD over 24 hours		
Temperature Device Check	2/year	$\pm$ 2°C of standard		
Precision (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV $\leq$ 10%	90% Confidence Limit of coefficient of variation. 40 CFR Part 58 App A sec 4.1.2	
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL $\leq \pm$ 10%	95% Confidence Limit of absolute bias estimate. 40 CFR Part 58 App A sec 4.1.3	
Annual Performance Evaluation				
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level $\leq$ 15%	3 consecutive audit concentration not including zero. 40 CFR Part 58 App A sec 3.2.2	
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4	
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference $\leq$ 15%	40 CFR Part 58 App A sec 2.4	
State audits	1/year	State requirements		
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	Intrument residence time $\leq$ 2 min Dynam. parameter $\geq$ 2.75 ppm-min All points within $\pm$ 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points) 40 CFR Part 50 App F	
Converter Efficiency	During multi-point calibrations, span and audit 1/ 2 weeks	96%		
Gaseous Standards		NIST Traceable	Vendor must participate in EPA Protocol Gas	

Requirement	Frequency	Acceptance Criteria	Information /Action	
		(e.g., EPA Protocol Gas)	Verification Program 40 CFR Part 58 App A sec 2.6.1	
Zero Air/ Zero Air Check	1/year	Concentrations below LDL		
Gas Dilution Systems	1/3 months	Accuracy ± 2 %		
Detection				
Noise	NA	0.005 ppm	40 CFR Part 53.20	
Lower detectable level	1/year	0.01 ppm	40 CFR Part 53.20	
SYSTEMATIC CRITERIA- NO_2				
Standard Reporting Units	All data	ppm (final units in AQS)		
Completeness (seasonal)	Quarterly	75%	Annual standard (hourly data)	
Sample Residence Times		< 20 seconds		
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E	
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E	

SO_2 Validation Template

Requirement	Frequency	Acceptance Criteria	Information /Action
CRITICAL CRITERIA- SO_2			
One Point QC Check Single analyzer	1/ 2 weeks	$\leq \pm 10\%$ (percent difference)	0.01 - 0.10 ppm Relative to routine concentrations 40 CFR Part 58 App A Sec 3.2
Zero/span check	1/ 2 weeks	Zero drift $\leq \pm$ 3% of full scale Span drift $\leq \pm$ 10 %	
OPERATIONAL CRITERIA- SO_2			
Shelter Temperature			
Temperature range	**Daily** (hourly values)	20 to 30° C. (Hourly ave) or per manufacturers specifications if designated to a wider temperature range	Generally the 20-30 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance
Temperature Control	Daily (hourly values)	$\leq \pm$ 2° C SD over 24 hours	
Temperature Device Check	2/year	$\pm$ 2°C of standard	
Precision (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	90% CL CV $\leq$ 10%	90% Confidence Limit of coefficient of variation 40 CFR Part 58 App A sec 4.1.2
Bias (using 1-point QC checks)	Calculated annually and as appropriate for design value estimates	95% CL $\leq \pm$ 10%	95% Confidence Limit of absolute bias estimate 40 CFR Part 58 App A sec 4.1.3
Annual Performance Evaluation			
Single analyzer	Every site 1/year 25 % of sites quarterly	Percent difference of each audit level $\leq$ 15%	3 consecutive audit concentrations not including zero 40 CFR Part 58 App A sec 3.2.2
Primary QA Organization (PQAO)	annually	95% of audit percent differences fall within the one point QC check 95% probability intervals at PQAO level of aggregation	40 CFR Part 58 App A sec 4.1.4
Federal Audits (NPAP)	1/year at selected sites 20% of sites audited	Mean absolute difference $\leq$ 15%	40 CFR Part 58 App A sec 2.4
State audits	1/year	State requirements	
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving 1/6 months if manual zero/span performed biweekly 1/year if continuous zero/span performed daily	All points within $\pm$ 2 % of full scale of best-fit straight line	Multi-point calibration (0 and 4 upscale points)
Zero Air		Concentrations below LDL	
Gaseous Standards		NIST Traceable (e.g., EPA Protocol Gas)	Vendor must participate in EPA Protocol Gas Verification Program 40 CFR Part 58 App A sec 2.6.1

Requirement	Frequency	Acceptance Criteria	Information /Action	
Zero Air/ Zero Air Check	1/year	Concentrations below LDL		
Gas Dilution Systems	1/3 months	Accuracy ± 2 %		
Detection				
Noise	NA	0.005 ppm	40 CFR Part 53.20	
Lower detectable level	1/year	0.01 ppm	40 CFR Part 53.20	
SYSTEMATIC CRITERIA- SO_2				
Standard Reporting Units	All data	ppm (final units in AQS)		
Completeness (seasonal)	Quarterly	75%	Annual standard	
	24 hours	75%	24-hour standard	
	3 hours	75%	3-hour standard	
Sample Residence Times		< 20 seconds		
Sample Probe, Inlet, Sampling train		Borosilicate glass (e.g., Pyrex®) or Teflon®	40 CFR Part 58 App E	
Siting		Un-obstructed probe inlet	40 CFR Part 58 App E	

$PM_{2.5}$ Filter Based Local Conditions Validation Template

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
CRITICAL CRITERIA- $PM_{2.5}$ Filter Based Local Conditions				
Filter Holding Times				
Sample Recovery	all filters	≤ 7 days 9 hours from sample end date	Part 50 App L Sec 10.10	
Post-sampling Weighing	all filters	≤ 10 days from sample end date if shipped at ambient temp, or ≤ 30 days if shipped below ave ambient (or 4° C or below for ave sampling temps < 4° C) from sample end date	Part 50 App L Sec 8..3.6	
Sampling Period (including multiple power failures)	all filters	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS [1/] midnight to midnight	Part 50 App L Sec 3.3 Part 50, App.L Sec 7.4.15	
Sampling Instrument				
Average Flow Rate	every 24 hours of op	average within 5% of 16.67 liters/minute	Part 50 App L Sec 7.4	
Variability in Flow Rate	every 24 hours of op	CV ≤ 2%	Part 50, App.L Sec 7.4.3.2	
Filter				
Visual Defect Check (unexposed)	all filters	see reference	Part 50, App.L Sec 10.2	
Filter Conditioning Environment				
Equilibration	all filters	24 hours minimum	Part 50, App.L Sec 8.2	
Temp. Range	all filters	24-hr mean 20-23° C	Part 50, App.L Sec 8.2	
Temp.Control	all filters	± 2° C SD* over 24 hr	Part 50, App.L Sec 8.2	
Humidity Range	all filters	24-hr mean 30% - 40% RH or ≤ 5% sampling RH but > 20%RH	Part 50, App.L Sec 8.2	
Humidity Control	all filters	± 5% SD* over 24 hr.	Part 50, App.L Sec 8.2	
Pre/post Sampling RH	all filters	difference in 24-hr means ≤ ± 5% RH	Part 50, App.L Sec 8.3.3	
Balance	all filters	located in filter conditioning environment	Part 50, App.L Sec 8.3.2	
Verification/Calibration				
One-point Flow Rate Verification	1/4 weeks	± 4% of transfer standard	Part 50, App.L, Sec 9.2.5 Part 58, Appendix A Sec 3.2.3 & 3.3.2	
OPERATIONAL EVALUATIONS TABLE $PM_{2.5}$ Filter Based Local Conditions				
Filter Checks				
Lot Blanks	9 filters per lot	less than 15 μg change between weighings	Method 2.12 Sec. 7.7	
Exposure Lot Blanks	3 filters per lot	less than 15 μg change between weighings	Method 2.12 Sec. 7.7	
Filter Integrity (exposed)	each filter	no visual defects	Method 2.12 Sec. 8.2	
Filter Holding Times				
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3	
Lab QC Checks				
Field Filter Blank	10% or 1 per weighing session	± 30 μg change between weighings	Part 50, App.L Sec 8.3	
Lab Filter Blank	10% or 1 per weighing session	± 15 μg change between weighings	Part 50, App.L Sec 8.3	
Balance Check	beginning, 10th sample, end	≤3 μg	Method Sec. 7.9	
Duplicate Filter Weighing	1 per weighing session	± 15 μg change between weighings	Method Sec 7.11	
Sampling Instrument				

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
Individual Flow Rates	every 24 hours of op	no flow rate excursions > ±5% for > 5 min. 1/	Part 50, App.L Sec 7.4.3.1	
Filter Temp Sensor	every 24 hours of op	no excursions of > 5° C lasting longer than 30 min 1/	Part 50, App.L Sec 7.4	
Verification/Calibration				
Routine Verifications				
External Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4	
Internal Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4	
One-point Temp Verification	1/4 weeks	± 2°C	Part 50, App.L, Sec 9.3	
Pressure Verification	1/4 weeks	± 10 mm Hg	Part 50, App.L, Sec 9.3	
Lab Temperature	1/6 months	± 2°C	Method Sec 3.3	
Lab Humidity	1/6 months	± 2%	Method Sec 3.3	
Annual Multi-point Verifications /Calibrations				
Temperature multi-point Verification/Calibration	1/yr	± 2°C	Part 50, App.L, Sec 9.3	
Pressure Verification/Calibration	on installation, then 1/yr	± 10 mm Hg	Part 50, App.L, Sec 9.3	
Flow Rate Multi-point Verification/ Calibration	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2	
Design Flow Rate Adjustment	at one-point or multi-point	± 2% of design flow rate	Part 50, App.L, Sec 9.2.6	
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual		
Mirobalance Calibration	1/yr	Manufacturer's specification	Part 50, App.L, Sec 8.1	
Precision				
Collocated Samples	every 12 days for 15% of sites	CV ≤ 10% of samples > 3 μg/m^3	Part 58 App A Sec 3.2.5	
Accuracy				
Temperature Audit	2/yr	± 2°C	Method Sec. 10.2	
Pressure Audit	2/yr	±10 mm Hg	Method Sec. 10.2	
Balance Audit	1/yr	± 0.050 mg or manufacturers specs, whichever is tighter	Method Sec. 10.2	
Semi Annual Flow Rate Audit	2/yr	± 4% of audit standard ± 5% of design flow rate	Part 58, App A, Sec 3.3.3	
Calibration & Check Standards -				
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method Sec 4.2 & 6.4	
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method Sec 4.2 & 6.5	
Working Mass Stds. (compare to primary standards)	1/3 mo.	0.025 mg	Method Sec 4.3 and 7.3	
Monitor Maintenance				
Impactor (WINs) Very Sharp Cut Cyclone	every 5 sampling events Every 30 days	cleaned/changed	Method Sec 9.2	
Inlet/downtube Cleaning	every 15 sampling events	cleaned	Method Sec 9.3	
Filter Chamber Cleaning	1/4 weeks	cleaned	Method Sec 9.3	

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
Leak Check @		see ***Verification/Calibration***		
Circulating Fan Filter Cleaning	1/4 weeks	cleaned/changed	Method Sec 9.3	
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP		
		SYSTEMATIC CRITERIA -$PM_{2.5}$ Filter Based Local Conditions		
Data Completeness	quarterly	$\geq$ 75%	Part 50, App. N, Sec. 4.1 (b) 4.2 (a)	
Reporting Units	all filters	$\mu g/m^3$ at ambient temp/pressure ($PM_{2.5}$)	Part 50.3	
Rounding Convention				
Annual 3-yr average	quarterly	nearest 0.1 $\mu g/m^3$ ($\geq$ 0.05 round up)	Part 50, App. N Sec 2.3	
24-hour, 3-year average	quarterly	nearest 1 $\mu g/m^3$ ($\geq$ 0.5 round up)	Part 50, App. N Sec 2.3	
Detection Limit				
Lower DL	all filters	$\leq$ 2 $\mu g/m^3$	Part 50, App.L Sec 3.1	
Upper Conc. Limit	all filters	$\geq$ 200 $\mu g/m^3$	Part 50, App.L Sec 3.2	
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards				
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, App.L Sec 9.1 & 9.2	
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method Sec 4.2.2	
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method Sec 4.2.2	
Primary Mass Stds. (compare to NIST-traceable standards)	1/yr	0.025 mg	Method Sec 4.3.7	
Microbalance				
Readability	at purchase	1 μg	Part 50, App.L Sec 8.1	
Repeatability	1/yr	1μg		
Calibration & Check Standards				
Flow Rate Transfer Std.	1/yr	± 2% of NIST-traceable Std.	Part 50, APP L, Sec 9.1 & 9.2	
Verification/Calibration				
Clock/timer Verification	1/4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	
Precision				
Single analyzer	1/3 mo.	Coefficient of variation (CV) $\leq$ 10%		
Single analyzer	1/ yr	CV $\leq$ 10%		
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV $\leq$ 10%	Part 58, App A, Sec 4.3.1	
Bias				
Performance Evaluation Program (PEP)	5 audits for PQAOs with $\leq$ 5 sites 8 audits for PQAOs with > 5 sites	±10%	Part 58, App A, Sec 3.2.7, 4.3.2	

1/ **value must be flagged** *** SD= standard deviation** **CV= coefficient of variation** **@ = Scheduled to occur immediately after impactor cleaned/changed.**

NOTE: The following validation template was constructed for use of PM_{10} at local conditions where PM_{10} is used in the calculation of the $PM_{10\text{-}2.5}$ measurement or for objectives other than comparison to the PM_{10} NAAQS. Although the PM $_{10\text{-}2.5}$ method is found in 40 CFR Part 50 Appendix O, Appendix O references Appendix L (the $PM_{2.5}$ Method) for the QC requirements listed below. Monitoring organizations using PM_{10} data for a NAAQS comparison purposes should refer to the PM_{10} validation template for STP (standard temperature and pressure correction).

PM_{10} Filter Based Local Conditions Validation Template

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
CRITICAL CRITERIA- PM_{10} Filter Based Local Conditions				
Filter Holding Times				
Sample Recovery	all filters	≤ 7 days 9 hours from sample end date	Part 50 App L Sec 10.10	
Post-sampling Weighing	all filters	≤ 10 days from sample end date if shipped at ambient temp, or ≤ 30 days if shipped below ave ambient (or 4° C or below for ave sampling temps < 4° C) from sample end date	Part 50 App L Sec 8..3.6	
Sampling Period (including multiple power failures)	all filters	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS [1/] midnight to midnight	Part 50 App L Sec 3.3 Part 50, App.L Sec 7.4.15	
Sampling Instrument				
Average Flow Rate	every 24 hours of op	average within 5% of 16.67 liters/minute	Part 50 App L Sec 7.4	
Variability in Flow Rate	every 24 hours of op	CV ≤ 2%	Part 50, App.L Sec 7.4.3.2	
Filter				
Visual Defect Check (unexposed)	all filters	see reference	Part 50, App.L Sec 10.2	
Filter Conditioning Environment				
Equilibration	all filters	24 hours minimum	Part 50, App.L Sec 8.2	
Temp. Range	all filters	24-hr mean 20-23° C	Part 50, App.L Sec 8.2	
Temp.Control	all filters	± 2° C SD* over 24 hr	Part 50, App.L Sec 8.2	
Humidity Range	all filters	24-hr mean 30% - 40% RH or ≤ 5% sampling RH but > 20%RH	Part 50, App.L Sec 8.2	
Humidity Control	all filters	± 5% SD* over 24 hr.	Part 50, App.L Sec 8.2	
Pre/post Sampling RH	all filters	difference in 24-hr means ≤ ± 5% RH	Part 50, App.L Sec 8.3.3	
Balance	all filters	located in filter conditioning environment	Part 50, App.L Sec 8.3.2	
Verification/Calibration				

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
One-point Flow Rate Verification	1/4 weeks	± 4% of transfer standard	Part 50, App.L, Sec 9.2.5 Part 58, Appendix A Sec 3.2.3 & 3.3.2	
OPERATIONAL EVALUATIONS TABLE PM_{10} Filter Based Local Conditions				
Filter Checks				
Lot Blanks	9 filters per lot	less than 15 μg change between weighings	Method 2.12 Sec. 7.7	
Exposure Lot Blanks	3 filters per lot	less than 15 μg change between weighings	Method 2.12 Sec. 7.7	
Filter Integrity (exposed)	each filter	no visual defects	Method 2.12 Sec. 8.2	
Filter Holding Times				
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3	
Lab QC Checks				
Field Filter Blank	10% or 1 per weighing session	± 30 μg change between weighings	Part 50, App.L Sec 8.3	
Lab Filter Blank	10% or 1 per weighing session	± 15 μg change between weighings	Part 50, App.L Sec 8.3	
Balance Check	beginning, 10th sample, end	$\leq$3 μg	Method Sec. 7.9	
Duplicate Filter Weighing	1 per weighing session	± 15 μg change between weighings	Method Sec 7.11	
Sampling Instrument				
Individual Flow Rates	every 24 hours of op	no flow rate excursions > ±5% for > 5 min. 1/	Part 50, App.L Sec 7.4.3.1	
Filter Temp Sensor	every 24 hours of op	no excursions of > 5° C lasting longer than 30 min 1/	Part 50, App.L Sec 7.4	
Verification/Calibration				
Routine Verifications				
External Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4	
Internal Leak Check	every 5 sampling events	< 80 mL/min	Part 50, App.L, Sec 7.4	
One-point Temp Verification	1/4 weeks	± 2°C	Part 50, App.L, Sec 9.3	
Pressure Verification	1/4 weeks	± 10 mm Hg	Part 50, App.L, Sec 9.3	
Lab Temperature	1/6 months	± 2°C	Method Sec 3.3	
Lab Humidity	1/6 months	± 2%	Method Sec 3.3	
Annual Multi-point Verifications /Calibrations				
Temperature multi-point Verification/Calibration	1/yr	± 2°C	Part 50, App.L, Sec 9.3	
Pressure Verification/Calibration	on installation, then 1/yr	± 10 mm Hg	Part 50, App.L, Sec 9.3	
Flow Rate Multi-point Verification/ Calibration	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2	

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
Design Flow Rate Adjustment	at one-point or multi-point	± 2% of design flow rate	Part 50, App.L, Sec 9.2.6	
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual		
Mirobalance Calibration	1/yr	Manufacturer's specification	Part 50, App.L, Sec 8.1	
Precision				
Collocated Samples	every 12 days for 15% of sites	CV $\leq$ 10% of samples > 3 $\mu g/m^3$	Part 58 App A Sec 3.2.5	
Accuracy				
Temperature Audit	2/yr	± 2°C	Method Sec. 10.2	
Pressure Audit	2/yr	±10 mm Hg	Method Sec. 10.2	
Balance Audit	1/yr	± 0.050 mg or manufacturers specs, whichever is tighter	Method Sec. 10.2	
Semi Annual Flow Rate Audit	2/yr	± 4% of audit standard ± 5% of design flow rate	Part 58, App A, Sec 3.3.3	
Calibration & Check Standards (working standards)				
Field Thermometer	1/yr	± 0.1° C resolution, ± 0.5° C accuracy	Method Sec 4.2 & 6.4	
Field Barometer	1/yr	± 1 mm Hg resolution, ± 5 mm Hg accuracy	Method Sec 4.2 & 6.5	
Working Mass Stds. (compare to primary standards)	1/3 mo.	0.025 mg	Method Sec 4.3 and 7.3	
Monitor Maintenance				
Inlet/downtube Cleaning	every 15 sampling events	cleaned	Method Sec 9.3	
Filter Chamber Cleaning	1/4 weeks	cleaned	Method Sec 9.3	
Leak Check [@]		see ***Verification/Calibration***		
Circulating Fan Filter Cleaning	1/4 weeks	cleaned/changed	Method Sec 9.3	
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP		
SYSTEMATIC CRITERIA -PM_{10} Filter Based Local Conditions				
Data Completeness	quarterly	$\geq$ 75%	Part 50, App. N, Sec. 2.1	
Reporting Units	all filters	$\mu g/m^3$ at ambient temp/pressure ($PM_{2.5}$)	Part 50.3	
Rounding Convention				
Annual 3-yr average	quarterly	nearest 0.1 $\mu g/m^3$ ($\geq$ 0.05 round up)	Part 50, App. N Sec 2.3	
24-hour, 3-year average	quarterly	nearest 1 $\mu g/m^3$ ($\geq$ 0.5 round up)	Part 50, App. N Sec 2.3	
Detection Limit				
Lower DL	all filters	$\leq$ 2 $\mu g/m^3$	Part 50, App.L Sec 3.1	

Criteria	Frequency	Acceptable Range	Information (CFR or Method 2.12)	
Upper Conc. Limit	all filters	$\geq$ 200 $\mu g/m^3$	Part 50, App.L Sec 3.2	
Verification/Calibration Standards Recertifications- All standards should have multi-point certifications against NIST Traceable standards				
Flow Rate Transfer Std.	1/yr	$\pm$ 2% of NIST-traceable Std.	Part 50, App.L Sec 9.1 & 9.2	
Field Thermometer	1/yr	$\pm$ 0.1° C resolution, $\pm$ 0.5° C accuracy	Method Sec 4.2.2	
Field Barometer	1/yr	$\pm$ 1 mm Hg resolution, $\pm$ 5 mm Hg accuracy	Method Sec 4.2.2	
Primary Mass Stds. (compare to NIST-traceable standards)	1/yr	0.025 mg	Method Sec 4.3.7	
Microbalance				
Readability	at purchase	1 μg	Part 50, App.L Sec 8.1	
Repeatability	1/yr	1μg		
Calibration & Check Standards				
Flow Rate Transfer Std.	1/yr	$\pm$ 2% of NIST-traceable Std.	Part 50, APP L, Sec 9.1 & 9.2	
Verification/Calibration				
Clock/timer Verification	1/4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	
Precision				
Single analyzer	1/3 mo.	Coefficient of variation (CV) $\leq$ 10%		
Single analyzer	1/ yr	CV $\leq$ 10%		
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV $\leq$ 10%	Part 58, App A, Sec 4.3.1	
Bias				
Performance Evaluation Program (PEP)	5 audits for PQAOs with $\leq$ 5 sites 8 audits for PQAOs with > 5 sites	$\pm$10%	Part 58, App A, Sec 3.2.7, 4.3.2	

1/ value must be flagged
SD= standard deviation
CV= coefficient of variation
@ = Scheduled to occur immediately after impactor cleaned/changed.

Attachment 3
Dominion Virginia Power Air Quality Monitoring Program Quarterly Monitoring Report

Dominion Virginia Power
Air Quality Monitoring Program
Brunswick County, Virginia

Quarterly Monitoring Report
For the Period of February 1, 2015 through April 30, 2015

Prepared for:

Dominion Resources Services, Inc.

Prepared by:

TRC Environmental

June 2015

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Appendices

1.0 INTRODUCTION AND PROJECT DESCRIPTION

The purpose of this monitoring program is to conduct at least one year of pre-construction prevention of significant deterioration (PSD) air quality monitoring in the vicinity of sites being considered for a new power generation facility. All parameters are monitored at a single location identified as the Edgerton Site, which provides representative air quality for the region.

The Edgerton Site meets USEPA siting criteria for air quality and meteorological instrumentation. Air quality measurements include concentrations of particulate matter (PM) with aerodynamic diameters less than or equal to 10 and 2.5 micrometers (PM_{10} and $PM_{2.5}$, respectively), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and nitrogen dioxide (NO_2).

A single tower with wind instrumentation installed at 30 meters allows for compliance with the general siting requirements specified in the Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV: Meteorological Measurements Version 2.0 (Final). Meteorological measurements include: horizontal wind speed and direction (WS and WD, respectively), vertical wind speed, temperature (T), relative humidity (RH), and solar radiation (SR).

1.1 Project Description and Schedule

Figure 1 indicates the locations of the Brunswick County monitoring station for this program. This site is consistent with the directive of the VDEQ. The monitoring station at the Edgerton Tower Site is equipped with the following continuous gas analyzers:

- Teledyne-Advanced Pollution Instrumentation (TAPI) model T100 UV Fluorescent SO_2 Analyzers. The T100 is designated as a Federal Equivalent Method (FEM), designation EQSA-0495-100.
- Thermo Scientific Model 48i Gas Filter Correlation (GFC) CO analyzer. The 48i is designated as a Federal Reference Method (FRM), designation RFCA-0981-054. Hourly averaged concentrations of CO will be calculated to comply with reporting requirements established for CO.
- T400 UV Absorption Ozone analyzer. The T400 photometric ozone analyzer is designated as a Federal Equivalent Method, designation EQOA-0992-087. Hourly averaged concentrations of O_3 will be calculated to comply with reporting requirements established for O_3.
- Thermo Environmental Model 42i Chemiluminescence NO/NO2 analyzer. The 42i is designated as a Federal Reference Method (FRM), designation RFNA-1289-074. Hourly averaged concentrations of NO/NO_2 will be calculated to comply with reporting requirements established for NO/NO_2.

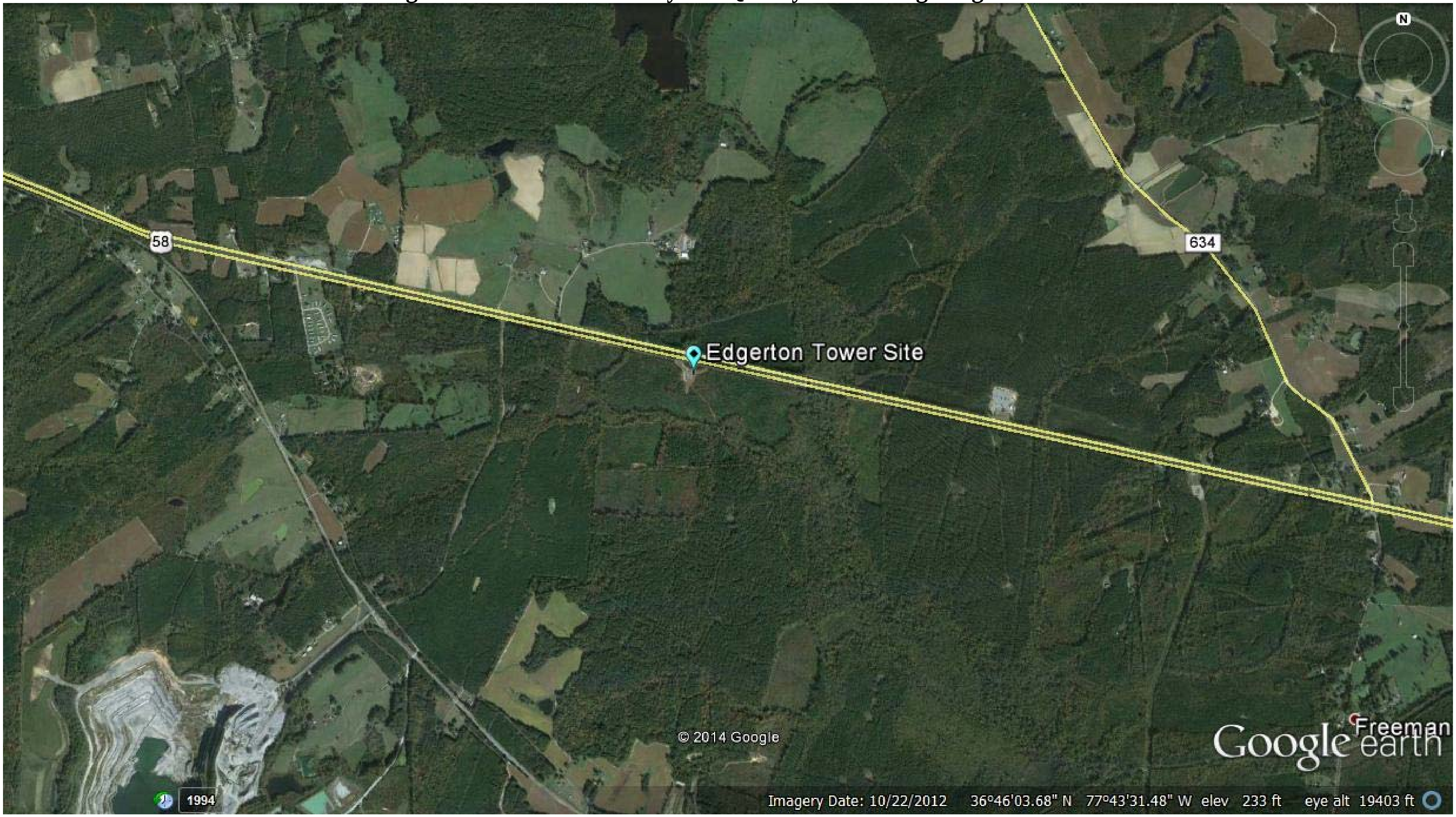
All gas analyzers are calibrated with a TAPI Model T700 dynamic dilution calibrator configured with gas phase titration (GPT) and an internal photometer certified as a Level 2 ozone transfer standard. Calibration dilution gas will be generated using a TAPI Model 701 zero air system.

The monitoring station is also equipped with four BGI PQ200 samplers which are designated as Federal Reference Methods. Two of the BGI PQ200 samplers are set up for the sampling of $PM_{2.5}$ and the other two are set up for the sampling of PM_{10}. The configuration of these collocated PM samplers allows for the determination of accuracy.

A meteorological tower at this site provides wind speed, wind direction, temperature, relative humidity, and solar radiation data on a 5-minute basis. The monitoring components for this program are outlined in the Quality Assurance Project Plan.

TRC began the ambient monitoring program on November 1, 2013. This report provides the results for the parameters identified above for the period of February 1, 2015 through April 30, 2015. TRC submitted a Revised Quality Assurance Project Plan to Dominion Resources on March 27, 2014 and is operating these stations in accordance with that Plan.

Figure 1: Brunswick County Air Quality Monitoring Program Site



1.2 Quality Criteria for Measurement Data

Quality criteria are defined for the measured data. These criteria, shown in Table 1, are designed to document the accuracy of measurements of particulate matter, SO_2, CO, NO_2 and O_3. The accuracy goal is instrument response within 10% of the "true" input concentration. The quality criteria for meteorological measurements are determined by Prevention of Significant Deterioration (PSD) monitoring guidelines developed by the United States Environmental Protection Agency (U.S. EPA). These are outlined in the Quality Assurance Handbook for Air Pollution Measurement Systems - Volume IV: Meteorological Measurements Version 2.0.

Table 1: Quality Criteria for Measurement Data

1. Continuous Measurements of Sulfur Dioxide, Ozone, and Nitrogen Dioxide	
Sensitivity	≤ 1.0 ppbv for 1-minute cycle time basis
Instrument Operating Range	0 – 500 ppb
Accuracy	15% for each audit level
Precision	SO_2: 90% CL CV ≤ 10% based on precision checks O_3: 90% CL CV ≤ 7% based on precision checks NO_2: 90% CL CV ≤ 15% based on precision checks
Completeness	90% of hourly values per monitoring quarter (Acts of Nature, vandalism, or terrorism that results in data loss of no more than 5 days will not be included in data loss calculations)
Zero level	± 3 ppb
2. Continuous Measurements of Carbon Monoxide	
Sensitivity	≤ 0.10 ppm for 1-minute cycle time basis
Instrument Operating Range	0 – 50 ppm
Accuracy	15% for each audit level
Precision	90% CL CV ≤ 10% based on precision checks
Completeness	90% of hourly values per monitoring quarter (Acts of Nature, vandalism, or terrorism that results in data loss of no more than 5 days will not be included in data loss calculations)
Zero Level	± 0.3 ppm
3. Particulate Matter	
Sensitivity	1 ug/m^3
Instrument Operating Range	0-1,000 $\mu g/m^3$
Accuracy	± 4% of reference flow standard and ±5% of nominal flow of $1m^3/hr$
Precision	CV < 10% for samples > 3 $\mu g/m^3$ (Note: This is a goal)
Completeness	Collocated FRM Sampler: 90% of valid samples per monitoring quarter (Acts of Nature, vandalism, or terrorism that results in data loss of no more than 5 days will not be included in data loss calculations)
2. Meteorological Data	
Wind speed	Accuracy ± 0.5 m/s
Wind direction	Accuracy ± 5 degrees
Completeness	90% or better for meteorological data based on 15-minute averages with a minimum 75% completeness of 5-minute data to construct a valid 15-minute average (Acts of God, vandalism, or terrorism that results in data loss of no more than five days will not be included in data loss calculations)

2.0 EXECUTIVE SUMMARY

The data presented in this report include air quality and meteorological measurements collected from February 1st through April 30th at the single monitoring site located in Brunswick County, VA.

Instrument failures during this monitoring quarter resulted in periods of data loss. On February 1st the O_3 analyzer experienced a software failure resulting in an approximately 8 hour period of data loss. The O_3 analyzer experienced another software failure on February 22nd resulting in a data loss of approximately 3 hours. On February 16th the SO_2 analyzer lost connection to the local area network (LAN), resulting in loss of data of approximately 3 hours.

Minor repairs and routine maintenance, including calibration checks and programming, are responsible for other small periods of data loss during this monitoring quarter.

All losses in data did not substantially affect the data capture for the quarter which is described further in Section 2.2.

2.1 Comparison to National Ambient Air Quality Standards

Maximum concentrations for the monitoring period of February 1, 2015 through April 30, 2015 are presented in Table 2 below. Concentrations are presented below based on criteria for comparison to the National Ambient Air Quality Standards (NAAQS).

Table 2: Quarterly Maximum Concentrations

	Parameter					
	CO (ppm)	**O_3 (ppb)**	**NO_2 (ppb)**	**SO_2 (ppb)**	**PM_{10} (μg/m^3)**	**$PM_{2.5}$ (μg/m^3)**
Highest 1 hour	0.7	58.8	26.4	7.0	N/A	N/A
Highest 8 hour	0.7	56.0	N/A	N/A	N/A	N/A
Highest 24 hour	N/A	N/A	N/A	N/A	16.4	13.0

There were no instances during the calendar period of February 1st through April 30th where any of the NAAQS were exceeded. Data collected throughout an entire year of monitoring (May 1, 2014 through April 30, 2015) are compared to the NAAQS in Table 3, below.

Table 3: NAAQS Comparison

Pollutant	NAAQS Concentration	Recorded Concentration for NAAQS Comparison	NAAQS Exceeded?
Particulate Matter (PM_{10})	24-hour average: 150 ug/m^3	Max 24-hour average: 26.2 ug/m^3	NO
Particulate Matter ($PM_{2.5}$)	Annual Mean: 12.0 ug/m^3	Annual Mean: 8.0 ug/m^3	NO
	24-hour average: 35 ug/m^3	Max 24-hour average: 15.2 ug/m^3	NO
Sulfur Dioxide	1-hour average: 75 ppb	Max 1-hour average: 6.8 ppb	NO
Nitrogen Dioxide	1-hour average: 100 ppb	Max 1-hour average: 26.5 ppb	NO
	Annual Mean: 53 ppb	Annual Mean: 4.21 ppb	NO
Carbon Monoxide	1-hour average: 35 ppm	Max 24-hour average: 1.6 ppm	NO
	8-hour average: 9 ppm	Max 8-hour average: 0.8 ppm	NO
Ozone	8-hour average: 75 ppb	Max 8-hour average: 59 ppb	NO

2.2 Data Completeness for the Period

The table below provides quarterly data capture on a parameter specific basis. The data completeness percentages are based on the VDEQ's definition of Data Completeness (data meeting all calibration, accuracy, and calibration check control requirements). Please note that data losses attributed to events out of TRC's control (including power outages, acts of nature, etc.) are not included in completeness calculations.

Table 4: 6th Quarter Percent Data Completeness

	Sulfur Dioxide		Ozone		Nitrogen Dioxide		Carbon Monoxide	
Continuous Gas Analyzers	6th Quarter	Cumulative	6th Quarter	Cumulative	6th Quarter	Cumulative	6th Quarter	Cumulative
	93.8%	93.0%	93.9%	94.6%	95.3%	94.4%	95.4%	96.8%
Particulate Matter (24-hour)	**PM_{10}**		**$PM_{2.5}$**					
	6th Quarter	Cumulative	6th Quarter	Cumulative				
	100%	97.3%	100%	97.3%				
Met Parameters	**Wind Speed/Wind Direction**		**Temperature**		**Relative Humidity**		**Solar Radiation**	
	6th Quarter	Cumulative	6th Quarter	Cumulative	6th Quarter	Cumulative	6th Quarter	Cumulative
	100.0%	97.0%	100.0%	80.6%	100.0%	97.0%	100.0%	97.1%%

Table 5: Cumulative Data Completeness May 1, 2014 through April 30, 2015

	Sulfur Dioxide	Ozone	Nitrogen Dioxide	Carbon Monoxide
Continuous Gas Analyzers	94.2%	95.4%	96.5%	96.6%
Particulate Matter (24-hour)	**PM_{10}**	**$PM_{2.5}$**		
	97.7%	95.9%		
Met Parameters	**Wind Speed/Wind Direction**	**Temperature**	**Relative Humidity**	**Solar Radiation**
	96.7%	96.7%	96.7%	96.8%

Data completeness for the sixth quarter of air monitoring satisfies the goal of 90% set forth in the Quality Assurance Project Plan. The Quarter 1 through Quarter 6 cumulative percent completeness does not meet the goal of 90% for temperature since all temperature data from the second quarter (February – April 2014) has been invalidated. However, the cumulative percent completeness for temperature data for the four consecutive quarters from May 1, 2014 through April 30, 2015 is 96.7%, as shown in Table 5.

Please note, the completeness for PM_{10} and $PM_{2.5}$ are based on collocated sample substitution. During the month of March, a total of four (4) collocated PM_{10} samples were invalid due to motor malfunctions of the sampler pump.

2.3 Meteorological Data

The wind speed and wind direction tables from the 30-meter tower located at the Edgerton Tower Site Location are presented in an Excel file labeled: Appendix_B-Meteorological _Parameters_Q6-BrunswickCounty_Edgerton Tower. All meteorological instruments are next scheduled for a complete audit and calibration in June 2015.

There were no losses of meteorological data during this monitoring quarter.

2.4 Summary of Measurement Results

Winds were variable during this reporting period. A wind rose is presented in Figure 2. Pollution Roses of gas concentrations, including: SO_2, O_3, CO, and NO_2 are presented in Figures 3 through 6.

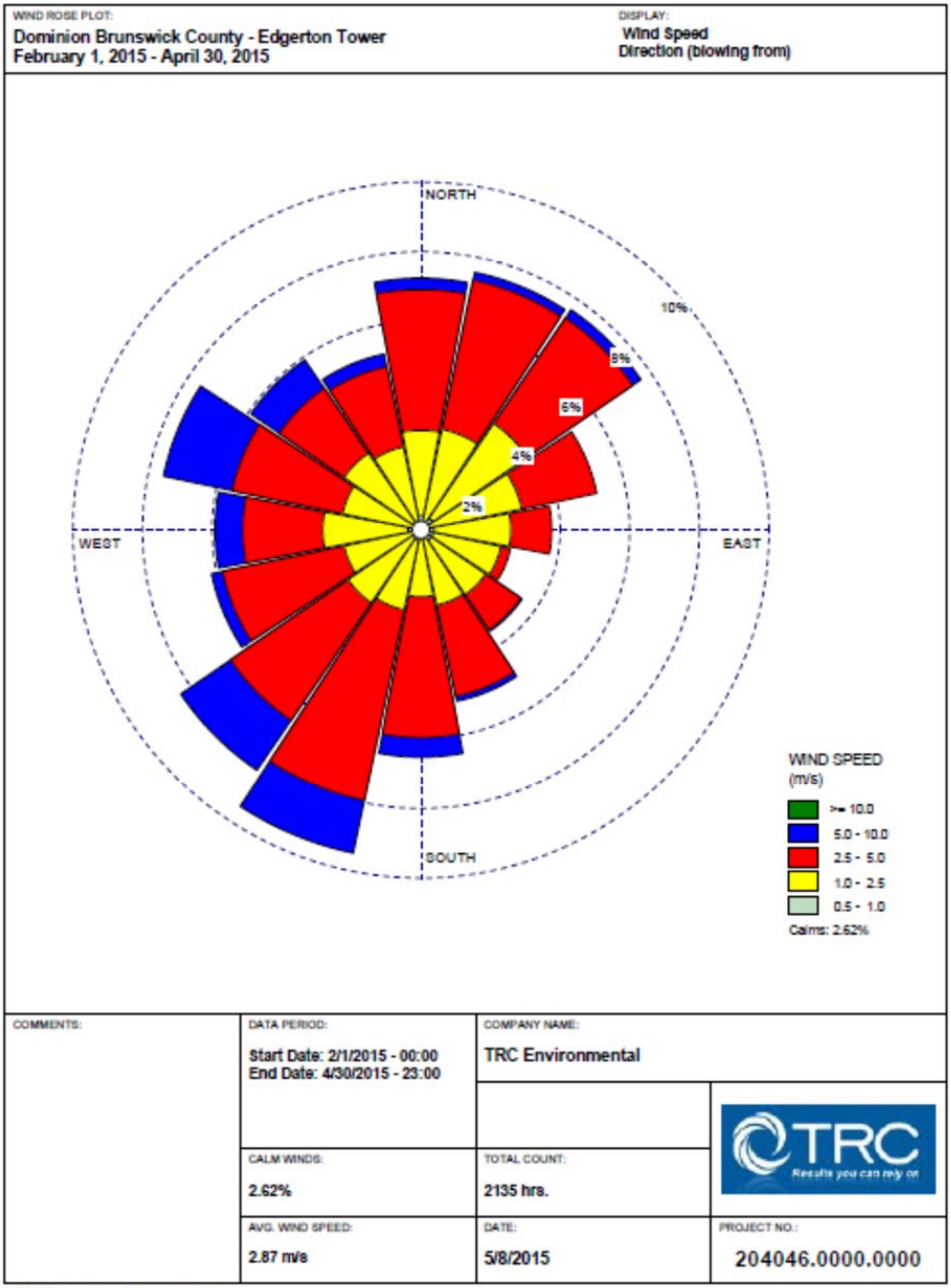


Figure 2: Wind Rose – 30m Meteorological Tower

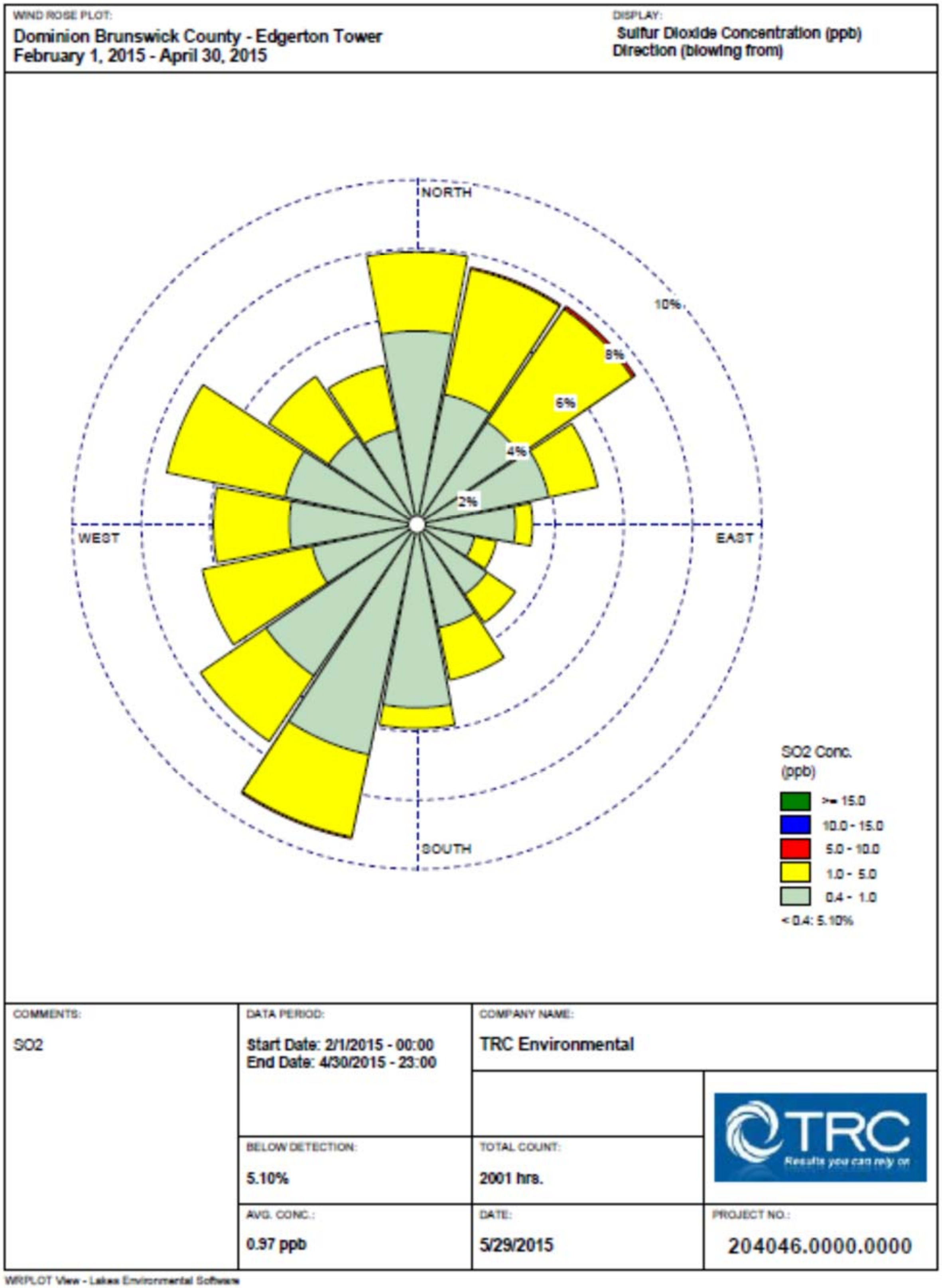


Figure 3: SO_2 Pollution Rose

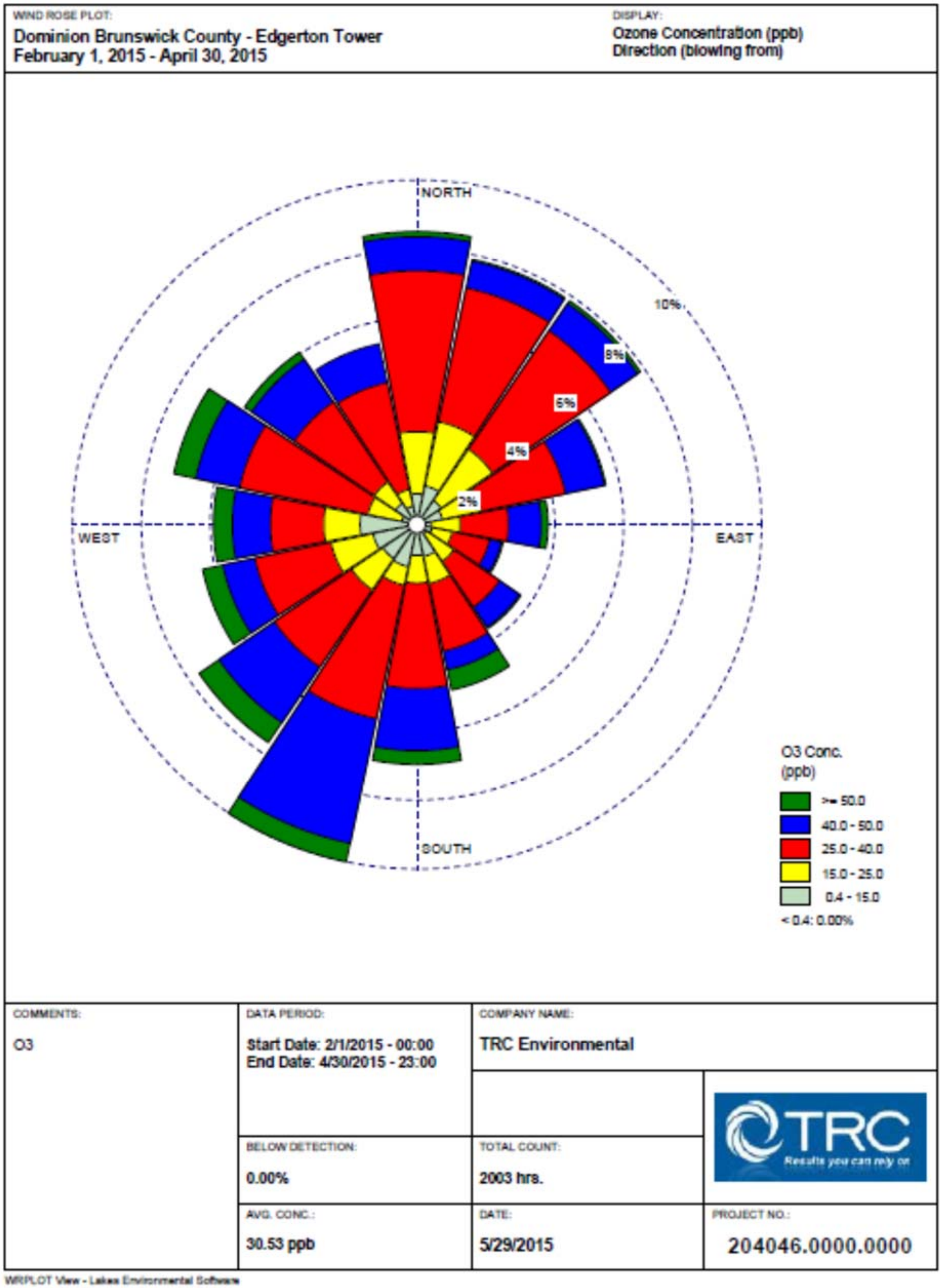


Figure 4: O_3 Pollution Rose

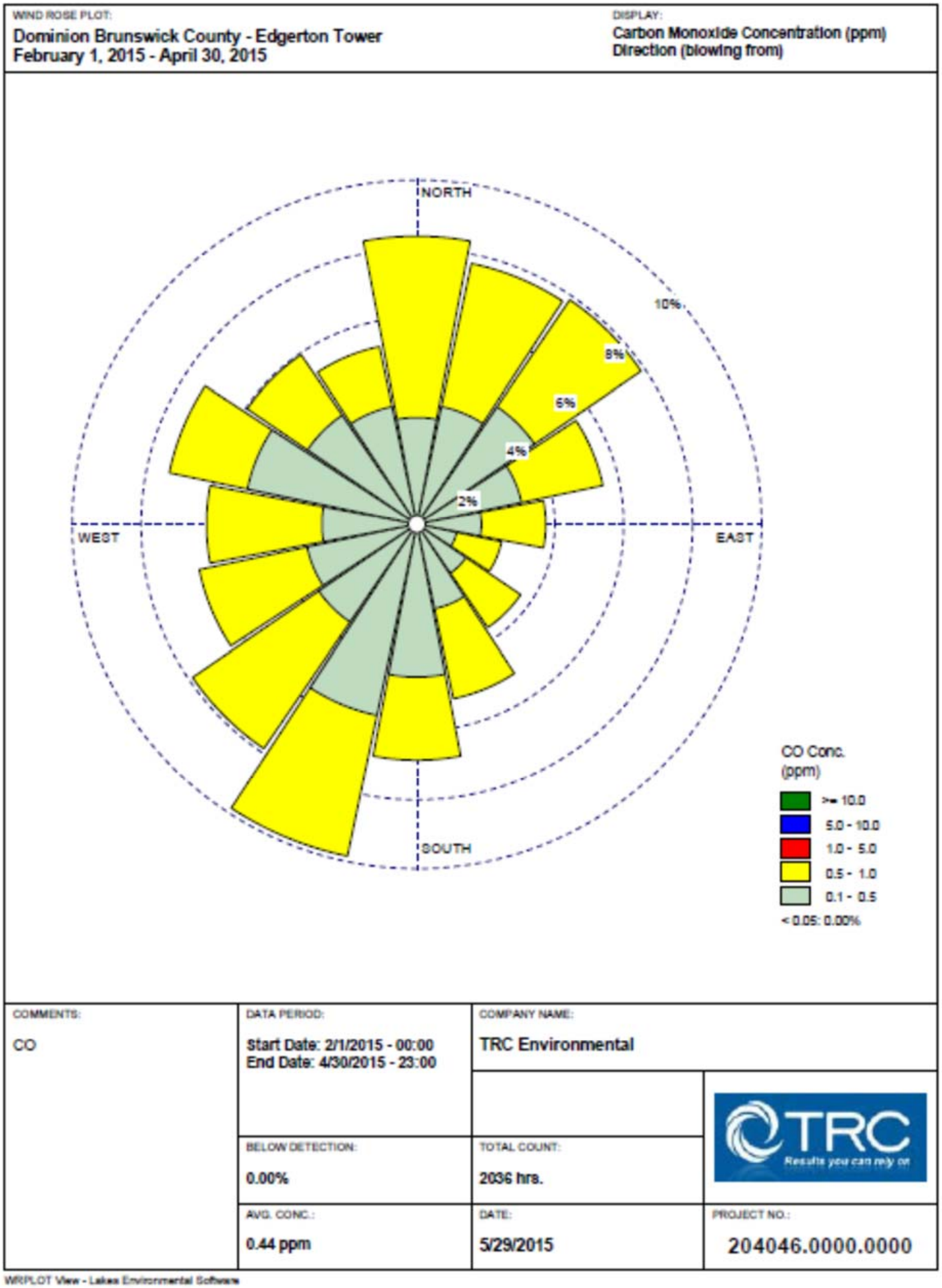


Figure 5: CO Pollution Rose

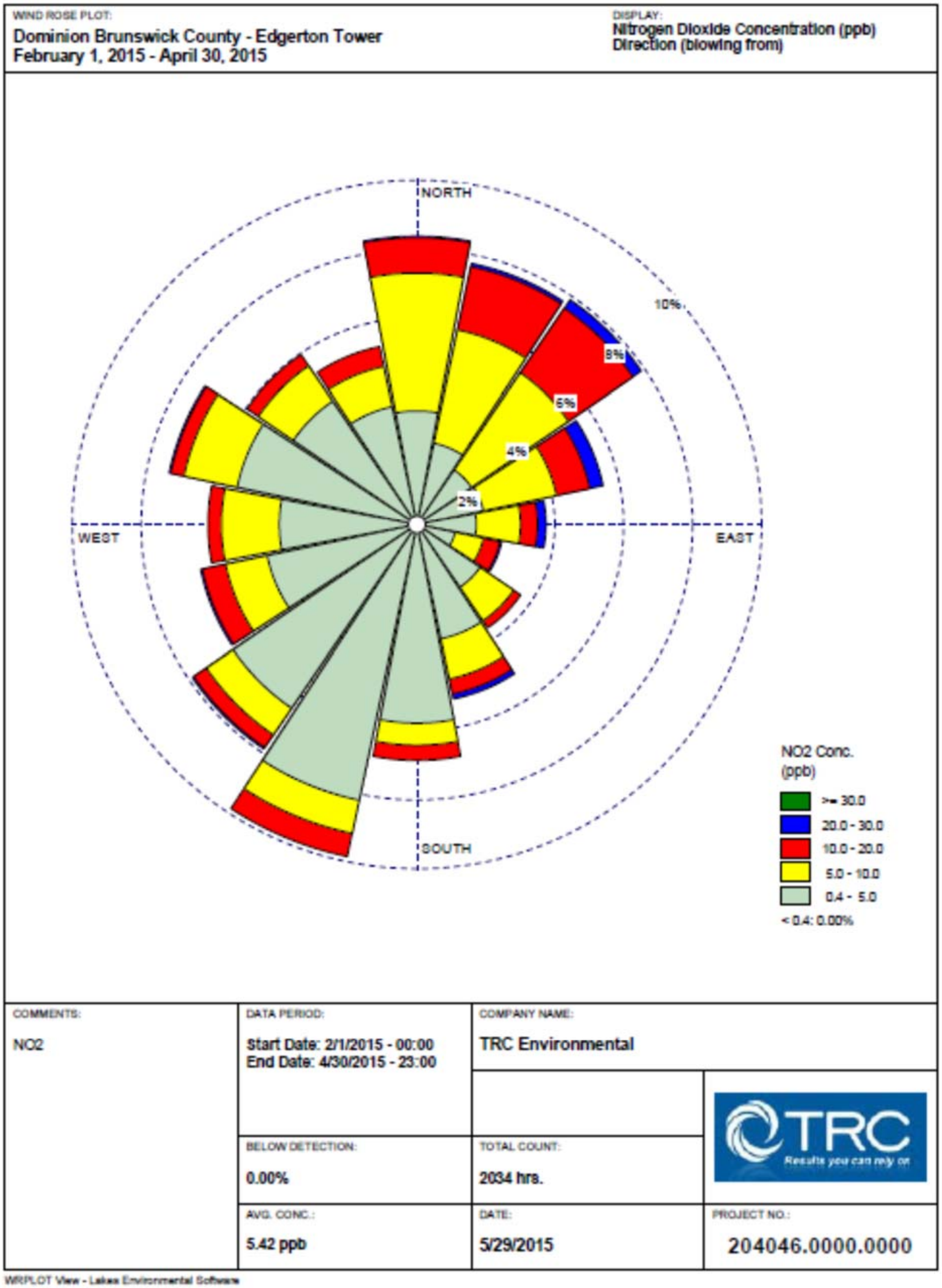


Figure 6: NO_2 Pollution Rose

3.0 QUALITY CONTROL DATA

3.1 Collocated FRM Particulate Samples

The precision of manual PM samplers is determined by collocated sampling (i.e. the simultaneous operation of two identical samplers placed side by side). The difference in the results of the two samplers is used to estimate the precision of the entire measurement process (i.e., both field and laboratory precision) by calculating the coefficient of variation (CV) of the relative percent differences (di).

For the determination of PM_{10} and $PM_{2.5}$ precision, collocated samples were collected at the Edgerton Tower site on a 6-day schedule utilizing collocated BGI PQ-200 FRM samplers.

Table 6, below, is a summary of collocated samples collected during the calendar period of February 1, 2015 through April 30, 2015.

Table 6: Collocated FRM Sample Results

Sample Collection Date	PARTICULATE MATTER CONCENTRATION (ug/m^3)			
	$PM_{2.5}$		PM_{10}	
	Primary	Collocated	Primary	Collocated
2/5/15	6.3	6.4	7.6	7.4
2/11/15	5.1	5.6	7.5	8.9
2/17/15	5.7	6.7	9.9	8.0
2/26/15	Invalid Sample	10.5	Invalid Sample	11.0
3/1/15	10.1	10.4	12.9	12.7
3/10/15	8.7	9.1	15.2	Invalid Sample
3/13/15	5.0	5.2	8.6	Invalid Sample
3/19/15	6.0	6.2	11.0	Invalid Sample
3/25/15	7.8	8.0	15.0	Invalid Sample
4/3/15	7.4	5.5	10.5	10.0
4/6/15	8.0	8.9	14.7	13.6
4/12/15	6.3	5.1	16.4	15.6
4/18/15	5.7	7.8	12.7	12.3
4/27/15	Not Collected	8.6	Not Collected	7.4
4/29/15	5.9	Not Collected	9.3	Not Collected

Please note, due to errors setting up the samplers on April 27th, only collocated samplers were running on the 27th, and primary samplers were run on the 29th.

Precision calculations are presented in Appendix C. Elevated CVs were observed for PM_{10} and $PM_{2.5}$ this quarter on account of a decreased number of samples for available for direct comparison.

3.2 Particulate Matter Monitors

Flow checks were performed on all PM samplers as shown in the table below. All units were within acceptable limits (± 4% for $PM_{2.5}$ and ± 7% PM_{10}). A summary of flow checks performed at the Edgerton Tower Site are presented in Table 7, below.

Calibration checks of three PM samplers were performed February 9th, and on unit S/N 0439 when it came into service on April 1st. All results were within acceptance limits indicating the units passed.

Table 7: PQ 200 Flow and Leak Checks

Date	PQ 200 Sampler		Sampler Flow (lpm)	Reference Flow (lpm)	% Difference	Leak Check	
	S/N	Size				Initial SP (cm)	Final SP (cm)
2/4/15	1617	PM10	16.65	16.49	1.0%	100	98
2/4/15	1621	PM2.5	16.65	16.50	0.9%	99	97
2/4/15	0432	PM10	16.62	16.48	0.8%	103	100
2/4/15	040R	PM2.5	16.70	16.71	-0.1%	98	96
3/27/15	1621	PM2.5	16.67	16.62	0.30%	95	94
3/27/15	1617	PM10	16.74	16.83	-0.54%	95	94
3/27/15	0432	PM10	Max load exceeded	13.3	NC	106	105
3/27/15	040R	PM2.5	16.65	16.62	0.18%	100	99
3/31/15	1621	PM2.5	16.67	16.60	0.42%	102	101
3/31/15	040R	PM2.5	16.6	16.66	-0.36%	97	96
3/31/15	1617	PM10	16.7	16.8	-0.60%	100	99
3/31/15	0432	PM10	16.7	16.73	-0.18%	134	134
4/1/15	0439	PM10	16.7	16.68	0.18%	97	95

NC: %D not calculable due to a malfunctioning motor, the motor was replaced on 3/31/15.

3.3 Automated Calibration Checks

Automated Calibration Checks of each continuous gas analyzer were performed on a weekly basis at the Edgerton Tower Site. Results of the calibrations performed during the calendar period of February 1, 2015 through April 30, 2015 are summarized below in Tables 8 – 11. All automated calibration checks were within acceptable limits this reporting quarter, as specified in the QA Handbook for Air Pollution Measurement Systems: "Volume II: Ambient Air Quality Monitoring Program", with the exception of the CO zero on February 11th.

The zero check for CO on February 11th was out of specification due to zero drift of the analyzer. The CO zero and span values were checked on February 13th and the zero was adjusted.

Following recertification of the T700 calibrator photometer by EPA, in November 2014, NO_2 concentrations generated during the Gas Phase Titration process did not match the target concentration values entered. For example; if 70 ppb O_3 was entered into the calibrator for generation the actual concentration was closer to 100 ppb. The generated concentration remained consistent through the calibration check procedure, even though it was not at the set concentration. For this reason, beginning in the fifth monitoring quarter, TRC calculates the expected NO_2 concentrations using original NO concentrations and final NO concentrations for reference during the NO_2 automated calibration check.

Table 8: SO_2 Auto Calibrations

	Zero		One Point QC Check (70 ppb)		Span (400 ppb)	
Date	Recorded (ppb)	Difference (±3)	Recorded (ppb)	% D (±10%)	Recorded (ppb)	% D (±10%)
2/4/2015	0.5	0.5	68.3	-2.4%	388.4	-2.9%
2/11/2015	0.7	0.7	69.3	-1.0%	392.6	-1.8%
2/18/2015	0.9	0.9	68.2	-2.6%	392.5	-1.9%
2/25/2015	1	1	69.1	-1.3%	388.1	-3.0%
3/4/2015	1	1	70.8	1.1%	418.6	4.7%
3/11/2015	0.9	0.9	69.2	-1.1%	385.6	-3.6%
3/18/2015	0.6	0.6	72.4	3.4%	419.3	4.8%
3/25/2015	0.6	0.6	69.1	-1.3%	387.6	-3.1%
4/1/2015	0.9	0.9	68.3	-2.4%	421	5.3%
4/8/2015	0.5	0.5	67.5	-3.6%	394.2	-1.5%
4/15/2015	0.5	0.5	67	-4.3%	391	-2.3%
4/22/2015	0.9	0.9	68.4	-2.3%	394.9	-1.3%
4/29/2015	0.9	0.9	69	-1.4%	405.2	1.3%

Table 9: O_3 Auto Calibrations

Date	Zero		One Point QC Check (70 ppb)		Span (400 ppb)	
	Recorded (ppb)	Difference (±3)	Recorded (ppb)	% D (± 10%)	Recorded (ppb)	% D (±10%)
2/4/2015	0	0	70.7	1.00%	413.3	3.33%
2/11/2015	0.1	0.1	70.2	0.29%	411.5	2.88%
2/18/2015	0.6	0.6	68.9	-1.57%	406.8	1.70%
2/25/2015	0.2	0.2	72	2.86%	412.2	3.05%
3/4/2015	0.9	0.9	74.4	6.29%	420.6	5.15%
3/11/2015	0	0	72.7	3.86%	417	4.25%
3/18/2015	0.2	0.2	73	4.29%	419.9	4.97%
3/25/2015	0.2	0.2	71.8	2.57%	423.8	5.95%
4/1/2015	0.2	0.2	71.9	2.71%	431.2	7.80%
4/8/2015	0.4	0.4	71.8	2.57%	422	5.50%
4/15/2015	0.4	0.4	72.6	3.71%	426	6.50%
4/22/2015	0.4	0.4	72.5	3.57%	424.2	6.05%
4/29/2015	-0.3	-0.3	71.7	2.43%	423.4	5.85%

Table 10: NO_2 Auto Calibrations

Date	Zero		One Point QC Check			Span		
	Recorded (ppb)	Difference (± 3)	Recorded (ppb)	Expected (ppb)	% D (± 10%)	Recorded (ppb)	Expected (ppb)	% D (± 10%)
2/4/2015	0.2	0.20	75.5	71	6.3%	393.6	394	-0.1%
2/11/2015	0.1	0.10	72.4	67.6	7.1%	390.9	392.1	-0.3%
2/18/2015	0.2	0.20	71.6	72.1	-0.7%	382.6	389.5	-1.8%
2/25/2015	0.2	0.20	72.9	75.4	-3.3%	387.9	388.2	-0.1%
3/4/2015	0.3	0.30	75.9	71.7	5.9%	387.3	386.6	0.2%
3/11/2015	0.1	0.10	76.2	71.8	6.1%	392.7	393.9	-0.3%
3/18/2015	0.3	0.30	78.6	78.4	0.3%	400	397.5	0.6%
3/25/2015	0.3	0.30	73.4	69.8	5.2%	394.9	396.8	-0.5%
4/1/2015	0.3	0.30	119.1	119	0.1%	414.3	415	-0.2%
4/8/2015	0.1	0.10	82.7	82.4	0.4%	409.3	408.8	0.1%
4/15/2015	0.1	0.10	81.9	82.5	-0.7%	407.4	407.4	0.0%
4/22/2015	0	0.00	77.8	77.2	0.8%	407.7	407	0.2%
4/29/2015	0	0.00	78.8	78.7	0.1%	409.2	408.6	0.1%

Table 11: CO Auto Calibrations

Date	Zero		One Point QC Check (7.0 ppm)		Span (40.0 ppm)	
	Recorded (ppm)	Difference (± 0.3)	Recorded (ppm)	% D (± 10%)	Recorded (ppm)	% D (± 10%)
2/4/2015	0.3	0.3	7.3	4.29%	39.7	-0.75%
2/11/2015	0.4	0.4	7.3	4.29%	39.8	-0.50%
2/18/2015	0.1	0.1	7.3	4.29%	39.3	-1.75%
2/25/2015	0.2	0.2	7.2	2.86%	40.6	1.50%
3/4/2015	0	0	7.3	4.29%	40.4	1.00%
3/11/2015	0.1	0.1	7.4	5.71%	40.6	1.50%
3/18/2015	0	0	7.2	2.86%	40.1	0.25%
3/25/2015	0.1	0.1	7.3	4.29%	40.4	1.00%
4/1/2015	0.1	0.1	7	0.00%	40.7	1.75%
4/8/2015	0.2	0.2	7.1	1.43%	40.8	2.00%
4/15/2015	0.2	0.2	7.2	2.86%	40.9	2.25%
4/22/2015	0.3	0.3	7	0.00%	41.3	3.25%
4/29/2015	0	0	7	0.00%	40.5	1.25%

3.4 Multipoint Calibration Results

Multipoint calibrations determine instrument responses for concentrations ranging from ~1 ppbv to ~ 500 ppbv for Sulfur Dioxide, Ozone, and Nitrogen Dioxide and ~1 ppmv to ~ 50 ppmv for Carbon Monoxide.

Multipoint calibrations for CO and SO_2 were performed on February 2nd, O_3 on March 4th, and NO_2 on March 5th.

The data from these multipoint calibrations are provided in Figures 7 – 10 below. Please note the calibrations performed were done as found, without prior adjustments to the analyzers.

Figure 7: Sulfur Dioxide Calibration 2/3/2015

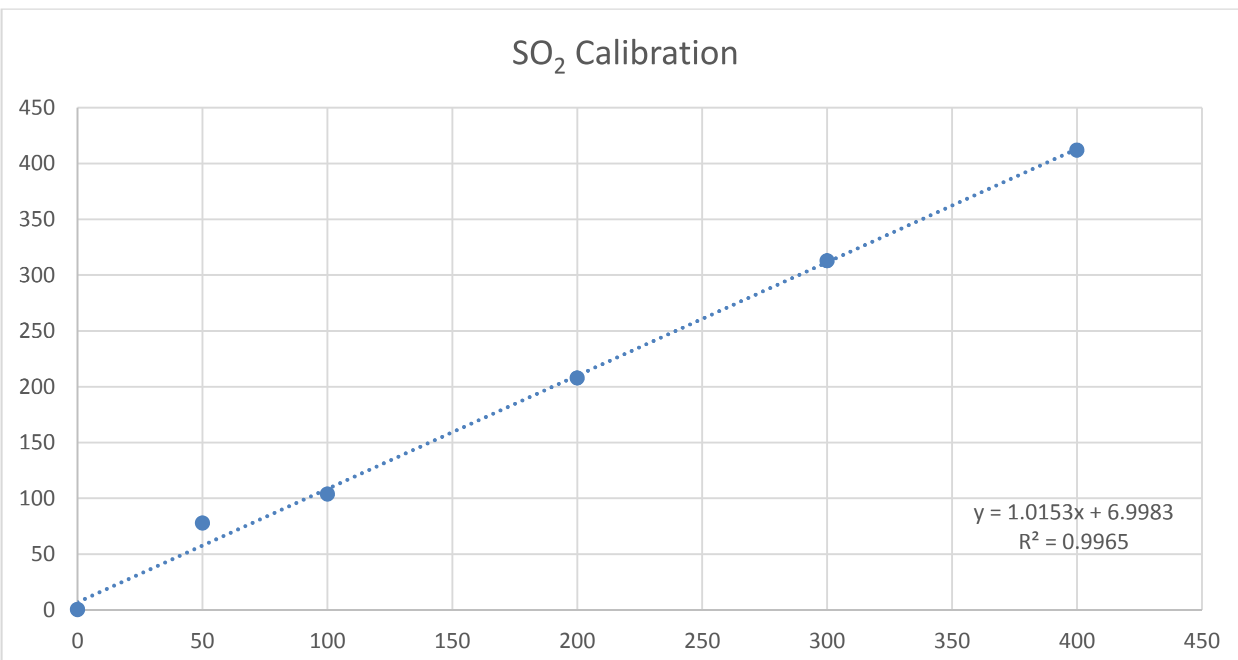


Figure 8: Carbon Monoxide Calibration 2/3/15

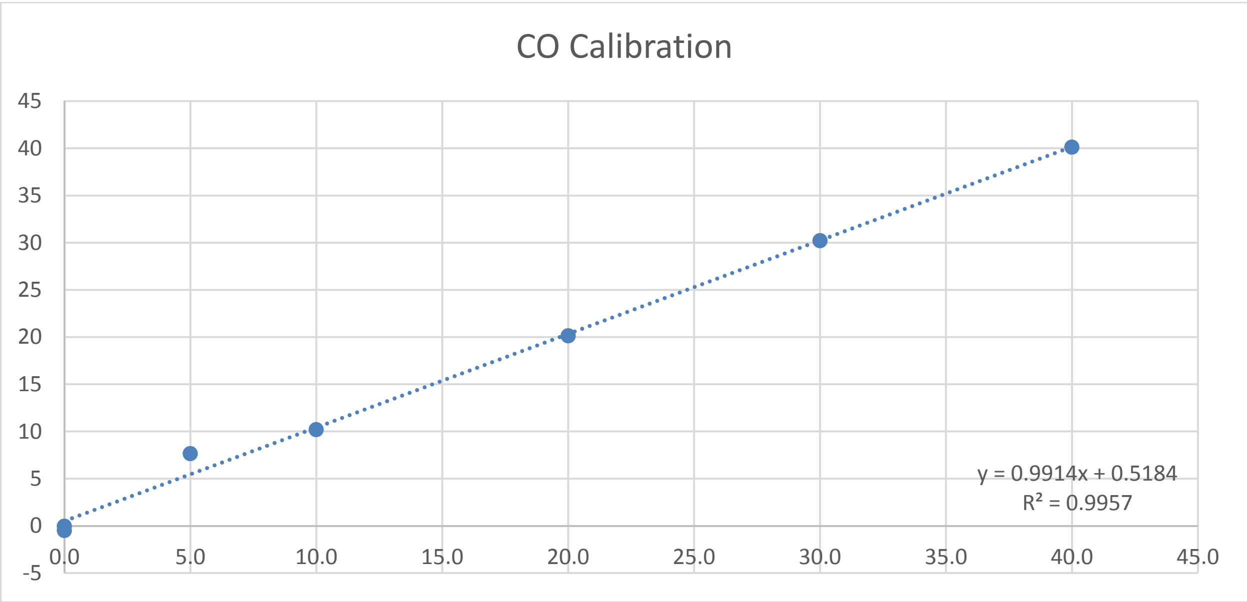


Figure 9: Ozone Calibration 3/4/15

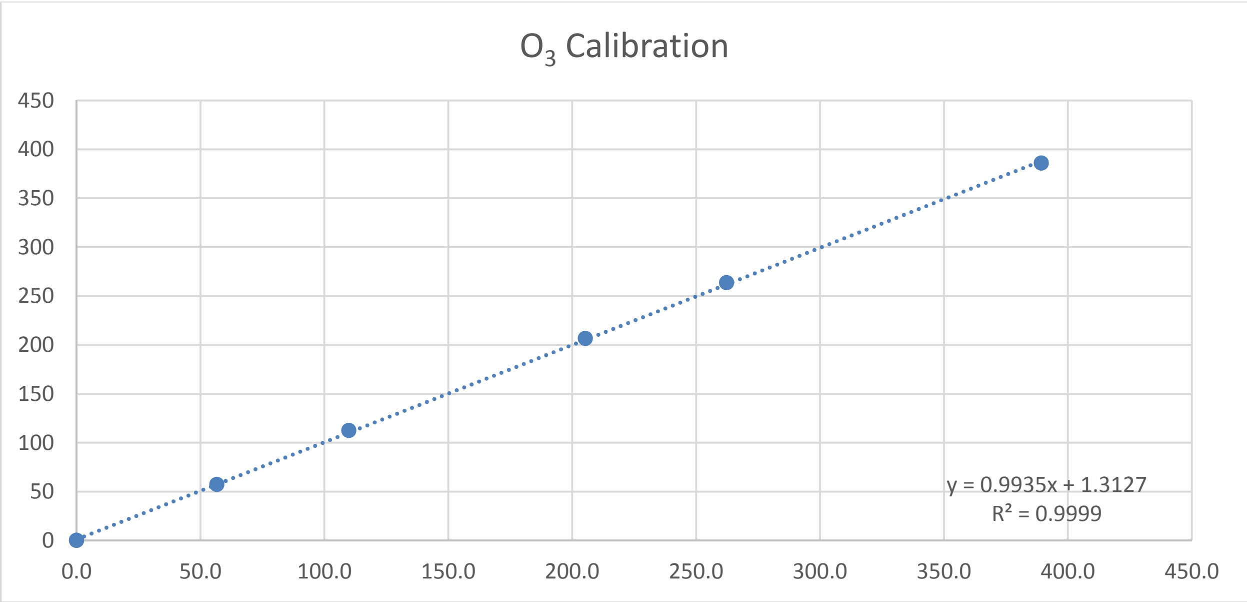
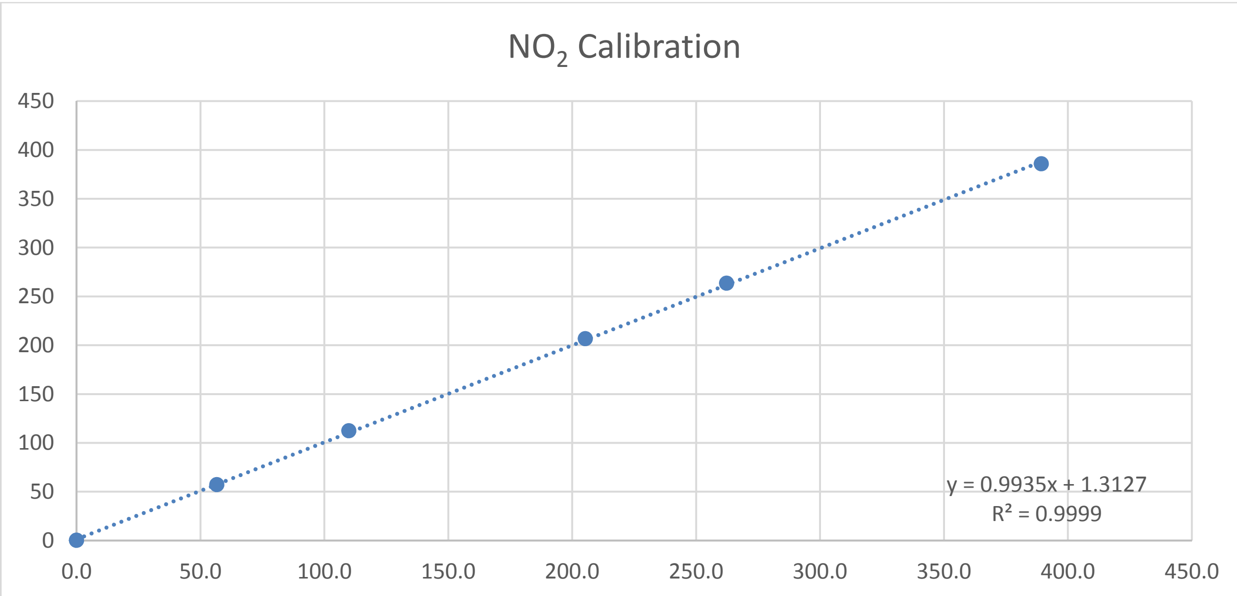


Figure 10: Nitrogen Dioxide Calibration 3/5/15



3.5 Precision of Continuous Gas Analyzers

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value. Simply stated, precision is a measure of the variability of an instrument.

The precision of the automated analyzers was evaluated by making multiple comparisons of the sample's known concentration against the instrument's response and calculating the upper bound of the coefficient of variation (CV). Results from the 1-point QC checks from the weekly automated calibration checks (refer to Section 3.3) were used to calculate the CV for this monitoring quarter.

Precision calculations are presented in Appendix C.

3.6 Field Performance Audit

On Monday March 30th EEMS personnel met TRC personnel at the station. The EEMS mobile lab was powered up and remained onsite overnight. All personnel returned to the site on Tuesday March 31st to complete the audits of the gaseous pollutant and particulate samplers.

Once the audit gaseous analyzers were at operating temperature and stable, ozone gas was generated in the audit lab dilution system and measured with the audit lab standard photometer, and delivered to the station inlet. Following the audit of the station ozone monitor, a mixture of CO, NO, and SO_2 audit gas was supplied to the shelter inlet. The operational parameters (temperatures, pressures, sample train integrity, and flow rates) of the four PM samplers at the site were audited.

Following the warm-up period, audit ozone gas was generated with the EEMS mobile lab and measured with the EEMS level-2 standard photometer. Ozone audit test gas was generated with the ozone generator in the mobile laboratory. The audit gas was delivered to the station analyzer through the station inlet tubing using a Teflon "tee" to allow the audit gas to vent at the inlet. The audit gas concentration was measured by the level-2 standard photometer in the mobile lab and recorded by the mobile lab DAS. Averages reported by the DAS from the station monitor were compared to the averages for the same time period from the standard.

Prior to beginning the NOx, CO, and SO_2 audits, the EEMS audit CO analyzer was calibrated using the NIST ultra-pure air and CO gases. This was accomplished by supplying the EEMS mobile lab CO analyzer with NIST gas directly from the cylinders and not through the mobile lab dilution system. Data from this "Pre-audit" calibration was entered into the OAQPS audit spreadsheet to be used to calculate the concentration of all audit gases generated during the station audits.

The site audits were accomplished by generating audit test gas using the mobile laboratory dilution system and the NIST multi-blend gas. The audit gas was delivered to the station analyzers at the station sample inlets, through all filters and fittings. The generated audit gas CO concentrations were verified with the mobile lab CO analyzer at the inlet of the site sample train. The other audit gas concentrations were then calculated based on the ratio of CO to the other gases in the NIST multi-blend audit gas cylinder.

Immediately following the station audits, the mobile lab CO analyzer was again challenged directly with the NIST cylinder gases. The results of this "Post-audit" challenge were entered into the OAQPS spreadsheet to correct the audit standard gas concentrations, accounting for any drift of the mobile lab CO analyzer. This procedure (Pre-audit CO calibration, multipoint station audits, and Post-audit CO challenge) is the same OAQPS standard procedure used routinely for all NPAP TTP audits.

Audit test gas concentrations were selected from the OAQPS approved audit level list currently under review for submission to CFR part 58. An effort was made to generate audit concentrations from three consecutive audit levels during the audit. Occasionally this is not accomplished since the final audit concentrations are unknown until correcting for the drift throughout the duration of the audit of the mobile lab CO analyzer used to measure the audit concentrations. It should be noted that this requirement is being removed as part of the 2015 revisions to 40 CFR Part 58. All station monitor values were obtained from the station DAS.

The unadjusted Through The Probe (TTP) audits indicated that the NO2, SO2, and O3 site analyzers were within the acceptance limits of ± 15% (± 10% for ozone) and within the warning limits of any single audit point. Although still within the acceptance limits of ± 15% the CO analyzer was above the warning limit of ±10%.

It was observed that the station CO analyzer's response to pollutant-free (zero) air was slightly high compared to the actual audit gas input but well within the limits documented in the station Quality Assurance Project Plan (QAPP). However, when challenging the analyzers at low concentration levels any offset caused by zero-drift will more significantly affect these lower audit concentrations. Since audits are typically performed in the range of low ambient concentration levels, small actual differences cause large percent differences.

With the exception of the lowest NO_2 concentration level, all analyzers responded with slightly higher measurements than the audit standards. The unadjusted audit results from the TTP performed on March 31st are summarized in Table 12 and 13. The field audit forms are included in Appendix D.

Table 12: Unadjusted Gaseous Analyzer Audit Results

Parameter and Audit Level	Audit Value (ppm)	Site Value (ppm)	% Difference	Pass Warning Fail
O_3 -- level 6	0.10681	0.1103	3.3 %	pass
O_3 -- level 5	0.07875	0.0818	3.9 %	pass
O_3 -- level 4	0.04546	0.0471	3.6 %	pass
O_3 -- level 3	0.02470	0.0261	5.7 %	pass
SO_2 -- level 6	0.0910	0.0965	6.0 %	pass
SO_2 -- level 5	0.0448	0.0486	8.5 %	pass
SO_2 -- level 4	0.0180	0.0196	8.9 %	pass
CO -- level 6	8.9372	9.960	11.4 %	warning
CO -- level 5	4.3985	4.959	12.7 %	warning
CO -- level 4	1.7707	2.022	14.2 %	warning
NO_2 – level 6	0.0651	0.0697	7.1 %	pass
NO_2 – level 5	0.0314	0.0335	6.7 %	pass
NO_2 – level 4	0.0154	0.0161	4.6 %	pass
NO_2 – level 3	0.0077	0.0075	-2.6 %	pass

Table 13: NO Converter Efficiency

Parameter and Audit Level	Converter Efficiency	Pass Warning Fail
NO Conv Eff -- level 6	100.0 %	pass
NO Conv Eff -- level 5	100.0 %	pass
NO Conv Eff -- level 4	98.8 %	pass
NO Conv Eff -- level 3	97.6 %	pass

Performance verifications of the station particulate samplers were performed following manufacturer's recommendations along with Section 5.0 of the Field Standard Operating Procedures for the Federal $PM_{2.5}$ Performance Evaluation Program using the EEMS DeltaCal. All sample trains were also tested for leaks. The results of those verifications are summarized in Table 13 and complete verification forms are included in Appendix D.

One sampler (#0432 PM_{10} co-located) was not operational when first challenged. TRC personnel replaced the sample pump prior to the audit. All operational parameters verified for the four PM samplers checked were within acceptance limits.

The time and dates of all samplers were verified and found to be within 5 minutes of each other and within 10 minutes (all behind) of actual time. The flow rates of each sampler are presented in Table 14. Flow rate is the most critical parameter. Temperature and pressure are used to calculate flow rate, therefore errors in the temperature and pressure measurements will be reflected in the calculated flow rate measurement.

It should be noted that repairs to the PM samplers have been performed since the previous audit. Repairs have included replacement of internal circuit boards in some samplers. Since the sampler serial number is contained on the circuit board some sampler serial numbers are different than when previously audited although the designation of the sampler is the same.

Table 14: PM Flow Rate Verifications

Sampler	Audit Flow (lpm)	Unadjusted Sampler Flow (lpm)	% Difference	Adjusted Audit Flow (lpm)	Adjusted Sampler Flow (lpm)	% Difference
$PM_{2.5}$ s/n 1621	16.60	16.67	0.42 %	N/A	N/A	N/A
$PM_{2.5}$ s/n 040R	16.66	16.60	-0.36 %	N/A	N/A	N/A
PM_{10} s/n 1617	16.80	16.70	-0.60 %	N/A	N/A	N/A
PM_{10} s/n 0432	16.73	16.70	-0.18 %	N/A	N/A	N/A

Appendix A

Hourly Concentrations for all Gas Parameters

Refer to MS Excel Files:
Appendix_A-Concentrations_Gas_Parameters_Q6-BrunswickCounty_Edgerton Tower
and
Appendix_A-Concentrations_Gas_Parameters_Q3toQ6-BrunswickCounty_Edgerton Tower(May 2014 through April 2015)

Appendix B

Hourly Meteorological Data

Refer to MS Excel File:
Appendix_B-Meteorological_Parameters_Q6-BrunswickCounty_Edgerton Towerand Appendix_B-Meteorological_Parameters_Q3toQ6-BrunswickCounty_Edgerton Tower(May 2014 through April 2015)

Appendix C

Precision Calculations for Continuous Gas Analyzers
Precision Calculations for Collocated Particulate Matter Monitors

CO Assessments:Q6

Brunswick County - Edgerton		Pollutant type: CO					CV$_{ub}$ (%)			Bias (%)
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$				
7.3	7	4.3	1.429	18.367	4.286	18.367				
7.3	7	4.3	**75th Percentile**	18.367	4.286	18.367	n	S_d	S_{d2}	Σ|d|
7.3	7	4.3	4.286	18.367	4.286	18.367	13	1.934	10.011	37.143
7.2	7	2.9		8.163	2.857	8.163	n-1	Σd	Σd^2	$\Sigma\|d\|^2$
7.3	7	4.3		18.367	4.286	18.367	12	37.143	151.020	151.020
7.4	7	5.7		32.653	5.714	32.653				
7.2	7	2.9		8.163	2.857	8.163				
7.3	7	4.3		18.367	4.286	18.367				
7.0	7	0.0		0.000	0.000	0.000				
7.1	7	1.4		2.041	1.429	2.041				
7.2	7	2.9		8.163	2.857	8.163				
7.0	7	0.0		0.000	0.000	0.000				
7	7	0.000		0.000	0.000	0.000				

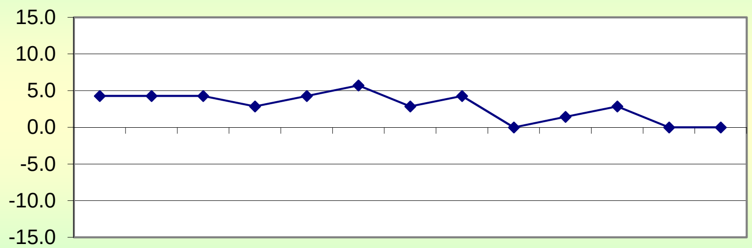
"AB" (Eqn 4)	"AS" (Eqn 5)
2.857	1.934

Bias (%) (Eqn 3)	Both Signs Positive
3.81	TRUE

CV (%) (Eqn 2)	Signed Bias (%)	Both Signs Negative
2.67	+3.81	FALSE

Upper Probability Limit	Lower Probability Limit
6.65	-0.93

Percent Differences



CO Assessments : Cumulative November 2013 - April 2015

Brunswick County - Edgerton	Pollutant type: NO2		CVub (%)	Bias (%)

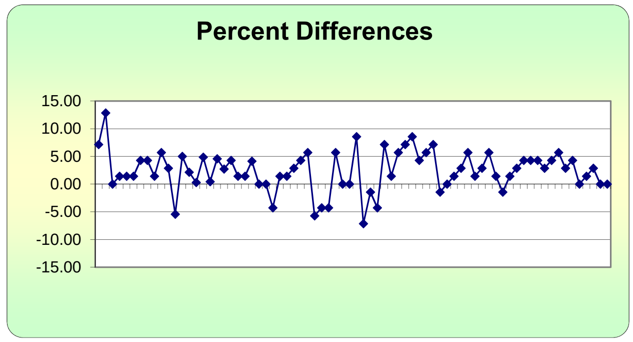
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
7.5	7	7.14	0.071	51.020	7.143	51.020
7.9	7	12.86	**75th Percentile**	165.306	12.857	165.306
7.0	7	0.00	4.286	0.000	0.000	0.000
7.1	7	1.43		2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.3	7	4.29		18.367	4.286	18.367
7.3	7	4.29		18.367	4.286	18.367
7.1	7	1.43		2.041	1.429	2.041
7.40	7	5.71		32.653	5.714	32.653
7.20	7	2.86		8.163	2.857	8.163
6.6	7	-5.43		29.469	5.429	29.469
7.4	7	5.00		25.000	5.000	25.000
7.2	7	2.14		4.592	2.143	4.592
7.0	7	0.29		0.082	0.286	0.082
7.3	7	4.86		23.592	4.857	23.592
7.0	7	0.43		0.184	0.429	0.184
7.3	7	4.57		20.898	4.571	20.898
7.2	7	2.71		7.367	2.714	7.367
7.3	7	4.29		18.367	4.286	18.367
7.1	7	1.43		2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.3	7	4.14		17.163	4.143	17.163
7	7	0.00		0.000	0.000	0.000
7.0	7	0.00		0.000	0.000	0.000
6.7	7	-4.29		18.367	4.286	18.367
7.1	7	1.43		2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
6.6	7	-5.71		32.653	5.714	32.653
6.7	7	-4.29		18.367	4.286	18.367
6.7	7	-4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
7.0	7	0.00		0.000	0.000	0.000
7.0	7	0.00		0.000	0.000	0.000
7.6	7	8.57		73.469	8.571	73.469
6.5	7	-7.14		51.020	7.143	51.020
6.9	7	-1.43		2.041	1.429	2.041
6.7	7	-4.29		18.367	4.286	18.367
7.5	7	7.14		51.020	7.143	51.020
7.1	7	1.43		2.041	1.429	2.041
7.4	7	5.71		32.653	5.714	32.653
7.5	7	7.14		51.020	7.143	51.020
7.6	7	8.57		73.469	8.571	73.469
7.3	7	4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
7.5	7	7.14		51.020	7.143	51.020
6.9	7	-1.43		2.041	1.429	2.041
7.0	7	0.00		0.000	0.000	0.000
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.4	7	5.71		32.653	5.714	32.653
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.4	7	5.71		32.653	5.714	32.653
7.1	7	1.43		2.041	1.429	2.041
6.9	7	-1.43		2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.3	7	4.29		18.367	4.286	18.367
7.3	7	4.29		18.367	4.286	18.367
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.0	7	0.00		0.000	0.000	0.000
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.0	7	0.00		0.000	0.000	0.000
7	7	0.00		0.000	0.000	0.000

n	S_d	S_{d2}	$\Sigma\|d\|$	"AB" (Eqn 4)
74	3.580	24.664	253.857	3.431
n-1	**Σd**	**Σd^2**	**$\Sigma\|d\|^2$**	**"AS" (Eqn 5)**
73	174.429	1346.714	1346.714	2.553

Bias (%) (Eqn 3)	Both Signs Positive
3.92	TRUE
Signed Bias (%)	**Both Signs Negative**
+3.92	FALSE

CV (%) (Eqn 2)
4.02

Upper Probability Limit	Lower Probability Limit
9.37	-4.66



CO Assessments : Annual May 2014 - April 2015

Brunswick County - Edgerton	Pollutant type: NO2		CV_{ub} (%)	Bias (%)

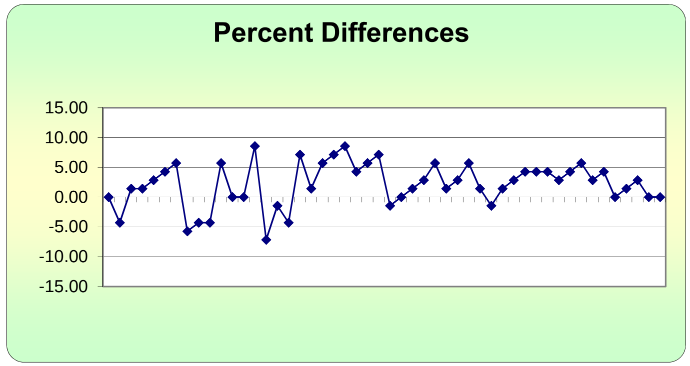
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
7.0	7	0.00	0.000	0.000	0.000	0.000
6.7	7	-4.29	**75th Percentile**	18.367	4.286	18.367
7.1	7	1.43	4.286	2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
6.6	7	-5.71		32.653	5.714	32.653
6.7	7	-4.29		18.367	4.286	18.367
6.7	7	-4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
7.0	7	0.00		0.000	0.000	0.000
7.0	7	0.00		0.000	0.000	0.000
7.6	7	8.57		73.469	8.571	73.469
6.5	7	-7.14		51.020	7.143	51.020
6.9	7	-1.43		2.041	1.429	2.041
6.7	7	-4.29		18.367	4.286	18.367
7.5	7	7.14		51.020	7.143	51.020
7.1	7	1.43		2.041	1.429	2.041
7.4	7	5.71		32.653	5.714	32.653
7.5	7	7.14		51.020	7.143	51.020
7.6	7	8.57		73.469	8.571	73.469
7.3	7	4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
7.5	7	7.14		51.020	7.143	51.020
6.9	7	-1.43		2.041	1.429	2.041
7.0	7	0.00		0.000	0.000	0.000
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.4	7	5.71		32.653	5.714	32.653
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.4	7	5.71		32.653	5.714	32.653
7.1	7	1.43		2.041	1.429	2.041
6.9	7	-1.43		2.041	1.429	2.041
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.3	7	4.29		18.367	4.286	18.367
7.3	7	4.29		18.367	4.286	18.367
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.4	7	5.71		32.653	5.714	32.653
7.2	7	2.86		8.163	2.857	8.163
7.3	7	4.29		18.367	4.286	18.367
7.0	7	0.00		0.000	0.000	0.000
7.1	7	1.43		2.041	1.429	2.041
7.2	7	2.86		8.163	2.857	8.163
7.0	7	0.00		0.000	0.000	0.000
7	7	0.00		0.000	0.000	0.000

n	S_d	S_{d2}	$\Sigma\|d\|$	"AB" (Eqn 4)
50	3.699	19.156	174.286	3.486
n-1	Σd	Σd^2	$\Sigma\|d\|^2$	**"AS" (Eqn 5)**
49	105.714	893.878	893.878	2.417

Bias (%) (Eqn 3)	Both Signs Positive
4.06	TRUE

CV (%) (Eqn 2)	Signed Bias (%)	Both Signs Negative
4.27	+4.06	FALSE

Upper Probability Limit	Lower Probability Limit
9.36	-5.14



NO_2 Assessments : Q6

Brunswick County - Edgerton	Pollutant type: NO_2		CV_{ub} (%)	Bias (%)

Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
75.5	71	6.3	0.084	40.171	6.338	40.171
72.4	67.6	7.1	**75th Percentile**	50.418	7.101	50.418
71.6	72.1	-0.7	5.858	0.481	0.693	0.481
72.9	75.4	-3.3		10.994	3.316	10.994
75.9	71.7	5.9		34.313	5.858	34.313
76.2	71.8	6.1		37.554	6.128	37.554
78.6	78.4	0.3		0.065	0.255	0.065
73.4	69.8	5.2		26.601	5.158	26.601
119.1	119	0.1		0.007	0.084	0.007
82.7	82.4	0.4		0.133	0.364	0.133
81.9	82.5	-0.7		0.529	0.727	0.529
77.8	77.2	0.8		0.604	0.777	0.604
78.8	78.7	0.127		0.016	0.127	0.016

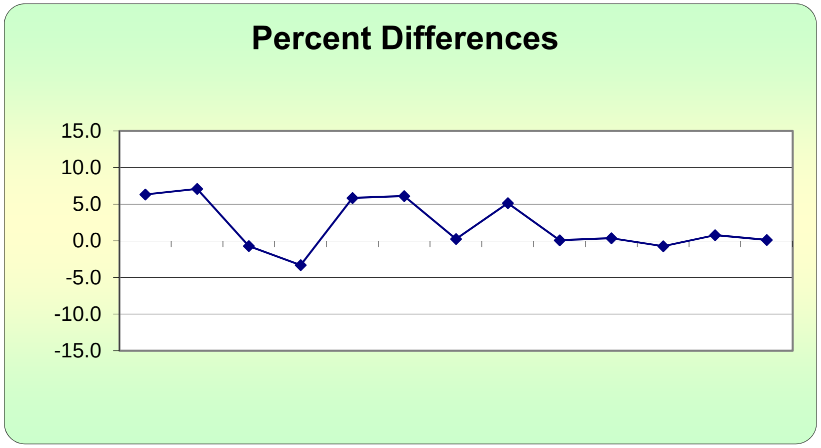
n	S_d	S_{d2}	$\Sigma\|d\|$	"AB" (Eqn 4)
13	3.463	19.230	36.926	2.840
n-1	**Σd**	**Σd^2**	**$\Sigma\|d\|^2$**	**"AS" (Eqn 5)**
12	27.453	201.885	201.885	2.843

Bias (%) (Eqn 3)	Both Signs Positive
4.25	TRUE

CV (%) (Eqn 2)
4.78

Signed Bias (%)	Both Signs Negative
+4.25	FALSE

Upper Probability Limit	Lower Probability Limit
8.9	-4.68



NO_2 Assessments : Cumulative November 2013 - April 2015

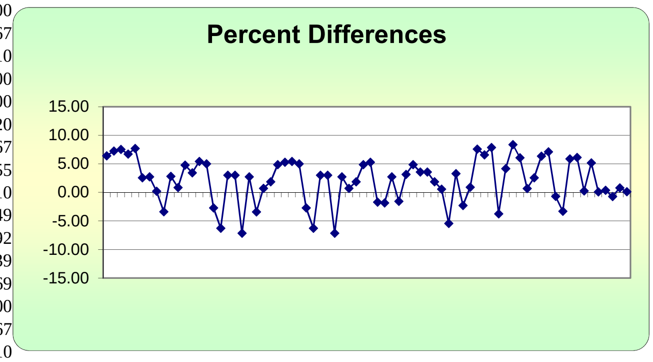
Brunswick County - Edgerton	Pollutant type: NO_2		CV$_{ub}$ (%)	Bias (%)

Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
74	70	6.41	0.147	41.088	6.410	41.088
75	70	7.26	**75th Percentile**	52.666	7.257	52.666
75	70	7.52	5.118	56.615	7.524	56.615
75	70	6.71		45.062	6.713	45.062
75	70	7.70		59.246	7.697	59.246
72	70	2.56		6.576	2.564	6.576
72	70	2.73		7.461	2.731	7.461
70	70	0.21		0.044	0.209	0.044
68	70	-3.39		11.482	3.389	11.482
72	70	2.82		7.952	2.820	7.952
71	70	0.85		0.720	0.849	0.720
73	70	4.77		22.712	4.766	22.712
72	70	3.44		11.804	3.436	11.804
73.8	70	5.43		29.469	5.429	29.469
73.5	70	5.00		25.000	5.000	25.000
68.1	70	-2.71		7.367	2.714	7.367
65.6	70	-6.29		39.510	6.286	39.510
72.1	70	3.00		9.000	3.000	9.000
72.1	70	3.00		9.000	3.000	9.000
65.0	70	-7.14		51.020	7.143	51.020
71.9	70	2.71		7.367	2.714	7.367
67.6	70	-3.43		11.755	3.429	11.755
70.5	70	0.71		0.510	0.714	0.510
71.3	70	1.86		3.449	1.857	3.449
73.4	70	4.86		23.592	4.857	23.592
73.7	70	5.29		27.939	5.286	27.939
73.8	70	5.43		29.469	5.429	29.469
73.5	70	5.00		25.000	5.000	25.000
68.1	70	-2.71		7.367	2.714	7.367
65.6	70	-6.29		39.510	6.286	39.510
72.1	70	3.00		9.000	3.000	9.000
72.1	70	3.00		9.000	3.000	9.000
65.0	70	-7.14		51.020	7.143	51.020
71.9	70	2.71		7.367	2.714	7.367
70.5	70	0.71		0.510	0.714	0.510
71.3	70	1.86		3.449	1.857	3.449
73.4	70	4.86		23.592	4.857	23.592
73.7	70	5.29		27.939	5.286	27.939
68.8	70	-1.71		2.939	1.714	2.939
68.7	70	-1.86		3.449	1.857	3.449
71.9	70	2.71		7.367	2.714	7.367
68.9	70	-1.57		2.469	1.571	2.469
72.2	70	3.14		9.878	3.143	9.878
73.4	70	4.86		23.592	4.857	23.592
72.5	70	3.57		12.755	3.571	12.755
72.5	70	3.57		12.755	3.571	12.755
71.3	70	1.86		3.449	1.857	3.449
70.4	70	0.57		0.327	0.571	0.327
66.2	70	-5.43		29.469	5.429	29.469
72.3	70	3.29		10.796	3.286	10.796
68.4	70	-2.29		5.224	2.286	5.224
56.4	55.9	0.89		0.800	0.894	0.800
75.3	70	7.57		57.327	7.571	57.327
74.6	70	6.57		43.184	6.571	43.184
75.5	70	7.86		61.735	7.857	61.735
69.3	72	-3.75		14.063	3.750	14.063
75.2	72.2	4.16		17.265	4.155	17.265
76.4	70.5	8.37		70.037	8.369	70.037
73.6	69.4	6.05		36.625	6.052	36.625
74.9	74.4	0.67		0.452	0.672	0.452
71.8	70	2.57		6.612	2.571	6.612
75.5	71	6.34		40.171	6.338	40.171
72.4	67.6	7.10		50.418	7.101	50.418
71.6	72.1	-0.69		0.481	0.693	0.481
72.9	75.4	-3.32		10.994	3.316	10.994
75.9	71.7	5.86		34.313	5.858	34.313
76.2	71.8	6.13		37.554	6.128	37.554
78.6	78.4	0.26		0.065	0.255	0.065
73.4	69.8	5.16		26.601	5.158	26.601
119.1	119	0.08		0.007	0.084	0.007
82.7	82.4	0.36		0.133	0.364	0.133
81.9	82.5	-0.73		0.529	0.727	0.529
77.8	77.2	0.78		0.604	0.777	0.604
78.8	78.7	0.13		0.016	0.127	0.016

n	S_d	S_{d2}	$\sum\|d\|$	"AB" (Eqn 4)
74	3.889	19.013	277.611	3.752
n-1	$\sum d$	$\sum d^2$	$\sum\|d\|^2$	**"AS" (Eqn 5)**
73	156.718	1436.085	1436.085	2.325

CV (%) (Eqn 2)	Bias (%) (Eqn 3)	Both Signs Positive
	4.2	TRUE
4.36	**Signed Bias (%)**	Both Signs Negative
	+4.2	FALSE

Upper Probability Limit	Lower Probability Limit
9.74	-5.51



NO_2 Assessments : Annual May 2014 - April 2015

Brunswick County - Edgerton	Pollutant type: NO_2		CV_{ub} (%)	Bias (%)

Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
73.5	70	5.00	-0.702	25.000	5.000	25.000
68.1	70	-2.71	**75th Percentile**	7.367	2.714	7.367
65.6	70	-6.29	4.893	39.510	6.286	39.510
72.1	70	3.00		9.000	3.000	9.000
72.1	70	3.00		9.000	3.000	9.000
65.0	70	-7.14		51.020	7.143	51.020
71.9	70	2.71		7.367	2.714	7.367
67.6	70	-3.43		11.755	3.429	11.755
70.5	70	0.71		0.510	0.714	0.510
71.3	70	1.86		3.449	1.857	3.449
73.4	70	4.86		23.592	4.857	23.592
73.7	70	5.29		27.939	5.286	27.939
73.8	70	5.43		29.469	5.429	29.469
73.5	70	5.00		25.000	5.000	25.000
68.1	70	-2.71		7.367	2.714	7.367
65.6	70	-6.29		39.510	6.286	39.510
72.1	70	3.00		9.000	3.000	9.000
72.1	70	3.00		9.000	3.000	9.000
65.0	70	-7.14		51.020	7.143	51.020
71.9	70	2.71		7.367	2.714	7.367
70.5	70	0.71		0.510	0.714	0.510
71.3	70	1.86		3.449	1.857	3.449
73.4	70	4.86		23.592	4.857	23.592
73.7	70	5.29		27.939	5.286	27.939
68.8	70	-1.71		2.939	1.714	2.939
68.7	70	-1.86		3.449	1.857	3.449
71.9	70	2.71		7.367	2.714	7.367
68.9	70	-1.57		2.469	1.571	2.469
72.2	70	3.14		9.878	3.143	9.878
73.4	70	4.86		23.592	4.857	23.592
72.5	70	3.57		12.755	3.571	12.755
72.5	70	3.57		12.755	3.571	12.755
71.3	70	1.86		3.449	1.857	3.449
70.4	70	0.57		0.327	0.571	0.327
66.2	70	-5.43		29.469	5.429	29.469
72.3	70	3.29		10.796	3.286	10.796
68.4	70	-2.29		5.224	2.286	5.224
56.4	55.9	0.89		0.800	0.894	0.800
75.3	70	7.57		57.327	7.571	57.327
74.6	70	6.57		43.184	6.571	43.184
75.5	70	7.86		61.735	7.857	61.735
69.3	72	-3.75		14.063	3.750	14.063
75.2	72.2	4.16		17.265	4.155	17.265
76.4	70.5	8.37		70.037	8.369	70.037
73.6	69.4	6.05		36.625	6.052	36.625
74.9	74.4	0.67		0.452	0.672	0.452
71.8	70	2.57		6.612	2.571	6.612
75.5	71	6.34		40.171	6.338	40.171
72.4	67.6	7.10		50.418	7.101	50.418
71.6	72.1	-0.69		0.481	0.693	0.481
72.9	75.4	-3.32		10.994	3.316	10.994
75.9	71.7	5.86		34.313	5.858	34.313
76.2	71.8	6.13		37.554	6.128	37.554
78.6	78.4	0.26		0.065	0.255	0.065
73.4	69.8	5.16		26.601	5.158	26.601
119.1	119	0.08		0.007	0.084	0.007
82.7	82.4	0.36		0.133	0.364	0.133
81.9	82.5	-0.73		0.529	0.727	0.529
77.8	77.2	0.78		0.604	0.777	0.604
78.8	78.7	0.13		0.016	0.127	0.016

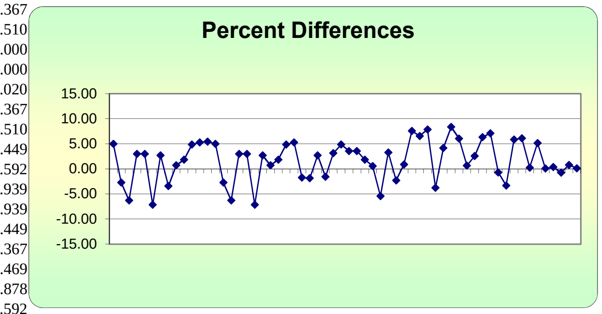
n	S_d	S_{d2}	Σ|d|	"AB" (Eqn 4)
60	3.929	18.262	215.818	3.597
n-1	**Σd**	**Σd^2**	**$\Sigma\|d\|^2$**	**"AS" (Eqn 5)**
59	101.703	1083.188	1083.188	2.281

Bias (%) (Eqn 3)	Both Signs Positive
4.09	FALSE

CV (%) (Eqn 2)
4.47

Signed Bias (%)	Both Signs Negative
+/-4.09	FALSE

Upper Probability Limit	Lower Probability Limit
9.4	-6.01



O_3 Assessments: Q6

Brunswick County - Edgerton		Pollutant type: O_3					CV_{ub} (%)			Bias (%)
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$				
70.7	70	1.0	2.571	1.000	1.000	1.000				
70.2	70	2.9	75th Percentile	8.163	2.857	8.163				
68.9	70	-1.6	3.714	2.469	1.571	2.469				
72.0	70	2.9		8.163	2.857	8.163				
74.4	70	6.3		39.510	6.286	39.510				
72.7	70	3.9		14.878	3.857	14.878				
73.0	70	4.3		18.367	4.286	18.367				
71.8	70	2.6		6.612	2.571	6.612				
71.9	70	2.7		7.367	2.714	7.367				
71.8	70	2.6		6.612	2.571	6.612				
72.6	70	3.7		13.796	3.714	13.796				
72.5	70	3.6		12.755	3.571	12.755				
71.7	70	2.4		5.898	2.429	5.898				

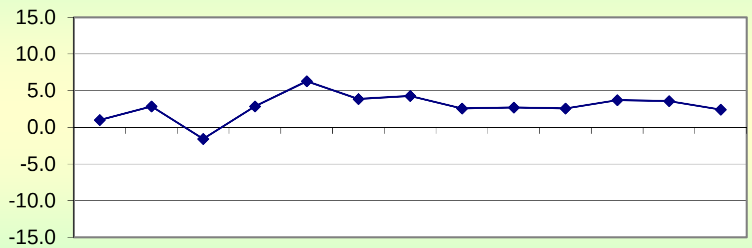
n	S_d	S_{d2}	$\Sigma\|d\|$	"AB" (Eqn 4)
13	1.814	9.828	40.286	3.099
n-1	Σd	Σd^2	$\Sigma\|d\|^2$	"AS" (Eqn 5)
12	37.143	145.592	145.592	1.315

Bias (%) (Eqn 3)	Both Signs Positive
3.75	TRUE
Signed Bias (%)	Both Signs Negative
+3.75	FALSE

CV (%) (Eqn 2)
2.5

Upper Probability Limit	Lower Probability Limit
6.41	-0.7

Percent Differences



O_3 Assessments : Cumulative November 2013 - April 2015

Brunswick County - Edgerton	Pollutant type: O_3		CV$_{ub}$ (%)	Bias (%)

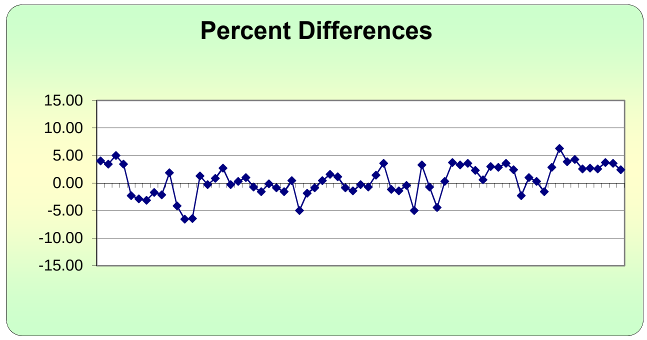
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
72.8	70	4.00	-1.429	16.000	4.000	16.000
72.5	70	3.43	**75th Percentile**	11.755	3.429	11.755
74	70	5.00	2.857	25.000	5.000	25.000
72	70	3.43		11.755	3.429	11.755
68	70	-2.29		5.224	2.286	5.224
68	70	-2.86		8.163	2.857	8.163
68	70	-3.14		9.878	3.143	9.878
69	70	-1.71		2.939	1.714	2.939
69	70	-2.14		4.592	2.143	4.592
71.3	70	1.86		3.449	1.857	3.449
67.1	70	-4.14		17.163	4.143	17.163
65	70	-6.57		43.184	6.571	43.184
66	70	-6.43		41.327	6.429	41.327
71	70	1.29		1.653	1.286	1.653
70	70	-0.29		0.082	0.286	0.082
71	70	0.86		0.735	0.857	0.735
72	70	2.71		7.367	2.714	7.367
70	70	-0.29		0.082	0.286	0.082
70	70	0.29		0.082	0.286	0.082
71	70	1.00		1.000	1.000	1.000
70	70	-0.71		0.510	0.714	0.510
69	70	-1.57		2.469	1.571	2.469
69.9	70	-0.14		0.020	0.143	0.020
69.4	70	-0.86		0.735	0.857	0.735
68.9	70	-1.57		2.469	1.571	2.469
70.3	70	0.43		0.184	0.429	0.184
66.5	70	-5.00		25.000	5.000	25.000
68.7	70	-1.86		3.449	1.857	3.449
69.4	70	-0.86		0.735	0.857	0.735
70.3	70	0.43		0.184	0.429	0.184
71.1	70	1.57		2.469	1.571	2.469
70.8	70	1.14		1.306	1.143	1.306
69.4	70	-0.86		0.735	0.857	0.735
69.0	70	-1.43		2.041	1.429	2.041
69.8	70	-0.29		0.082	0.286	0.082
69.5	70	-0.71		0.510	0.714	0.510
71.0	70	1.43		2.041	1.429	2.041
72.5	70	3.57		12.755	3.571	12.755
69.2	70	-1.14		1.306	1.143	1.306
69.0	70	-1.43		2.041	1.429	2.041
69.7	70	-0.43		0.184	0.429	0.184
66.5	70	-5.00		25.000	5.000	25.000
72.3	70	3.29		10.796	3.286	10.796
69.5	70	-0.71		0.510	0.714	0.510
67	70	-4.43		19.612	4.429	19.612
70	70	0.29		0.082	0.286	0.082
72.6	70	3.71		13.796	3.714	13.796
72.3	70	3.29		10.796	3.286	10.796
72.5	70	3.57		12.755	3.571	12.755
71.6	70	2.29		5.224	2.286	5.224
70.4	70	0.57		0.327	0.571	0.327
72.1	70	3.00		9.000	3.000	9.000
72.0	70	2.86		8.163	2.857	8.163
72.5	70	3.57		12.755	3.571	12.755
71.7	70	2.43		5.898	2.429	5.898
68.4	70	-2.29		5.224	2.286	5.224
70.7	70	1.00		1.000	1.000	1.000
70.2	70	0.29		0.082	0.286	0.082
68.9	70	-1.57		2.469	1.571	2.469
72.0	70	2.86		8.163	2.857	8.163
74.4	70	6.29		39.510	6.286	39.510
72.7	70	3.86		14.878	3.857	14.878
73.0	70	4.29		18.367	4.286	18.367
71.8	70	2.57		6.612	2.571	6.612
71.9	70	2.71		7.367	2.714	7.367
71.8	70	2.57		6.612	2.571	6.612
72.6	70	3.71		13.796	3.714	13.796
72.5	70	3.57		12.755	3.571	12.755
71.7	70	2.43		5.898	2.429	5.898

n	S_d	S_{d2}	$\Sigma\|d\|$	"AB" (Eqn 4)
69	2.799	9.766	160.143	2.321
n-1	**Σd**	**Σd^2**	**$\Sigma\|d\|^2$**	**"AS" (Eqn 5)**
68	34.714	550.102	550.102	1.620

Bias (%) (Eqn 3)	Both Signs Positive
2.65	FALSE

CV (%) (Eqn 2)	Signed Bias (%)	Both Signs Negative
3.15	+/-2.65	FALSE

Upper Probability Limit	Lower Probability Limit
5.99	-4.98



O_3 Assessments : Annual May 2014 - April 2015

Brunswick County - Edgerton	Pollutant type: O_3	CV$_{ub}$ (%)	Bias (%)

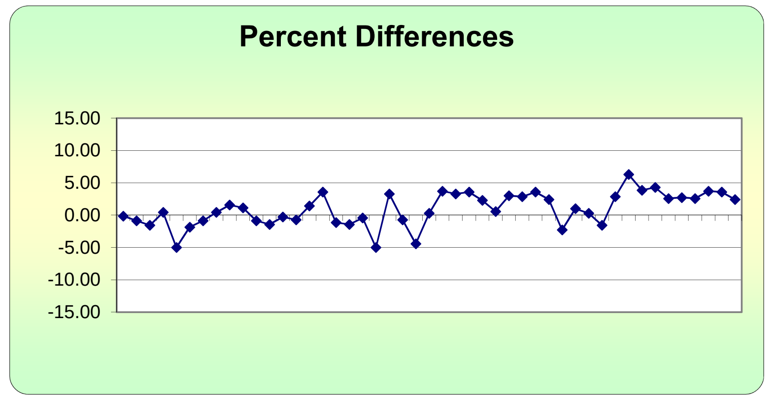
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$
69.9	70	-0.14	-0.857	0.020	0.143	0.020
69.4	70	-0.86	**75th Percentile**	0.735	0.857	0.735
68.9	70	-1.57	2.929	2.469	1.571	2.469
70.3	70	0.43		0.184	0.429	0.184
66.5	70	-5.00		25.000	5.000	25.000
68.7	70	-1.86		3.449	1.857	3.449
69.4	70	-0.86		0.735	0.857	0.735
70.3	70	0.43		0.184	0.429	0.184
71.1	70	1.57		2.469	1.571	2.469
70.8	70	1.14		1.306	1.143	1.306
69.4	70	-0.86		0.735	0.857	0.735
69.0	70	-1.43		2.041	1.429	2.041
69.8	70	-0.29		0.082	0.286	0.082
69.5	70	-0.71		0.510	0.714	0.510
71.0	70	1.43		2.041	1.429	2.041
72.5	70	3.57		12.755	3.571	12.755
69.2	70	-1.14		1.306	1.143	1.306
69.0	70	-1.43		2.041	1.429	2.041
69.7	70	-0.43		0.184	0.429	0.184
66.5	70	-5.00		25.000	5.000	25.000
72.3	70	3.29		10.796	3.286	10.796
69.5	70	-0.71		0.510	0.714	0.510
67	70	-4.43		19.612	4.429	19.612
70	70	0.29		0.082	0.286	0.082
72.6	70	3.71		13.796	3.714	13.796
72.3	70	3.29		10.796	3.286	10.796
72.5	70	3.57		12.755	3.571	12.755
71.6	70	2.29		5.224	2.286	5.224
70.4	70	0.57		0.327	0.571	0.327
72.1	70	3.00		9.000	3.000	9.000
72.0	70	2.86		8.163	2.857	8.163
72.5	70	3.57		12.755	3.571	12.755
71.7	70	2.43		5.898	2.429	5.898
68.4	70	-2.29		5.224	2.286	5.224
70.7	70	1.00		1.000	1.000	1.000
70.2	70	0.29		0.082	0.286	0.082
68.9	70	-1.57		2.469	1.571	2.469
72.0	70	2.86		8.163	2.857	8.163
74.4	70	6.29		39.510	6.286	39.510
72.7	70	3.86		14.878	3.857	14.878
73.0	70	4.29		18.367	4.286	18.367
71.8	70	2.57		6.612	2.571	6.612
71.9	70	2.71		7.367	2.714	7.367
71.8	70	2.57		6.612	2.571	6.612
72.6	70	3.71		13.796	3.714	13.796
72.5	70	3.57		12.755	3.571	12.755
71.7	70	2.43		5.898	2.429	5.898

n	S_d	S_{d2}	$\sum\|d\|$	"AB" (Eqn 4)
47	2.538	8.276	104.143	2.216
n-1	**$\sum d$**	**$\sum d^2$**	**$\sum\|d\|^2$**	**"AS" (Eqn 5)**
46	43.000	335.694	335.694	1.510

Bias (%) (Eqn 3)	Both Signs Positive
2.59	FALSE

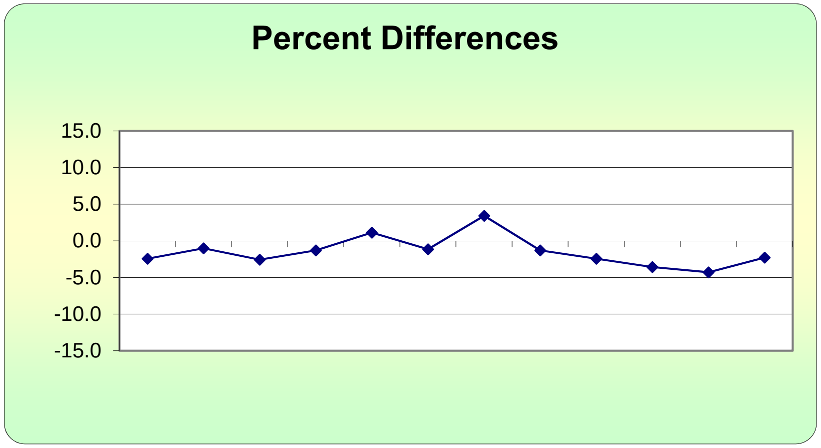
CV (%) (Eqn 2)	Signed Bias (%)	Both Signs Negative
2.94	+/-2.59	FALSE

Upper Probability Limit	Lower Probability Limit
5.89	-4.06



SO_2 Assessments: Q6

Brunswick County - Edgerton		Pollutant type: SO_2					CV_{ub} (%)			Bias (%)	
Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile	d^2	|d|	$\|d\|^2$					
68.3	70	-2.4	-2.429	5.898	2.429	5.898					
69.3	70	-1.0	75th Percentile	1.000	1.000	1.000	n	S_d	S_{d2}	$\sum\|d\|$	"AB" (Eqn 4)
68.2	70	-2.6	-1.143	6.612	2.571	6.612	13	1.985	5.437	28.286	2.176
69.1	70	-1.3		1.653	1.286	1.653	n-1	$\sum d$	$\sum d^2$	$\sum\|d\|^2$	"AS" (Eqn 5)
70.8	70	1.1		1.306	1.143	1.306	12	-19.143	75.469	75.469	1.077
69.2	70	-1.1		1.306	1.143	1.306					
72.4	70	3.4		11.755	3.429	11.755				Bias (%) (Eqn 3)	Both Signs Positive
69.1	70	-1.3		1.653	1.286	1.653				2.71	FALSE
68.3	70	-2.4		5.898	2.429	5.898	CV (%) (Eqn 2)			Signed Bias (%)	Both Signs Negative
67.5	70	-3.6		12.755	3.571	12.755	2.74			-2.71	TRUE
67.0	70	-4.3		18.367	4.286	18.367					
68.4	70	-2.3		5.224	2.286	5.224	Upper Probability Limit			Lower Probability Limit	
69	70	-1.429		2.041	1.429	2.041	2.42			-5.36	



SO_2 Assessments : Cumulative November 2013 - April 2015

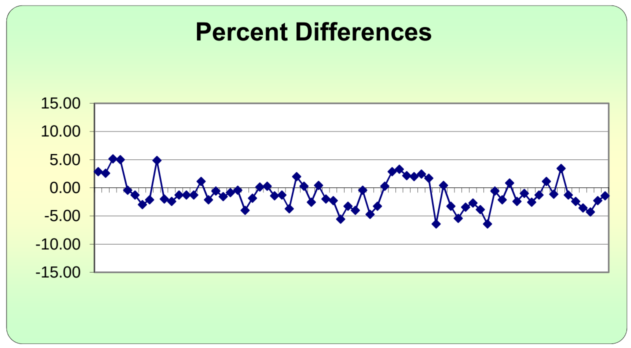
Brunswick County - Edgerton		Pollutant type: SO_2				
Meas Val (Y)	**Audit Val (X)**	**d (Eqn. 1)**	**25th Percentile**	**d^2**	**|d|**	**$\|d\|^2$**
72	70	2.86	-2.571	8.163	2.857	8.163
71.8	70	2.57	**75th Percentile**	6.612	2.571	6.612
74	70	5.14	0.393	26.449	5.143	26.449
74	70	5.00		25.000	5.000	25.000
70	70	-0.43		0.184	0.429	0.184
69	70	-1.29		1.653	1.286	1.653
68	70	-3.00		9.000	3.000	9.000
69	70	-2.14		4.592	2.143	4.592
73	70	4.86		23.592	4.857	23.592
69	70	-2.00		4.000	2.000	4.000
68	70	-2.43		5.898	2.429	5.898
69.1	70	-1.29		1.653	1.286	1.653
69.1	70	-1.29		1.653	1.286	1.653
69.1	70	-1.29		1.653	1.286	1.653
70.8	70	1.14		1.306	1.143	1.306
68.5	70	-2.14		4.592	2.143	4.592
69.6	70	-0.57		0.327	0.571	0.327
68.9	70	-1.57		2.469	1.571	2.469
69.4	70	-0.86		0.735	0.857	0.735
69.7	70	-0.43		0.184	0.429	0.184
67.2	70	-4.00		16.000	4.000	16.000
68.7	70	-1.86		3.449	1.857	3.449
70.1	70	0.14		0.020	0.143	0.020
70.2	70	0.29		0.082	0.286	0.082
69.0	70	-1.43		2.041	1.429	2.041
69.1	70	-1.29		1.653	1.286	1.653
67.4	70	-3.71		13.796	3.714	13.796
71.4	70	2.00		4.000	2.000	4.000
70.2	70	0.29		0.082	0.286	0.082
68.2	70	-2.57		6.612	2.571	6.612
70.3	70	0.43		0.184	0.429	0.184
68.6	70	-2.00		4.000	2.000	4.000
68.4	70	-2.29		5.224	2.286	5.224
66.1	70	-5.57		31.041	5.571	31.041
67.7	70	-3.29		10.796	3.286	10.796
67.2	70	-4.00		16.000	4.000	16.000
69.7	70	-0.43		0.184	0.429	0.184
66.7	70	-4.71		22.224	4.714	22.224
67.7	70	-3.29		10.796	3.286	10.796
70.2	70	0.29		0.082	0.286	0.082
72.0	70	2.86		8.163	2.857	8.163
72.3	70	3.29		10.796	3.286	10.796
71.5	70	2.14		4.592	2.143	4.592
71.4	70	2.00		4.000	2.000	4.000
71.7	70	2.43		5.898	2.429	5.898
71.2	70	1.714		2.939	1.714	2.939
65.5	70	-6.429		41.327	6.429	41.327
70.3	70	0.429		0.184	0.429	0.184
67.7	70	-3.286		10.796	3.286	10.796
66.2	70	-5.429		29.469	5.429	29.469
67.6	70	-3.429		11.755	3.429	11.755
68.1	70	-2.714		7.367	2.714	7.367
67.3	70	-3.857		14.878	3.857	14.878
65.5	70	-6.429		41.327	6.429	41.327
69.6	70	-0.571		0.327	0.571	0.327
68.5	70	-2.143		4.592	2.143	4.592
70.6	70	0.857		0.735	0.857	0.735
68.3	70	-2.429		5.898	2.429	5.898
69.3	70	-1.000		1.000	1.000	1.000
68.2	70	-2.571		6.612	2.571	6.612
69.1	70	-1.286		1.653	1.286	1.653
70.8	70	1.143		1.306	1.143	1.306
69.2	70	-1.143		1.306	1.143	1.306
72.4	70	3.429		11.755	3.429	11.755
69.1	70	-1.286		1.653	1.286	1.653
68.3	70	-2.429		5.898	2.429	5.898
67.5	70	-3.571		12.755	3.571	12.755
67.0	70	-4.286		18.367	4.286	18.367
68.4	70	-2.286		5.224	2.286	5.224
69	70	-1.429		2.041	1.429	2.041

CV_{ub} (%)				Bias (%)
n	**S_d**	**S_{d2}**	**$\Sigma\|d\|$**	**"AB" (Eqn 4)**
70	2.623	9.502	164.429	2.349
n-1	**Σd**	**Σd^2**	**$\Sigma\|d\|^2$**	**"AS" (Eqn 5)**
69	-73.857	552.592	552.592	1.553

Bias (%) (Eqn 3)	Both Signs Positive
2.66	FALSE
Signed Bias (%)	Both Signs Negative
+/-2.66	FALSE

CV (%) (Eqn 2)
2.95

Upper Probability Limit	**Lower Probability Limit**
4.09	-6.2



SO_2 Assessments : Annual May 2014 - April 2015

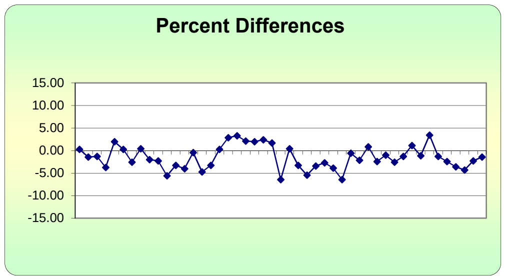
Brunswick County - Edgerton	Pollutant type: SO_2	CV_{ub} (%)	Bias (%)

Meas Val (Y)	Audit Val (X)	d (Eqn. 1)	25th Percentile		d^2	$\lvert d \rvert$	$\lvert d \rvert^2$
70.2	70	0.29		-3.286	0.082	0.286	0.082
69.0	70	-1.43	**75th Percentile**		2.041	1.429	2.041
69.1	70	-1.29		0.357	1.653	1.286	1.653
67.4	70	-3.71			13.796	3.714	13.796
71.4	70	2.00			4.000	2.000	4.000
70.2	70	0.29			0.082	0.286	0.082
68.2	70	-2.57			6.612	2.571	6.612
70.3	70	0.43			0.184	0.429	0.184
68.6	70	-2.00			4.000	2.000	4.000
68.4	70	-2.29			5.224	2.286	5.224
66.1	70	-5.57			31.041	5.571	31.041
67.7	70	-3.29			10.796	3.286	10.796
67.2	70	-4.00			16.000	4.000	16.000
69.7	70	-0.43			0.184	0.429	0.184
66.7	70	-4.71			22.224	4.714	22.224
67.7	70	-3.29			10.796	3.286	10.796
70.2	70	0.29			0.082	0.286	0.082
72.0	70	2.86			8.163	2.857	8.163
72.3	70	3.29			10.796	3.286	10.796
71.5	70	2.14			4.592	2.143	4.592
71.4	70	2.00			4.000	2.000	4.000
71.7	70	2.43			5.898	2.429	5.898
71.2	70	1.714			2.939	1.714	2.939
65.5	70	-6.429			41.327	6.429	41.327
70.3	70	0.429			0.184	0.429	0.184
67.7	70	-3.286			10.796	3.286	10.796
66.2	70	-5.429			29.469	5.429	29.469
67.6	70	-3.429			11.755	3.429	11.755
68.1	70	-2.714			7.367	2.714	7.367
67.3	70	-3.857			14.878	3.857	14.878
65.5	70	-6.429			41.327	6.429	41.327
69.6	70	-0.571			0.327	0.571	0.327
68.5	70	-2.143			4.592	2.143	4.592
70.6	70	0.857			0.735	0.857	0.735
68.3	70	-2.429			5.898	2.429	5.898
69.3	70	-1.000			1.000	1.000	1.000
68.2	70	-2.571			6.612	2.571	6.612
69.1	70	-1.286			1.653	1.286	1.653
70.8	70	1.143			1.306	1.143	1.306
69.2	70	-1.143			1.306	1.143	1.306
72.4	70	3.429			11.755	3.429	11.755
69.1	70	-1.286			1.653	1.286	1.653
68.3	70	-2.429			5.898	2.429	5.898
67.5	70	-3.571			12.755	3.571	12.755
67.0	70	-4.286			18.367	4.286	18.367
68.4	70	-2.286			5.224	2.286	5.224
69	70	-1.429			2.041	1.429	2.041

n	S_d	S_{d2}	$\Sigma\lvert d \rvert$	"AB" (Eqn 4)
47	2.563	10.084	116.143	2.471
n-1	**Σd**	**Σd^2**	**$\Sigma\lvert d \rvert^2$**	**"AS" (Eqn 5)**
46	-69.000	403.408	403.408	1.591

CV (%) (Eqn 2)	Bias (%) (Eqn 3)	Both Signs Positive
	2.86	FALSE
	Signed Bias (%)	**Both Signs Negative**
2.97	+/-2.86	FALSE

Upper Probability Limit	Lower Probability Limit
3.55	-6.49



PM10 Assesments: Q6

Brunswick County Air Monitoring - Edgerton Tower

		Primary Sampler					Collocated Sampler					Precision Values			
Sample Date	Sample Type	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Primary FRM µg/m^3	Collocated FRM µg/m^3	d_i	d_i^2
2/5/2015	PM10	25.69	135.23	135.04	194	7.55	25.67	135.269	135.079	190	7.40	7.6	7.4	-2.67	7.11
2/11/2015	PM10	25.74	132.46	132.27	194	7.54	25.74	135.763	135.535	228	8.86	7.5	8.9	17.07	291.49
2/17/2015	PM10	26.24	135.32	135.06	259	9.87	26.23	140.622	140.413	209	7.97	9.9	8.0	-21.23	450.67
2/26/2015	PM10			Invalid Sample			25.87	134.038	133.754	284	10.98		11.0		
3/1/2015	PM10	26.17	135.37	135.04	338	12.92	26.09	133.684	133.353	331	12.69	14.1	13.7	-2.67	7.12
3/10/2015	PM10	25.53	134.33	134.05	280	10.97			Invalid Sample			11.0			
3/13/2015	PM10	25.70	136.31	136.09	221	8.60			Invalid Sample			8.6			
3/19/2015	PM10	25.53	134.33	134.05	280	10.97			Invalid Sample			11.0			
3/25/2015	PM10	25.14	134.61	134.23	378	15.04			Invalid Sample			15.0			
4/3/2015	PM10	24.55	138.62	138.36	258	10.51	24.47	136.855	136.611	244	9.97	10.5	10.0	-4.88	23.80
4/6/2015	PM10	24.47	137.41	137.05	360	14.71	24.38	137.373	137.042	331	13.58	14.7	13.6	-7.77	60.43
4/12/2015	PM10	24.68	139.11	138.70	405	16.41	24.58	135.082	134.698	384	15.62	16.4	15.6	-5.00	25.00
4/18/2015	PM10	24.46	134.93	134.62	311	12.71	24.36	135.78	135.481	299	12.27	12.7	12.3	-3.20	10.24
4/27/2015	PM10			Not Collected			23.99	138.866	138.659	207	8.63				
4/29/2015	PM10	24.43	138.28	138.06	228	9.33			Not Collected						
													SUM	-30.34	875.87

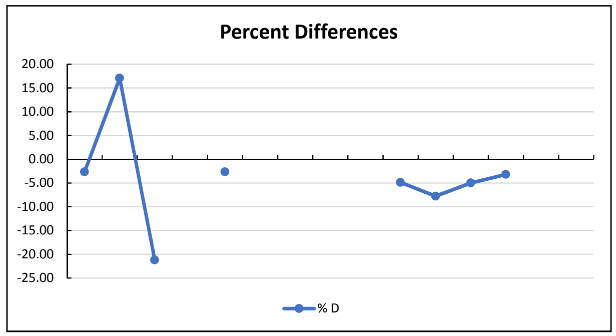
n= 8

Chi Sq 2.833107

CV= 11.59

Note:

PM_{10} sample volumes have been corrrected to standard temperature and pressure. (25°C, 760 mmHg)



PM2.5 Assesments: Q6

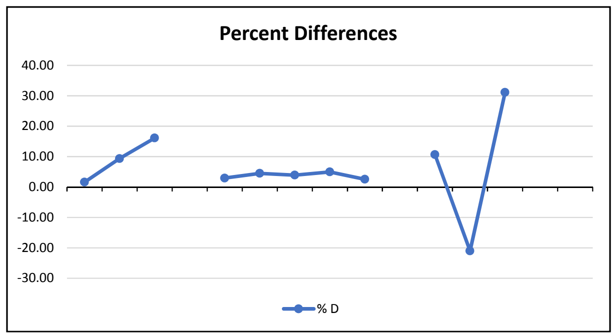
Brunswick County Air Monitoring - Edgerton Tower

		Primary Sampler					Collocated Sampler					Precision Values			
Sample Date	Sample Type	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Primary FRM µg/m^3	Collocated FRM µg/m^3	d_i	d_i^2
2/5/2015	PM2.5	23.98	134.833	134.681	152	6.34	23.89	134.99	134.84	153.00	6.40	6.3	6.4	1.57	2.48
2/11/2015	PM2.5	23.99	133.104	132.981	123	5.13	23.90	135.71	135.58	133.00	5.56	5.1	5.6	9.35	87.34
2/17/2015	PM2.5	23.99	138.961	138.824	137	5.71	23.89	139.02	138.86	159.00	6.66	5.7	6.7	16.13	260.15
2/26/2015	PM2.5	Invalid Sample					23.89	134.15	133.90	251.00	10.51		10.5		
3/1/2015	PM2.5	24.01	136.611	136.369	242	10.08	23.88	134.38	134.13	248.00	10.39	10.1	10.4	2.93	8.57
3/10/2015	PM2.5	23.98	135.289	135.081	208	8.67	23.85	133.21	133.00	217.00	9.10	8.7	9.1	4.49	20.20
3/13/2015	PM2.5	23.98	133.554	133.435	119	4.96	24.01	134.99	134.86	124.00	5.16	5.0	5.2	3.92	15.38
3/19/2015	PM2.5	24.01	135.935	135.793	142	5.91	23.87	136.42	136.27	147.00	6.16	5.9	6.2	4.96	24.59
3/25/2015	PM2.5	23.98	134.97	134.783	187	7.80	23.86	133.77	133.58	190.00	7.96	7.8	8.0	2.53	6.41
4/3/2015	PM2.5	23.99	134.961	134.783	178	7.42	24.00	136.07	135.93	131.00	5.46	7.4	5.5		
4/6/2015	PM2.5	24	137.187	136.995	192	8.00	23.99	138.12	137.91	213.00	8.88	8.0	8.9	10.65	113.44
4/12/2015	PM2.5	24	138.442	138.29	152	6.33	23.99	137.54	137.42	123.00	5.13	6.3	5.1	-21.05	443.21
4/18/2015	PM2.5	24	136.762	136.625	137	5.71	23.99	136.70	136.51	186.00	7.75	5.7	7.8	31.11	967.90
4/27/2015	PM2.5	Not Collected					23.99	138.87	138.66	207.00	8.63				
4/29/2015	PM2.5	23.99	137.314	137.173	141	5.88	Not Collected								
													SUM	66.59	1949.67

n= 11

Chi Sq 4.865182

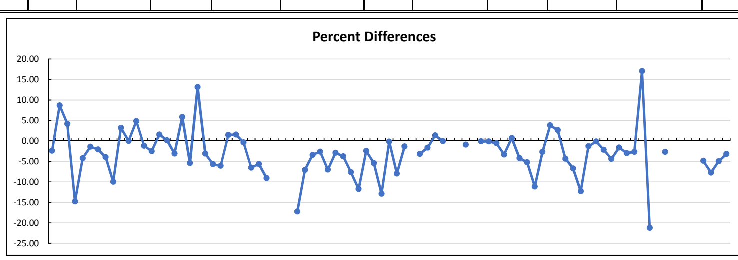
CV= 12.61



PM10 Assesments : Cumulative November 2013 - April 2015

Brunswick County Air Monitoring - Edgerton Tower

		Primary Sampler					Collocated Sampler					Precision Values				
Sample Date	Sample Type	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration $µg/m^3$	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration $µg/m^3$	Primary FRM $µg/m^3$	Collocated FRM $µg/m^3$	d_i	d_i^2	
11/6/2013	PM10	24.012	145.496	145.208	288	11.99	23.998	141.843	141.562	281	11.71	12.0	11.7	-2.40	5.76	n= 77
11/12/2013	PM10	24.012	145.496	145.262	234	9.75	23.998	143.151	142.896	255	10.63	9.7	10.6	8.65	74.80	Chi Sq 60.68986
11/18/2013	PM10	24.01	144.747	144.535	212	8.83	24.01	144.632	144.411	221	9.20	8.8	9.2	4.16	17.28	
11/24/2013	PM10	24.029	143.959	143.815	144	5.99	23.998	147.826	147.702	124	5.17	6.0	5.2	-14.80	218.94	
11/30/2013	PM10	23.998	143.003	142.611	392	16.33	24.012	143.111	142.735	376	15.66	16.3	15.7	-4.23	17.86	
12/6/2013	PM10	23.998	141.502	141.217	285	11.88	23.998	141.338	141.057	281	11.71	11.9	11.7	-1.41	2.00	
12/12/2013	PM10	23.998	142.818	142.569	249	10.38	24.012	141.956	141.712	244	10.16	10.4	10.2	-2.09	4.36	
12/18/2013	PM10	23.998	141.234	141.105	129	5.38	23.998	143.188	143.064	124	5.17	5.4	5.2	-3.95	15.62	
12/24/2013	PM10	24.012	142.167	142.02	147	6.12	24.012	142.160	142.027	133	5.54	6.1	5.5	-10.00	100.00	
12/30/2013	PM10	24.012	145.743	145.586	157	6.54	23.998	141.234	141.072	162	6.75	6.5	6.8	3.19	10.21	
1/5/2014	PM10	24.01	146.590	146.422	168	7.00	24.01	145.816	145.648	168	7.00	7.0	7.0	0.00	0.00	
1/11/2014	PM10	24.01	143.256	143.133	123	5.12	24.00	148.450	148.321	129	5.38	5.1	5.4	4.82	23.25	
1/17/2014	PM10	24.01	148.098	147.846	252	10.49	24.01	144.943	144.694	249	10.37	10.5	10.4	-1.20	1.43	
1/23/2014	PM10	24.01	146.522	146.279	243	10.12	24.01	142.713	142.476	237	9.87	10.1	9.9	-2.50	6.25	
1/29/2014	PM10	24.01	146.095	145.778	317	13.20	24.01	147.587	147.265	322	13.41	13.2	13.4	1.56	2.45	
2/4/2014	PM10	25.900	139.836	139.540	296	11.43	25.860	142.762	142.466	296	11.45	11.4	11.4	0.15	0.02	
2/10/2014	PM10	25.960	142.531	142.090	441	16.99	25.930	144.351	143.924	427	16.47	17.0	16.5	-3.11	9.67	
2/16/2014	PM10	25.78	142.195	141.957	238	9.23	25.75	144.089	143.837	252	9.79	9.2	9.8	5.84	34.12	
2/22/2014	PM10	25.228	143.894	143.744	150	5.95	25.208	146.210	146.068	142	5.63	5.9	5.6	-5.40	29.15	
2/28/2014	PM10	26.367	145.387	145.098	289	10.96	26.309	138.356	138.027	329	12.51	11.0	12.5	13.16	173.31	
3/6/2014	PM10	26.215	146.32	145.812	508	19.38	26.137	145.199	144.708	491	18.79	19.4	18.8	-3.11	9.65	
3/12/2014	PM10	24.248	146.142	145.187	955	39.38	24.220	147.077	146.176	901	37.20	39.4	37.2	-5.70	32.53	
3/18/2014	PM10	25.965	144.496	144.269	227	8.74	25.888	145.399	145.186	213	8.23	8.7	8.2	-6.07	36.81	
3/24/2014	PM10	25.943	144.798	144.566	232	8.94	25.898	145.752	145.517	235	9.07	8.9	9.1	1.46	2.13	
3/30/2014	PM10	24.992	144.928	144.852	76	3.04	24.928	143.813	143.736	77	3.09	3.0	3.1	1.56	2.44	
4/6/2014	PM10	25.18	144.213	144.013	200	7.94	25.15	142.411	142.212	199	7.91	7.9	7.9	-0.39	0.15	
4/11/2014	PM10	24.29	142.609	141.229	1380	56.81	24.28	144.054	142.762	1292	53.21	56.8	53.2	-6.55	42.88	
4/17/2014	PM10	25.75	139.827	139.478	349	13.55	25.68	140.576	140.247	329	12.81	13.6	12.8	-5.64	31.86	
4/23/2014	PM10	24.43	144.875	144.449	426	17.44	24.37	141.660	141.272	388	15.92	17.4	15.9	-9.09	82.59	
4/29/2014	PM10			Invalid Sample			24.79	142.244	142.095	149	6.01		6.0			
5/5/2014	PM10			Invalid Sample			24.630	145.376	145.064	312	12.67		12.7			
5/12/2014	PM10			Invalid Sample			24.090	147.475	147.045	430	17.85		17.8			
5/17/2014	PM10	24.75	149.002	148.709	293	11.84	24.70	148.366	148.120	246	9.96	11.8	10.0	-17.24	297.18	
5/23/2014	PM10	23.960	141.677	141.127	550	22.95	24.040	147.835	147.321	514	21.38	23.0	21.4	-7.10	50.41	
5/29/2014	PM10	24.330	140.368	140.103	265	10.89	24.420	140.929	140.672	257	10.52	10.9	10.5	-3.43	11.79	
6/4/2014	PM10	23.510	141.695	141.081	614	26.12	23.630	144.676	144.075	601	25.43	26.1	25.4	-2.65	7.02	
6/10/2014	PM10	23.440	143.073	142.636	437	18.64	23.590	141.788	141.378	410	17.38	18.6	17.4	-7.01	49.18	
6/16/2014	PM10	23.660	146.889	146.428	461	19.48	23.780	143.443	142.993	450	18.92	19.5	18.9	-2.92	8.53	
6/22/2014	PM10	23.840	143.500	143.178	322	13.51	23.910	145.074	144.763	311	13.01	13.5	13.0	-3.77	14.20	
6/28/2014	PM10	23.920	143.692	143.384	308	12.88	24.060	145.221	144.934	287	11.93	12.9	11.9	-7.64	58.39	
7/4/2014	PM10	23.72	143.325	142.975	350	14.76	23.86	143.073	142.76	313	13.12	14.8	13.1	-11.75	138.01	
7/10/2014	PM10	23.95	142.998	142.600	398	16.62	24.05	143.314	142.924	390	16.22	16.6	16.2	-2.45	5.99	
7/16/2014	PM10	23.78	146.768	146.334	434	18.25	23.72	145.164	144.754	410	17.28	18.3	17.3	-5.43	29.54	
7/22/2014	PM10	23.76	138.888	138.603	285	11.99	23.82	142.983	142.732	251	10.54	12.0	10.5	-12.94	167.39	
7/28/2014	PM10	23.46	141.888	141.505	383	16.33	23.50	142.337	141.954	383	16.30	16.3	16.3	-0.17	0.03	
8/3/2014	PM10	23.95	138.90	138.63	277	11.57	24.07	137.551	137.294	257	10.68	11.6	10.7	-7.99	63.83	
8/9/2014	PM10	24.21	135.844	135.365	479	19.79	24.28	137.475	137.001	474	19.52	19.8	19.5	-1.34	1.79	
8/15/2014	PM10			Invalid Sample					Invalid Sample				10.0			
8/21/2014	PM10	23.71	135.282	134.857	425	17.92	23.61	136.019	135.609	410	17.37	17.9	17.4	-3.17	10.05	
8/27/2014	PM10	24.1	137.884	137.525	359	14.90	24.09	137.291	136.938	353	14.65	14.9	14.7	-1.64	2.70	
9/2/2014	PM10	23.58	137.04	136.431	609	25.83	23.53	136.961	136.345	616	26.18	25.8	26.2	1.36	1.84	
9/8/2014	PM10	24.24	136.808	136.666	142	5.86	24.25	137.995	137.853	142	5.86	5.9	5.9	-0.04	0.00	
9/14/2014	PM10	24.69	137.15	136.878	272	11.02			Invalid Sample			11.0				
9/23/2014	PM10	24.78	137.776	137.623	153	6.17			Invalid Sample			6.2				
9/26/2014	PM10	24.44	136.909	136.571	338	13.83	24.3	137.03	136.697	333	13.70	13.8	13.7	-0.92	0.84	
10/2/2014	PM10	24.28	138.106	137.568	538	22.16			Invalid Sample			22.2				
10/8/2014	PM10	24.21	134.224	133.893	331	13.67	24.16	135.478	135.148	330	13.66	13.7	13.7	-0.10	0.01	
10/14/2014	PM10	23.99	134.640	134.293	347	14.46	23.95	136.288	135.942	346	14.45	14.5	14.4	-0.12	0.01	
10/20/2014	PM10	24.49	135.292	134.971	321	13.11	24.48	136.582	136.263	319	13.03	13.1	13.0	-0.58	0.34	
10/26/2014	PM10	24.54	138.810	138.514	296	12.06	24.52	136.431	136.145	286	11.66	12.1	11.7	-3.35	11.26	
11/1/2014	PM10	25.13	138.28	138.09	187	7.44	25.1	136.787	136.599	188	7.49	7.4	7.5	0.67	0.45	
11/7/2014	PM10	25.07	138.69	138.57	122	4.87	25.06	138.936	138.819	117	4.67	4.9	4.7	-4.19	17.58	
11/13/2014	PM10	25.31	137.22	136.87	349	13.79	25.28	137.569	137.238	331	13.09	13.8	13.1	-5.21	27.13	
11/19/2014	PM10	26.22	137.61	137.28	322	12.28	26.24	136.798	136.51	288	10.98	12.3	11.0	-11.18	124.95	
11/25/2014	PM10	24.69	137.44	137.09	347	14.05	24.64	138.363	138.026	337	13.68	14.1	13.7	-2.67	7.12	
12/1/2014	PM10	24.88	136.56	136.32	237	9.53	24.86	136.503	136.257	246	9.90	9.5	9.9	3.81	14.51	
12/7/2014	PM10	25.75	135.07	134.94	125	4.85	25.72	135.649	135.521	128	4.98	4.9	5.0	2.64	7.00	
12/13/2014	PM10	25.61	135.81	135.53	276	10.78	25.68	137.562	137.297	265	10.32	10.8	10.3	-4.36	19.01	
12/19/2014	PM10	25.94	136.55	136.26	291	11.22	25.92	135.452	135.18	272	10.49	11.2	10.5	-6.73	45.23	
12/25/2014	PM10	24.99	137.90	137.79	108	4.32	24.85	136.569	136.474	95	3.82	4.3	3.8	-12.29	150.92	
12/31/2014	PM10	26.32	137.10	136.88	220	8.36	26.31	133.251	133.034	217	8.25	8.4	8.3	-1.32	1.75	
1/6/2015	PM10	26.08	135.72	135.52	199	7.63	26.1	133.076	132.877	199	7.62	7.6	7.6	-0.13	0.02	
1/15/2015	PM10	26.00	135.32	135.04	277	10.65	26.01	136.491	136.22	271	10.42	10.7	10.4	-2.18	4.77	
1/18/2015	PM10	25.69	137.56	137.18	383	14.91	25.65	138.529	138.163	366	14.27	14.9	14.3	-4.39	19.24	
1/24/2015	PM10	25.24	138.09	137.87	219	8.68	25.18	136.426	136.211	215	8.54	8.7	8.5	-1.63	2.64	
1/30/2015	PM10	25.59	133.63	133.46	174	6.80	25.58	135.792	135.623	169	6.61	6.8	6.6	-2.99	8.91	
2/5/2015	PM10	25.69	135.23	135.04	194	7.55	25.67	135.269	135.079	190	7.40	7.6	7.4	-2.67	7.11	
2/11/2015	PM10	25.74	132.46	132.27	194	7.54	25.74	135.763	135.535	228	8.86	7.5	8.9	17.07	291.49	
2/17/2015	PM10	26.24	135.32	135.06	259	9.87	26.23	140.622	140.413	209	7.97	9.9	8.0	-21.23	450.67	
2/26/2015	PM10			Invalid Sample			25.87	134.038	133.754	284	10.98		11.0			
3/1/2015	PM10	26.17	135.37	135.04	338	12.92	26.09	133.684	133.353	331	12.69	14.1	13.7	-2.67	7.12	
3/10/2015	PM10	25.53	134.33	134.05	280	10.97			Invalid Sample			11.0				
3/13/2015	PM10	25.70	136.31	136.09	221	8.60			Invalid Sample			8.6				
3/19/2015	PM10	25.53	134.33	134.05	280	10.97			Invalid Sample			11.0				
3/25/2015	PM10	25.14	134.61	134.23	378	15.04			Invalid Sample			15.0				
4/3/2015	PM10	24.55	138.62	138.36	258	10.51	24.47	136.855	136.611	244	9.97	10.5	10.0	-4.88	23.80	
4/6/2015	PM10	24.47	137.41	137.05	360	14.71	24.38	137.373	137.042	331	13.58	14.7	13.6	-7.77	60.43	
4/12/2015	PM10	24.68	139.11	138.70	405	16.41	24.58	135.082	134.698	384	15.62	16.4	15.6	-5.00	25.00	
4/18/2015	PM10	24.46	134.93	134.62	311	12.71	24.36	135.78	135.481	299	12.27	12.7	12.3	-3.20	10.24	
4/27/2015	PM10			Not Collected			23.99	138.866	138.659	207	8.63					
4/29/2015	PM10	24.43	138.28	138.06	228	9.33			Not Collected							



SUM -227.94 3244.96

CV=	4.60

PM2.5 Assesments : Cumulative November 2013 - April 2015

Brunswick County Air Monitoring - Edgerton Tower

		Primary Sampler					Collocated Sampler					Precision Values			
Sample Date	Sample Type	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Primary FRM µg/m^3	Collocated FRM µg/m^3	d_i	d_i^2
11/6/2013	PM2.5	24.01	139.209	139.059	150	6.25	24.00	145.885	145.735	150	6.25	6.2	6.3	0.06	0.00
11/12/2013	PM2.5	24.01	145.54	145.405	135	5.62	24.01	143.822	143.678	144	6.00	5.6	6.0	6.45	41.62
11/18/2013	PM2.5	24.012	144.142	144.057	85	3.54	24.012	146.811	146.643	168	7.00	3.5	7.0	65.61	4305.02
11/24/2013	PM2.5	24.00	144.081	144.008	73	3.04	24.01	142.999	142.919	80	3.33	3.0	3.3	9.09	82.64
11/30/2013	PM2.5	24.00	145.973	145.676	297	12.38	24.00	143.860	143.554	306	12.75	12.4	12.8	2.99	8.91
12/6/2013	PM2.5	24.00	145.019	144.827	192	8.00	24.00	139.817	139.620	197	8.21	8.0	8.2	2.57	6.61
12/12/2013	PM2.5	24.00	143.997	143.816	181	7.54	24.00	144.917	144.735	182	7.58	7.5	7.6	0.55	0.30
12/18/2013	PM2.5	24.00	144.112	144.029	83	3.46	24.01	140.816	140.731	85	3.54	3.5	3.5	2.32	5.39
12/24/2013	PM2.5	24.00	145.193	145.073	120	5.00	24.00	140.474	140.345	129	5.38	5.0	5.4	7.23	52.26
12/30/2013	PM2.5	24.00	141.282	141.172	110	4.58	24.01	141.079	140.976	103	4.29	4.6	4.3	-6.63	43.99
1/5/2014	PM2.5	24.01	148.588	148.489	99	4.12	24.01	149.152	149.047	105	4.37	4.1	4.4	5.88	34.60
1/11/2014	PM2.5	24.01	147.395	147.321	74	3.08	24.01	145.943	145.867	76	3.17	3.1	3.2	2.67	7.11
1/17/2014	PM2.5	24.00	142.074	141.914	160	6.67	24.01	141.526	141.354	172	7.16	6.7	7.2	7.17	51.40
1/23/2014	PM2.5	24.01	142.954	142.819	135	5.62	24.01	143.782	143.626	156	6.50	5.6	6.5	14.43	208.31
1/29/2014	PM2.5	24.01	147.190	146.994	196	8.16	24.01	149.780	149.585	195	8.12	8.2	8.1	-0.51	0.26
2/4/2014	PM2.5	23.99	145.498	145.341	157	6.54	23.99	146.482	146.330	152	6.34	6.5	6.3	-3.24	10.47
2/10/2014	PM2.5	23.99	144.623	144.303	320	13.34	23.99	142.269	141.946	323	13.46	13.3	13.5	0.93	0.87
2/16/2014	PM2.5	23.990	144.358	144.150	208	8.67	23.980	141.182	140.968	214	8.92	8.7	8.9	2.89	8.32
2/22/2014	PM2.5	23.99	146.111	146.037	74	3.08	23.98	144.567	144.491	76	3.17	3.1	3.2	2.71	7.34
2/28/2014	PM2.5	23.99	143.236	143.062	174	7.25	23.98	146.277	146.116	161	6.71	7.3	6.7	-7.72	59.59
3/6/2014	PM2.5	23.98	145.264	144.966	298	12.43	24.00	146.618	146.340	278	11.58	12.4	11.6	-7.03	49.39
3/12/2014	PM2.5	24.00	146.806	146.463	343	14.29			Invalid Sample			14.3			
3/18/2014	PM2.5	23.99	142.816	142.682	134	5.59	23.98	142.979	142.848	131	5.46	5.6	5.5	-2.22	4.94
3/24/2014	PM2.5	23.99	144.519	144.38	139	5.79	23.99	144.818	144.697	121	5.04	5.8	5.0	-13.85	191.72
3/30/2014	PM2.5			Invalid Sample					Invalid Sample						
4/6/2014	PM2.5	24.00	143.670	143.527	143	5.96	24.00	141.730	141.589	141	5.87	6.0	5.9	-1.41	1.98
4/11/2014	PM2.5	24.01	139.978	139.664	314	13.08	24.00	139.848	139.537	311	12.96	13.1	13.0	-0.90	0.81
4/17/2014	PM2.5	23.99	140.402	140.238	164	6.84	23.99	141.699	141.540	159	6.63	6.8	6.6	-3.10	9.59
4/23/2014	PM2.5			Invalid Sample			23.99	141.562	141.351	211	8.80		8.8		
4/29/2014	PM2.5			Invalid Sample			23.99	141.551	141.463	88	3.67		3.7		
5/5/2014	PM2.5			Invalid Sample			23.98	145.441	145.290	151	6.30		6.3		
5/12/2014	PM2.5			Invalid Sample			23.99	146.519	146.272	247	10.30		10.3		
5/17/2014	PM2.5	23.990	149.872	149.751	121	5.04	23.990	146.592	146.469	123	5.13	5.0	5.1	1.64	2.69
5/23/2014	PM2.5	23.99	141.584	141.357	227	9.46	23.98	146.338	146.086	252	10.51	9.5	10.5	10.48	109.83
5/29/2014	PM2.5			Invalid Sample			23.99	142.692	142.533	159	6.63		6.6		
6/4/2014	PM2.5			Invalid Sample			23.99	140.393	140.096	297	12.38		12.4		
6/10/2014	PM2.5	23.99	140.618	140.408	210	8.75	23.99	141.303	141.097	206	8.59	8.8	8.6	-1.92	3.70
6/16/2014	PM2.5			Invalid Sample			23.99	143.025	142.688	337	14.05		14.0		
6/22/2014	PM2.5			Invalid Sample			23.99	142.190	142.001	189	7.88		7.9		
6/28/2014	PM2.5	23.99	141.282	141.122	160	6.67	23.98	140.779	140.640	139	5.80	6.7	5.8	-14.01	196.15
7/4/2014	PM2.5	23.99	143.087	142.894	193	8.05	23.99	140.865	140.667	198	8.25	8.0	8.3	2.56	6.54
7/10/2014	PM2.5	23.99	142.794	142.518	276	11.50	23.99	142.877	142.606	271	11.30	11.5	11.3	-1.83	3.34
7/16/2014	PM2.5	23.99	145.164	144.905	259	10.80			Invalid Sample			10.8			
7/22/2014	PM2.5	23.99	144.889	144.738	151	6.29			Invalid Sample			6.3			
7/28/2014	PM2.5	23.99	139.892	139.69	202	8.42			Invalid Sample			8.4			
8/3/2014	PM2.5	23.99	136.727	136.573	154	6.42			Invalid Sample			6.4			
8/9/2014	PM2.5	23.01	136.634	136.31	324	14.08			Invalid Sample			14.1			
8/15/2014	PM2.5			Invalid Sample					Invalid Sample						
8/21/2014	PM2.5	23.99	134.917	134.646	271	11.30	23.99	137.676	137.402	274	11.42	11.3	11.4	1.10	1.21
8/27/2014	PM2.5	23.99	136.14	135.922	218	9.09	23.99	139.513	139.296	217	9.05	9.1	9.0	-0.46	0.21
9/2/2014	PM2.5	23.98	136.537	136.22	317	13.22	23.99	136.678	136.354	324	13.51	13.2	13.5	2.14	4.59
9/8/2014	PM2.5	23.99	136.483	136.382	101	4.21	23.99	136.16	136.068	92	3.83	4.2	3.8	-9.33	86.98
9/14/2014	PM2.5	24	145.893	145.749	144	6.00	24	141.849	141.71	139	5.79	6.0	5.8	-3.53	12.49
9/23/2014	PM2.5	23.98	137.11	137.033	77	3.21	23.99	138.711	138.635	76	3.17	3.2	3.2	-1.35	1.82
9/26/2014	PM2.5	23.99	137.177	137.046	131	5.46	23.99	136.745	136.616	129	5.38	5.5	5.4	-1.54	2.37
10/2/2014	PM2.5	23.99	134.401	134.108	293	12.21	24	135.433	135.138	295	12.29	12.2	12.3	0.64	0.41
10/8/2014	PM2.5	23.99	138.323	138.156	167	6.96	23.99	135.122	134.946	176	7.34	7.0	7.3	5.25	27.54
10/14/2014	PM2.5	23.98	134.130	134.036	94	3.92	23.99	135.211	135.113	98	4.09	3.9	4.1	4.12	17.02
10/20/2014	PM2.5	23.99	133.623	133.441	182	7.59	24	137.704	137.520	184	7.67	7.6	7.7	1.05	1.11
10/26/2014	PM2.5	23.99	135.699	135.523	176	7.34	23.99	134.599	134.440	159	6.63	7.3	6.6	-10.15	103.01
11/1/2014	PM2.5	23.99	136.155	136.027	128	5.34	23.99	138.05	137.94	115.00	4.79	5.3	4.8	-10.86	117.91
11/7/2014	PM2.5	23.99	136.574	136.524	50	2.08	23.87	136.56	136.49	67.00	2.81	2.1	2.8	29.86	891.43
11/13/2014	PM2.5	24	138.309	138.112	197	8.21	23.87	135.96	135.76	194.00	8.13	8.2	8.1	-0.98	0.96
11/19/2014	PM2.5	23.99	138.009	137.811	198	8.25	23.88	134.54	134.35	190.00	7.96	8.3	8.0	-3.58	12.80
11/25/2014	PM2.5	23.99	135.507	135.329	178	7.42	23.86	138.19	138.02	179.00	7.50	7.4	7.5	1.07	1.15
12/1/2014	PM2.5	24	136.602	136.434	168	7.00	23.86	136.08	135.87	204.00	8.55	7.0	8.6	19.94	397.43
12/7/2014	PM2.5	23.99	138.968	138.881	87	3.63	23.87	136.05	135.93	120.00	5.03	3.6	5.0	32.33	1045.39
12/13/2014	PM2.5	23.99	136.116	135.894	222	9.25	23.89	136.44	136.21	231.00	9.67	9.3	9.7	4.44	19.71
12/19/2014	PM2.5	24	138.989	138.799	190	7.92	23.88	136.35	136.15	199.00	8.33	7.9	8.3	5.05	25.46
12/25/2014	PM2.5	23.99	135.075	135.015	60	2.50	23.86	136.19	136.13	58.00	2.43	2.5	2.4	-2.84	8.06
12/31/2014	PM2.5	23.98	134.268	134.093	175	7.30	23.90	135.71	135.53	187.00	7.82	7.3	7.8	6.88	47.31
1/6/2015	PM2.5			Invalid Sample			23.88	135.49	135.36	129.00	5.40		5.4		
1/15/2015	PM2.5	24	136.239	135.995	244	10.17	23.88	134.06	133.81	247.00	10.34	10.2	10.3	1.66	2.75
1/18/2015	PM2.5	23.98	135.427	135.163	264	11.01	23.87	134.91	134.61	291.00	12.19	11.0	12.2	10.17	103.48
1/24/2015	PM2.5	23.99	134.71	134.554	156	6.50	23.89	134.45	134.28	168.00	7.03	6.5	7.0	7.83	61.38
1/30/2015	PM2.5	23.99	134.341	134.221	120	5.00	23.87	137.03	136.91	127.00	5.32	5.0	5.3	5.83	33.93
2/5/2015	PM2.5	23.98	134.833	134.681	152	6.34	23.89	134.99	134.84	153.00	6.40	6.3	6.4	1.57	2.48
2/11/2015	PM2.5	23.99	133.104	132.981	123	5.13	23.90	135.71	135.58	133.00	5.56	5.1	5.6	9.35	87.34
2/17/2015	PM2.5	23.99	138.961	138.824	137	5.71	23.89	139.02	138.86	159.00	6.66	5.7	6.7	16.13	260.15
2/26/2015	PM2.5			Invalid Sample			23.89	134.15	133.90	251.00	10.51		10.5		
3/1/2015	PM2.5	24.01	136.611	136.369	242	10.08	23.88	134.38	134.13	248.00	10.39	10.1	10.4	2.93	8.57
3/10/2015	PM2.5	23.98	135.289	135.081	208	8.67	23.85	133.21	133.00	217.00	9.10	8.7	9.1	4.49	20.20
3/13/2015	PM2.5	23.98	133.554	133.435	119	4.96	24.01	134.99	134.86	124.00	5.16	5.0	5.2	3.92	15.38
3/19/2015	PM2.5	24.01	135.935	135.793	142	5.91	23.87	136.42	136.27	147.00	6.16	5.9	6.2	4.96	24.59
3/25/2015	PM2.5	23.98	134.97	134.783	187	7.80	23.86	133.77	133.58	190.00	7.96	7.8	8.0	2.53	6.41
4/3/2015	PM2.5	23.99	134.961	134.783	178	7.42	24.00	136.07	135.93	131.00	5.46	7.4	5.5	-29.46	867.74
4/6/2015	PM2.5	24	137.187	136.995	192	8.00	23.99	138.12	137.91	213.00	8.88	8.0	8.9	10.65	113.44
4/12/2015	PM2.5	24	138.442	138.29	152	6.33	23.99	137.54	137.42	123.00	5.13	6.3	5.1	-21.05	443.21
4/18/2015	PM2.5	24	136.762	136.625	137	5.71	23.99	136.70	136.51	186.00	7.75	5.7	7.8	31.11	967.90
4/27/2015	PM2.5			Not Collected			23.99	138.87	138.66	207.00	8.63				
4/29/2015	PM2.5	23.99	137.314	137.173	141	5.88			Not Collected						

n= 71

Chi Sq 55.32894

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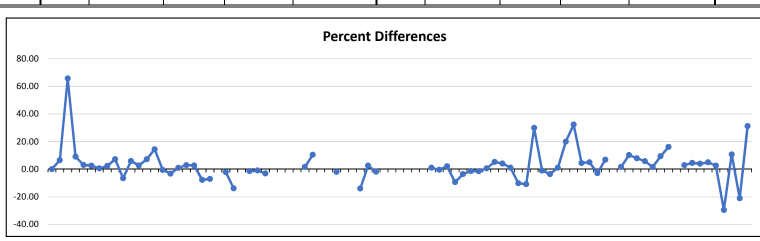

PM10 Assesments : Annual May 2014 - April 2015

Brunswick County Air Monitoring - Edgerton Tower

		Primary Sampler					Collocated Sampler					Precision Values			
Sample Date	Sample Type	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Primary FRM µg/m^3	Collocated FRM µg/m^3	d_i	d_i^2
5/5/2014	PM10			Invalid Sample			24.630	145.376	145.064	312	12.67		12.7		
5/12/2014	PM10			Invalid Sample			24.090	147.475	147.045	430	17.85		17.8		
5/17/2014	PM10	24.75	149.002	148.709	293	11.84	24.70	148.366	148.120	246	9.96	11.8	10.0	-17.24	297.18
5/23/2014	PM10	23.960	141.677	141.127	550	22.95	24.040	147.835	147.321	514	21.38	23.0	21.4	-7.10	50.41
5/29/2014	PM10	24.330	140.368	140.103	265	10.89	24.420	140.929	140.672	257	10.52	10.9	10.5	-3.43	11.79
6/4/2014	PM10	23.510	141.695	141.081	614	26.12	23.630	144.676	144.075	601	25.43	26.1	25.4	-2.65	7.02
6/10/2014	PM10	23.440	143.073	142.636	437	18.64	23.590	141.788	141.378	410	17.38	18.6	17.4	-7.01	49.18
6/16/2014	PM10	23.660	146.889	146.428	461	19.48	23.780	143.443	142.993	450	18.92	19.5	18.9	-2.92	8.53
6/22/2014	PM10	23.840	143.500	143.178	322	13.51	23.910	145.074	144.763	311	13.01	13.5	13.0	-3.77	14.20
6/28/2014	PM10	23.920	143.692	143.384	308	12.88	24.060	145.221	144.934	287	11.93	12.9	11.9	-7.64	58.39
7/4/2014	PM10	23.72	143.325	142.975	350	14.76	23.86	143.073	142.76	313	13.12	14.8	13.1	-11.75	138.01
7/10/2014	PM10	23.95	142.998	142.600	398	16.62	24.05	143.314	142.924	390	16.22	16.6	16.2	-2.45	5.99
7/16/2014	PM10	23.78	146.768	146.334	434	18.25	23.72	145.164	144.754	410	17.28	18.3	17.3	-5.43	29.54
7/22/2014	PM10	23.76	138.888	138.603	285	11.99	23.82	142.983	142.732	251	10.54	12.0	10.5	-12.94	167.39
7/28/2014	PM10	23.46	141.888	141.505	383	16.33	23.50	142.337	141.954	383	16.30	16.3	16.3	-0.17	0.03
8/3/2014	PM10	23.95	138.90	138.63	277	11.57	24.07	137.551	137.294	257	10.68	11.6	10.7	-7.99	63.83
8/9/2014	PM10	24.21	135.844	135.365	479	19.79	24.28	137.475	137.001	474	19.52	19.8	19.5	-1.34	1.79
8/15/2014	PM10			Invalid Sample					Invalid Sample				10.0		
8/21/2014	PM10	23.71	135.282	134.857	425	17.92	23.61	136.019	135.609	410	17.37	17.9	17.4	-3.17	10.05
8/27/2014	PM10	24.1	137.884	137.525	359	14.90	24.09	137.291	136.938	353	14.65	14.9	14.7	-1.64	2.70
9/2/2014	PM10	23.58	137.04	136.431	609	25.83	23.53	136.961	136.345	616	26.18	25.8	26.2	1.36	1.84
9/8/2014	PM10	24.24	136.808	136.666	142	5.86	24.25	137.995	137.853	142	5.86	5.9	5.9	-0.04	0.00
9/14/2014	PM10	24.69	137.15	136.878	272	11.02			Invalid Sample			11.0			
9/23/2014	PM10	24.78	137.776	137.623	153	6.17			Invalid Sample			6.2			
9/26/2014	PM10	24.44	136.909	136.571	338	13.83	24.3	137.03	136.697	333	13.70	13.8	13.7	-0.92	0.84
10/2/2014	PM10	24.28	138.106	137.568	538	22.16			Invalid Sample			22.2			
10/8/2014	PM10	24.21	134.224	133.893	331	13.67	24.16	135.478	135.148	330	13.66	13.7	13.7	-0.10	0.01
10/14/2014	PM10	23.99	134.640	134.293	347	14.46	23.95	136.288	135.942	346	14.45	14.5	14.4	-0.12	0.01
10/20/2014	PM10	24.49	135.292	134.971	321	13.11	24.48	136.582	136.263	319	13.03	13.1	13.0	-0.58	0.34
10/26/2014	PM10	24.54	138.810	138.514	296	12.06	24.52	136.431	136.145	286	11.66	12.1	11.7	-3.35	11.26
11/1/2014	PM10	25.13	138.28	138.09	187	7.44	25.1	136.787	136.599	188	7.49	7.4	7.5	0.67	0.45
11/7/2014	PM10	25.07	138.69	138.57	122	4.87	25.06	138.936	138.819	117	4.67	4.9	4.7	-4.19	17.58
11/13/2014	PM10	25.31	137.22	136.87	349	13.79	25.28	137.569	137.238	331	13.09	13.8	13.1	-5.21	27.13
11/19/2014	PM10	26.22	137.61	137.28	322	12.28	26.24	136.798	136.51	288	10.98	12.3	11.0	-11.18	124.95
11/25/2014	PM10	24.69	137.44	137.09	347	14.05	24.64	138.363	138.026	337	13.68	14.1	13.7	-2.67	7.12
12/1/2014	PM10	24.88	136.56	136.32	237	9.53	24.86	136.503	136.257	246	9.90	9.5	9.9	3.81	14.51
12/7/2014	PM10	25.75	135.07	134.94	125	4.85	25.72	135.649	135.521	128	4.98	4.9	5.0	2.64	7.00
12/13/2014	PM10	25.61	135.81	135.53	276	10.78	25.68	137.562	137.297	265	10.32	10.8	10.3	-4.36	19.01
12/19/2014	PM10	25.94	136.55	136.26	291	11.22	25.92	135.452	135.18	272	10.49	11.2	10.5	-6.73	45.23
12/25/2014	PM10	24.99	137.90	137.79	108	4.32	24.85	136.569	136.474	95	3.82	4.3	3.8	-12.29	150.92
12/31/2014	PM10	26.32	137.10	136.88	220	8.36	26.31	133.251	133.034	217	8.25	8.4	8.3	-1.32	1.75
1/6/2015	PM10	26.08	135.72	135.52	199	7.63	26.1	133.076	132.877	199	7.62	7.6	7.6	-0.13	0.02
1/15/2015	PM10	26.00	135.32	135.04	277	10.65	26.01	136.491	136.22	271	10.42	10.7	10.4	-2.18	4.77
1/18/2015	PM10	25.69	137.56	137.18	383	14.91	25.65	138.529	138.163	366	14.27	14.9	14.3	-4.39	19.24
1/24/2015	PM10	25.24	138.09	137.87	219	8.68	25.18	136.426	136.211	215	8.54	8.7	8.5	-1.63	2.64
1/30/2015	PM10	25.59	133.63	133.46	174	6.80	25.58	135.792	135.623	169	6.61	6.8	6.6	-2.99	8.91
2/5/2015	PM10	25.69	135.23	135.04	194	7.55	25.67	135.269	135.079	190	7.40	7.6	7.4	-2.67	7.11
2/11/2015	PM10	25.74	132.46	132.27	194	7.54	25.74	135.763	135.535	228	8.86	7.5	8.9	17.07	291.49
2/17/2015	PM10	26.24	135.32	135.06	259	9.87	26.23	140.622	140.413	209	7.97	9.9	8.0	-21.23	450.67
2/26/2015	PM10			Invalid Sample			25.87	134.038	133.754	284	10.98		11.0		
3/1/2015	PM10	26.17	135.37	135.04	338	12.92	26.09	133.684	133.353	331	12.69	14.1	13.7	-2.67	7.12
3/10/2015	PM10	25.53	134.33	134.05	280	10.97			Invalid Sample			11.0			
3/13/2015	PM10	25.70	136.31	136.09	221	8.60			Invalid Sample			8.6			
3/19/2015	PM10	25.53	134.33	134.05	280	10.97			Invalid Sample			11.0			
3/25/2015	PM10	25.14	134.61	134.23	378	15.04			Invalid Sample			15.0			
4/3/2015	PM10	24.55	138.62	138.36	258	10.51	24.47	136.855	136.611	244	9.97	10.5	10.0	-4.88	23.80
4/6/2015	PM10	24.47	137.41	137.05	360	14.71	24.38	137.373	137.042	331	13.58	14.7	13.6	-7.77	60.43
4/12/2015	PM10	24.68	139.11	138.70	405	16.41	24.58	135.082	134.698	384	15.62	16.4	15.6	-5.00	25.00
4/18/2015	PM10	24.46	134.93	134.62	311	12.71	24.36	135.78	135.481	299	12.27	12.7	12.3	-3.20	10.24
4/27/2015	PM10			Not Collected			23.99	138.866	138.659	207	8.63				
4/29/2015	PM10	24.43	138.28	138.06	228	9.33			Not Collected						

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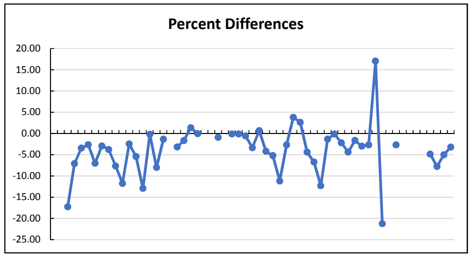
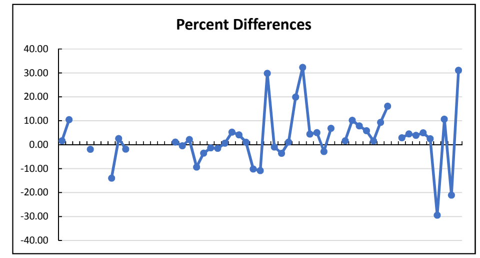


PM2.5 Assesments : Annual May 2014 - April 2015

Brunswick County Air Monitoring - Edgerton Tower

		Primary Sampler					Collocated Sampler					Precision Values			
Sample Date	Sample Type	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Volume m^3	Final weight (mg)	Filter Tare (mg)	Net Weight (µg)	Concentration µg/m^3	Primary FRM µg/m^3	Collocated FRM µg/m^3	d_i	d_i^2
5/5/2014	PM2.5			Invalid Sample			23.98	145.441	145.290	151	6.30		6.3		
5/12/2014	PM2.5			Invalid Sample			23.99	146.519	146.272	247	10.30		10.3		
5/17/2014	PM2.5	23.990	149.872	149.751	121	5.04	23.990	146.592	146.469	123	5.13	5.0	5.1	1.64	2.69
5/23/2014	PM2.5	23.99	141.584	141.357	227	9.46	23.98	146.338	146.086	252	10.51	9.5	10.5	10.48	109.83
5/29/2014	PM2.5			Invalid Sample			23.99	142.692	142.533	159	6.63		6.6		
6/4/2014	PM2.5			Invalid Sample			23.99	140.393	140.096	297	12.38		12.4		
6/10/2014	PM2.5	23.99	140.618	140.408	210	8.75	23.99	141.303	141.097	206	8.59	8.8	8.6	-1.92	3.70
6/16/2014	PM2.5			Invalid Sample			23.99	143.025	142.688	337	14.05		14.0		
6/22/2014	PM2.5			Invalid Sample			23.99	142.190	142.001	189	7.88		7.9		
6/28/2014	PM2.5	23.99	141.282	141.122	160	6.67	23.98	140.779	140.640	139	5.80	6.7	5.8	-14.01	196.15
7/4/2014	PM2.5	23.99	143.087	142.894	193	8.05	23.99	140.865	140.667	198	8.25	8.0	8.3	2.56	6.54
7/10/2014	PM2.5	23.99	142.794	142.518	276	11.50	23.99	142.877	142.606	271	11.30	11.5	11.3	-1.83	3.34
7/16/2014	PM2.5	23.99	145.164	144.905	259	10.80			Invalid Sample			10.8			
7/22/2014	PM2.5	23.99	144.889	144.738	151	6.29			Invalid Sample			6.3			
7/28/2014	PM2.5	23.99	139.892	139.69	202	8.42			Invalid Sample			8.4			
8/3/2014	PM2.5	23.99	136.727	136.573	154	6.42			Invalid Sample			6.4			
8/9/2014	PM2.5	23.01	136.634	136.31	324	14.08			Invalid Sample			14.1			
8/15/2014	PM2.5			Invalid Sample					Invalid Sample						
8/21/2014	PM2.5	23.99	134.917	134.646	271	11.30	23.99	137.676	137.402	274	11.42	11.3	11.4	1.10	1.21
8/27/2014	PM2.5	23.99	136.14	135.922	218	9.09	23.99	139.513	139.296	217	9.05	9.1	9.0	-0.46	0.21
9/2/2014	PM2.5	23.98	136.537	136.22	317	13.22	23.99	136.678	136.354	324	13.51	13.2	13.5	2.14	4.59
9/8/2014	PM2.5	23.99	136.483	136.382	101	4.21	23.99	136.16	136.068	92	3.83	4.2	3.8	-9.33	86.98
9/14/2014	PM2.5	24	145.893	145.749	144	6.00	24	141.849	141.71	139	5.79	6.0	5.8	-3.53	12.49
9/23/2014	PM2.5	23.98	137.11	137.033	77	3.21	23.99	138.711	138.635	76	3.17	3.2	3.2	-1.35	1.82
9/26/2014	PM2.5	23.99	137.177	137.046	131	5.46	23.99	136.745	136.616	129	5.38	5.5	5.4	-1.54	2.37
10/2/2014	PM2.5	23.99	134.401	134.108	293	12.21	24	135.433	135.138	295	12.29	12.2	12.3	0.64	0.41
10/8/2014	PM2.5	23.99	138.323	138.156	167	6.96	23.99	135.122	134.946	176	7.34	7.0	7.3	5.25	27.54
10/14/2014	PM2.5	23.98	134.130	134.036	94	3.92	23.99	135.211	135.113	98	4.09	3.9	4.1	4.12	17.02
10/20/2014	PM2.5	23.99	133.623	133.441	182	7.59	24	137.704	137.520	184	7.67	7.6	7.7	1.05	1.11
10/26/2014	PM2.5	23.99	135.699	135.523	176	7.34	23.99	134.599	134.440	159	6.63	7.3	6.6	-10.15	103.01
11/1/2014	PM2.5	23.99	136.155	136.027	128	5.34	23.99	138.05	137.94	115.00	4.79	5.3	4.8	-10.86	117.91
11/7/2014	PM2.5	23.99	136.574	136.524	50	2.08	23.87	136.56	136.49	67.00	2.81	2.1	2.8	29.86	891.43
11/13/2014	PM2.5	24	138.309	138.112	197	8.21	23.87	135.96	135.76	194.00	8.13	8.2	8.1	-0.98	0.96
11/19/2014	PM2.5	23.99	138.009	137.811	198	8.25	23.88	134.54	134.35	190.00	7.96	8.3	8.0	-3.58	12.80
11/25/2014	PM2.5	23.99	135.507	135.329	178	7.42	23.86	138.19	138.02	179.00	7.50	7.4	7.5	1.07	1.15
12/1/2014	PM2.5	24	136.602	136.434	168	7.00	23.86	136.08	135.87	204.00	8.55	7.0	8.6	19.94	397.43
12/7/2014	PM2.5	23.99	138.968	138.881	87	3.63	23.87	136.05	135.93	120.00	5.03	3.6	5.0	32.33	1045.39
12/13/2014	PM2.5	23.99	136.116	135.894	222	9.25	23.89	136.44	136.21	231.00	9.67	9.3	9.7	4.44	19.71
12/19/2014	PM2.5	24	138.989	138.799	190	7.92	23.88	136.35	136.15	199.00	8.33	7.9	8.3	5.05	25.46
12/25/2014	PM2.5	23.99	135.075	135.015	60	2.50	23.86	136.19	136.13	58.00	2.43	2.5	2.4	-2.84	8.06
12/31/2014	PM2.5	23.98	134.268	134.093	175	7.30	23.90	135.71	135.53	187.00	7.82	7.3	7.8	6.88	47.31
1/6/2015	PM2.5			Invalid Sample			23.88	135.49	135.36	129.00	5.40		5.4		
1/15/2015	PM2.5	24	136.239	135.995	244	10.17	23.88	134.06	133.81	247.00	10.34	10.2	10.3	1.66	2.75
1/18/2015	PM2.5	23.98	135.427	135.163	264	11.01	23.87	134.91	134.61	291.00	12.19	11.0	12.2	10.17	103.48
1/24/2015	PM2.5	23.99	134.71	134.554	156	6.50	23.89	134.45	134.28	168.00	7.03	6.5	7.0	7.83	61.38
1/30/2015	PM2.5	23.99	134.341	134.221	120	5.00	23.87	137.03	136.91	127.00	5.32	5.0	5.3	5.83	33.93
2/5/2015	PM2.5	23.98	134.833	134.681	152	6.34	23.89	134.99	134.84	153.00	6.40	6.3	6.4	1.57	2.48
2/11/2015	PM2.5	23.99	133.104	132.981	123	5.13	23.90	135.71	135.58	133.00	5.56	5.1	5.6	9.35	87.34
2/17/2015	PM2.5	23.99	138.961	138.824	137	5.71	23.89	139.02	138.86	159.00	6.66	5.7	6.7	16.13	260.15
2/26/2015	PM2.5			Invalid Sample			23.89	134.15	133.90	251.00	10.51		10.5		
3/1/2015	PM2.5	24.01	136.611	136.369	242	10.08	23.88	134.38	134.13	248.00	10.39	10.1	10.4	2.93	8.57
3/10/2015	PM2.5	23.98	135.289	135.081	208	8.67	23.85	133.21	133.00	217.00	9.10	8.7	9.1	4.49	20.20
3/13/2015	PM2.5	23.98	133.554	133.435	119	4.96	24.01	134.99	134.86	124.00	5.16	5.0	5.2	3.92	15.38
3/19/2015	PM2.5	24.01	135.935	135.793	142	5.91	23.87	136.42	136.27	147.00	6.16	5.9	6.2	4.96	24.59
3/25/2015	PM2.5	23.98	134.97	134.783	187	7.80	23.86	133.77	133.58	190.00	7.96	7.8	8.0	2.53	6.41
4/3/2015	PM2.5	23.99	134.961	134.783	178	7.42	24.00	136.07	135.93	131.00	5.46	7.4	5.5	-29.46	867.74
4/6/2015	PM2.5	24	137.187	136.995	192	8.00	23.99	138.12	137.91	213.00	8.88	8.0	8.9	10.65	113.44
4/12/2015	PM2.5	24	138.442	138.29	152	6.33	23.99	137.54	137.42	123.00	5.13	6.3	5.1	-21.05	443.21
4/18/2015	PM2.5	24	136.762	136.625	137	5.71	23.99	136.70	136.51	186.00	7.75	5.7	7.8	31.11	967.90
4/27/2015	PM2.5			Not Collected			23.99	138.87	138.66	207.00	8.63				
4/29/2015	PM2.5	23.99	137.314	137.173	141	5.88			Not Collected						
													SUM	128.80	6167.57

n=	45
Chi Sq	32.48713



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Appendix D

Audit Data Sheets

FINAL SUMMARY AUDIT REPORT
EEMS Van 2

Site Name: Edgerton Tower

Audit Date: 3/31/2015

Parameter	NPEP Lab Response (ppm)	Station Response (ppm)	Percent Difference	Pass/Fail	Warning
Ozone Audit					
Ozone Level 5	0.0000			N/A	
Ozone Level 4	0.0000			N/A	
Ozone Level 3	0.0000			N/A	
Ozone Level 2	0.0000			N/A	
Ozone Level 1	0.0000			N/A	
CO Audit					
CO Level				N/A	
CO Level 6	8.9372	9.9600	11.4	Pass	Warning
CO Level 5	4.3985	4.9590	12.7	Pass	Warning
CO Level 4	1.7707	2.0220	14.2	Pass	Warning
CO Level 3				N/A	
CO Level 3				N/A	
SO2 Audit					
SO2 Level				N/A	
SO2 Level 6	0.0910	0.0965	6.0	Pass	
SO2 Level 5	0.0448	0.0486	8.5	Pass	
SO2 Level 4	0.0180	0.0196	8.9	Pass	
SO2 Level 3				N/A	
SO2 Level 2				N/A	

TTP SO2 Audit Report - CO Analyzer Based Measurements

FINAL NPEP THROUGH THE PROBE AUDIT REPORT

EEMS Van 2

General Site Information	**Site Name:**	Edgerton Tower	**Airs ID:**	0
	Auditor:	Eric Hebert (EEMS)	**Audit Date:**	03/31/15
	Station Manager:	Jon Bowser (TRC)		

		Audited Analyzer		NPEP Analyzer	
Instrument Information	**Instrument:**	**SO2**		**CO**	
	Manufacturer/Model #:	T-API	T100	TEI	48i TLE
	Serial #	181		1406960656	
	Full Scale Range	0		50	
	Calibration Date:	02/03/15		03/31/15	
	Slope/Intercept:	1.0153	6.9980	0.9990	-0.0428
	Indicated Flow:	0.47 L/min			
	In-Line Filter Change:	3/5/2015			
	Manifold Type:	Glass			

SO2 Audit Results

	NPEP Level	NPEP SO2 Concentration (ppm)	Site Response (ppm)	Percent Difference	Pass/Fail	Warning
	Pre Audit Zero	**-0.0001**	**0.0003**			
High Multi Blend Cylinder (>10 ppm SO2)	**SO2 Level**				**N/A**	
	SO2 Level 6	**0.0910**	**0.0965**	**6.0**	**Pass**	
	SO2 Level 5	**0.0448**	**0.0486**	**8.5**	**Pass**	
	SO2 Level 4	**0.0180**	**0.0196**	**8.9**	**Pass**	
	SO2 Level 3				**N/A**	
	SO2 Level 2				**N/A**	
	Post Audit Zero	**-0.0001**	**0.0003**			

Eric Hebert   Eric Hebert

Auditor Name (print name followed by signature)

FINAL NPEP THROUGH THE PROBE AUDIT REPORT

EEMS - Van 2

General Site Information	**Site Name:**	Edgerton Tower	**Airs ID:**	0
	Auditor:	Eric Hebert (EEMS)	**Audit Date:**	03/31/15
	Station Manager:	Jon Bowser (TRC)		

		Audited Analyzers				NPEP Analyzer	
Instrument Information	**Instrument:**	**0**		**NOx**		**CO**	
	Manufacturer/Model #:	0	0	TEI	42i	TEI	48i TLE
	Serial #	0		0525012323		1406960656	
	Full Scale range:	0		0.500 ppm		50.0 ppm	
	Calibration Date:	01/00/00		03/05/15		03/31/15	
	Slope/Intercept:	0.0000	0.0000	0.9916	1.8100	1.0020	-0.0207
	Indicated Flow:	0		640 cc/min			
	In-Line Filter Change:	1/0/1900		3/5/2015			
	Manifold Type:	0		Glass and Teflon			

	NPEP Level	NPEP NO Concentration (ppm)	Site Response (ppm)	Percent Difference	Pass/Fail	Warning
NO Audit Results	Pre Zero	0.0001	0.0002			
	NO point for start of GPT	0.1044	0.1126	7.85	Pass	
	NO Level for NO regression curve	0.0438	0.0468	6.85	Pass	
	NO Level for NO regression curve	0.0166	0.0178	7.23	Pass	
	NO Level for NO regression curve				N/A	
	Post Audit Zero	-0.0001	0.0002			

	NPEP Level	NPEP NOx Concentration (ppm)	Site Response (ppm)	Percent Difference	Pass/Fail	Warning
NOx Audit Results	Pre Zero	0.0001	0.0001			
	NOx point for start of GPT	0.1044	0.1122	7.47	Pass	
	NOx level for NO regression	0.0438	0.0470	7.31	Pass	
	NOx level for NO regression	0.0166	0.0180	8.43	Pass	
	NOx level for NO regression				N/A	
	Post Audit Zero	-0.0001	0.0002			

	NPEP Level	NPEP NO2 Concentration (ppm)	Site Response (ppm)	Percent Difference	Pass/Fail	Warning	Converter Efficiency	Pass/Fail
NO2 Audit Results	Pre Zero	0.0000	-0.0001					
	NO2 Level				N/A			N/A
	NO2 Level 6	0.0651	0.0697	7.07	Pass		100.0%	Pass
	NO2 Level 5	0.0314	0.0335	6.69	Pass		100.0%	Pass
	NO2 Level 4	0.0154	0.0161	4.55	Pass		98.8%	Pass
	NO2 Level 3	0.0077	0.0075	-2.60	Pass		97.6%	Pass
	Post Audit Zero	0.0000	0.0000					

	NPEP Level	NPEP NPN Concentration (ppm)	Site NO2 Response (ppm)	Percent Difference	Pass/Fail	Warning	Converter Efficiency	Pass/Fail
NOy Audit Results	Pre Zero	0.0001	-0.0001					
	NPN Test Point Level 4				N/A			N/A
	NPN Test Point Level 3				N/A			N/A
	NPN Test Point Level 2				N/A			N/A
	NPN Test Point Level 1				N/A			N/A
	Post Audit Zero	-0.0001	0.0000					

Eric Hebert (EEMS) / Eric Hebert

Auditor Name (print name followed by signature)

EPA person notified in case of audit failure

Audit Limits for NPEP Levels 1, 2, 3, 4, and 5	
Pass	less than or = ± 15 percent difference or ± 0.0015 ppm difference OR
Fail	greater than ± 15 percent difference AND ± 0.0015 ppm difference AND and
Warning	greater than ±10% difference

EEMS - FINAL NOx ANALYZER

CO ANALYZER BASED

Site Name: Edgerton Tower

Audit Date: 3/31/2015

Parameter	NPEP Lab Response (ppm)	Station Response (ppm)	Percent Difference	Pass/Fail	Warning
NO point for start of GPT	0.1044	0.1126	7.9	Pass	
NO Level for NO regression curve	0.0438	0.0468	6.9	Pass	
NO Level for NO regression curve	0.0166	0.0178	7.2	Pass	
NO Level for NO regression curve				N/A	
NOx point for start of GPT	0.1044	0.1122	7.5	Pass	
NOx level for NO regression	0.0438	0.0470	7.3	Pass	
NOx level for NO regression	0.0166	0.0180	8.4	Pass	
NOx level for NO regression				N/A	
NO2 Level				N/A	
NO2 Level 6	0.0651	0.0697	7.1	Pass	
NO2 Level 5	0.0314	0.0335	6.7	Pass	
NO2 Level 4	0.0154	0.0161	4.6	Pass	
NO2 Level 3	0.0077	0.0075	-2.6	Pass	
Converter Efficiency NO2 Level				N/A	
Converter Efficiency NO2 Level 6			100.0%	Pass	
Converter Efficiency NO2 Level 5			100.0%	Pass	
Converter Efficiency NO2 Level 4			98.8%	Pass	
Converter Efficiency NO2 Level 3			97.6%	Pass	
NPN Cylinder w/ dilution					
NOy Level 5				N/A	
NOy Level 4				N/A	
NOy Level 3				N/A	
NOy Level 2				N/A	
NPN Converter Efficiency Level 5				N/A	
NPN Converter Efficiency Level 4				N/A	
NPN Converter Efficiency Level 3				N/A	
NPN Converter Efficiency Level 2				N/A	

TTP Trace CO Audit Report - CO Analyzer Based Measurements

FINAL NPEP THROUGH THE PROBE AUDIT REPORT
EEMS Van 2

General Site Information	**Site Name:**	Edgerton Tower	**Airs ID:**	0
	Auditor:	Eric Hebert (EEMS)	**Audit Date:**	03/31/15
	Station Manager:	Jon Bowser (TRC)		

		Audited Analyzer		**NPEP Analyzer**	
Instrument Information	**Instrument:**	**CO**		**CO**	
	Manufacturer/Model #:	Thermo	48i	TEI	48i TLE
	Serial #	JC1302100619		1406960656	
	Full Scale Range:	0		50	
	Calibration Date:	02/03/15		03/31/15	
	Slope/Intercept:	0.9914	0.5184	0.9990	-0.0428
	Indicated Flow:	0.5 lpm			
	In-Line Filter Change:	3/5/2015			
	Manifold Type:	Glass			

CARBON MONOXIDE AUDIT RESULTS

	NPEP Level	NPEP CO Concentration (ppm)	Site Response (ppm)	Percent Difference	Pass/Fail	Warning
	Pre Audit Zero	**-0.0052**	**0.0550**			
High Multi Blend Cylinder (>500 ppm CO)	**CO Level**				**N/A**	
	CO Level 6	**8.9372**	**9.9600**	**11.4**	**Pass**	**Warning**
	CO Level 5	**4.3985**	**4.9590**	**12.7**	**Pass**	**Warning**
	CO Level 4	**1.7707**	**2.0220**	**14.2**	**Pass**	**Warning**
	CO Level 3				**N/A**	
	CO Level 3				**N/A**	
	Post Audit Zero	**-0.0112**	**0.0390**			

Eric Hebert Eric Hebert

Auditor Name (print name followed by signature)

PM Sampler Performance Verification

Delta Cal Version	**3.37P**	**Sampler Location**	**Edgerton Tower PQ200**
Firmware Version		**PM-2.5 Primary Sampler S/N**	**1621**
DeltaCal S/N	**932** EEMS #01450	**PM-2.5 Co-located Sampler S/N**	**040R**

Date and Site of Verification	**03/31/2015 --- Edgerton Tower PQ200 PM-2.5 s/n 1621**				
Parameter	**DeltaCal**	**PQ200 PM2.5**	**Difference**	**Acceptance Criteria**	**Pass/Fail**
Flow Rate (Lpm)	16.60	16.67	0.42%	≤ ± 4%	Pass
Design Flow Rate (16.67 Lpm)	16.60		-0.42%	≤ ± 4%	Pass
Ambient Temperature (^{o}C)	22.2	22	-0.2	≤ ± 2 ^{o}C	Pass
Barometric Pressure (mm Hg)	747.0	747	0	≤ ± 10 mm Hg	Pass
Filter Temperature (^{o}C)	23.7	24.2	0.5	≤ ± 2 ^{o}C	Pass
Leak Check	start = 102	end = 101	1	≤ 5cm H2O	Pass

Date and Site of Verification	**03/31/2015 --- Edgerton Tower PQ200 PM-2.5 s/n 040R**				
Parameter	**DeltaCal**	**PQ200 PM2.5**	**Difference**	**Acceptance Criteria**	**Pass/Fail**
Flow Rate (Lpm)	16.66	16.60	-0.36%	≤ ± 4%	Pass
Design Flow Rate (16.67 Lpm)	16.66		-0.06%	≤ ± 4%	Pass
Ambient Temperature (^{o}C)	22.7	22.4	-0.3	≤ ± 2 ^{o}C	Pass
Barometric Pressure (mm Hg)	746.5	747	0.5	≤ ± 10 mm Hg	Pass
Filter Temperature (^{o}C)	23.0	22.5	-0.5	≤ ± 2 ^{o}C	Pass
Leak Check	start = 97	end = 96	1	≤ 5cm H2O	Pass

Notes:

PM Sampler Performance Verification

Delta Cal Version	**3.37P**	**Sampler Location**	**Edgerton Tower PQ200**
Firmware Version		**PM-10 Primary Sampler S/N**	**1617**
DeltaCal S/N	**932** EEMS #01450	**PM-10 Co-located Sampler S/N**	**0432**

Date and Site of Verification	**03/31/2015 --- Edgerton Tower PQ200 PM-10 s/n 1617**				
Parameter	**DeltaCal**	**PQ200 PM10**	**Difference**	**Acceptance Criteria**	**Pass/Fail**
Flow Rate (Lpm)	16.80	16.70	-0.60%	≤ ± 4%	Pass
Design Flow Rate (16.67 Lpm)	16.80		0.78%	≤ ± 4%	Pass
Ambient Temperature (^{o}C)	22.2	22.1	-0.1	≤ ± 2 ^{o}C	Pass
Barometric Pressure (mm Hg)	747.5	746	-1.5	≤ ± 10 mm Hg	Pass
Filter Temperature (^{o}C)	23.2	23.6	0.4	≤ ± 2 ^{o}C	Pass
Leak Check	start = 100	end = 99	1	≤ 5cm H2O	Pass

Date and Site of Verification	**03/31/2015 --- Edgerton Tower PQ200 PM-10 s/n 0432**				
Parameter	**DeltaCal**	**PQ200 PM10**	**Difference**	**Acceptance Criteria**	**Pass/Fail**
Flow Rate (Lpm)	16.73	16.70	-0.18%	≤ ± 4%	Pass
Design Flow Rate (16.67 Lpm)	16.73		0.36%	≤ ± 4%	Pass
Ambient Temperature (^{o}C)	22.7	22.7	0	≤ ± 2 ^{o}C	Pass
Barometric Pressure (mm Hg)	746.5	746	-0.5	≤ ± 10 mm Hg	Pass
Filter Temperature (^{o}C)	22.7	23.3	0.6	≤ ± 2 ^{o}C	Pass
Leak Check	start = 135	end = 134	1	≤ 5cm H2O	Pass

Notes:

Verification of the co-located PM10 sampler was performed following repair of sampler by TRC