Overview of Quality Assurance for Citizen Science

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Acknowledgement

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The Goal……

To insure that environmental information collected and/or used by Citizen Scientists is useable and credible.

Your Instructor - Ron Williams

- 35 year veteran of academic, private institution, and government-based environmental or associated research programs
- Currently, the Project Lead for EPA-ORD's Air, Climate, and Energy's Emerging Technology research area
- Has designed and executed some of the most complicated field data collection campaigns for the US EPA
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Disclaimer

- There is no single QA plan that fits every desire to collect environmental data. That being said, the approach and suggestions discussed here provide a general overview of the type of information one needs to consider in ensuring the data **to be collected** meets their desired purpose. Note the emphasis on “to be collected”….

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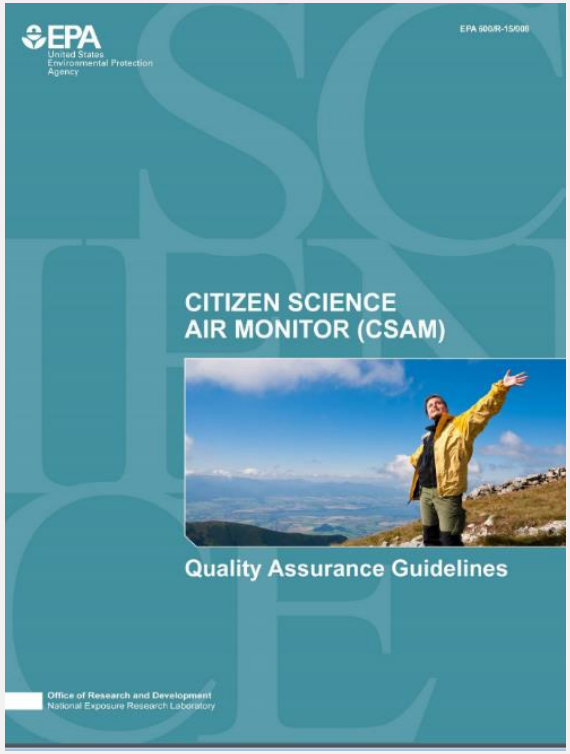
The Role of the QAPP

A Quality Assurance Project Plan (QAPP) documents the project planning process.

It provides in one document, a clear, concise and complete plan for describing the environmental information collection and/or use activities associated with a project.

When is a QAPP Needed?

- A QAPP should be prepared for every project that collects or uses environmental information.
- A QAPP is necessary if you want others to consider using your information.
- A QAPP is required for all projects funded by EPA that involve the collection and/or use of environmental Information.

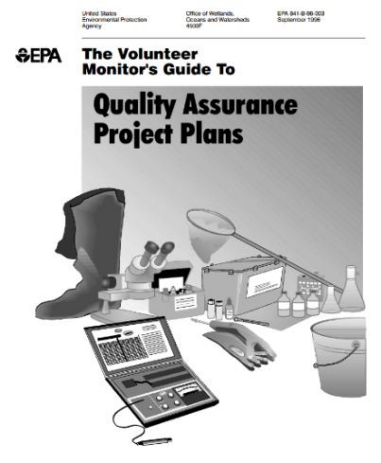


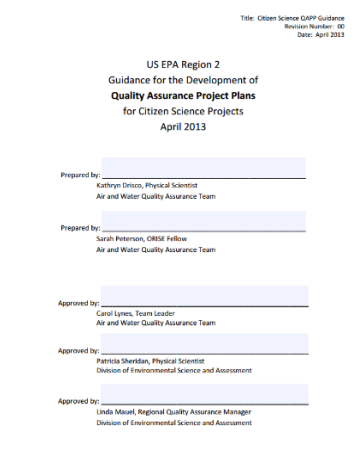
Citizen Science QAPPs

- **Most Regions have templates and/or guidance available for your use. Make contact early in the planning process with those who you might want to discuss your findings with to ensure necessary QA features are being considered.**

- **Typically, citizen science QAPPs represent a streamlined version of what EPA or other regulatory institutions (e.g., States, municipalities) are required to develop.**

- **The more thought and consideration you place on quality assurance, the more confident you can be in your eventual data summarization and findings.**





A QAPP is a Project Blueprint …….

It provides a documentation of important project info including:

- Who is involved in the effort?
- What are the goals or hypotheses to be determined?
- Why are the measurements needed?
- Where will the study take place?
- When will data collections be performed?
- How will you assess the data and determine findings?

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Who…..?

You should consider discussing:

- **A title of the effort and who has agreed to conduct the research according to the plan.**
- **An organizational flow chart or table showing who has specific responsibilities.**
- **Who needs to have a copy of the QAPP (i.e., QAPP distribution list)?**
- **Who else besides the citizen science group is involved in the effort and their role?**
- **Who has the expertise to conduct key components of the work (e.g., data collection, data review, data analysis, community interaction, etc.)?**

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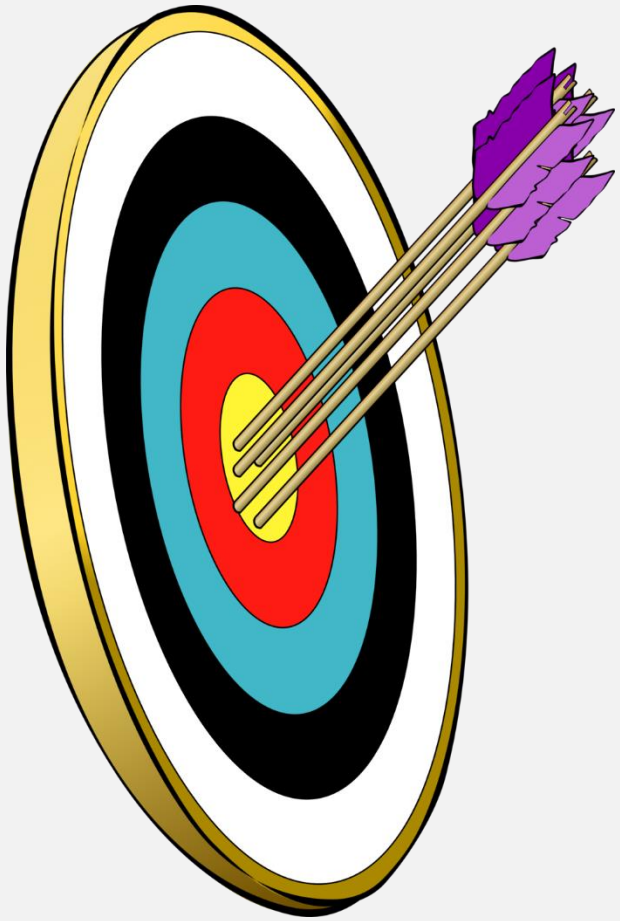
What……..?

- What are the primary goals/objectives of the research? Be as specific as possible. Doing so helps you define not only the potential end result but also ensures you are collecting the data needed to meet your ultimate goal.

- What needs to happen for you to be successful? Do you need to collect a specific amount of information, transfer environmental awareness to other parties, or define a potential condition that has not previously been identified?



Why……?

Why is this research needed? A description of background information is always useful and highly relevant.

Why is it important?

Why are you choosing to collect new data?

Where…….?

- It is important for others to understand where you are collecting data. They might be able to bring a different perspective to your plan that might assist you in meeting your goal.

- Maps (overhead as well as street view) as well as other similar tools will ensure the sites you have collected at are appropriate for the research.

When……?

Define the timeline of the study (when it starts, when it will end and critical time points for success)

Common timeline points often include:

1. Obtaining the necessary resources
2. Development of the overall research plan (goal)
3. Buy-in and community involvement, especially participatory-based
4. QAPP development and approval
5. Initiation of data collection
6. Completion of data collection
7. Completion of data review and summarization
8. Reporting out findings

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How……?

- Do you consider historical data (if it exists)?
- Do you define data quality objectives? How good must the data be to be able to answer a question?
- Do you intend to collect the data? What methods will you use?
- Do you plan to operate the equipment and what procedures will be used to determine the instrument is functioning and responding appropriately?
- Do you document key happenings (e.g., with log sheets)?
- Do you determine when something is or is not working as desired?
- Do you intend to review the data? What steps are necessary and who is involved?
- Do you summarize key findings and who performs these actions?
- Do you intend to report findings to stakeholders and others?

Possible Sensor Tiers

Tier	Application Area	Pollutants	Precision and Bias Error	Data Completeness*	Rationale (Tier I-IV)
I	Education and Information	All	<50%	≥ 50%	Measurement error is not as important as simply demonstrating that the pollutant exists in some wide range of concentration.
II	Hotspot Identification and Characterization	All	<30%	≥ 75%	Higher data quality is needed here to ensure that not only does the pollutant of interest exist in the local atmosphere, but also at a concentration that is close to its true value.
III	Supplemental Monitoring	Criteria pollutants, Air Toxics (incl. VOCs)	<20%	≥ 80%	Supplemental monitoring might have value in potentially providing additional air quality data to complement existing monitors. To be useful in providing such complementary data, it must be of sufficient quality to ensure that the additional information is helping to "fill in" monitoring gaps rather than making the situation less understood.
IV	Personal Exposure	All	<30%	≥ 80%	Many factors can influence personal exposures to air pollutants. Precision and bias errors suggested here are representative of those reported in the scientific literature under a variety of circumstances. Error rates higher than these make it difficult to understand how, when, and why personal exposures have occurred.

Select Quality Assurance Parameters

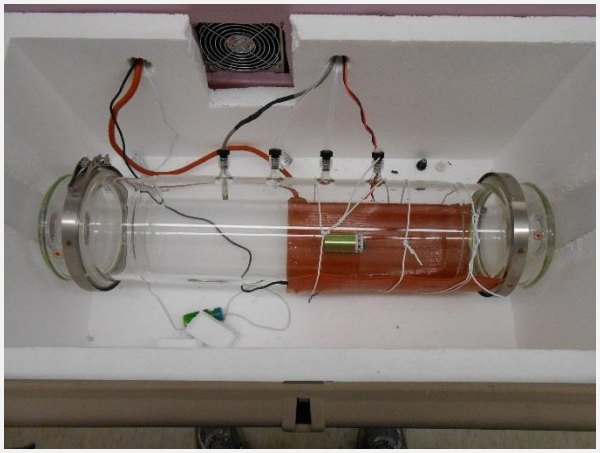
- Bias - is it routinely high or low with respect to the true value
- Precision - how repeatable is the measurement
- Calibration - does it respond in a systematic fashion as conc. changes
- Detection limit - how low and high will it measure successfully
- Response time - how fast does the response vary with conc. change
- Linearity of sensor response - what is the linear or multi-linear range
- Measurement duration - how long do you need to collect data (time)
- Measurement frequency - how many collection periods are needed
- Data aggregation - value in aggregating data (1 sec, 1 min, 1 hr, etc.)
- Selectivity/specificity - does it respond to anything else
- Interferences - how does heat/cold impact response
- Sensor poisoning and expiration - how long will the sensor be useful
- Concentration range - will the device cover expected highs and lows
- Drift - how stable is the response
- Accuracy of timestamp - what response output relates to the event
- Climate susceptibility - does RH, temp, direct sun, etc. impact data
- Data completeness - what % of planned data collections need to occur
- Response to loss of power - what happens when it shuts down

Sampling Considerations

1. Define the number and types of data needed to achieve your intended goal
2. Define data collected to ensure the methods are working appropriately (e.g., include replicate samples, blanks, audit samples, etc.)
3. Define the schedule for when item number 2 will occur

Sensor Calibration Considerations

1. If possible, obtain sensors with known manufacturer calibration certifications
2. Operate the device within manufacturer's stated lifespan
3. Calibrate or audit the device if possible on a regular schedule using accepted standards
4. Collocate the device in close proximity to regulatory monitors and use such data to "correct" a number of issues with non-regulatory devices



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Data Logs Should Indicate…

- What activity occurred and when?
- Were there any unusual events that might have impacted the data quality (e.g., weather, presence of sources)?
- Who did what (e.g., serviced the sensor, harvested data)?

CSAM Monitoring Record

CSAM unit #: _____ Date: _____ Data recorded by: _____

Test location (description): _____

_____

Fresh batteries installed? Yes ☐ No ☐

If yes, date: _____

Data logging interval: _____ min Operation mode: AC power ☐ Battery ☐

Start date: _____ End date: _____

Start time: _____ End time: _____

Total run time: _____ hours

Pre-test Instrument Setup

$PM_{2.5}$ zero check Performed by: _____ Date: _____

$PM_{2.5}$ flow rate check Performed by: _____ Date: _____

NO_2 zero and span check Performed by: _____ Date: _____

Post-test Instrument Operations

Data downloaded Yes ☐ No ☐ File name: _____

Performed by: _____ Date: _____

Comments

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Data Management Considerations

- Clear and consistent documentation of record keeping. Use of pre-described forms ensure necessary information is being documented.
- Who has access to data and what events have occurred from the time data were collected, processed, and summarized? Did data have to be corrected, dismissed, or amended in any fashion?
- How will data be archived? Are there electronic and written records? Dates/signatures should be part of this record.

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Thank You. Questions?