Stormwater Effectiveness Studies

Detailed Study Design Proposal & Quality Assurance Project Plan (QAPP) Template

Study Classification: (select one)

☐ Structural BMP ☐ Operational BMP ☑ Education & Outreach

May 16, 2017

Template Prepared By: Aimee S. Navickis-Brasch, P.E., PhD Candidate
Prepared for: Art Jenkins, P.E. City of Spokane Valley
Template QA/QC: Donald Carpenter. P.E., Ph.D., LEED AP

HDR

EW
Effectiveness Studies Development Project

E&O QAPP Template Presentation
Agenda

- Background: Eastern Washington Effectiveness Studies
- Template Purpose
- Overview of Content
- Focus on Sections:
  - → 6.0 Data Quality Indicators
  - → 8.0 Instrument Design and Development
  - → 13.0 Data Analysis Methods
  - → Appendix A – Sample Size Determination *(if time allows)*

Example for Applying QAPP Template - Mobile Contractor Illicit Discharge Education

EW Effectiveness Studies Development Project

- Phase II MS4 NDES Permit Requirement
  - Evaluate effectiveness of SW management programs & activities
  - Presumptive → Demonstrative
- EWA Stormwater Group (EWSG)
  - *24 cities & counties*
  - Lead or Participating Agency
- Study Phases

  Phase 1 & 2 - Identified & Rank Studies

  Pre-Phase 3 – Develop QAPP Templates

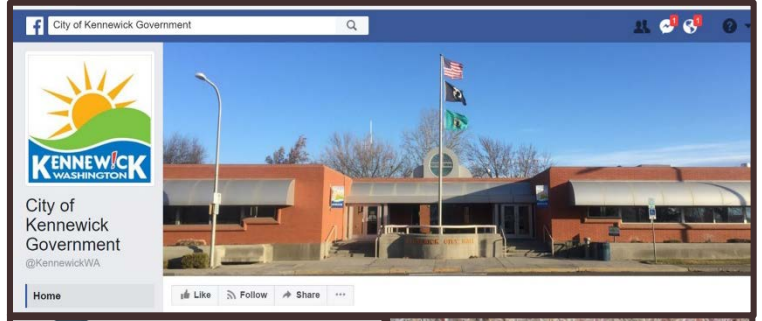
  Phase 3a – Detailed Study Design Proposals

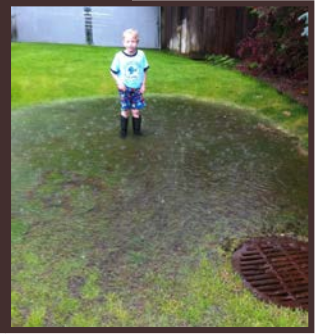
  Phase 3b – Quality Assurance Project Plan

  Phase 4 - Conduct Studies

  Phase 5 – Analyze Data & Report Results → Improve SW Management Program

  Repeat
- Study Funding
  - *Ecology Gross Grants Phase 1-3a*
  - *City of Spokane Valley – Grant Recipient*





EW
Effectiveness Studies
Development Project

- Phase II MS4 NDES Permit Requirement for Proposals (S8.B.4):

  For each study, describe the purpose, objectives, design, and methods; list the Permittees that will participate, and their roles and responsibilities; describe anticipated outcomes; identify methods to report the results; and describe expected modifications to the Permittees' stormwater management programs.

- QAPP Template Purpose #1

  1. Identify the differences in the information expected in a Proposal compared to a QAPP

- EWA Effectiveness Studies Classifications

  - Structural BMPs, Operational BMPs, and Education and Outreach BMPs

- QAPP Template Purpose #2

  2. Provide guidance for preparing a Proposal and a QAPP that generally addresses conditions specific to studies that focus on Structural BMPs, Operational BMPs and *Education & Outreach BMPs.*

QAPP Templates – City of Spokane Valley EWA Effectiveness Studies Website:

http://www.spokanevalley.org/content/6836/6914/8301/10121/default.aspx

What is a Quality Assurance Project Plan (QAPP)?

- QAPP – Report that defines:
  - Experimental Design
  - How (QA) and (QC) will be applied to a research project
- Purpose
  - Ensure data collected during study is scientifically and legally defensible
  - Required for studies to be performed in compliance with Ecology (or EPA) regulatory requirement*s*

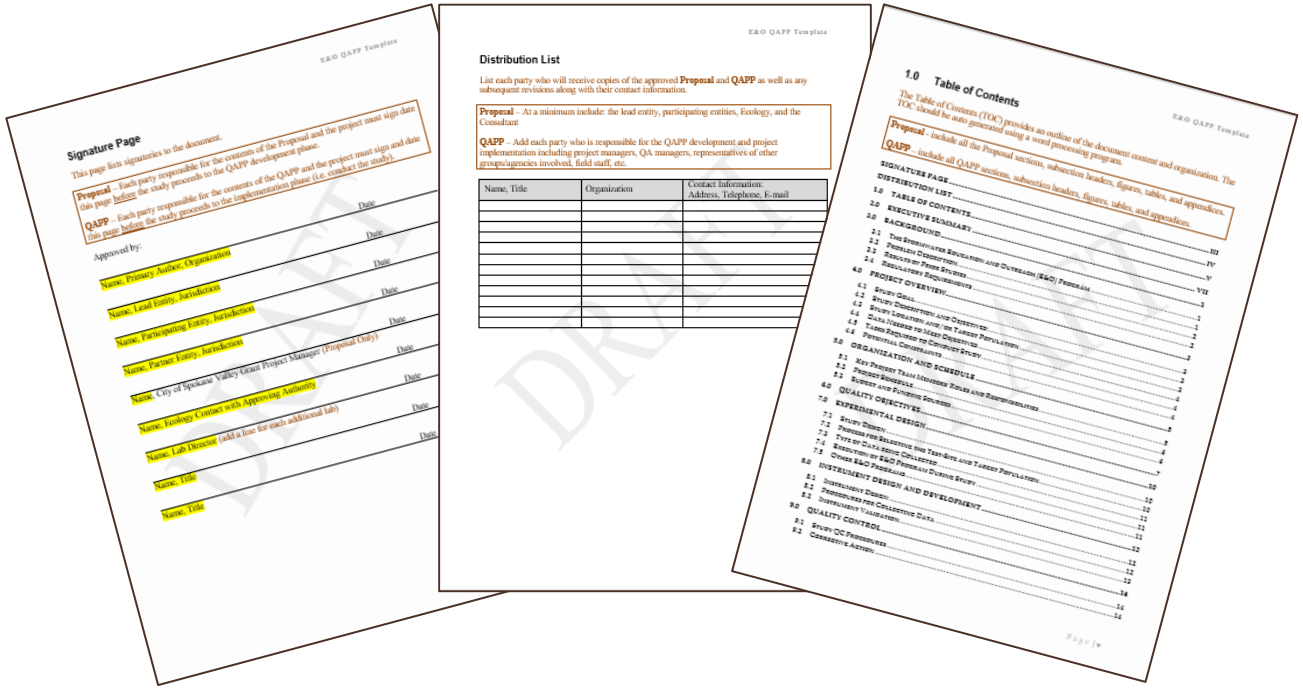
Template Instructions

- Template defines information expected in the QAPP

Proposal – indicates the information expected in the Proposal. However, users are encouraged to provide as much information and detail as known at the time the Proposal is developed.

- **Brown text** - instructions & guidance for developing the section
  - Delete from final document
- Text highlighted in yellow - replace with the information relevant to a specific study
- For Sections that do not apply to a study
  - Enter "**Not applicable**" along with an explanation

1.0 Signature Page, Table of Contents, Distribution List



2.0 Executive Summary - *QAPP Only*

The executive summary is a non-technical summary of the project that is typically written for a more general audience and includes the "key" elements of the study.

3.0 Background

Section Purpose: Describe the stormwater education and outreach program that is the focus of this study, the reason(s) why the study is being conducted including results from prior studies, and the stormwater management program conditions in the EWA NPDES Municipal permit the study addresses.

- 3.1 The Stormwater Education and Outreach (E&O) Program
- 3.2 Problem Description
- 3.3 Results of Prior Studies – QAPP Only
- 3.4 Regulatory Requirements

4.0 Project Overview

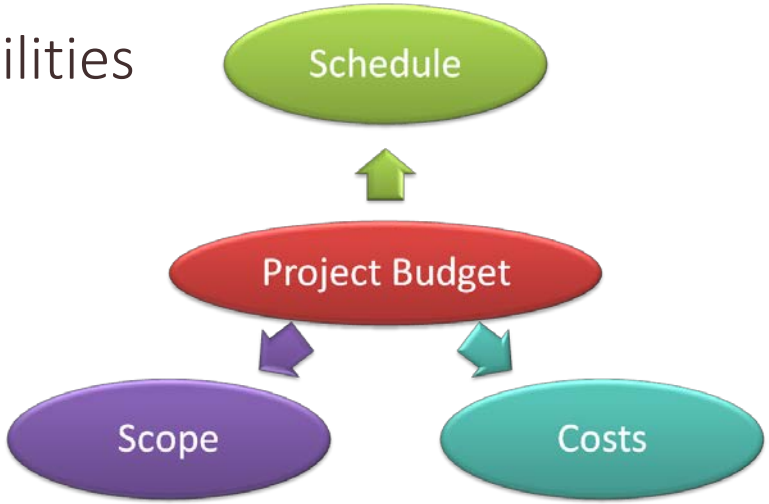
Section Purpose: Provide an overview of the entire study. If the reader only reads this section, they should generally understand what the study intends to accomplish and how it will be accomplished.

- 4.1 Study Goal
- 4.2 Study Description and Objectives
- 4.3 Study Location and/or Target Population
- 4.4 Data Needed to meet Objectives
- 4.5 Tasks Required to Conduct Study *(table format)*
- 4.6 Potential Constraints

5.0 Organization & Schedule

Section Purpose: Describe who is responsible for completing the tasks, when the tasks will be completed, how much each task will cost, and how the study will be funded.

- 5.1 Key Project Team Members: Roles and Responsibilities
  (table format)
- 5.2 Project Schedule
  (table format)
- 5.3 Budget and Funding Sources
  (table format; broken down by tasks & subtask)



6.0 Quality Objectives

QAPP Only

Section Purpose: provide a *roadmap of the QA/QC plan* will be employed during the project: provide a brief written description that addresses how QA/QC is addressed throughout the QAPP.

- **Data quality indicators (DQIs)**
  - Characterize the aspects of quality data
  - Minimize error and improve accuracy of data
- **Measurement performance criteria (MPCs)**
  - Specifies how good the data must be to meet the project objectives

6.0 Quality Objectives

Principal DQIs

Traditional QAPP	E&O QAPP Template
1. Precision	1. Validity
2. Bias	2. Reliability
3. Representativeness	3. Objectivity
4. Completeness	4. Completeness
5. Comparability	5. Credibility
6. Sensitivity	6. Transferability
	7. Integrity

6.0 Quality Objectives

Seven Principal DQIs for E&O Studies

1. **Validity** (bias) - Closeness between the measured value and the true value. An instrument is considered valid when it measures what it is purported to measure.

Potential Approaches for Addressing DQI in Studies:

- Develop new instrument using acceptable methods
- Use established instruments that have been validated
- Questions written in language that is accessible to audience
- Peer review of instruments by panel of experts
- Field test/validate instrument (pilot test) before broad application

Instruments are a measurement device *(i.e. a survey, test, observation log, focus group, etc.) used to assess what the researcher wants to know.*

6.0 Quality Objectives

Seven Principal DQIs for E&O Studies

2. **Reliability (precision)** - The degree to which an instrument produces stable and consistent results on repeated measurements

Potential Approaches for Addressing DQI in Studies:

- Define and follow Standard Operating Procedures (SOPs) for data collection
- Use multiple instruments to collect data
- Pilot test instruments
- Use larger sample size
- Interrater reliability

6.0 Quality Objectives

Seven Principal DQIs for E&O Studies

3. **Objectivity** - Attempt to diminish or eliminate the investigators bias. An objective investigator is neutral and open all sides of the argument without imposing their own bias, motivations, interested or perspectives.

Potential Approaches for Addressing DQI in Studies:

- Remove investigator from direct contact with subjects
- Investigator avoids the use of prompts during interviews
- Use data analysis procedures and methods that are appropriate for the types of data collected
- Provide evidence that conclusions are based on findings
- SOPs are defined, consistently followed, and appropriate for the study

6.0 Quality Objectives

Seven Principal DQIs for E&O Studies

4. **Completeness** - The amount of valid data needed to be obtained from the measurement system. Data is considered complete when: the sample size is representative of the target population.

   Potential Approaches for Addressing DQI in Studies:

   - Sound justification is provided for sample size selected
   - Define procedures for handling missing data
   - Use appropriate coding for missing data
   - Report missing data with the results
   - Results should include consideration for how missing data could limit the transferability of the data set

6.0 Quality Objectives
Seven Principal DQIs for E&O Studies

5. **Credibility** – often referred to as ***social desirability bias***: describes a type of response bias where survey respondents answer questions in a manner they believe will be viewed favorably by others. It can take the form of over-reporting "good behavior" or under-reporting "bad", or undesirable behavior.
   - Ask the same question with response categories in reverse order
   - Careful consideration of instruments; how research is introduced; and how questions are worded
   - Use multiple types of instruments and sources to collect and cross check data can assist the investigator in understanding and interpretation the response.
   - Appropriate use of priming respondent *(i.e. let them know it is okay to admit behavior)*

6.0 Quality Objectives

Seven Principal DQIs for E&O Studies

6. **Transferability** – The extent to which sample data can be transferred from a sample to a population. Datasets are considered transferable if the instruments, data sources, data collection procedures, sample selectin procedures, and reporting are equivalent.
   - Define the process and provide justification for selecting the: target audience, study area, and sample size (representative of population)
   - Define and justify the process applied to for compare datasets between populations and/or study areas
   - Use sound sampling procedures that yield a sample representative of the population on key variables
   - Use statistical comparisons to generalize study findings
   - Provide follow up procedures for non-respondents

6.0 Quality Objectives

Seven Principal DQIs for E&O Studies

7. **Integrity** - Integrity is concerned with minimizing errors through the process of collecting, recording, and analyzing data.
   - Develop and consistently follow: data collection SOPs; data recording and reporting procedures; use standard forms; verify data has been properly recorded and logged
   - Properly train those involved in data collection
   - Provide assurances for maintaining respondent confidentiality
   - Use data analysis procedures/methods appropriate for data types
   - Verify (through audits) that all procedures are followed
   - Describe process for minimizing errors that could limit the transferability

7.0 Experimental Design

Section Purpose: Describe the experimental design that will be used to evaluate (and/or compare) the E&O program(s) effectiveness and/or develop an E&O program (i.e. collecting baseline data). Provide the basis for why the experimental design was selected; may include a literature search.

- 7.1 Study Design
- 7.2 Process for Selecting Test-Site & Target Populatio
- 7.3 Type of Data being Collected
- 7.4 Execution of E&O Program During Study
- 7.5 Other E&O Programs

8.0 Instrument Design & Development

QAPP Only

Section Purpose:

- In the context of E&O studies, instruments are a measurement device (i.e. a survey, test, observation log, focus group, etc.) used to assess what the researcher wants to know.
- Describe the instrument(s) that will be used during the study along with the process used to develop and validate the instruments.

8.0 Instrument Design & Development

8.1 Instrument Design

Subsection Purpose: Describe how the instruments were designed and developed. This may include:

- ✓ Identify the instruments proposed to measure or compare effectiveness for an E&O program
- ✓ Describe how/why the instruments were designed to collect data from the target population
- ✓ Include a copy of the instrument with the survey and/or interview questions (attachment)

8.0 Instrument Design & Development

8.2 Procedures for Collecting Data

Subsection Purpose: Define the procedures for collecting the various types of data created during the study. Standard operating procedures (SOPs) are the procedures that define specifically how to conduct an activity.

SOPs for E&O studies may include:

- ✓ Instructions that will be provided to the participant before they take the survey
- ✓ How the instruments will be disseminated to the target population
- ✓ How interviews will be conducted
- ✓ What data will be recorded

8.0 Instrument Design & Development

8.3 Instrument Validation

Subsection Purpose: After the instrument(s) have been developed, the next step is to validate the instrument. Validation is the process to verify the instrument measures what it was intended to measure and produces stable results. This subsection should describe the process that will be employed to validate the instruments.

- ✓ The use of established instruments from similar studies that have already been validated
- ✓ Field testing of instruments before broad implementation
- ✓ Asking the same question with response categories read in reverse order (quantitative data)
- ✓ Using peer debriefing
- ✓ Defining acceptable interrater reliability ratings (for MPCs)
- ✓ Using multiple methods
- ✓ Peer review of instrument/questionnaire by panel of experts

9.0 Quality Control

QAPP Only

Section Purpose: Describe the QC procedures that will be employed during the study to minimizing errors and support the integrity of the data through the process of collecting, recording, and analyzing data. *Recommend using tables to keep the section brief.*

- 9.1 Study QC Procedures
- 9.2 Corrective Action

10.0 Data Management Plan Procedures
QAPP Only

Section Purpose: Define the data management plan: how the data and other important project documents will be managed, stored, and archived during the study. The reason data management plans are developed is to reduce the potential for errors during the data collection and analysis phases of the project.

- 10.1 Data Identification
- 10.2 Data Recording & Reporting Requirements
- 10.3 Procedures for Missing Data
- 10.4 Acceptance Criteria for Existing Data

11.0 Audit

QAPP Only

Section Purpose: Describe what will be audited; the process and procedures; number of audits; audit schedule and frequency; audit responsibility (who will audit)

Type of Audit: Technical System Audit – qualitative; verify conformance to Quality Assurance Project Plan. This may include:

- ✓ Verify the field staff are trained and following the SOPs
- ✓ Verify the data management procedures are followed including recording the data in the field
- ✓ Confirm instrument validation procedures are followed
- ✓ Verify the process defined for selecting test-sites and target population was followed.

12.0 Data Verification & Usability Assessment
QAPP Only

Section Purpose: defines the process that the project will employ to evaluate the quality of the data and the usability of the data for meeting the project objectives.

- 12.1 Data Verification
- 12.2 Data Usability Assessment

13.0 Data Analysis Methods
Section Purpose & 13.1 Hypothesis Testing

Section Purpose: define the methods the project will use to analyze the data and address the study goals outlined in Section 4.1

13.1 Hypothesis Testing

- **Subsection Purpose**: For datasets that will be compared, either between the target audience and control-audience or between baseline and post responses, describe how the datasets will be analyzed to determine if there is a statistically significant difference. This could include:
  - ✓ Summary of hypothesis testing process and methods that will be used to analyze the data.
  - ✓ Definition of the null and alternative hypothesis that will be evaluated
  - ✓ Definition of the methods and describe how/why the methods are appropriate for the types and quantity of data. *This is particularly important for non-normally distributed data and ordinal data*

13.0 Data Analysis Methods

13.2 Quantitative & 13.3 Qualitative Analysis Methods

13.2 Quantitative Data Analysis Methods

- **Subsection Purpose**: Define the quantitative data analysis process and methods. *(Yes/No, True/False, Multiple Choice Questions)*:
  - ✓ Summary of methods that will be used to analyze the data
  - ✓ Summary of methods that will be used to compare data sets
  - ✓ A description regarding how multiple choice surveys will be coded with a Likert scale

13.2 Qualitative Data Analysis Methods

- **Subsection Purpose**: Describe the technique that will be used to analyze qualitative data. *(Open Ended Questions):*
  - ✓ Organizing and categorizing the data into themes and codes
  - ✓ Connecting the data to show how one concept may influence another
  - ✓ Using a peer debriefing to validate the codes and themes
  - ✓ Summary of methods that will be used to determine the number of similar or dissimilar responses

13.0 Data Analysis Methods

13.4 Data Presentation Methods

- **Subsection Purpose**: Describe how the data will be presented (i.e. tables, charts, and/or graphs) in the final reports to illustrate trends, relationships, and anomalies.

Appendix A
Sample Size Determination

Four Primary Considerations (hypothesis testing):

1. Criteria for Statistical Significance
2. Level of Statistical Power
3. **Statistical Analysis Strategy**
4. Effect Size (judged to be meaningful)

Appendix A
Sample Size Determination

Criteria for Statistical Significance

- Probability of rejecting null hypothesis (H_o), given that H_o is <u>true</u>
  - Type I error – due to sampling errors
  - α = Chance of making Type 1 error
  - α = 0.05 (common in social sciences)
- Probability of rejecting null hypothesis (H_o), given that H_o is false
  - Confidence Interval (CI) or risk level
  - If α = 0.05 then CI = 95%

<u>Sample size is inversely related to significance level (α)</u>

Appendix A
Sample Size Determination

Level of Statistical Power

- **Statistical Power** - Probability of **NOT** rejecting H_o, given that H_o is <u>false</u>
  - Type II Error
  - Less of a concern, but cannot ignore
  - Typical Statistical Power values: 0.70 to 0.85 (TAPE uses 0.80)
- **Statistical Power** - Chance of making Type II error depends upon:
  - Sample Size
  - Actual Value of Parameter

<u>Reduce chance of Type II Error → take larger sample size</u>

(Statistical Power increases as sample size increases)

Appendix A
Sample Size Determination

Statistical Analysis Strategy *(Data analysis procedures)*

- Data analysis procedure for testing hypothesis depend upon:
  - Research Design (i.e. Case Studies)
  - Research question of interest
  - Nature or type of variables studied
- Analysis strategies that consider more information about subjects, require fewer subjects
  - Quantitative Independent variables require fewer subjects compared to qualitative
  - Studies with data collected pre and post require fewer subjects compared to post alone
  - 12 samples are the minimum number for most statistical analysis methods

<u>The more independent variables, the more subjects needed</u>

Appendix A
Sample Size Determination

Effect Size

- Degree to which the null hypothesis is false (degree of variability)
- When comparing two population means:
  - Difference is large → smaller sample size
  - Difference is small → larger sample size
  - The more heterogeneous a population → larger sample size needed
  - The more homogeneous a population → smaller sample size needed
- Effect size in relation to assessment tool or instrument
  - New tools – more difficult to detect effect size
  - Use established tools or pilot test tools

Appendix A
Sample Size Determination - Strategies

1. **Using a Census for Small Populations**
   - **Approach**: Sample the entire population
   - Best for small populations, provides highest level of reliability (precision)

2. **Using a Sample Size of a Similar Study**
   - **Approach**: Use the same or typical sample size as similar studies (literature search)
   - Must carefully review procedures to avoid repeating errors made in other studies

Appendix A

Sample Size Determination - Strategies

3. **Use Published Tables**
   - **Approach**: Rely on published tables to provide sample size based on a given set of criteria
   - Typical Criteria: Statistical Significance, Statistical Power, Degree of Variability

4. **Use Formulas to Calculate Sample Size**
   - **Approach**: Calculate sample size using appropriate methods
   - Use when combinations of different criteria's are needed to select sample size
   - Online Calculators

     https://www.checkmarket.com/sample-size-calculator/

Table 2. Sample size for ±5%, ±7% and ±10% Precision Levels Where Confidence Level is 95% and P=.5.

Size of Population	Sample Size (n) for Precision (e) of:		
	±5%	±7%	±10%
100	81	67	51
125	96	78	56
150	110	86	61
175	122	94	64
200	134	101	67
225	144	107	70
250	154	112	72
275	163	117	74
300	172	121	76
325	180	125	77
350	187	129	78
375	194	132	80
400	201	135	81
425	207	138	82
450	212	140	82

Appendix A

Sample Size Determination - Strategies

- Minimum sample size: 100
  - If population is less than 100; need to survey the entire population
- Maximum sample size: 10% of population
  - Not to exceed 1000
- Chose Minimum when:
  - time and money are limited
  - Only rough estimate is needed (relate to CI and power)
  - You don't plan to divide sample into different groups during the analysis or you plan to use a few large subgroups (i.e. males/females)
- Chose Maximum when:
  - time and money are available
  - Accurate results are important (relate to CI and power)
  - You plan to divide sample into different groups during data analysis (i.e. age groups, etc)

Reference: http://www.tools4dev.org/resources/how-to-choose-a-sample-size/


ANY
QUESTIONS
?