APPENDIX 7A

Modeling Plan and Reporting

Contents

List of Tables

1. INTRODUCTION

This appendix presents the SPU-preferred outlines for a Modeling Plan, Key Goals Technical Memorandum, Modeling Report, Flow Monitoring Plan, and Flow Monitoring Report.

2. MODELING PLAN

All SPU projects with hydrologic and hydraulic (H/H) modeling must have a Modeling Plan. The Modeling Plan must follow the sample outline presented in this appendix. SPU DWW LOB representative must approve any deviations from the plan. All approved deviations from the Modeling Plan must be documented in the Modeling Report.

The Modeling Plan is a roadmap for the modeling team to follow and understand how key inputs, outputs, assumptions, and other decisions will be made. The following are key steps in developing a modeling plan. For further details about each of these steps, please refer to relevant sections in the main body of Chapter 7.:

1. Determine key goals for the project, including how others will use the results
2. Determine the areas covered by the model, identify boundary conditions, and level of detail required
3. Develop a Quality Assurance (QA) plan
4. Develop a documentation strategy
5. Determine model input requirements and data sources
6. Prepare a Flow Monitoring plan (if applicable)
7. Develop a strategy for calibrating and validating model
8. Develop a strategy for uncertainty analysis (if applicable).

All projects with flow monitoring must have a flow monitoring plan prepared before flow monitoring installation. See Flow Monitoring Plan and Report outline below.

3. MODELING REPORT

Table 1 shows the preferred content for an SPU modeling report.

Table 7A-1
SPU Modeling Report Content

Section of Report	Content
Model Development	Documents work from project inception to pre-calibration: • Project definition, background, and purpose • Description of model construction for existing conditions

Section of Report	Content
	• Data description, sources, reliability, and location of data storage. Data documentation should be as specific as possible. Reference firm or agency of origin, date, format, modifications, and any comments on data quality or assumptions. • Assumptions and simplifications • Naming conventions for maintenance holes, pipes, structures, etc. • Flow estimation methodology. • Deviations from Modeling Plan
Model Calibration and Validation	Documents accuracy of the model against measured data: • Calibration records including initial variable assumptions and justifications for variable adjustments • Metrics indicating the models compliance with calibration and validation standards. Refer to DSG section 7.9 Model Calibration and Validation. • Description and justification of changes to the model during calibration • Graphs comparing predicted to actual flow both for the calibration and validation period. Comments of the model's suitability for the intended use, particularly if the model does not meet one or more validation standards • Analysis used to evaluate the suitability of a model not conforming to the validation standards • Limitations of the model • Correlation of predicted and observed attributes specific to the project • Defined range acceptable for model calibration and validation results
Alternative Analysis **(If applicable. This chapter is usually in the Preliminary Engineering Report)**	Documents how the model was used to identify capacity limitations, evaluate alternatives to improve service, and model future conditions. Particularly important when a model is used for design, evaluations for future conditions, and optimization. Project specific but should include details of changes made to the calibrated model: • Capacity assessment results • Description of capital and/or operational project alternatives • Modeling of the alternatives • Future sewer flow projections and key assumptions • Operation changes such as pump replacements or modifications to flow control structures
Conclusions and Recommendations	Project specific and can include: • Existing system performance including key flow control facilities • Capacity limitations or surpluses • Rehabilitation recommendations • Surcharge prediction • Any limitations of the model for future use and what is needed to fill gap. • Any conclusions or recommendations developed using the model should be supported by the models output (e.g. graphs, surcharge depths, peak flows)
Appendices	Additional documentation must include: • Hydraulic and/or Hydrologic Model Development • Calibration and Validation • QA/QC documentation including Modeling QA/QC Checklist (see Appendix B) • Technical Memoranda

4. MODELING PLAN AND REPORT

The following is the SPU preferred outline for H/H modeling plans and reports:

Executive Summary

Chapter 1 Introduction
- 1.1 Background and Project Goals and Objectives
- 1.2 Study Boundaries

Chapter 2 Basin Characterization
- 2.1 Overview
  - 2.1.1 Conveyance System
  - 2.1.2 Climate
  - 2.1.3 Land Use
  - 2.1.4 Soils
  - 2.1.5 Population
- 2.2 Sub-basin 1
- 2.3 Sub-basin 2
- 2.4 Sub-basin 3

Chapter 3 Data Collection
- 3.1 System Data
  - 3.1.1 Pipe and Maintenance Holes
  - 3.1.2 Special Structures
  - 3.1.3 Datum Adjustments
- 3.2 Population Data
- 3.3 Surface Data
- 3.4 Rainfall and Flow Meter Data
- 3.5 Filling Data Gaps

Chapter 4 Model Development
- 4.1 Modeling Platform
- 4.2 Hydraulic Model Construction
  - 4.2.1 Maintenance Holes
  - 4.2.2 Pipes and Open Channels
  - 4.2.3 Special Structures
  - 4.2.4 Outfalls
- 4.3 Hydrologic Model Construction
  - 4.3.1 Subcatchment Delineation
  - 4.3.2 Loading Points
  - 4.3.3 Dry-Weather Flow Conditions
  - 4.3.4 Wet-Weather Flow Conditions
- 4.4 Boundary Conditions

Chapter 5 Calibration
- 5.1 Calibration Process
- 5.2 Calibration Events
- 5.3 Target Calibration Criteria
- 5.4 Calibration Points
- 5.5 Preliminary Calibration (Manual Calibration)
- 5.6 Automated Calibration (if applicable)
  - 5.6.1 Sampled Parameters and Ranges
  - 5.6.2 Event and Meter Weighting Factors
- 5.7 Best Fit Parameter Sets and Goodness-of-Fit (if applicable)

5.8 Flow Calibration Results
5.9 Depth Calibration Results

Chapter 6 Existing System Performance
6.1 System Response to Rainfall
6.2 Capacity Limitations and Surface Flooding in the System
6.3 Performance of Control Facilities (if applicable)
6.4 Performance of Pump Stations (if applicable)
6.5 Performance of Recent Projects (if applicable)
6.6 Characteristics of Combined Sewer Overflows (if applicable)

Chapter 7 Long-Term System Performance
7.1 Existing Conditions
7.2 Future Conditions
7.3 Uncertainty Analysis

Chapter 8 QA/QC Review Process
8.1 Model Refinement
8.2 Calibration
8.3 Uncertainty Analysis

Chapter 9 Alternative Analysis (if applicable)

Chapter 10 Summary and Conclusions
Appendix
List of Tables
List of Figures

5. KEY GOAL TECHNICAL MEMORANDUM

The goals should be described in the project scope of work. Listing the key goals of the project helps the modeling team determine the necessary level of detail. The following are elements that could be included in key goals:

- Necessary level of detail (conceptual, planning, CIP-development, design, calibration)
- Type of hydraulics (simplified kinematic or fully hydrodynamic)
- Area of concerns (local or systemwide)
- Important physical processes (I/I, surface water runoff, hydraulic capacity limits, and control systems)

6. FLOW MONITORING PLAN AND REPORT

All SPU projects with flow monitoring must have a Flow Monitoring Plan. The Flow Monitoring Plan must follow the sample outline presented below. SPU DWW LOB representative must approve any deviations from the plan. All approved deviations from the Flow Monitoring Plan must be documented in the Flow Monitoring Report.

The Flow Monitoring Plan is a roadmap for the modeling and monitoring team to follow and understand how key inputs, outputs, assumptions, and other decisions will be made. The following are key steps in developing a flow monitoring plan

- Determine key goals and objectives for the project, including how others will use the results
- Type and quality of data required. Determine if there is existing data available to fit project needs.
- Determine project boundaries and the areas covered by the monitoring, identify critical structures and/or flow control features to monitor
- Plan monitoring and precipitation locations
- Identify major milestones
- Develop a Quality Assurance (QA) plan
- Develop a documentation strategy
- Determine flow monitoring equipment requirements and provide specifications and description of monitoring technology selected based upon type and quality of data required and the hydraulic constraints of monitoring locations. Provide all necessary and/or site specific procedures requirement for successful monitoring.
- Develop data review and data management procedures which include data verification and validation process
- Develop a safety plan

7. FLOW MONITORING PLAN AND REPORT OUTLINE

The following is the SPU preferred outline for flow monitoring plans and reports:

Chapter 1 Introduction
- 1.1 Project Description
  - 1.1.1 Project Goals
  - 1.1.2 Project Objectives
  - 1.1.3 Information Requirements
  - 1.1.4 Study Boundaries
  - 1.1.5 Practical Constraints
  - 1.1.6 Data Collection
  - 1.1.7 Decision-making
- 1.2 Background
  - 1.2.1 Study Area
  - 1.2.2 Logistical Problems
  - 1.2.3 History
- 1.3 Parameters of Concern
  - 1.3.1 Previous Studies
  - 1.3.2 Criteria and/or Standards

Chapter 2 Organization and Schedule
- 2.1. Roles & Responsibilities