

Hydraulic Model Calibration Project Checklist

A field-tested checklist to structure your next hydraulic model calibration project – from data review to final validation. Use it to prepare an RFP, respond to one, or jump-start your project.

My first hydraulic model calibration project was at AECOM – data processing in Excel for the City of Markham water model update. 13 years later, the process hasn't changed. What has changed is my ability to standardize and practically automate a repetitive task. This checklist is the result. I hope it helps you structure your next project.



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Founder & CEO HydraLink

How to use this checklist

Work through each section in order. Items marked **KEY** are the most commonly missed steps. Items marked **FIELD** require on-site coordination. Items marked **DATA** depend on client data availability.

1 Background data review, gap analysis & model update

Before modelling begins

- Review existing water hydraulic model **DATA**
Assess existing model, software and software version, and completeness of existing network representation
- Review major infrastructure components **DATA**
Pump stations, reservoirs, storage tanks, valves, and major transmission mains
- Review SCADA data and water demands **DATA** **KEY**
Assess historical SCADA logs, billing data and any existing demand allocation. Quality of SCADA data directly determines calibration accuracy attainment.
- Review operational constraints, design criteria and standards **DATA**
Minimum and maximum pressure requirements, fire flow standards, and regulatory design criteria applicable to the municipality.
- Identify data gaps and prepare gap analysis report **KEY**
Document what is missing before the project starts. Use the data request list in the bonus section below.

2 Demand analysis

Understanding real water use

- Review historical consumption data **DATA**
Minimum 2 years of billing data. Identify seasonal trends, industrial users, and anomalies.
- Perform zonal flow balance and establish diurnal pattern per pressure zone **KEY**
Each pressure zone should have its own diurnal demand curve based on SCADA flow data. Generic patterns reduce calibration accuracy significantly.
- Evaluate non-revenue water **KEY**
Calculate NRW as a percentage of system input volume. Establish baseline before calibration – helps identify model demand allocation issues.
- Establish average day demand (ADD) and maximum day demand (MDD)
ADD from annual billing totals. MDD typically $1.5-2.0 \times \text{ADD}$. Confirm with historical SCADA peak day records.
- Allocate demands to model nodes based on GIS parcel or meter data
Spatial allocation method (nearest node, area-weighted, or meter-based). Document the method used for future model updates.

3 Hydraulic model update

GIS-driven network update

- Update watermains based on latest GIS dataset** DATA KEY
Import from municipality's current GIS. Check for pipe splits, duplicate nodes, and connectivity errors after import. Common source of model run simulation errors and failures.
- Update pump settings based on available pump curve data** DATA
Manufacturer pump curves plus field testing results if available. Incorrect pump curves are a common pitfall during model calibration.
- Update valve settings and operational status** DATA KEY
Closed boundary valves define pressure zones. Even one open boundary valve can prevent successful calibration.
- Update tank and reservoir settings** DATA
Current operating levels, volumes, and control rules. Confirm with operations staff – SCADA logs often differ from design documentation.
- Run initial steady-state simulation and check for errors**
Fix all negative pressure warnings, disconnected nodes, and pump operation errors before proceeding to calibration.

4 Field testing

On-site data collection – requires advance scheduling

- Review previous hydrant test data and locations** FIELD DATA
If recent tests exist (within 3–5 years), assess whether locations are still representative and data is usable for calibration.
- Establish a field-testing plan** FIELD KEY
Select test locations to cover all pressure zones, avoid transmission mains to start, and suspected problem areas. Minimum 2–3 tests per pressure zone is recommended.
- Budget for number of tests and coordinate with operations team** FIELD
Hydrant flow tests require 2-person field crew, traffic control in some locations, and advance notice to residents. Plan 4–6 weeks ahead.
- Conduct C-factor testing** FIELD KEY
Hazen-Williams C-factors by pipe material and age. New PVC typically C=140+, older cast iron C=80–100. Critical for accurate head loss calculations.
- Conduct hydrant flow testing** FIELD
Record static pressure, residual pressure at multiple flow rates, and flow using diffuser gauge. Document ambient conditions and time of day. Time of day is important to be able to match with SCADA data and system flow and pressure conditions at facilities.
- Download SCADA data for calibration period** DATA
Request 1-minute interval data for pump flows, tank levels, and pressure loggers for the calibration period (minimum 1 week). For micro-level calibration, request SCADA data for duration of the field testing program.

5 Model calibration & validation

The core technical work

- Establish model accuracy criteria using AWWA M32 Manual** KEY
Typical criteria: $\geq 85\%$ of pressure residuals within 0.5 m, $\geq 95\%$ within 2.0 m during hydrant flow tests. Agree criteria with client before starting.
- Establish calibration period – 1 week calibration, 1 week validation** KEY
Calibration period: adjust model parameters. Validation period: verify against independent data with no further adjustments. Both must pass accuracy criteria.
- Macro-level calibration using Extended Period Simulation (EPS)** KEY
Match tank levels, pump runtimes, and system-wide pressure trends over 24-hour cycles. No pump stations in boundary conditions. Fix boundary conditions before micro-level work.
- Micro-level calibration using hydrant flow tests**
Match residual pressures at flow test locations. Adjust C-factors and minor losses. Include pump On/Off scheduling from SCADA during test period.
- Investigate and resolve outlier test results** KEY
One or two tests that won't calibrate often indicate an open boundary valve, misrepresented pressure zone, or incorrect pipe connectivity. Investigate – do not simply exclude.
- Run validation simulation and confirm accuracy criteria are met**
Run against the second week of data with no model adjustments. Document pass/fail against agreed criteria.
- Prepare calibration report documenting methodology and results**
Include calibration criteria, period, methodology, results tables, and any limitations. This document accompanies the model handover.

Tips from years of model calibration experience

- 1 Always check for open boundary valves before concluding that your model has a calibration problem. Color-code junctions by pressure head and look for zones where the pressure differential disappears at the boundary.
- 2 Do macro-level calibration first. Fixing pump runtimes and tank levels before tuning C-factors saves hours of work. If your tanks aren't cycling correctly, your C-factor adjustments are compensating for the wrong problem.
- 3 Never schedule a water master plan kick-off in November. The field season will be over before calibration starts, causing a multi-month delay. Start in summer and collect field data in the same season.
- 4 Send the data request list to the client before the kick-off meeting. Getting data 2 weeks into the project instead of at the start is the single most common cause of schedule delays.

BONUS – INCLUDED FREE

Pre-project data request list

Send this to your client before the project kick-off meeting. Getting the right data on day one saves weeks. Modify the list based on project scope. If you're a utility or municipality, ensure that you have this data ahead of the project kick-off. Consultants will request this data and make you liable for project delays if it's not available right away.

DATA ITEM	FORMAT	PURPOSE	PRIORITY
GIS watermain network	Shapefile / Geodatabase	Model update and connectivity	HIGH
GIS hydrant locations	Shapefile / Geodatabase	Demand allocation and flow testing	HIGH
SCADA data – pump flows, tank levels, pressures	CSV / Excel (1-min intervals)	Calibration period simulation	HIGH
Water billing data	Excel / CSV by meter	Demand allocation	HIGH
Pump curves	PDF / Excel	Pump model settings	HIGH
Existing hydraulic model file	.WTG / .INP / .mxd	Model update baseline	HIGH
Pressure zone boundary map	PDF / GIS	Boundary condition setup	HIGH
Valve status (open/closed)	GIS / spreadsheet	Network connectivity	HIGH
Previous hydrant flow test results	PDF / Excel	Calibration data (if available)	MED
Tank geometry and operating levels	As-built drawings / SCADA	Storage simulation	MED
Major industrial / commercial meters	SCADA / billing data	Large demand allocation	MED
Design criteria and standards	PDF document	Calibration criteria setting	MED
Capital improvement plan	PDF / Excel	Planned infrastructure context	MED