Water Transport and Distribution Systems

Computer Modelling and Digital Twins with EPANET, QGISRed and Epanet-js

FORMAT	DATES	CPD POINTS	FROM
Online or Public	25 – 27 November 2026	3 CPD Points	R 12 999 per delegate

Course Overview

EPANET, QGISRed and Epanet-js are freely available applications for analysing and managing water distribution systems. This course teaches participants what each application does, the benefits of each, and the advantages of combining them in the analysis and management of water distribution systems.

Before installing and using the software, participants work through the engineering foundations: the components of a distribution system and their characteristics, the formulae that govern them, the technical terms used in modelling, and the operations involved in water transport and distribution. This knowledge is then applied to computer modelling and to digital twins of water distribution systems.

The course is deliberately workshop-driven. Participants build, run, troubleshoot and modify models themselves, and about 70% of the time is spent on exercises and practical problem solving with the applications.

What "digital twin" means in this course

A fully operational digital twin is continuously fed with live data (for example SCADA and metering data) and continuously calibrated against the physical network. This course gives participants the foundation for that: a hydraulic model, tied to GIS network data, that can be exchanged between platforms and used to test operating scenarios. Participants are shown where such a model sits on the path from a static model to a data-fed twin, and what additional data, calibration and system integration a live twin requires.

Choose How You Attend

OPTION 1 · ONLINE

R 12 999 per delegate

Live online training, 25 – 27 November 2026.

OPTION 2 · PUBLIC COURSE

R 14 499 per delegate

Venue: Holiday Inn Express Woodmead, Johannesburg, 25 – 27 November 2026.

Tick your preferred option on the registration form.

About the Facilitator

Ebenezer Kankam Appiah, Pr Eng

Water engineer and hydraulic modelling specialist

Ebenezer is a professional engineer with more than 20 years' experience in water supply and sanitation across Ghana and South Africa. He holds an M.Sc. in Water Supply and Environmental Sanitation and is a member of ECSA and SAICE. A practising modeller, he has used EPANET and QGISRed on live networks, and was Lead Technical Engineer on three water supply projects worth over €185 million. His modelling papers have been published by SAICE, and he has facilitated water distribution seminars across South Africa.

Who Should Attend

- ✓ Civil, Water and Hydraulic Engineers
- ✓ Consulting Engineers and Engineering Consultants
- ✓ Municipal and Water-Utility Professionals
- ✓ Technical Managers and Infrastructure Managers
- ✓ Technical Directors and Engineering Directors

Prerequisites and Participant Requirements

Recommended background

- ✓ Basic knowledge of fluid mechanics or hydraulics (pressure, flow, headloss)
- ✓ General familiarity with water supply or reticulation systems
- ✓ Basic GIS familiarity is helpful but not required; QGIS fundamentals are covered as needed

What participants must bring

- ✓ A Windows laptop with administrator rights. QGISRed currently runs on Windows only and is available in English only
- ✓ A modern web browser (Chrome, Firefox, Safari or Edge) for Epanet-js
- ✓ Pre-installed software: an installation pack and instructions are sent before the course so that class time is spent on modelling, not installing

Software Used

APPLICATION	ROLE IN THE COURSE	NOTES
EPANET	Hydraulic and water quality simulation engine and desktop interface; used to build and solve models	Simulation engines are continuing to develop (version 2.2 introduced pressure-dependent demands; 2.3 added leakage modelling). The exact version is confirmed in the pre-course pack.
QGISRed	QGIS plugin to build, edit and analyse water network models with spatial data; imports and exports EPANET INP files and Shapefiles	Requires QGIS and Windows. Uses the EPANET toolkit for simulations.
Epanet-js	Browser-based application that runs EPANET simulations with no installation	Models are held locally in the browser; confirm file formats for exchange with EPANET and QGISRed.

Because the three applications may run different EPANET engine versions, participants are taught to keep exchanged models within the features that all three platforms support, and to verify results after every transfer.

Course Objectives

By the end of the course, participants will be able to:

- ✓ Describe the components of a water distribution system (tanks, pumps, pipelines and valves) and their functions and characteristics.
- ✓ Apply the key hydraulic formulae for flow, velocity, head, headloss and hydraulic gradient to practical problems.
- ✓ Use the technical terms of distribution analysis and modelling correctly.
- ✓ Explain how a physical network is represented as a computer model, and the assumptions and limitations involved.
- ✓ Build, simulate and interpret a water distribution model in EPANET.
- ✓ Develop and analyse a network model in QGISRed using spatial data.
- ✓ Load, run and review a model in Epanet-js.
- ✓ Transfer models between EPANET, QGISRed and Epanet-js and verify that nothing has been corrupted in the transfer.
- ✓ Identify network deficiencies, modify the model and compare operating scenarios.
- ✓ Explain what a digital twin of a water distribution system is, and apply an integrated EPANET and QGISRed workflow as its foundation.

Programme at a Glance

DAY 1 · SESSIONS 1 TO 8

Foundations and Theory

Components, formulae, technical terms, modelling theory and South African design criteria, ending with a paper-based workshop.

DAY 2 · SESSIONS 9 TO 12

Software Tutorials

Guided tutorials in EPANET, QGISRed and Epanet-js, followed by the first hands-on practice problem.

DAY 3 · SESSIONS 13 TO 16

Integration and Digital Twins

A more complex problem, model exchange between all three applications and an integrated case study.

DAY 1: Hydraulics of Water Distribution Systems and Computer Modelling Theory — Sessions 1 to 8

Day 1 builds the engineering foundation. Concepts are developed through discussion and worked examples, with calculation exercises throughout.

SESSION	CONTENT	FORMAT
1. Introduction	• Purpose and function of water transport and distribution systems • Why distribution systems are modelled and how models are used • The route from a static model to a digital twin	**Presentation and discussion**
2. Components and Functions	• Tanks: storage and balancing functions, water levels • Pumps: function, pump curves, operating point • Pipelines: diameter, length, roughness, losses • Valves: isolation, flow and pressure control	**Presentation and discussion**
3. Characteristics of Each Component	• Hydraulic behaviour of each unit within a network • Pump performance and Net Positive Suction Head (NPSH). NPSH is covered as theory; EPANET does not calculate it • Valve types and how they are represented in models	**Presentation, worked examples**
4. Formulae	• Flow, continuity and velocity • Energy, hydraulic head and the hydraulic gradient line • Friction headloss: Hazen-Williams and Darcy-Weisbach, and when each is used • Minor losses and pump head • Application of the formulae to practical problems	**Worked examples and calculation exercises**
5. Technical Terms	• Pressure, discharge, velocity, headloss, hydraulic gradient, hydraulic gradient line • Steady state and unsteady state • Net Positive Suction Head, residual head, residual chlorine • Single-period and extended-period simulation • Nodes, links, demand patterns, model inputs and outputs	**Presentation and short exercises**
6. Computer Modelling Theory	• Physical network versus computer model: nodes, links, demands and boundary conditions • Steady-state and extended-period modelling • Demand-driven and pressure-driven analysis • Model limitations and common sources of error	**Presentation**
7. Design Criteria in South Africa	• How residual pressure and fire-flow criteria are set, and where they come from (for example the Red Book, SANS 10090 and SANS 10252-1) • Municipal guideline requirements and why criteria must always be checked against the current edition	**Presentation and discussion**
Workshop 1	• Translate a simplified physical water network into a conceptual model: network components, hydraulic parameters, simulation and expected results	**Paper-based workshop**

DAY 2: Using EPANET, QGISRed and Epanet-js — Sessions 9 to 12

Day 2 moves to the software. Each application is introduced with a guided tutorial, followed by the first practical problem.

SESSION	CONTENT	FORMAT
1. EPANET: Installation and Tutorial	• Installation, interface and project setup • Creating nodes, reservoirs, tanks, pipes, pumps and valves • Entering elevations, demands and hydraulic properties • Running a simulation and reading pressure, flow and headloss results • Finding and correcting model errors	**Guided tutorial**
2. QGISRed: Installation and Tutorial	• Installing the plugin and working with QGISRed projects • Importing a model from an EPANET INP file or from Shapefiles • Creating and editing network elements, assigning demands and properties • Running the hydraulic analysis and viewing results on the map	**Guided tutorial**
3. Epanet-js: Access and Tutorial	• Opening the application and loading a network model • Running simulations and reviewing results • Understanding where Epanet-js fits in the overall modelling workflow	**Guided tutorial**
4. Practice Problem Solving with EPANET, Part 1	• Interpret a supplied network problem and identify the model components needed • Build the network, enter parameters and run the simulation • Identify hydraulic problems (low pressure, high velocity, excessive headloss) • Modify the network, re-run and compare results • Explain the engineering implications	**Hands-on workshop**

DAY 3: Advanced Problem Solving, Model Exchange and Digital Twins — Sessions 13 to 16

Day 3 raises the complexity of the modelling problems, then connects the three applications into a single workflow.

SESSION	CONTENT	FORMAT
1. Practice Problem Solving with EPANET, Part 2	• A more complex network with multiple pumps, tanks and valves • Extended-period simulations, demand patterns and operating scenarios • Fire-flow and peak-demand checks against design criteria • Introduction to water quality: water age and chlorine decay • Comparing model results with supplied field measurements, and why calibration matters • Troubleshooting and comparing alternative scenarios	**Hands-on workshop**
2. Importing and Exporting Models	• Importing EPANET models into QGISRed and Epanet-js, and exporting back • What is preserved and what can be lost in a transfer • Checking connectivity, hydraulic properties and results after exchange • Identifying and fixing data-transfer problems	**Guided demonstration and workshop**
3. Interoperation of EPANET and QGISRed for Digital Twins	• What a digital twin is, and how it differs from a hydraulic model • Combining spatial network data and hydraulic information • Maintaining and updating the model as network information changes • Running scenarios and identifying network deficiencies • What a live, data-fed twin additionally requires: SCADA and metering data, and continuous calibration	**Presentation and workshop**
Integrated Case Study	• Build the model in EPANET, transfer it to QGISRed, review it spatially, exchange it with Epanet-js and verify integrity • Use the integrated model to investigate selected operating scenarios and present the engineering conclusions	**Group workshop**

Practical Component

Approximately 70% of the course is practical. Participants work through:

- ✓ Hydraulic calculations for flow, pressure, headloss and pump operation
- ✓ EPANET model development, simulation and troubleshooting
- ✓ Pressure, flow and headloss analysis, including pump, tank and valve modelling
- ✓ Scenario analysis and comparison
- ✓ QGISRed network development with spatial data
- ✓ Epanet-js exercises
- ✓ Model exchange between all three applications, with verification
- ✓ An integrated digital-twin case study

Learning Outcomes

On successful completion of the course, participants will be able to:

- ✓ Calculate flow, velocity, head, headloss and hydraulic gradient for pipe, pump and tank problems.
- ✓ Build a water distribution model in EPANET and run steady-state and extended-period simulations.
- ✓ Interpret pressure, flow and headloss results and identify hydraulic deficiencies.
- ✓ Modify a network model and compare operating scenarios to support engineering decisions.
- ✓ Develop and analyse a network model in QGISRed and view the results spatially.
- ✓ Load and run models in Epanet-js.
- ✓ Move models between the three applications and validate them after transfer.
- ✓ Explain the principles of a digital twin and the data needed to move from a hydraulic model to a data-fed twin.

Secure Your Place

Online: **R 12 999** per delegate | Public Course at Holiday Inn Express Woodmead, Johannesburg: **R 14 499** per delegate
Complete the registration form on the next page and email it to **info@independenttraining.co.za**, or call **+27 (0) 87 265 4063**.

Registration Form

Water Transport and Distribution Systems | 25 – 27 November 2026 | Online / Public

Online: R 12 999
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per delegate

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☐ **Online** — Live online training — **R 12 999**

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Independent Training Management (Pty) Ltd	FNB South Africa	Randburg (251650)	62685879276

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11 to 30 days before course	10%
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