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# **SWMM5+ status and future plans**

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# Goals for the SWMM5+ project

- Mass conservative hydraulics
- Parallelization
- Couples with existing EPA SWMM hydrology
- Uses EPA SWMM \*.inp input file
- Solve long-standing problems with surcharged flows
- Easy for new programmers to learn the code
- Fast and robust simulations.

# SWMM5+ and 7 years of code development

- **Hydraulic solver** update for EPA SWMM v5.1 with finite-volume solution.
- **Automatic parallelization** for multi-core desktop machines, supercomputers, or cloud-based computation.
- **Automated sub-discretization of links** in finite-volume solution.
- **New dynamic Preissmann slot** for surcharged flow solves problems associated with parameterization of slot and shocks.
- **HDF5 binary output** for fast data read/write by SWMM5+ and python scripting.
- **New air trapping algorithm** (Sazzad Sharior will discuss later)

## Code status -- still in debugging

- **Mass conservation** is perfect (machine accuracy) or there is a bug!
- **Overflows/ponding** are buggy (we're working on it).
- **Junctions are brittle** --- although they are OK, they are not sufficiently robust for small manholes with rapidly-changing flows --- we have thoughts on improvements, but we want to get rid of known bugs first!

# Compiling source-code and installation

- **GitHub** open source (public domain) <https://github.com/CIMM-ORG/SWMM5plus>
- **Docker source code install/compile** runs under Linux or Windows Subsystem for Linux (WSL) but is a large and complicated install.
- **Direct Linux install/compile** works for Linux (Ubuntu) and WSL. Requires installation of Intel oneAPI compiler with HPC library, JSON, cmake, and HDF5 packages.
- **Native Windows install/compile** is in the works. Presently functions but not yet released as the package installation is not fully tested.

# Documentation

- **Install guide** is available on GitHub with release package.
- **User guide** is available on GitHub with release package.
- **Programmer's guide** is still in progress.

# What's there and what's missing

- All hydraulic features up to EPA SWMM v5.1.013 are included.
- Does NOT include pollutant transport. Mass conservative finite-volume hydraulics allows new advective-diffusive-reactive transport algorithms.
- Does NOT do Kinematic Wave simulations. Only the full Saint-Venant (dynamic wave) solution is modeled.
- Does NOT use Inertial Damping. High Froude numbers can be handled by SWMM5+, including hydraulic jumps.



## Fast simulations (?)

- **More computational nodes:** SWMM5+ requires (roughly) 10x the number of computational elements of a link-node EPA SWMM model.
- **Smaller time step** is required for smaller elements.
- **100x more computations (?)** are typically required for a SWMM5+ run.
- For small to medium systems, EPA SWMM will be faster.
- **SWMM5+ speed -up for large systems with parallelization (?)**: EPA SWMM is known to get slower on larger systems. SWMM5+ should not have this problem.

## Parallelization and speed up (in testing)

- Effective parallelization requires 5000+ elements per core, or CPU communication will degrade performance.
- We cannot parallelize using threads.
- **Example:** 64 cores can be used for 320,000+ elements, which is a link-node system of about 16,000 links and 16,000 nodes.

## Robust solution (yet to be proven)

- Our goal is removing the "art" in making SWMM work. We want the code to always run properly without having to mess with model settings.
- If SWMM5+ always runs, it can be faster even if its slower.
- We still have some way to go, but the approach we use is guaranteed robust --- so problems are indicative of bugs in the code rather than settings that should be manipulated.

## The Last Word...

- SWMM5+ is available for free download.
- Install/compile is not yet smooth.
- Recommended for people who want to mess around with more advance hydraulics and are OK with some bugs.
- A future version (late summer?) should be robust and be distributed with executables for Linux and Windows.



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