



Domestic Water Service System Model Update and Analysis Using WaterGEMS

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1. Introduction

The Domestic Water Service system (DWS) is responsible for supplying water for personal, household, sanitary purposes, and fire protection. It is of extreme importance to everyone on Fermilab property, those in the village and working in person.

Fermilab previously has hired consultants to update the Domestic Water Service and Industrial Cooling Water (ICW) models, it has now been determined that updating the models can be done in-house. In 2019 a SIST intern worked on the ICW model, this summer I was tasked with the DWS model.



Figure 1: Fermilab GIS, Light Blue Indicates ICW and Darker Blue Indicates DWS

WaterGEMs is a hydraulic modeling software used to analyze, design, and optimize water distribution systems. The tools utilized were the steady-state analysis, automated fire flow simulations, scenario management, and water quality analysis. Due to the nature and use of domestic water, the system is in compliance with the National Environmental Protection Agency (NEPA) and Illinois Environmental Protection Agency (IEPA). The water supply is purchased by Fermilab from the City of Warrenville.

2. Project Goals

The projects to be updated and examined for discrepancies within the DWS model was PIP-II and IERC. PIP-II is still under construction, but the plans were used to update the model to reflect the entirety of the future of PIP-II. To ensure that the model is as close to reality as possible many factors are taken into account such as: pipe length, pipe diameter, pipe material, elevation, and water demand.

3. Process

The project plans were given to me by my supervisor to translate to lengths and add to the existing DWS WaterGEMS model.

3.1 IERC

The Integrated Engineering Research Center (IERC) will serve as a cross-divisional facility for Fermilab and is expected to be completed by June 2022. IERC was already input into the model, but there were some adjustments made on my end to reflect a newer version of the construction plans. On the following page the construction plans for IERC are shown in comparison to the WaterGEMS representation.

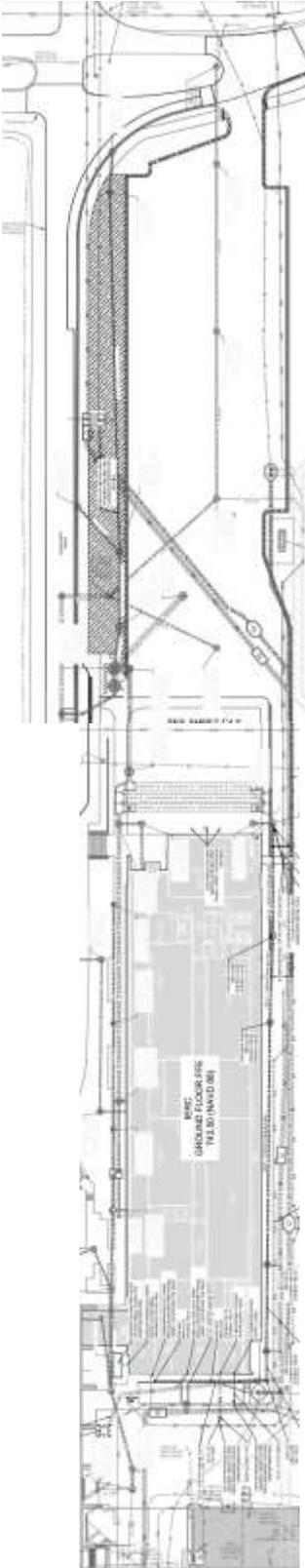


Figure 2: IERC Plans

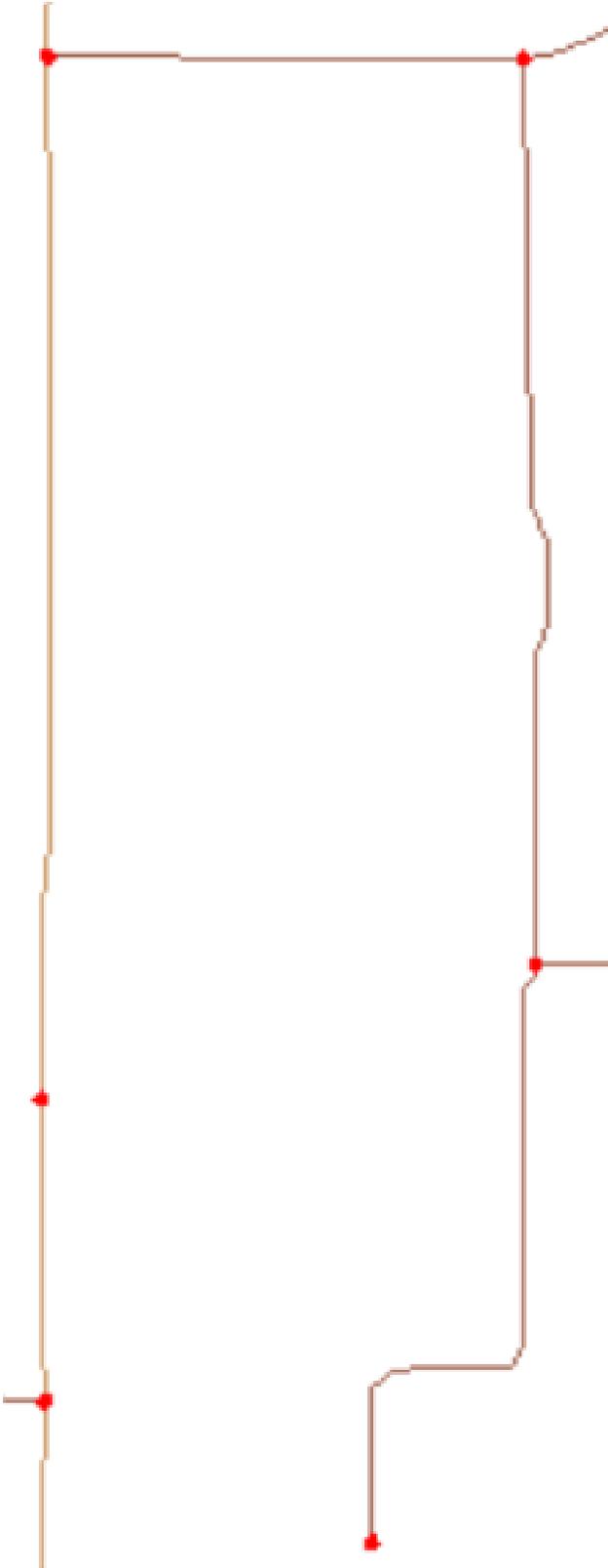


Figure 3: IERC WaterGEMS Representation

3.2 PIP-II

The Proton Improvement Plan-II will serve to power a neutrino beam for the Deep Underground Experiment (DUNE), which is still under construction.



Figure 4: PIP-II Plan

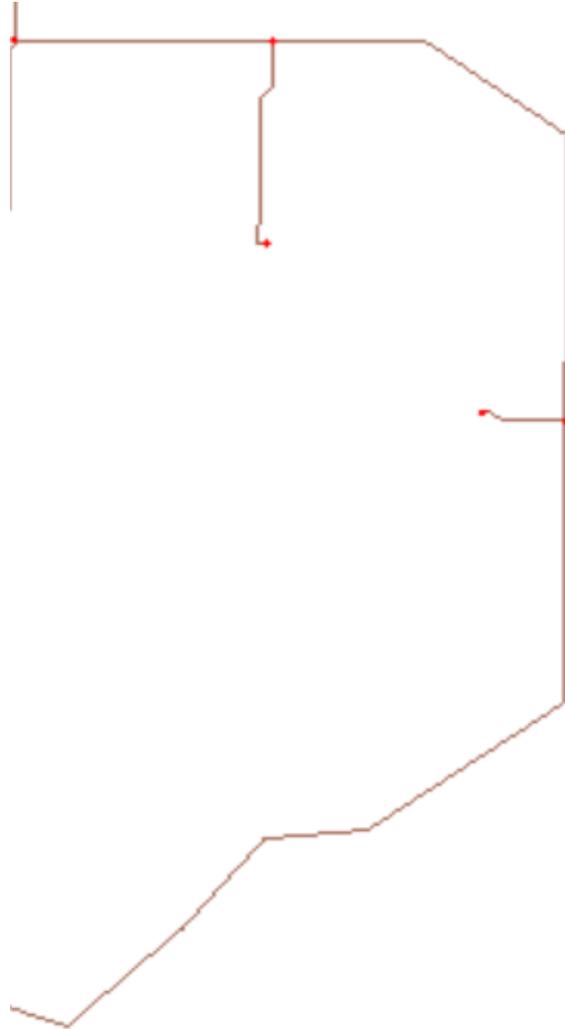


Figure 5: PIP-II WaterGEMS Representation

4. Future Work

The DWS and ICW models will continuously need updating with all improvements and new construction for Fermilab. I was not able to include the water demand for IER or PIP-II, which is important to look at the average day demand with in WaterGEMS. Within the future, there is

the possibility to change the water source of the DWS to possibly become more independent on the City of Warrenton.

5. Conclusions

The model is an important tool for understanding the behavior of the DWS. Having an accurate representation of the domestic water service, with factors as close to reality as possible is important for many factors of safety, such as healthy drinking water and fire safety measures. The updated model can show that, with proper management and operation setpoint changes, the existing DWS can handle the current and near future demands at Fermilab.

The new DWS WaterGEMS model summarizes the viability of adding water flow rate to the current system and allows for an efficient initial analysis on the effects of upcoming projects' added demands of the DWS. The model update was necessary to accurately predict the effects a change in the DWS system would have in the system overall. The new DWS model enable engineers at Fermilab to easily change some parameters of the system to better understand how the system would work under said parameters.

The insight gained using this tool is valuable and should be it used whenever a change is being considered in the DWS system at Fermilab.

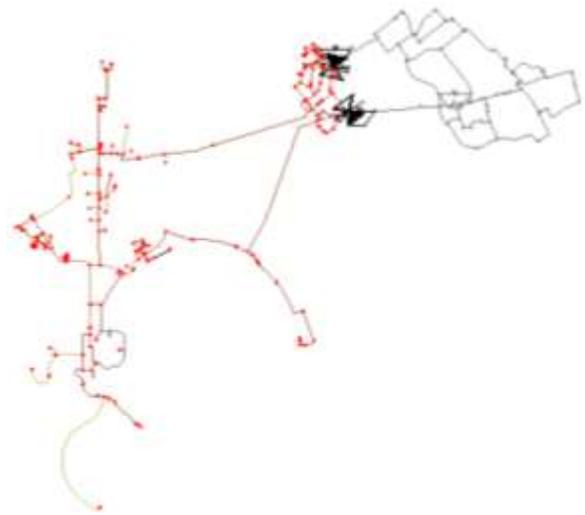


Figure 6: Updated Domestic Water Service System WaterGEMS Model

6. Acknowledgments

I would like to start by thanking my supervisor, Jonathan Hunt, for assigning this summer project to me. I would also like to thank my group mentors Ahmed Syed, Linden Carmichael, and Michael Geelhoed who provided important information and insight throughout the project, which could not be completed without their valuable help.

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