PROVO WATER AUDIT
PROJECT ID: CEEN_CPST_007

by

J.A.M. Engineering
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A Capstone Project Final Report

Submitted to

Barry Prettyman
Provo City Water

Department of Civil and Construction Engineering
Brigham Young University

April 8, 2024

Executive Summary

PROJECT TITLE:	PROVO WATER AUDIT
PROJECT ID:	CEEn_CPST_007
PROJECT SPONSOR:	Provo City Water
TEAM NAME:	J.A.M. Engineering

This project is an audit of a pressure zone just east of BYU. The water supply to the zone has been measured and a discrepancy of approximately 50,000 gallons has been found between the flow into the zone and the flow into the houses in the zone. The goal of this project is to provide a report to the city identifying possible reasons for the discrepancy and supplying reasonable recommendations to decrease it. We have examined the zone for causes of the discrepancy, and determined that it is likely a combination of three things: a leak or series of leaks, the water used on nearby construction sites, or inaccuracies in the meter data. The city has the most direct control over the first of these causes. However, due to the difficulty in locating leaks in the system, our final recommendation is that the city wait until leaks in the zone surface, meaning no current action is necessary.

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Introduction

This study began as a proposal submitted by Provo City to the civil engineering department at Brigham Young University, suggesting an idea for an undergraduate capstone project. The project was accepted by the department, and then assigned to our team. The initial intent of our project, and the reason we were brought on to the project, was to determine the reason for the discrepancy between the flow of water into Provo City Water Audit Zone 26, and out of it into local residences. If the discrepancy was a leak, it was our responsibility to provide recommendations to the city as to how it should be addressed. However, as work began, city engineers determined that the discrepancy was almost certainly due to at least one leak in the system, and so the scope of this project shifted. Instead, the project was to focus on identifying which methods were feasible to locate the leak, and whether it was an effective use of funding to locate it.

Thus, while the purpose of this study is still to address a discrepancy between the flow to the specified audit zone and the measured flow reaching the homes in the zone, it has shifted from the question of “is it a leak” to the question of “where is the leak.” We have employed several different methods to locate the leak, including an analysis of system inputs and outputs, acoustic leak detection, and visual inspection. In addition to locating the leak, we have also attempted to compare Provo City water data with other jurisdictions of similar sizes and ages to determine whether the discrepancy is considered abnormal or not in pipe systems of this size and age. Each of these methods, findings, and their implications will be addressed in turn, along with our limitations in available data, our assumptions made, and our recommendations on the means by which to diagnose the discrepancy.

Schedule

- ***Weekly:***
  - Met as a group and discussed progress and plans
  - Status report and other crucial communication prepared for our client and our faculty member
- September
  - Teams were formed and roles assigned
- October
  - Met with client over Capstone dinner, assessed expectations
  - Initial data retrieval
- November
  - Data interpretation, various meetings with client
- December
  - Opinions shared with client
  - Visited pressure regulating valve for Provo City Water Audit Zone 26
- January
  - Received shapefiles of Provo City Water Audit Zone 26
  - Used ArcGIS to prepare a figure of our zone
- February
  - Attended city sponsored training with sponsor to become familiar with acoustic leak detection equipment
- March
  - Visited Provo City Water Audit Zone 26 and implemented acoustic leak detection in 3 separate locations
  - Received final data set
  - Composed conclusions based on zonal data, site visits, and discussions with the sponsor
- April
  - Created the final presentation, report, and poster
  - Presented/will present the project to the sponsor and to undergraduate seminar

Assumptions & Limitations

There are two main assumptions made in this study: that one or more leaks exist and that Provo City has disclosed to us all pertinent resources that are available to address the discrepancy. The main limitation is that we were working with a limited amount of data, whose accuracy is unverified.

The assumption that there are one or more leaks meant that we did not initially search for other possible reasons for the discrepancy. We also conducted our work under the assumption that Provo City has disclosed to us all pertinent resources that are available to address the discrepancy. One of these resources was the instruments provided by the City of Provo, that would help collect the data needed to determine the location of leak(s). Another resource was Provo City's flow data and shapefiles, which work in tandem to supply consistent conclusions.

The limitations of our project did not hinder the progress of our moving forward with the project. The major limitation was that the discrepancy in our waterflow data could also be the result of any number of things, such as issues with data collection from the main pump or from several of the meters in the zone. After considering such limitations, we discussed possible solutions with Barry and have included those in this report. Another limitation was that we do not have access to all resources controlled by Provo City—only the ones that Provo City identified as pertinent to our project--and if there are other reasonable methods of addressing the discrepancy, we are unaware of them. Another limiting factor of the progress of our project was that we were to cooperate with various professionals to schedule site visits at convenient times. Therefore, progress on our project was dependent on frequent coordination of such meetings.

Design, Analysis & Results

Upon receiving this project, we initiated contact with our sponsor, Provo City, and their representative, Barry Prettyman. We invited him to a dinner meeting and discussed the project. At the close of the evening, he invited us to come with him and take a look in the vault where the meter providing data for our zone of interest was located, so that we could become more familiar with it. We accepted, and a date was selected when we could meet with Barry at the vault to inspect the meter.

Figure 1: Descending into the Vault

We met Barry at the vault, and after descending the ladder, as seen in figure 1, we were introduced to the pressure regulating valve (PRV), as seen in figure 2, that controls the pressure for Provo City Water Audit Zone 26. We also got to see the transmitter that was supplying us with the data we will discuss later. At this point in time, the transmitter was awaiting a replacement, so there was no live data coming from the meter. After spending some time in the vault to familiarize ourselves with the system, we climbed out and thanked Barry for the tour.

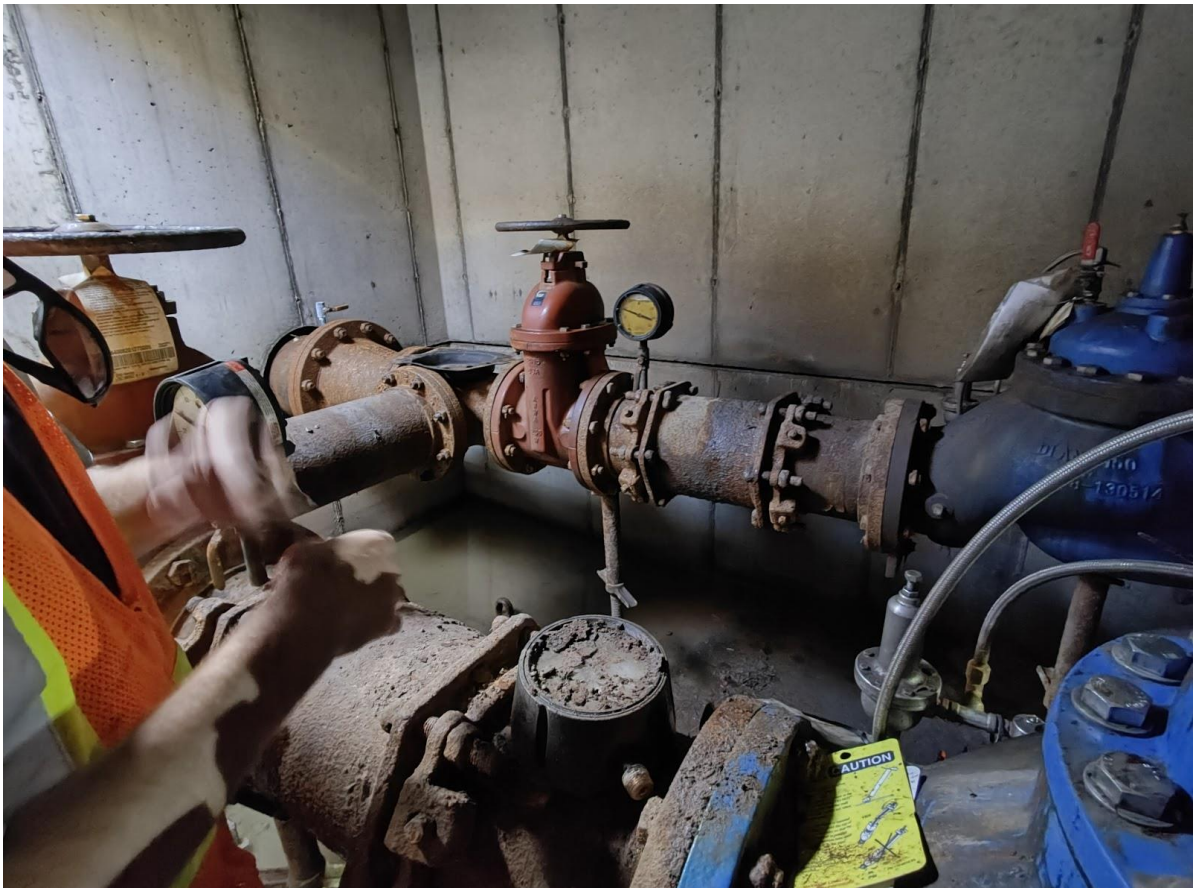

Figure 2: PRV for Provo City Water Audit Zone 26

In preparation for the tour with Barry, we had begun and completed our statement of work. However, as we composed it, we became concerned with what our scope entailed. We wondered if we were expected to find the leak or not, and we were worried what would happen if we didn't. We only had limited data available to us, and we wondered if any more had become available. Thus, we scheduled a lunch with Barry to ask him this and other questions pertaining to the project. Our statement of work was

due before the meeting could be scheduled, but we made do, and are happy to report that our original scope has been completed in full, despite our initial concerns.

Before the lunch with Barry, we decided to review the materials he had provided us for the project. Our first line of inquiry was comparing the water loss of this zone to other similarly sized zones in similar jurisdictions. However, after thorough investigation we discovered that this type of information is not readily made available by many jurisdictions, and is instead kept private. We were therefore unable to verify whether discrepancies of this size are common between jurisdictions.

With our first search ended, we began two others. We read through the pertinent sections of the AWWA M6 manual describing how to conduct an audit of a water system. We also took the opportunity to parse the previously provided data, and our results confirmed the discrepancy in measured flow into and out of the water system. This discrepancy of about 50,000 gallons can be seen in figure 3, and is evident in the gap between the red and blue lines. Disrupting the data, however, were several spikes up and down that did not seem to fit the general trend, so we asked Barry what was causing the spikes in flow. We learned that occasionally, when there is an issue with transmitting data from a meter, the meter continues to take measurements, but does not record when those measurements took place. Thus, there is an initial drop in flow, but when its connection to the network is restored there is a huge spike, as the system adds all the flow missing from the previous days to the current day. This is also seen in the PRV meter from May 22nd to the 27th in figure 3.

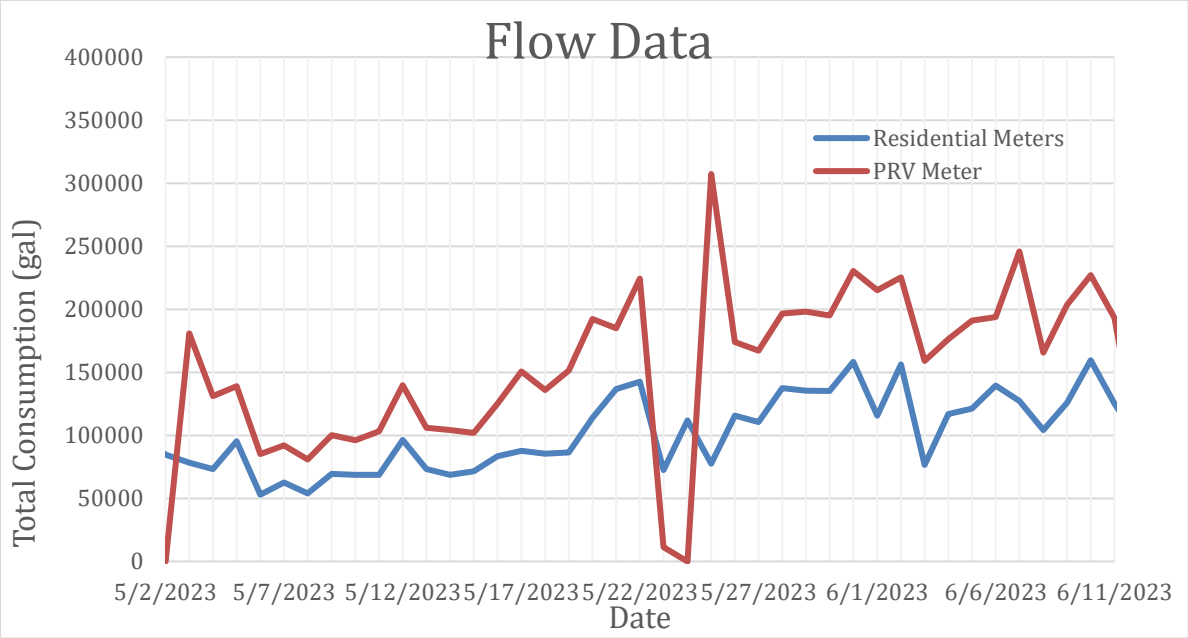

Figure 3: Flow Meter Discrepancy

After this revelation, we continued to look for trends in the data. We hoped we would find a leak on one of the residential properties, which could be identified by an abnormally large amount of flow for a small home. Eventually, however, we realized that even if there was a leak in one of these homes, it could not be the cause of the discrepancy. This was because a leak from a home would occur after it passed the meter, whereas the discrepancy was caused by a leak occurring in between the home meters and the PRV. Given that our data did not specify water flow throughout the system, but rather only at the entrance to the zone and the exits from the zone, it could not inform us where the leak was. We therefore abandoned use of the data altogether, as it could not provide us with the information that we wanted: flow differences *within* the system that would expose a leak.

When we met for lunch with Barry, we learned several more things about our project. First, we learned that the discrepancy was most likely a leak. Given our limited experience in auditing a city water system, this was very important information, from someone with experience. We also learned that the city's general practice with leaks is to wait until they surface, rather than searching for it along suspect lengths of pipe. However, the city was planning to have a training meeting in a few weeks for technology they had purchased several years ago to locate leaks. This technology is made by Sewerin, a German company that sells a device for acoustically detecting leaks. We were unfamiliar with the device, and therefore invited to participate in that meeting.

At the meeting, we learned a lot about the theory of how acoustic leak detection works, and the various ways it can be applied to complex situations, but the training did not focus on the machine's basic functionality. The training was helpful however, as it allowed us to meet the specialists who operate the device, and allowed us a chance to go out in the field and search for the leaks. We set a date with Barry, and met him that day out by the vault.

Upon meeting with Barry at the vault, we discussed some of the basic functionalities of the device with the technician who had accompanied him, as seen in figure 4, and then we got to work. We each got an opportunity to test out listening for the leak, as well as pacing out the distances above ground to accurately pinpoint the spot indicated by the device. Crucial to note here is that the device is made simply to locate the spot along the segment with the greatest quantity of sound, which may or may not be the leak. Thus, if traffic, construction, or any other significant auditory disturbance is operating somewhere near the segment, the device picks up that location instead of a leak. Because of this, the testing often occurs at night, to avoid the possibility of incorrect readings. However, we were testing during working hours and

there was a good deal of traffic, and we did not locate a leak at any of the three locations we surveyed.

Figure 4: Acoustic Leak Detection in the Field

While we did not manage to find a leak, we realized why Provo City has not often used acoustic leak detection. Ensuring that the device is actually detecting a leak is difficult, and it is even more difficult during the day when the city employees are working. In order to accurately use this device, the city has to either close the road, or have employees test at night, which becomes very expensive. Also, testing an area might require each segment in the zone to be tested, which is very tedious. We strategically tested only 3 zones, as seen in figure 5, and the testing took a couple hours. In addition, testing may or may not yield results. For instance, a couple days after our testing, a sinkhole appeared outside of our zone. This sinkhole was not in the area contained in the project's jurisdiction, but it was just upstream of the first segment we tested. It was

caused by a leaky pipe, but even though we were so close, we did not hear it at all. This demonstrates well the difficulty of using this device.

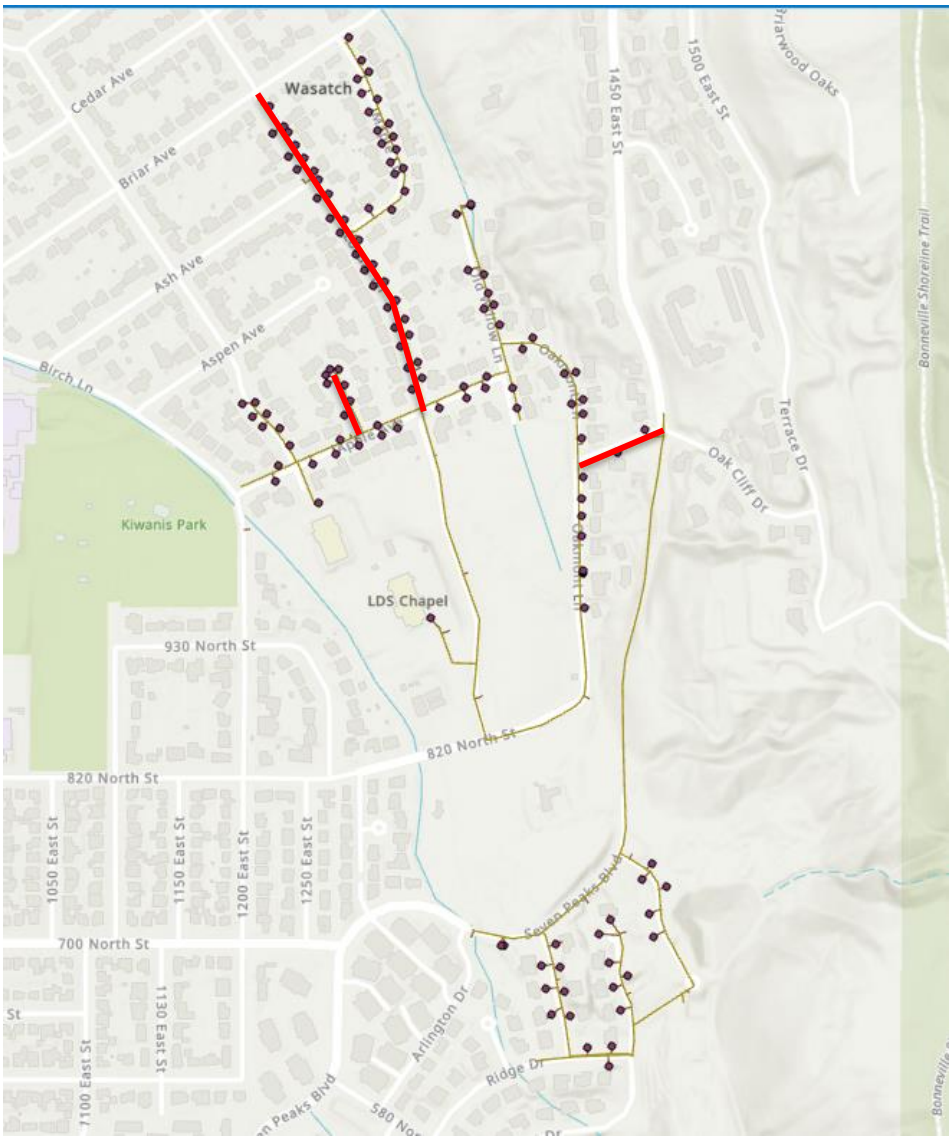

Figure 5: Pipe Segments Tested with Acoustic Leak Detection

After proving unable to find the leak with acoustic leak detection, we turned to other ways of addressing the discrepancy. We had exhausted our options for investigating a leak, and so we began thinking about what other possible reasons there could be for the discrepancy. Barry brought it to our attention that within Provo City Water Audit Zone 26 there are currently two large construction sites whose water use would not show up in our data. This was because the construction sites were pulling water from fire hydrants rather than the houses whose meters contributed the data we

were using. Thus, these fire hydrants created an unrecorded water loss that could contribute to a discrepancy between the PRV data and the house meter data. Barry also reminded us that there may be several meters that measure inaccurately, or report their data incorrectly. With these factors brought to light, we realized that the main cause of the discrepancy was likely not a leak. This was the last part of the puzzle we needed, as it explained the sheer volume of water loss given that there were no leaks evident from the surface of the zone.

Related Issues

Locating a leak in a public water system is important for many reasons, but the biggest motivator is money. There are high costs associated with residential water, the highest being treatment. In a typical public water system, residents pay for the water that reaches their house through their meter. This means the city only generates revenue from the water that reaches the residential meters. If the system has a leak, that water doesn't generate any revenue. The city pays to treat and transport that water, even though it is going to waste. This loss of revenue may cause the city to raise the charge for residential water use through the city to cover the extra costs. Another cost that accrues from a leak is the cost of locating and repairing the leaking pipeline. Although this cost can be high, it becomes much higher after the leak surfaces. Once the leak surfaces, the repairs are more expensive because they require emergency services and cannot be planned far in advance.

Water leaks have social impacts as well. If a leak is in a pipe between the resident's meter and their house, that resident will be charged for the water that is going through their meter, which may be much more than they are using. This makes residents unhappy and can cause distrust in the government agencies. People will also be very upset if their water is unclean or if they cannot trust that their water is being treated and transported with integrity. An important part of government agencies is public trust and taxpayer support.

Leak detection is also very important in protecting public health. For example, wastewater treatment plants use leak detection to make sure that they are only discharging clean and safe water. If untreated water leaks into the groundwater or gets discharged into water bodies, it could end up in drinking water supply, causing a public health crisis. Contact with contaminated water could cause various illnesses, infections, and diseases. In a drinking water system, such as Provo City Audit Zone 26, a leak into the system could bring groundwater contaminants into the water supply, supplying unsafe water to unknowing residents. These groundwater contaminants can come from agriculture fields, construction sites, or leaks in a wastewater infrastructure system. These contaminants can be difficult to detect as they may not have a taste or an odor, so consumers may not realize their water is unsafe. If the system is pressurized, as it is in our case, contaminants are unlikely to make their way in through a leak. Despite this, it is important to be aware of the possibility.

A leak in a wastewater treatment plant would also cause environmental concerns as contaminated water is harmful to wildlife as well as humans. Discharging

contaminated water into a water body may cause fish and other aquatic animals to suffer from the treatment chemicals or untreated water. Another environmental impact of water leaks is the resources of treatment plants where the water is coming from. These treatment plants will have a larger environmental footprint as they are treating more water than is needed.

Clean water is a precious resource around the globe. In many communities through the world and United States, droughts are a constant concern for agriculture and residential use. Conserving as much of the clean water in the system is important, especially in these areas where clean water is scarce. Pipes that do not leak are a vital component of global health. If a pipe has a leak and the water is not highly pressurized, contaminants will enter the water supply. Globally, this is an issue because these contaminants cause various illnesses and could wipe out entire communities.

Water leaks are a safety concern before and after they surface. Prior to surfacing, a leak can compromise the geotechnical stability of structures and other infrastructure. These issues can be dangerous because they are beneath the ground and cannot be seen at first glance. A surface leak can damage equipment and possibly be a fire hazard if a leak occurs near electrical equipment. Water content in soil has a direct relationship to the stability of the soil. Soil that has a leak beneath the surface may be less stable than before, posing a safety hazard for those walking or driving on it.

Leak detection and location is an important piece of water infrastructure around the world. Leak detection helps protect public health, safety, and the environment. Public trust in the agency supplying water is an important issue socially and culturally and can be greatly affected by water leaks due to safety and economic reasons.

Lessons Learned

During this project, we learned many lessons. Overall, we learned that coordination with professionals in the field of city engineering and inspection yielded enhanced results. Our use of data was more dependable, our conclusions more consistent, and our work more efficient.

In terms of data dependency, if one or more data-producing instruments are underperforming, this may lead to a series of unintended consequences and can cause false assumptions to be made. This path of unintended consequences can be difficult to trace back to its source. When there are inaccuracies present in collected data, it can be hard to localize the cause of the problem because the inaccurate data confounds the conclusions. However, the existence of data retrieval tools is very efficient and can enhance an entire city's combined functions, especially water piping networks.

In terms of consistency, conclusions are more consistent when organizational and technical knowledge is passed between employees, ensuring continuity when employees come and go over the years. In the area of city engineering, exchange of information passed down from one professional to be replaced by another may lead to loss of important methods of data collection and presentation. We learned, or it was heavily emphasized, that it is important for data retrieval members to understand how data analysis works. This will provide consistent results. Otherwise, incorrect assumptions and practices can negatively impact leak detection efforts.

Within the scope of this project, we were also exposed to the nature of time-sensitive matters. Timely action is especially important in projects such as ours, where accident prevention and hazard avoidance are prized outcomes. Where inconsistencies are present in data or in the field, the urgency of errors can be unknown, which may lead to unintended consequences down the road.

Conclusions

We have drawn several conclusions about the Provo Water Audit project. Some of these include the nature of city-scale waterflow networks being vastly complex, collection of data with regards to these systems has improved immensely within the past few years, and that discrepancies in the actual data we were observing were likely due to a nearby construction project.

Waterflow networks in the city of Provo are intricate and require sensitivity in order to supply consistent water to citizens. Citizens of a city expect constant waterflow, and systems are in place to ensure this demand is always met. We observed that everyone entrusted to this responsibility with whom we've come in contact has proven able to complete this task. The organization of city engineering in Provo is thorough and intricate, just like the issues they're facing. We noted that proper tools, software, and trainings are being supplied to maintain this ecosystem.

The collection of waterflow data for these intricate systems has been enhanced over the past few years and can provide more consistent and accurate data than ever before. Upgrades to the waterflow system data are either being executed or planned in nearly every aspect of waterflow data retrieval within the area that we observed. However, verifying the data can be a lengthy process and can require physical inspection of several points to guarantee conclusions. When one of these systems is malfunctioning, it becomes much harder to have accurate data.

Our terminating conclusion drawn about our project was that the discrepancies in the data present in Provo City Water Audit Zone 26 are likely due mostly to nearby construction projects, which have been underway during the entirety of our Capstone project. These construction sites have been using lots of water and may have been drawing directly from the mainline, without going through a residential meter. However, possible meter inaccuracies and leaks also play a role, with the latter of these most within the city's ability to control. Thus, with leaks being the portion of the discrepancy the city can most directly address, this is what our technical recommendations will center around.

Recommendations

While we're far from experts in city engineering and inspection, we feel it important to supply recommendations for our client and future stakeholders. The areas in which we would make recommendations for the state of the project we were able to work on are in the joint understanding and operation of tools, enhanced awareness of external factors, and the maintenance of professional relationships.

With joint understanding of operational tools, any given project will progress in a more organized and fluid manner. In Provo City, we realized that there were professionals that were in charge of each aspect of data collection. There were inspectors, collectors, and analyzers of data. The common understanding of data retrieval along each of these steps leads to a more fluid and accurate analysis. For example, an inspector can be notified to ensure equipment at each site is functional so that a data analysis expert can have consistent results.

In addition to our organizational observations, we realized that discrepancies such as this are likely common. Despite the unavailability of similar data, the causes of the discrepancy are common across jurisdictions, so the flow discrepancy is likely common as well. Real-time analysis of the connection between nearby construction/other water-usage projects, local data collection devices, and other similar factors will likely lead to a better understanding of these discrepancies in this and similar jurisdictions. Through such a process, discrepancies in data can be better addressed both now and in the future.

We also recommend that everyone involved in this and other projects maintain healthy professional relationships. Within the steps of the project that we completed, through site visits and the visit to the city offices, we observed good relations among different sectors of city organizations. Such professional relationships should be maintained in order to communicate potential problems and avoid unnecessary voids in project understanding.

Finally, we present the technical results of our study. We have concluded that there are three possible reasons for the discrepancy: a leak or series of leaks, the water used on the construction sites, or inaccuracies in the meter data. It is most likely due to a combination of these three, two of which, construction and meter inaccuracies, are largely out of our control. The leak or leaks can be addressed by the city by means of acoustic leak detection, however, given the amount of time and money it would take to find the one or more leaks within the zone and the city's current leak detection technology, we do not recommend actively searching out the leak or leaks. The money lost in detecting the leak is likely larger than the amount of money lost to the city by the missing water flow. Thus, Provo City's current approach of waiting for a leak to surface

is, in this case, our recommended approach. The discrepancy is not currently causing any disruption of service to residents, and until it does, we propose that this discrepancy requires no further action.

Appendix A

JARED JEWELL

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www.linkedin.com/in/jared-jewell
Provo, UT · (208) 206-3439

EDUCATION

Bachelor of Science in Civil Engineering
Brigham Young University, PROVO, UTAH

- GPA – 3.80
- Structural emphasis with a minor in mathematics
- Relevant Coursework: Pavement Management, Reinforced Concrete Design, Prestressed Concrete Design
- **Graduation Date – April 2024**

EXPERIENCE

Research Assistant
Brigham Young University, PROVO, UTAH
OCT 2023 – PRESENT

- Batching and comprehensive testing of 7 different concrete mixes for UDOT
- Studying effect of natural pozzolans on concrete mix design
- Examining design implications of FRP bars in lightweight concrete

Production Engineer
Acute Engineering, OREM, UTAH
AUG 2021 – NOV 2023

- Researched sustainable engineering materials and applied findings to design decisions
- Ranked #1 in profitability for experience level
- Completed drawings and calculations for over 60 different homes
- Contributed to 300+ projects, with engineering for several valuing more than $10,000

PROJECTS

Project Precast Design Competition
FEB 2024

- Selected after competitive application process to design a structure of precast concrete
- Collaborate with students from different disciplines in a team of 4
- Presented design at a conference to 100+ industry professionals

SKILLS

- Experience batching and testing concrete
- Technical writing experience
- High personal accountability
- Programs: AutoCAD, Excel

Arianna Kee

(360)819-7642 • ariannakee@hotmail.com • linkedin.com/in/ariannakee

EDUCATION

Brigham Young University April 2024
Bachelor of Science: Civil Engineering Provo, UT

- GPA 3.75
- Relevant Coursework: AutoCAD, Technical Writing, Fluid Mechanics, Geomatics, VBA/Microsoft Office, Hydrology, Soil Mechanics, Materials Sciences, Environmental Engineering, Capstone, Urban Transportation Planning, Urban Water Infrastructure
- Capstone Project: Locate a leak in Provo City's Water Infrastructure by evaluating water meter data from over 200 homes

EXPERIENCE

BYU Civil Engineering, Dr. Woodruff Miller Jan. 2023 - Current
Head Teaching Assistant – Hydraulics and Fluid Flow Theory Provo, UT

- Prepared a weekly lab for 40 students to connect principles of fluid flow to real-world applications
- Guided students to a better understanding of hydraulics through 36 sets of application problems

Thurston County Public Works June-August 2021, June-August 2022
Design Engineering Intern Tumwater, WA

- Designed two alternatives (Civil3D) for a County Fish Passage Enhancement project and wrote the alternatives analysis report
- Created Engineer's Estimate and calculated quantities for a 6-million-dollar capital improvement project
- Inspected construction of two fish passage enhancement culverts and two fish passage bridges
- Trained new intern on construction inspection procedures, software use, and pre-construction responsibilities

BYU Civil Engineering, Dr. Gus Williams September 2020-June 2021
Hydraulics Research Assistant Provo, UT

- Piloted drones and surveyed land to create a 3D model of a 1.1 million ft^2 retention basin
- Identified 500+ low head dams for a nationwide initiative to prevent drowning deaths

PROFESSIONAL SERVICE EXPERIENCE

Women in Civil Engineering

- *President (April 2022 – December 2023):* led a committee of 8 officers who planned activities for 60 club members to develop professional skills, gain confidence in their abilities, and network with professionals

Society of Women Engineers

- *Treasurer (April 2021- May 2022):* Managed $20,000 budget for BYU Chapter of National Society

VOLUNTEER EXPERIENCE

Provo Community Resource Center Jan 2022-Current
Adult Educator Provo, UT

- Instructed students with no prior musical experience to playing advanced classical pieces in a recital
- Mentored youth in developing healthy social and physical habits
- Taught an "English as a second language" class to working immigrants from Spanish-speaking countries

SKILLS

- Certified sUAS pilot (Part 107), through the Federal Aviation Association, experienced in flight planning, piloting, photography, and modelling
- Passed the Fundamentals of Engineering Exam (August 2023)

Marcus Young
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EDUCATION

Brigham Young University — Apr 2024
Bachelor of Science in Civil Engineering — Provo, UT
Minor in Mathematics

- GPA 3.4
- 200+ hours of programming in C++, Python, JavaScript, and VBA
- Promise Scholarship, BYU Academic Performance Scholarship
- Classes Including: Urban Transportation Planning, Water Treatment Fac Design, etc.

EXPERIENCE

Research Lab Lead — March 2023-Present
BYU Sustainability Lab — Provo, UT

- Evaluated methods to improve air quality polluted by brick-making factories in developing communities of 50,000+ people in Nepal
- Led a team of six students and two professors from various disciplines to collaborate on methodology for appropriate intervention ideation for social impact issues
- Co-authored various research papers and presentations to more effectively disseminate data

Research Assistant — March 2022-Sep 2022
BYU Hydroinformatics Lab — Provo, UT

- Aided in the software development of a waterflow analyzing tool which has been used in 150+ countries
- Learned to be proficient in JavaScript and ArcGIS to aid in development and dissemination of said tool

Caretaker for Disabled Adults — Sep 2022-Oct 2023
At Your Home Caretaking Services — Orem, UT

- Created enjoyable growth opportunities for several mentally disabled adults
- Solved unanticipated health, social, and emotional problems by teaching coping mechanisms and social skills
- Resolved physical and verbal disputes between adult men that occurred daily in a careful manner

VOLUNTEER EXPERIENCE

MyHometown Provo — March 2023-Present
Youth Mentor and Leader — Provo, UT

- Served as a translator for Hispanic immigrants learning English to increase their employment opportunities
- Organized monthly activities for 50 high schoolers in low-income neighborhoods to develop healthier physical and social habits
- Led activities to foster meaningful connections between teenagers in low-income neighborhoods

ACHIEVEMENTS/ABILITIES

- Fluent in Spanish on a professional working level
- Certified sUAS (drone) pilot through FAA Part 107
- Lead singer and guitarist of a local band, organizing dozens of shows across several cities and maintaining good connections with other professionals
- Achievement of Eagle Scout award through collecting and donating 300+ of articles of clothing and necessities to refugees seeking shelter and safety