



**Four Mile Run Stormwater Improvement Project
Virtual Community Meeting Minutes
6:30 – 9:00 p.m. on Wednesday, September 15, 2020**

Meeting participants included local residents, project stakeholders, and representatives from community organizations, nonprofits, and government agencies.

Alex Sciuilli, Chief of Program Management at PWSA began the presentation by sharing that the project design is almost complete and that Tony Igwe, Project Manager at Wade Trim is transitioning to be the project manager for the Four Mile Run Stormwater Project. Tony Igwe then explained PWSA’s mission and the goals of this stormwater project.

Pat Sullivan, Principal at Civil and Environmental Consultants (CEC) described the planned changes for Panther Hollow Lake to increase the lake’s capacity to hold stormwater and the ecological health of the lake. Tim Nuttle, Ecosystem Restoration Ecologist at CEC explained the design plans for the stream and two trails in Junction Hollow. The pedestrian trail replacing the existing Junction Hollow Trail will be constructed by the stream, while the City of Pittsburgh Department of Mobility and Infrastructure (DOMI) Mon-Oakland Mobility Corridor trail will be constructed to the west of the pedestrian trail.

Kari Mackenbach, Environmental Business Development at ms consultants shared information about the enhanced modeling and flood mitigation benefits for the Four Mile Run watershed. The project is designed to eliminate flooding of buildings from 10-year rainstorms and reduce flooding from larger storms. Modeling of the Mon-Oakland Mobility Corridor shows no adverse effect on flood reduction, since the mobility trail project includes dedicated stormwater management infrastructure.

Mallory Griffin, Water/Wastewater Section Head at Johnson, Mirmiran & Thompson (JMT) explained how a deep, gravity storm sewer pipe will transport stormwater from the new Junction Hollow stream and the Run neighborhood to the Monongahela River. PWSA will be installing the largest stormwater pipeline possible and as many smaller stormwater pipes in the neighborhood as possible considering the many underground utility conflicts.

Tony Igwe provided an overview of the project schedule and budget. The Joint Permit Application for the project was submitted in August 2020 and will be reviewed by both the Pennsylvania Department of Environmental Protection (PA DEP) and the U.S. Army Corps of Engineers, which is expected to take approximately 9 to 12 months. Construction is expected to begin in spring 2021, depending permit approval. At this 90% design stage, the total project is estimated to cost approximately \$28 million. PWSA has committed full funding for the project.

The presentation and the following question and answer session were recorded and are available at www.pgh2o.com/4mr.

Comments in red below are status updates since the September 15, 2020 meeting.

Joint Permit Application

- Question: Can you clarify what is meant by "joint" permit process?
 - Answer: A Joint Permit Application means the permit is reviewed by both the PA DEP and U.S. Army Corps of Engineers.
- Question: Does the permit also include the DOMI shuttle road planned to run through Schenley Park?
 - Answer: Yes, both projects were submitted as part of the same permit application.
- Question: Is PWSA willing to hand over the up-to-date plan documents for the project?
 - Answer: Tony Igwe offered to meet with Ray to go through the project documents together and explain.
 - Update: PWSA is considering ways to share this information with the public to correspond with DEP's public process period. We will notify members of the public when that begins and can make the documents available. We are also available to meet with individuals or groups that have questions about the information submitted to the state.
- Question: Can we get a copy of the permit application? And when is the public comment period for that permit review?
 - Answer: We submitted the Joint Permit Application a few weeks ago, we received some administrative comments, which we need to return to PA DEP, then PA DEP will advance to technical review. Once PA DEP posts the notice of intent (NOI) for this project to the state website as part of public comment period, the permit application becomes a public document, and we can share copies of it then. It is also possible to request a copy of the permit from PA DEP once the NOI is posted.
- Comment: It would be helpful if PWSA could notify everyone here of when that public comment period is posted.
 - Answer: Yes, we will do that.
- Question: The residents are continuing to fight with the city about the mobility corridor. Given that the permit includes the road, the extended timeline, and that the pipe needs to be moved before the road is built, if the residents stop the roadway, will that affect your stormwater project in any way?
 - Answer: We are going to do the stormwater project no matter what. If the roadway stopped being planned, we would have to amend our permit, which would result in a paperwork review for PA DEP and some timing changes, but we would still do our project. For the stormwater project, the money is committed, the PWSA board has

approved it, the design is essentially complete, and we are moving forward with it. We combined the stormwater project with the mobility corridor project because we wanted to limit the number of conflicts from a construction perspective and to make sure the costs were reasonable for our ratepayers and city taxpayers.

Panther Hollow Lake

- Question: Didn't the Pittsburgh Parks Conservancy's (PPC's) environmental engineers take drilled samples of the lakebed that indicated the sediment level is actually 18 feet? Also, no way is there 4 feet of water in the lake at the moment. It would be optimistic to say there's 24 inches in the middle.
 - Answer: We did bathometric survey of the lake. The existing top of the sediment that we see from that topography was at elevation 802 feet. It could be that if the water level was low in the lake, like at elevation 805 feet or 804 feet, which would mean only two feet of water in the lake. It is possible that there could be more sediment in the lake, but not likely to be 18 feet of sediment since the older design plans of the lake don't indicate that depth. We decided for a design standpoint to remove six feet of sediment to elevation 796 feet, which gives us space to address the capacity issue in the lake. We could perhaps review the sediment removal during construction, if there is additional material that we would like to take out.
- Question: Is the OPTI system staying in place? Will it continue to be used?
 - Answer: The design is compatible with the use of the Opti Valve or similar control valve. It can also be used to draw the lake down in emergencies or for maintenance. The Opti system will be removed for construction at Panther Hollow Lake and reinstalled after.
- Question: I remember discussion of an automated system that would lower the water level in Panther Hollow Lake in advance of expected storms. Is that part of this plan?
 - Answer: Answered in a previously answered question about the Opti system.
- Question: For the path around the lake, is 5 feet wide enough for Americans with Disabilities Act (ADA) regulations? It is not wide enough for two bicycles to pass.
 - Answer: The 5 feet width is just the paved asphalt portion of the trail. There is a structural supplement on both sides, likely to be a crushed limestone. The total width of the trail is 13 feet, which provides enough space for two bicycles to pass. From an ADA standpoint, we have minimum slope changes to meet ADA standards.
- Question: What will be done about the landslides under the Panther Hollow bridge and the hill side behind Phipps to prevent landslides from happening again?
 - Answer: There isn't much that we can do about the landslides along Panther Hollow Lake as part of this stormwater project. We have raised the elevation of the ground surface adjacent to that landslide area to hopefully act as a buttress, but we can't stop the landslides from occurring as part of this project.

Junction Hollow

- Question: You said the lake will hold a 100-year flood. What is the stream designed to hold?
 - Answer: The stream and it's floodplain are designed to contain the 100-yr flow that originates from the lake in addition to the limited amount of additional hydrology originating in Junction Hollow that flows into the stream, understanding that the lake outflow/stream inflow is constrained by the pipe size, thereby limiting the peak discharge to the Junction Hollow stream.

- Question: This design doesn't give much space for stream meanders and stream natural dynamics. It's very "perfect". The one thing about water is that it isn't perfect, and it likes to move and wiggle. How is that being accounted for?
 - Answer: The design in an appropriate amount of meandering for the slope and the amount of stormwater discharge. Steeper streams meander less, and flatter streams meander more.

- Question: How does the stream and the footpath impact the existing tree canopy and Zig Zag trail?
 - Answer: The Zig Zag trail is outside of the project area, so not touching that at all. For the Junction Hollow tree canopy, some trees will be removed to allow construction of the project, but it will be reforested.

- Question: The last presentation indicated a new pipe being built under the shuttle road. Is that pipe still being installed and, if so, does the pipe need to be finished before the road is built? Or is that construction simultaneous?
 - Answer: Yes, we are still relocating a 50-inch water main through the park at the same time. We are planning to install underneath the new trails and the exact alignment for construction is in design at this time. The plan for construction sequencing is that the water main will be installed before both the stream and roadway grading is completed to ensure no construction disturbance is duplicated.

- Question: Will there still be some sort of trail access through Junction Hollow during construction? Or is it a closure with a detour?
 - Answer: There are multiple phases of closures and detours planned, depending on where the stormwater project construction is occurring at those times. We have to place a 50-inch water main through the park first, so the existing trail will be closed and there will be a temporary trail during that time. There will be iterations of temporary trails during construction, but there will be some days when the trail is closed due to construction.

- Question: What is the pedestrian path material?

- Answer: Asphalt.
- Question: The existing pedestrian path is asphalt and crushed stone currently by the soccer field. Why are you eliminating half of the pedestrian trail that joggers frequently use?
 - Answer: For the mobility corridor, we asked for it to be asphalt because there will be a water main underneath. We don't want the mobility path to be permeable because we don't want stormwater draining down to the water main and potentially harming it. For the pedestrian path, we believe it will have permeable material in addition to asphalt, but we will follow up with DOMI to see their final design for the paving.
 - Update: The mobility trail and the Three Rivers Heritage Trail will be constructed with paved asphalt.
- Question: Is there a crossing for people in wheelchairs?
 - Answer: There is no wheelchair accessible stream crossing, but access points will be provided for people with mobility constraints to experience the stream.
- Question: In the plans, the pedestrian path to the east of the soccer field and the DOMI path to the west of the soccer field join to the south of the soccer field. How does that help pedestrians if they have to walk alongside the road shuttles?
 - Answer: When the paths are beside each other, each one will remain the same width and be separate. The design of the DOMI path is DOMI's design, but we believe there will be bollards where the paths are adjacent to each other.
- Question: How wide is the DOMI road? For people who don't want to ride bicycles with cars/shuttles, will they be able to ride on the "pedestrian" path? People won't want to ride with their children alongside motor vehicles.
 - Answer: Question forwarded to DOMI.
- Question: Is DOMI only willing to help the Run with flooding via the best management practices (BMPs) if there is the private road?
 - Answer: Question forwarded to DOMI.

Connection to the River

- Question: Saline Street is very wide. While the street is being dug up for new stormwater and gas lines, is there an opportunity to install curb cuts, tree pits or green infrastructure controls in the right of way to capture water from exploding pipes by the Church and flooding up near the dead end in The Run?
 - Answer: As wide as Saline Street is, it is jam-packed with utilities. The gas lines are going to be relocated to the sidewalks, which would likely limit curb cuts, tree pits, or other green infrastructure controls. PWSA will discuss this with the City.

- Question: Is the new substation Duquesne Light Company (DLC) is building up the Hollow changing that underground electrical line on the map at all?
 - Answer: No, the DLC duct bank line is not being relocated at all. We talked to DLC about relocating that electrical line in order to make our stormwater pipeline bigger, but the cost to relocate it was astronomical, so we are stuck with that electrical line where it is.
- Question: Will the new network of pipelines down by the park also help alleviate the exploding pipes further up on Saline Street by the church and the flooding near the Greenfield Bridge?
 - Answer: Indirectly, yes. We are building this new pipe network, which will help the hydraulics upstream. We looked at extending the new pipe network up Saline Street to the church, but it didn't provide significant changes for hydraulics.
- Question: Since this project will be handling significant stormwater from the Parkway, does that mean they are contributing to the project financially?
 - Answer: We have had some discussions with PennDOT, but we don't have a cost-share with them for the project. We are progressing to fund the cost and we hope to seek reimbursement for some of the stormwater that PennDOT has contributed.
- Question: Was the outfall elevation at the Monongahela River with consideration of rising river levels due to climate change?
 - Answer: It takes a lot of climate change to change a river's elevation, but we did take climate change into account for the design. Instead of setting the outfall elevation at the "normal pool elevation", we set the outfall elevation at the "ordinary high-water elevation" to provide additional protection against rising river levels from climate change. In addition, the U.S. Army Corps of Engineers operate the lock and dam system on the three rivers to help manage flooding.
- Question: How will the outfall of the new pipe affect potential water recreation activities at Hazelwood Green? Thinking about river flows and potential entry for boats.
 - Answer: The pipe outfall will be 20 feet below ground, so it won't impact anything at the land surface. The outfall will be located at an existing barge mooring. The plot of land will be green space for that development. The pipe will only be flowing during rain events, like the flow from existing outfalls, like the M-29 Combined Sewer Outfall. With this project, there won't be an increase in flow that will impact velocities in the river.

Modeling and Flood Mitigation

- Question: Some residents emailed some questions to the PWSA board which included "Has PWSA done a model of the stormwater plans that does not include the proposed Mon-Oakland Mobility Corridor, and if not, why not?" We were told that such a model was not created because PWSA was not directed to do so. Who directed PWSA to do the flood mitigation plans that included the mobility corridor only?

- Answer: For the original modeling, we did not include the DOMI mobility corridor project because we were focused on the stormwater project. Following the public meetings with questions that were asked about the DOMI project, we did model the project. We described the results of that modeling in this presentation. This subsequent modeling was done in response to the public's questions.

Question regarding project modeling from members of the public and PWSA's response

Why did this board not direct PWSA and its contractors to produce a project model without MOC—either before the direct request from residents or after?

Response

The model that PWSA has developed can be used to evaluate the impact of the portion of the MOC that touches the proposed stormwater project. The current regulations are set to enforce that new projects like the MOC do not result in any increases in stormwater flow. As a result, PWSA will develop a model to show that the parts of the MOC that touch the Four Mile Run project do not result in any increases in stormwater flow. We are working with DOMI's design team to ensure that any runoff coming from the Connector project will be accommodated and will not impact the success of the stormwater project. The Four Mile Run Stormwater Project will go forward no matter what the outcome with the Connector. However, the plan is to build these projects in collaboration with each other.

- Question: For presentation slide 21 that said essentially there was no effect from the Mon-Oakland Mobility Corridor on the flooding risk, the numbers on the slide don't explain why. What is the effect of the corridor on the stormwater project?
 - Answer: Presentation slide 20 has the modeling data in a table. The Mon-Oakland Mobility Corridor is not having a negative effect on the stormwater project. With the best management practices (BMPs) that will be included with the mobility trail, there will be less stormwater generated and impacting the surrounding area. BMPs are green stormwater infrastructure, in this case rain gardens. As of the June community meeting, we had not done this model and therefore did not know the impact of the mobility trail and its BMPs. Now we do, and the good news is that it is a positive impact. The mobility trail's additional asphalt is counteracted with the rain gardens to a degree that provides more stormwater benefit than the existing conditions. There is no plan to build the rain gardens without the road.
- Question: Mr. Sullivan said the emergency spillway for the lake cover a 100+ year incident. Does the system under The Run neighborhood do the same?

- Answer: There are improvements in flood mitigation for storm events, up to a 45% reduction in structures at risk of flooding for a 100-year storm event, but the project does not eliminate the risk of flooding for a 100-year storm event. The project intent is to eliminate risk from the 10-year storm events. Many agencies like PWSA typically design for the 10-year storm for stormwater projects because of costs.
- Question: There was a large storm in 2009 or 2011 that was identified as a 75-year flood event. Raw sewage and stormwater were coming up 70 inches in basements and up through first floor slats. With this plan, how many inches of raw sewage and stormwater should residents expect during a 75-year flood event?
 - Answer: If we could financially, we would provide full flood protection up to a 100-year storm. However, we also have other watersheds in the city that need flood protection as well, so we are investing as much as we can to protect Four Mile Run with our limited budget. For a 10-year storm, the structures at risk of flooding will be reduced by 100%. For a 25-year storm, the number of structures at risk will be reduced by 27%. For a 50-year storm, the number of structures at risk will be reduced by 50%. For a 100-year storm, the number of structures at risk will be reduced by 45%.
 - Update: The percent reduction of structures at risk provided are for surface/street flooding and do not depict depth of flooding in the basement. As was mentioned in our meeting on Tuesday, the goal of the project was to mitigate surface/street flooding and not water in basements and hence depth of basement flooding in each of the structures at risk was not quantified. That would involve an effort to take the results from the model and overlay that information with basement elevations for structures at risk. We are not aware if we have basement elevations available for structures in “The Run” neighborhood near the bowls.
- Comment: Maybe using inches of water instead of year-based events would help people understand what to expect on their properties. (i.e. inches of water in the street.)
- Question: Is there a guarantee that Run residents will be able to buy affordable flood insurance, which they cannot buy now?
 - Answer: There are different rates for flood insurance depending on whether you live in a Federal Emergency Management Agency (FEMA) delineated floodplain. If you do not live in a FEMA delineated floodplain, there is a reduced flood insurance rate that you can buy through the Federal Flood Insurance Program. This project is not within a FEMA 100-year floodplain. Kari Mackenbach offered to work with PWSA to answer resident’s questions about flood insurance.
 - Update: Any structure can purchase flood insurance, even if the structure is outside the FEMA identified Special Flood Hazard Area (SFHA) as long as the community participates in the National Flood Insurance Program (NFIP), the City of Pittsburgh is a participant. Flood insurance rates can be cheaper (typically 1/3 the cost of what one would pay for structures within the floodplain) if purchased when not in the SFHA.
- Question: Will PWSA cause the FEMA designation to change?

- Answer: No. FEMA designation of floodplains will not change with this project. The only FEMA designated flood plain is along the bank of the Monongahela River. The rest of the project area is well above the FEMA flood plain, so designation changes are not required. Overland flooding within the Run neighborhood, however, will have significant reduction with this project.
- Comment: I hope everyone has heard of the new resource that is really valuable: <https://www.floodfactor.com/>.
- Question: Why is there no improvements to help with water coming into the Run from the Greenfield side of the Run?
 - Answer: We modeled it, and that option did not provide significant improvements to the hydraulics of the system.
- Question: Could the flooding be further reduced with a large storage system beneath the soccer field? And/or under the transit way?
 - Answer: We modeled that option among dozens of options. It narrowed down that we still need to get that water to the river, and we are putting in the biggest pipeline we can, so storage under the soccer field would not provide significant benefits.
- Question: Have these stormwater plans been modeled alongside ALCOSAN's tunnel and plant expansion plans to show the cumulative impact on flooding?
 - Answer: With this project, there will be a direct discharge of stormwater to the river. The only impact it would have to ALCOSAN is the reduction in stormwater flow to the ALCOSAN drop shaft. This project should not impact what they are doing with their tunnel.
- Question: Has PWSA kept a running number of houses flooded since the initial neighborhood survey? I know of at least one house that has had water in the basement after the last set of storms. The manhole cover was also blown off up by the Saint John's church from the flood water.
 - Answer: Usually when a resident experiences a flooding event or a basement backup event, they will call our 24/7 Emergency Dispatch, who will then record the event. However, not all residents report these events to us. We did complete a survey of Run residents towards the end of last year which provided us with additional information about these events in the Run neighborhood.
 - Comment: Justin, great question! I would love to follow up with you on that for my job at 3RWW. We are having other issues about flood reporting. There isn't a system to report flooding right now. My email is aquinn@3rww.org.

General

- Question: Is the PWSA an autonomous public body or agency?
 - Answer: PWSA is a municipal authority. Currently PWSA is under the jurisdiction of the Pennsylvania Public Utility Commission (PA PUC). PWSA is not a part of the City of Pittsburgh government. The current PWSA board members were selected by the Mayor's Office but going forward new board members will not be selected by the Mayor's Office. Instead the Blue Ribbon Panel will recommend board candidates to the Mayor's Office, then the Mayor's Office will present these recommendations to City Council for approval. Three new PWSA board members were selected by the Blue Ribbon Panel recently and are up for approval in order to join the PWSA board in September.

- Question: I have witnessed some bad interactions where the surveyors and workers hired by PWSA thus far have basically verbally assaulted bicycle commuters. Is this what we are expect from PWSA and DOMI as this project moves forward?
 - Answer: No, that is not what you can expect. We will address this issue. In addition, pedestrians and bicyclists should be careful of workers and any signs.

- Question: Although the city is a combined system, communities all over the area have municipal separate storm sewer system (MS4) permits and are required to treat stormwater prior to discharge and decrease pollution loads. Urban runoff is very polluted. Is water quality in the plan for this stormwater discharge?
 - Answer: Water quality is important to us, and we are looking at it. The water that enters Junction Hollow stream and Panther Hollow Lake will primarily be stormwater from the park. Water entering the lake will be cleaned by the forebay pond and the pretreatment wetland. Water entering the stream from the lake is expected to be clean and clear. Additional stormwater entering the stream will be just runoff from the landscape by that narrow band by the stream, which is mostly grass and trees. Stormwater from the DOMI mobility trail will not be directed into the stream. Once the stream enters the underground pipe, it will be mixed with runoff from the Run neighborhood streets. This new stormwater project will provide large reductions in combined sewer overflows (CSOs) of raw sewage mixed within stormwater into the river. With these improvements for the stream, we are meeting the PA DEP's requirements for water quality.

- Question: I was wondering if the frequency of 100-year floods has increased in the last 20 years and, if so, by how much?
 - Answer: The term "100-year storm" is based on statistical analysis and means that there is a 1% chance every year that we will experience a storm of that particular large size. It doesn't necessarily mean that a 100-year storm only happens once every 100 years. We know that storm patterns have changed over the last decade or so, and we are experiencing more frequent intense bursts of rain here in Pittsburgh. For Pittsburgh, there is only about 60 to 70 years of rain gauge data for the statistical analysis for storm

sizes, which makes accurately defining the 100-year storm difficult, but more data over the years will help clarify the 100-year storm for Pittsburgh.

- Comment: 3RWW, my organization keeps track of rain fall! We have a really amazing system: <http://3riverswetweather.org/municipalities/calibrated-radar-rainfall-data>. I also recommend Tom Batrone and his blog. He has an amazing StoryMap for 2018 that is really interesting around flooding (<https://storymaps.arcgis.com/stories/1e26258d4ccc450d895dd24b5eb9cf2e>) and his blog is also very informative (<https://pghflood.home.blog/>).
- Comment: While the technicalities of the 100 year flood are a little tricky, the gist of Tiffany's question is a good one - basically, what used to be infrequent giant storms are getting more common, making this kind of project even more important.
- Question: Thanks, Kara. I was really looking for an answer to the question of are we measuring the increasing frequency of big storms and what is the change. I imagine someone is measuring them. It would be nice to define what a 100-year storm is in Pittsburgh and if that definition has changed over time. Not all of us are flood experts... Defining the terms would help. For example, when I googled, I found the interval between 100-year floods on the Danube between 1501 and 2013 ranged from 37 to 192 years. (Wikipedia) I want to know is the interval decreasing in Pittsburgh, and if so, by how much?
 - Answer: These storm events are designated statically, based on data that is available. For Pittsburgh, the longest standing rain gauge in the region is at the Pittsburgh International Airport. The last time the analysis was done in Pittsburgh was around 2008, and there was only about 50 years of data used to project out 100 years. First of all, as we get closer to 100 years of data, the analysis will improve, and the storm event definitions will change. Secondly, climate change is happening. With those two things combined, defining 100-year storm events is a moving target. The project design is based on a 10-year storm, which is much more reliable in terms of data. The idea is to cover the 10-year storm, and then try to improve the situation for the larger storms. Tom Batrone's blog tracks local storms, and that may help answer additional questions about storm patterns. The number of inches of rainfall is changing in Pittsburgh, but people are still trying to fine-tune the information. This past 5 or 10 or 20 years of changing rainfall information isn't enough data to base the analysis on for the next 100 years. Rainfall is changing in the short-term, but we don't know exactly what is going to happen in the next 20 years.

Transcribed questions from September 15 meeting regarding 100-year storm

From Tiffany, Hazelwood Initiative to Everyone: 07:07 PM

I was wondering if the frequency of 100-year floods has increased in the last 20 years and, if so, by how much?

From Kara Smith to Everyone: 07:55 PM

While the technicalities of the 100-year flood are a little tricky, the gist of Tiffany's question is a good one - basically, what used to be infrequent giant storms are getting more common, making this kind of project even more important

From Tiffany, Hazelwood Initiative to Everyone: 08:02 PM

Thanks, Kara. I was really looking for an answer to the question of are we measuring the increasing frequency of big storms and what is the change. I imagine someone is measuring them. It would be nice to define what a 100-year storm is in Pittsburgh and if that definition has changed over time. Not all of us are flood experts... Defining the terms would help. For example, when I googled, I found the interval between 100-year floods on the Danube between 1501 and 2013 ranged from 37 to 192 years. (Wikipedia) I want to know is the interval decreasing in Pittsburgh, and if so, by how much?

From Tiffany, Hazelwood Initiative to Everyone: 08:36 PM

I don't think the 100-year flood has been answered, really. If you can answer it in the next meeting, or via email, I would appreciate it.

PWSA's detailed response

The basic question is ... "the gist of Tiffany's question is a good one - basically, what used to be infrequent giant storms are getting more common, making this kind of project even more important."

The analysis that is performed to determine values for 2, 5, 10, 100-year storms are based on applying acceptable statistical analysis on existing rainfall data. The data has to be from a high-quality and long-term rain gauge which usually limits it to rain gauges installed at airports and National Oceanic and Atmospheric Administration (NOAA) weather stations. The approach of obtaining detailed rainfall information using high quality gauges date back to the early 1940s (1960s for Pittsburgh International Airport rain gauge.) With this background, we can immediately see various potential issues, which are addressed below:

1. We are using 50 to 60 years of data to estimate the value of an event with a recurrence interval of 100 years.
2. The analysis is a probability and statistical analysis which is reported in "percent chance of occurrence." This percent chance is derived from the frequency a storm of a given magnitude happened in the past. 100-year storm - which is 4.93 inches falling in 24 hours - means that a storm of that size has a 1% (1 in 100) chance of happening in any given year (this value is extrapolated and modeled from lots of data sources, since we don't have 100 years of data from Pittsburgh).

3. Climate change is happening. Unfortunately, the timeline for the impact of climate change on frequency and occurrence of extreme rainfall is recent – the last 20 to 25 years. For example, PWSA consultants have developed a graphic indicating that between 1953 and 2010 (57 years) we have had **34 rain events** of 1-inch of rain within a one-hour period compared to between 2010 and 2018 (8 years) we’ve experienced and **27** rain events of 1-inch of rain within one-hour. This has resulted in various agencies like NOAA or Federal Emergency Management Agency (FEMA) considering a change to include these storm events to take into consideration climate change, which is another factor to consider. The impact of climate change on NOAA estimates of precipitation frequency are addressed in FAQ Question 3.6 at NOAA’s National Weather Service website ([nws.noaa.gov/oh/hdsc/FAQ.html](https://www.nws.noaa.gov/oh/hdsc/FAQ.html)). In the meantime, we still use the published storm-depth frequency values to indicate a relative frequency of occurrence (very common to very rare), recognizing that they are in flux.

4. Even with these considerations, the 4MR Stormwater Project is using the following rainfall depths for the analysis which is higher than PWSA’s standard green stormwater infrastructure design storm which was previously 1.5 inches of rain in 24 hours. As can be seen from the Table below, a 1.5-inch depth storm for a 24-hr duration is less than a 1-year storm event. The table below shows the rainfalls associated with each design storm.

Table 1: Twenty-Four Hour Total Rainfall Depths for Storm Frequencies (NOAA Atlas 14)

Design Storm Frequency (Years)	Rainfall Depth (inches)
1	1.96
2	2.36
5	2.88
10	3.31
25	3.91
50	4.41
100	4.93

The project was sized for a 10-year storm event, or a storm that has a 1 in 10 chance of occurring each year. It also means that for storms larger than the 3.31 inches, say the 25-year at 3.91 inches, the runoff from the first 3.31 can be transported, reducing the severity of the flooding. The performance of the project is shown below. The 4MR Project reduces the depth of flooding in the South Bowl from 1.9 ft to 0.7 ft at the deepest point (relative to the ground surface) for the 10-year storm, and from 3.2 ft to 1.9 ft for the 25-year storm, etc. The performance for the remaining design conditions are shown in the figures below.

