ADVENTURES IN FLOOD CONTROL:
THE JOHNSTOWN, PENNSYLVANIA STORY

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The city of Johnstown throughout its history has had an unusually high occurrence of flooding. This small Pennsylvania city is located in the south western part of Cambria County which is about 58 miles east of Pittsburgh, the closest neighboring major urban center. The city of Johnstown has an elevation of 1165 feet above mean sea level (as measured in the vicinity known as "The Point".) and is 440 above the city of Pittsburgh. For over a century Johnstowners have been greeted all over the globe in this fashion; "So you are from Johnstown, Pennsylvania! I know that town. That's the place they have the floods."[1] Thus Johnstown has been given the notorious name of "The Flood City" by many outsiders. Most of these individuals if questioned about this dubious title invariably bring up the catastrophic flood of 1889 as the origin of this name, however Johnstown's flooding history dates back to at least 1808.

One of the factors which contribute to the frequent flooding in Johnstown is its location. The city of Johnstown is situated at the bottom of a relatively narrow, steep-sided valley which to some degree is reminiscent of a funnel. The downtown area lies between Stony Creek and the Little Conemaugh River, which then converge at the point to form the Conemaugh River, one of the Allegheny River's chief tributaries. Stony Creek has several principal tributaries and the Little Conemaugh River has two; The North Branch and the South Fork. The water sheds of both Stony Creek and the Little Conemaugh River above the city are fan shaped and steep. The drainage area of these two basins above the city comprise a total area of 657 square miles; of which the majority of this area (468 square miles) are within the Stony Creek basin and the remaining 189 square miles are in the Little Conemaugh River drainage basin. Both the Little Conemaugh River and Stony Creek have a downward slope of 24 feet/mile throughout their 15 miles immediately upstream of the city. These two smaller channels merge to form the Conemaugh River immediately before the river plunges through a gorge and breaks through the Laurel Hill Ridge (elevation 2800 feet). Johnstown sits in the valley at the head of this gorge.[2]

The Rivers have brought great prosperity to the city of Johnstown and initially provided a means of transportation for people and trade goods, especially the locally produced iron ore and coal. The rivers have played a major role in the transformation of Johnstown from a small frontier outpost at the beginning of the nineteenth century to a prosperous steelmaking center with a population of 30,000 by the late 1880's. However, the rivers have also been one of Johnstown's greatest misfortunes as it grew. As the city branched out and increased in size during the late 1880's it repeatedly encroached upon the waterways. Most of the business, industrial, and various residential areas in the downtown area were located on the flood plain.

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[1] Weinschenk, Sid A., Flood Free Johnstown (Johnstown, Pa.:"Flood Free Johnstown Observance Committee, 1943)

[2] U.S. Army Corps of Engineers, Pittsburgh District, Johnstown Channel Improvement (Pittsburgh, Pa: 1939), p. 1.

These areas were flooded on a regular basis throughout the nineteenth and beginning of the twentieth centuries (23 floods occurred between 1808 and 1937).

The first major flood at Johnstown occurred in 1833. During this flood the rivers reached a height 26.6 feet above flood stage. The most disastrous flooding event at Johnstown occurred on May 31, 1889. The 1889 Johnstown Flood, is considered to be one of the three worst American natural disasters, the others being the Gavelston hurricane and the San Francisco earthquake and fire. Johnstown on May 31,1989, was already at flood stage at 10:44 a.m. in the morning, when the Conemaugh River was measured to be 20 feet above the low water mark. The continuous heavy precipitation (6.2 inches) had caused flooding which placed Johnstown's downtown area under ten feet of water. What made the flood even more catastrophic was that at 3:00 p.m. that afternoon the heavy precipitation had caused the South Fork Dam on the South Fork of the Little Conemaugh River to over top and fail sending an estimated forty foot wall of water and debris crashing into the city of Johnstown fourteen miles below via the Little Conemaugh River Valley. At that time the South Fork dam was the World's largest earth work dam in existence. The South Fork Dam held back Lake Conemaugh, which at that time was being used as a retreat for Pittsburgh's millionaire sportsmen who belonged to the South Fork Fishing and Hunting Club, the organization which owned the lake and surrounding property. The South Fork Dam was approximately two miles long, about a mile wide and sixty feet deep. The dam was originally constructed by the state in 1852 to serve as a water supply for the portage canal and was built at a total cost of $190,000.00. When the canal project was retired in favor of the new railroad system the reservoir was abandoned and neglected until 1879, when the South Fork Fishing and Hunting Club purchased the property at a bargain price of $2,500.00. Earlier Congressman John Reilly modified the Dam by removing the five huge cast iron runoff pipes which were embedded in the base of the dam leaving a large 274 foot hole at the base of the dam. The club owners rebuilt the dam with fill dirt, rocks, and logs. No runoff mechanism was installed or even considered. In fact, the club did not even consult with an engineer on the project and instead hired a muleskinner to construct the dam. During construction the mulemen dragged dirt to the dam site, dumped it, and stomped it down.[3] When the dam burst it released about twenty million tons of water which was moving at an estimated velocity of 40 miles per hour, smashing or crushing everything in its way. When the flood wave struck Johnstown it was carrying fourteen miles of accumulated debris including massive steam locomotives, buildings, trees, bridges, trees, people and animals both living and dead. Most of the debris jammed up at the railroad's 75 foot high Stone Arch Bridge which spanned the Conemaugh River in Johnstown. Later, this huge debris pile caught fire and burned resulting in an estimated death toll of 300 from the fire alone. Over all the death toll in Johnstown was estimated to be over 2,200 dead and the number of missing people was totaled at 967 individuals. This flood destroyed much of Johnstown's downtown area and in some cases entire streets had just disappeared, the property damage was estimated at well over a 17

[3] Oxford, Edward, "The Johnstown Flood", American History Illustrated,(May, 1989).

million dollars. At this time an admirable and heroic effort was undertaken by the citizens of Johnstown to rebuild there city and make it even better. Later in 1889 the City Elders commissioned an engineer to study the problem of flooding in Johnstown. The Engineers recommendations to make the steam channels wider and deeper also to set river widths by city ordinance was only partially followed. Although some flooding occurred such as the severe flood of 1891, however none that rivaled the 1889 flood occurred and thus encroachment on the stream channels began to occur anew.

Although the greatest flooding of all time at Johnstown was the catastrophic flood of 1889. The St. Patrick's Day Flood of March, 1936, represented at that time the greatest flood of record without unnatural augmentation. There were a number of factors contributed to the occurrence of the 1936 flood; among these were the abnormally deep snowpack which did not begin to thaw until March 9, initiated by unseasonably warm temperatures and some minor precipitation of 1-2 inches. This first amount of precipitation did not cause any flooding, although it did increase the potential for future flooding. A second series of storms occurred between March 16-17, dumping an estimated 5-8 inches of precipitation on the Johnstown area. The majority of this precipitation occurred on March 17th. The additional rainfall, in combination with the increasing amount of meltwater from the snowpack being added to the drainage basins caused widespread flooding which exceeded the unaugmented 1889 flood levels. By night fall on that 1936 St. Patrick's Day, one third of the city of Johnstown lay underneath 17 feet of cold and murky water. Stony Creek rose to a height of 30.2 feet, a level approximately 15 feet above flood stage, as measured at the gauge on the Poplar Street Bridge. At the "Point" the stream rose to about 14 feet above flood stage.[4] During the 1936 flood the following peak discharges were obtained at the "Point": Stony Creek, 59,000 cubic feet per second (CFS); The Little Conemaugh River, 30,000 CFS; and the Conemaugh River, 78,000 CFS. Typical flood stage at the head of the Conemaugh River is equivalent to a discharge of 22,000 CFS.[5] Although the "1936 Flood" caused almost fourfold more property damage than the "1889 Flood" with damages estimated at 42 million dollars, however because of the timely warning of the forthcoming disaster, made possible through the use of modern communication systems, a great loss of life was averted and only 25 people lost their lives in the St. Patrick's Day Flood of 1936.
The 1936 Flood was the straw that broke Johnstown's back. The people of Johnstown were fed up with the continuous flooding and rebuilding of their city. After the 1936 Flood, the city's populace united with a grim determination to once and for all settle the question of how flood control could be achieved in Johnstown. Most of the citizens of Johnstown felt that the

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[4] U. S. Army Corps of Engineers, Pittsburgh District, Johnstown Channel Improvement, (Pittsburgh, Pa.: 1939), p. 5.

[5] Army Corp of Engineers, Pittsburgh District, Johnstown Channel Improvement (Pittsburgh, Pa.: 1939), p. 5.

ever present flood hazard threatened the very existence of their community. From the people of Johnstown 15,000 letters were sent to President Franklin Delano Roosevelt at the White House. These letters expressed Johnstowners' fears of what future flooding might do to their community and asked the President for the Federal government to step in and assist them. The Johnstown Tribune and Democrat as well as other local papers demanded via the written word that federal aid be granted for dredging of the rivers and other flood control projects. Franklin Delano Roosevelt heard the people of Johnstown and decided to take action and aid them in their plight. This action took the form of The Flood Control Act of June 22, 1936. This legislation authorized the federal government for the first time to construct river walls, dams and other flood control systems throughout the nation's high risk flooding zones. On August 31, 1936, President Roosevelt came to Johnstown and gave a speech before fifty thousand cheering citizens of Johnstown and the surrounding area. During this speech President Roosevelt said, "We want to keep you from having these floods again. The federal government, if I have anything to do with it, will cooperate with your state and community to prevent further flooding."

The Pittsburgh District, of the U.S. Army Corps of Engineers were ordered to investigate and report on the flood situation in Johnstown and if possible develop a flood control plan which would effectively protect the city. As a result of this investigation the Army Corps of Engineers proposed to construct reservoirs for water storage in an area adjacent to Cambria County, however this flood control plan was later determined to be unfeasible and was abandoned. The citizens of Johnstown would have to wait another two years before any type of flood control project would begin and also suffer through yet another flood. This flood occurred in April, 1937. The channels still heavily loaded by debris from the previous year's flood over flowed and filled the lower part of town with five feet of water. The people of Johnstown were yet again aroused about the issue of flood control. The Controller of Cambria County in response to the wishes of the people proposed that the county expend two million dollars for the widening and deepening of the river channels. The Controller's proposal was quickly approved by a Cambria County Grand Jury in June, 1937. During this time there was much coming and going of federal and local officials between Johnstown and Washington D.C.. General Edwin Markham who was then Chief of the U.S. Army Corps of Engineers, supported the idea of flood control through channel improvement. However, in order for the project to take place Congress would have to amend the Flood Control Act. This amendment to the Flood Control Act was approved by Congress on April 27, 1937, and read as thus:

> IT IS HEREBY FURTHER AMENDED TO PROVIDE THAT, IF, IN THE EXECUTION OF THE PROJECT FOR A RESERVOIR SYSTEM FOR THE PROTECTION OF PITTSBURGH, IT IS FOUND THAT GEOLOGICAL AND ENGINEERING CONDITIONS MAKE IT IMPRACTICABLE TO CONSTRUCT A RESERVOIR FOR THE CITY OF JOHNSTOWN, PENNSYLVANIA, FLOOD PROTECTION SHALL BE PROVIDED FOR SAID CITY BY CHANNEL ENLARGEMENT OR OTHER WORKS; PROVIDED, THAT THE TOTAL ESTIMATED CONSTRUCTION COST OF THE ENTIRE PROJECT SHALL NOT

BE INCREASED.

As a result of this legislation the Army Corps of Engineers started to look at channel improvements as the best way to control flooding in Johnstown.

The purpose of channel improvement, in regards to flood control, is to increase the discharge (Q), of a stream. In other words the stream channel is altered so as to increase the carrying capacity of a stream so that when a flood event occurs the water within the stream flows faster thus decreasing the height and duration of flood waters. This increase in capacity in turn reduces the frequency of flood damage within a particular area. There are two ways in which stream discharge (Q) can be increased:

1. By increasing the cross-section or size of the stream channel.

2. By increasing the velocity or rate of flow of the water within the channel.[6]

Normally it is not feasible to enlarge the channel of a stream or river so as to contain all the waters of a standard flood within its banks. In fact, this type of improvement is in most cases only feasible for narrow and shallow streams, with small watersheds in which the depth of flooding is small and the period of overflow is short. If a stream meets those criteria it may be practicable to deepen and widen the channel to a limited extent and use the dredged material to increase the height of the channel's banks. However, it is economically impracticable to solve a flooding problem for a large stream or river, which drains several thousand square miles, in this manner. Such a stream would need to have its banks increased to such a great size that the value of protection received would be many times less than the cost of the enlargement. As mentioned above the other method for increasing the discharge is by increasing the stream's velocity. This may be done by altering any one of the three factors which affect the velocity of flowing water. These factors are:

1. The slope of the water surface.

2. The hydraulic radius

3. The roughness of the channel.

Luckily for Johnstown, channel improvement was a viable flood control measure, however the Army Corps of Engineers had their work cut out for them. In order to determine the most effective type and placement of channel improvements, the Army Corps of Engineers enlisted the aid of the U.S. Waterways Experiment Station in Vicksburg, Mississippi. At the

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[6] Pickels, George W., Drainage and Flood Control Engineering 2nd ed.(New York, NY: McGraw-Hill Book Company, 1941), p. 321-323.

Waterways Experiment Station a model of the proposed flood control project was constructed. However, the model was initially constructed to duplicate the stream conditions which existed during the St. Patrick's Day Flood of 1936. The model was constructed to a scale of 1 to 200 horizontal and 1 to 80 vertical.[7] Using this model the Corps of Engineers determined the amount of water necessary to recreate the March, 1936 flood. The effects of various natural and manmade obstructions such as bridges, walls and other restricted areas. After the study on the existing conditions was completed, the model was revised to test various proposed channel improvements using a volume of water which would be necessary to create a flood similar to the 1936 flood. Using this model, the Corps of Engineers was able to check out various designs of channel improvements and were rapidly able to propose a solution which was economically sound and which determined the most effective channel alignment and the approximate extent of the channel improvement.

In August, 1938, a steam shovel gouged out the first ceremonial bucket of bottom mud from the middle of the Conemaugh River, launching the most extensive channel improvement in American history. The channel improvement project, in order to expedite the work, was constructed in six units. The unit break down was as follows: three units for the Conemaugh River section of the improvement, two for Stony Creek, and one for the Little Conemaugh River. The total project encompassed 9.1 miles of channel improvement. From the "Point", the channel improvement extends 3.52 miles down the Conemaugh River, 4.05 miles up the Stony Creek, and 1.53 miles up the Little Conemaugh River. The major features of the project were as follows:

1. Enlarging and realigning the present channels.

2. Concrete pavement protection of the stream banks.

3. Relocation of railroad tracks, highways, and utilities.

4. Alterations to sewers and drain pipes, bridge piers, and other structures where necessary.[8]

The Johnstown Channel Improvement Project was completed on November 27, 1943, by that time 2,989,300 cubic yards of bottom material (mud and muck) and dirt had been excavated. For the 8 inch thick side slope paving 156,631 cubic yards of concrete was utilized and

[7] Army Corps of Engineers, Pittsburgh District, Johnstown Channel Improvement (Pittsburgh, Pa.: Feb. 1939), p. 5-6.

[8] Army Corp of Engineers, Pittsburgh District, Johnstown Channel Improvement (Pittsburgh, Pa.: Feb.,1939), p.7.

485,600 cubic yards of soil was also needed to provide the necessary fill.[9] The estimated cost of the entire channel improvement project was 7.6 million dollars. An illustration of the channel improvement is attached. This illustration depicts a cross section of the Conemaugh River before and after completion of the channel improvement.

On November 27, 1943, Colonel Gilbert Van B. Wilkes, Chief of the Army Corps of Engineers, Pittsburgh District, in a statement made to an audience of city leaders, confirmed that Johnstown's flood problem had been effectively solved. The people of Johnstown in response to this statement immediately launched a six month propaganda campaign. This campaign's purpose was to let the world in general and the "Captains of Industry" in particular aware that Johnstown was now "Flood Free" and "A good place to live, to work, to do business".[10] In their fervor to lift the "Flood City" stigma from the city, 100,000 men, women, and children from the community engaged in a letter writing campaign to friends and family all over the U.S.A. informing them that Johnstown was now free of the flooding hazard due to the channel improvement. As the years passed, the channel improvement functioned as designed carrying off excessive snowmelt and precipitation fed stream waters and so it did indeed seem that Johnstown was free of the flood hazard for good.

The channel improvement since its completion has twice been credited with preventing serious floods; once in October, 1954, and once during June, 1972, when Tropical Storm Agnes caused flooding in other Pennsylvania Cities while the streets and homes in Johnstown remained safe. Prior to Tropical Storm Agnes in May, 1972, The Pittsburgh District, Army Corps of Engineers, completed a feasibility study of extending the existing channel improvement to protect upstream communities along the Little Conemaugh and Stony Creek. Upon completion of this study the Corps of Engineers determined that extending the flood control project upstream was not economically feasible and instead recommended that the local governments implement flood plain management programs instead.

Although Johnstown was thought to be "Flood free" by the general populace, the Army Corps of Engineers knew that it was not, regardless of what Colonel Wilkes said in 1943. The Corps had designed the channel improvement to contain a flood equal to the March 1936, flood, the maximum flood of record for the Conemaugh, Little Conemaugh, and Stony Creek. The Corps of Engineers however did not design the channel improvement to contain a standard project flood (S.P.F.). The standard project flood can be defined as the largest flood that can be expected from the most severe combination of meteorological and hydrological conditions considered to be characteristic of a geographical region. Although the occurrence

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[9] Weinschenk, Sid A., Flood Free Johnstown (Johnstown, Pa.: Flood Free Johnstown Observance Committee, 1943).

[10] Weinschenk, Sid A., Flood Free Johnstown (Johnstown, Pa.: Flood Free Johnstown Observance Committee, 1943.).

of such a flood would be extremely rare; it could however occur within any year. The Corps of Engineers when designing the channel improvement did not even consider protection to the 500 year level as economically feasible. A project to give that level of protection would include channel improvements on all the numerous small streams in the area.[11] The Army Corps of Engineers were concerned enough about the general belief that Johnstown was "flood free", that they published a report in 1974, on "The Potential for Future Flooding in the Johnstown Area". This report through various illustrations of Johnstown's buildings depicted the estimated highwater levels that a standard project flood might reach. However, the belief that Johnstown was "flood free" was still firmly entrenched in the minds of the leaders and the people of Johnstown. One of the reasons the Corps of Engineers report was disregarded was that they could not predict when or if a standard project flood might occur.

Between the afternoon of July 19th, and the morning of July 20th, 1977, the people of Johnstown found out that their city which was toted to be flood proof was indeed still vulnerable to Mother Nature's ravages. During this period, two major squall lines moved across Pennsylvania. The first storm formed just west of Pittsburgh and moved east-south eastward dropping approximately one inch of precipitation over the Johnstown area. The second line of thunderstorms formed over northwestern Pennsylvania and slowly moved toward the southeast. The second line of storms became quasi-stationary above the Johnstown area. Radar information during the period of storm activity indicated that twelve separate thunderstorm cells moved over the Johnstown area.[12] These storms let loose blinding and deafening displays of thunder and lightning. The bulk of the precipitation fell during a period of 6-9 hours over the Johnstown area. My hometown of Nanty Glo, Pennsylvania, which is 10 miles north of Johnstown, received 12 inches of rain during the 24 hours in which the storm occurred. To illustrate how localized the brunt of the storm actually was, areas 30 miles to the southwest of Johnstown received negligible or no precipitation during the same 24 hour period. This excess rainfall caused the Conemaugh River flood, its discharge was measured as 115,000 feet per second. The Channel Improvement was designed to contain only 81,500 cubic feet per second. By dawn, Johnstown was at least under six feet of water, which covered 64% of the city's land area. The U.S. Geologic Survey (U.S.G.S.) and the Army Corps of Engineers classified the July, 1977 flood, as being a 500 year flood. The stage at the Conemaugh River gauging station reached 95% of the Army Corps of Engineers estimated standard project flood.

The heavy rains had also caused seven privately owned, earthfill, gravity-type dams to fail. The collapse of the Laurel Run Dam however, was the only dam failure which resulted in

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[11] U.S. General Accounting Office, The Johnstown Area Flood Of 1977: A Case Study For The Future (Washington, D.C.: May, 1978), p. 3.

[12] U.S. Department of the Interior, Johnstown-Western Pennsylvania Storm and Floods of July 19-20, 1977, Geological Survey Professional Paper 1211 (Washington, D.C.: 1977), p. 21.

fatalities. The Laurel Run Dam was the largest of the seven earth work dams which failed with a 101 million gallon capacity. When the dam broke the water which was held back poured down on the small village of Tanneryville killing forty-one people. Of the other dams which failed two were considered minor dams and the remaining four were small dams built without state permits.

After the rain had stopped and flooding had subsided the job of sorting through the aftermath began. It was found that 78 people had lost their lives during the flood and eight people were missing. There was also 2,700 other individuals who were either sick or injured due to the flood. The city of Johnstown had suffered an estimated 117 million dollars in property damages, while damages to the surrounding areas was estimated at 213 million dollars. On July 21, 1977, the President of the United States declared Johnstown a disaster area. The Red Cross reported that 413 houses, 135 mobile homes, and 52 housing units were totally destroyed, while 5,256 dwelling units sustained major damage.[13] 405 business structures were also destroyed of which half were located in downtown Johnstown. Bethlehem Steel Corporation, the areas largest employer, estimated that total damages to its facilities would total 35-40 million dollars. Over the next year, the federal government would spend nearly 200 million dollars on the Johnstown area, for rebuilding damaged facilities and loaning funds or giving grants to property owners for reconstruction and repair.

The people of Johnstown felt betrayed, many thought what good is the flood control project if it doesn't protect the city from floods. The Army Corps of Engineers response stated that although the flood control project overtopped, they estimated that without the project Johnstown would have been under 11 more feet of water. In other words instead of having the basement and first floor flooding that was common place, 2nd and 3rd story flooding would have occurred without the channel improvement.

A report by the U.S. Comptroller General determined a number of factors which contributed to the severe impact that the 1977 flood had on the Johnstown area. They are as follows:

1. Flood warning and forecasting - There is no river forecasting service available for the Conemaugh, Little Conemaugh, or Stony Creek.

2. Flood fighting and emergency evacuation - There are no formal flood fighting or emergency evacuation plan in effect at the local level in the Johnstown area.

3. Lack of communications - Lightning put 41 local radio systems, including police and firefighter systems out of order. The police auxiliary system could not be used for 36 hours due to the flooding.

[13] U.S. General Accounting Office, The Johnstown Area Flood Of 1977: A Case Study For The Future (Washington, D.C.: May, 1978), p.2.

4. Flood insurance program in the city of Johnstown - Flood insurance was available in Johnstown since 1972. Although most of Johnstown is out of the 100 year plain due to the Army Corps of Engineers' Flood Control Project. Although most of the damage according to F.I.A. would only have been caused by 100 year or greater floods, however most of the damage occurred on the 100 year flood plain. As of January, 1977, only 60 flood insurance policies had been purchased in Johnstown. The main reason for this lack of insurance can be attributed to the belief that Johnstown was flood proof.

The people of Johnstown no longer hold tight to the flood proof dream and have take steps to lessen the danger from a possible future flood. The National Weather Service has increased its number of volunteer flood watchers around the city and keeps them involved with regularly held meetings. The Tri-County Flood Recovery Coordinating Committee has given permission to conduct various studies whose purpose is to spot weak points in the Johnstown areas' protective systems and to manage the floodplain more actively. Johnstown has developed an emergency plan which can be rapidly put into place in the case of a flood emergency. A radio tower atop Blue Knob broadcasts up to date weather information into Conemaugh Valley.

The people of Johnstown have found out the hard way that flood-proofing is an unattainable goal, however flood mitigation is achievable to a certain extent if flood plain management is taken seriously by the surrounding communities. Although man might erect mighty works to protect population centers against natural hazards, Mother Nature is always waiting to give her proudest son a lesson in humility.

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