APPENDIX 8 | FIRE FLOW ANALYSIS

Shippensburg University Master Plan
Water System Fire Flow Analysis and Options
Pennoni Associates
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The existing facilities on campus were analyzed in accordance with Appendix B of the 2006 International Fire Code to determine the maximum required fire flow for fire protection purposes in order to determine the feasibility of the removal of the existing 1,000,000 gallon water tower. Shippensburg University provided approximate gross floor area values for each building on campus as well as an approximation of the Type of Construction in accordance with the 2006 International Building Code.

Attached is a spreadsheet that outlines the required fire flow for each building on campus based on information provided by the University. Based on past experience with required fire flows for institutions of similar size, an initial engineering estimate for a required fire flow of 2500 to 3000 gpm for a duration of 2 to 3 hours was assumed. A more in depth analysis was performed to further refine the estimate based on information provided in the Fire Code. The required fire flow is based upon the single building with the largest demand.

The total gross floor area was used for this required fire flow calculation. In accordance with the Fire Code, the required fire flow can be reduced based on the area of fire rated compartments with fire rated partitions within the structures, which we can reasonably assume that there are some in all of the occupancies. Without a detailed survey of the locations and types of these compartments, an accurate fire flow would be difficult to determine.

There are five occupancies on campus that skew the available data and are significantly above the initial estimate. These five occupancies are:

Occupancy (Year of Construction)	Fire Flow
Old Main (1871)	3000 gpm
Reisner Dining Hall (1965)	3250 gpm
Horton Hall (1894)	4250 gpm
Lehman Library (1967)	4000 gpm
Heiges Field House (1970)	5500 gpm

Reisner Dining Hall is undergoing a renovation that will including sprinklers, therefore it can be removed from the list of critical occupancies. A field survey of the other occupancies was completed on January 4, 2008 and potential areas of partitioning are identified in Appendix A. These recommendations were based on an evaluation that assumed that minor improvements, such as the addition of rated doors, partition walls, etc., could be made with minimal impact to the function of the structure. Lehman Library is the remaining facility that cannot be easily compartmentalized would likely drive the total flow calculation. As a result, we would make the recommendation that the minimum required campus fire flow be assigned at 4000 gpm for a duration of 4 hours based on current conditions. This is a reasonable engineering estimate based on the available data which will be adequate for our master planning purposes.

It should be noted that other alternatives are available to lower the required fire flow, specifically the sprinklering of buildings. Sprinklering also offers direct life safety and property protection advantages over the advantage that water tower provides alone. It may be more cost efficient to sprinkler some of the critical non-sprinkled occupancies, specifically the Library versus relocating or building a new water tower. Sprinklering of the Library, along with the addition of other fire rated assemblies will reduce the total required fire flow to approximately 2500 gpm for a 3 hour duration.

A discussion with Steve Hunsinger at CET, Inc., the Shippensburg Borough Water Authority Engineer, revealed their modeling predicted an available capacity of 1700 to 2240 gpm at the

campus connection points. Actual hydrant flow testing increased the calculated value to 2200 to 2800 gpm. Variation within the water system is normal given the total system demand. Steve was comfortable with providing a number of 2000 gpm as a minimum available flow from the Borough system at the campus connection points. Total volume of water available in the Borough reservoir is 1.5 million gallons, therefore supplying the duration of flow is not an issue.

Given this the 2000 gpm is under our predicted value of 2500 gpm for a required on-campus fire flow demand, we have a couple of options:

- Option #1 - Complete a more detailed investigation to further refine the fire flow demand by investigating maximum floor areas within fire-rated assemblies for critical occupancies on campus. The scope of an engineering feasibility study should include the following:
    - A. Flow testing of critical hydrants on the main 12" campus fire protection loop and within the distribution network.
    - B. Computer modeling of the existing private domestic water system on campus based on the results of hydrant testing and modeling provided by the Shippensburg Borough Authority Engineer.
    - C. An evaluation of existing building plans and field view of all facilities to refine the areas used in determining the required fire flow.
    - D. A meeting with the Shippensburg Borough Authority and their Engineer to discuss future capital improvement projects to the Borough system and the future growth within the system to determine the effect of the public water feed to the University Campus.
    - E. A meeting with the Authority Having Jurisdiction (AHJ) to determine any requirements that the removal of the water tower may have on future projects on campus and the ability of the AHJ to provide adequate fire protection.
    - F. Evaluation of the effect of removal of the water tower on the existing system
    - G. Completion of an engineering feasibility study which documents the results of scope items A-E
    - H. Submission of the feasibility study to the Department of General Services and their excess insurance carrier for their review and comment.

- Option #2 - Demolish the water tower and work with the Authority to upgrade the main feed to campus.

- Option #3 - Demolish the water tower and sprinkler key occupancies, thus reducing the total required demand.

- Option #4 - Maintain the water tower in some form in the current location or relocate/reconstruct at a different location.

Maintaining the water tower in its current location is not without disadvantages. The tower is approaching 20 years of age and is due for a interior and exterior coating renovation. During this renovation, it is recommended that automated monitoring systems be installed to determine the level of water within the tower and the flow rate and timing of water flows in and out of the tower. Finally, valve automation integrated in the building management system should be considered to allow for the regular cycling of water within the tower to prevent stagnation and potential dechlorination.

With the available data and without a more detailed study, an absolute determination for the need for the water tower cannot be made. At this point, it is reasonable that options be considered that maintain the water tower in its current location until a detailed engineering evaluation be performed to determine the feasibility of removal. Based on the preliminary data available and

the analysis performed a part of the master plan, it is reasonable to assume that removal of the water tower is at the least a viable option.

APPENDIX A

OLD MAIN

1. Basement: Fire barrier can be completed separating mechanical and storage space.

   Mechanical (SF) = 8,132
   Storage (SF) = 18,736

2. First – Third Floor: Fire barrier can be completed by adding 90 minute doors separating the center annex from the remainder of the building. Each floor is also a separate fire area giving two (2) fire areas per floor.

	Center Annex (SF)	Remainder (SF)
First	5,463	15,263
Second	5,560	15,260
Third	3,124	15,264

LEHMAN LIBRARY

1. Building has no separation and is interconnected between floors with an open stairway. The only means of separation would be between floors by enclosing the stairway and consequently dividing each floor into a fire area.

HEIGES FIELD HOUSE

1. Ground Floor: No separation.

2. First Floor: Three (3) separate existing areas requiring only the doors entering the pool area from the corridor and locker room to be upgraded to 90 minute doors.

   Gym (SF) = 41,385
   Office/Lockers (SF) = 11,046
   Pool (SF) = 7,164

3. Second Floor: No separation.

REISNER DINING ROOM

1. The new building will be fully sprinklered and will not have any interior fire barriers.

HORTON HALL

1. Ground Floor – Third Floor: On each floor, the wall separating the center annex and the stair wells can serve as a fire barrier by adding 90 minute doors to all openings.

	Front (SF)	Center Annex (SF)

Ground	6,598	3,915
First	6,994	3,894
Second	7,019	3,894
Third	7,019	3,894