

Duluth Transit Authority Bus Storage Area Sprinkler System Upgrade Evaluation

Preliminary Report

February 4, 2022

LHB No. 210882

For:
Duluth Transit Authority
2402 West Michigan Street
Duluth MN



SIGNATURE SHEET

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: _____

Typed/Printed: Alec J. Ashton, P. E.

Date: 02/04/2022

License No.: 57256

TABLE OF CONTENTS

SIGNATURE SHEET

NARRATIVE 1

EXTRA HAZARD GROUP 1 SYSTEM CHANGE SUMMARY 1

 Extra Hazard Group 1 Upgrade 2

 Opinion Of Probable Cost of Option 2

ILLUSTRATION OF EH-1 WORK (RISER ROOM) 3

ILLUSTRATION OF EH-1 WORK (STORAGE ROOM) 4

EXTRA HAZARD GROUP 2 SYSTEM CHANGE SUMMARY 5

 Extra Hazard Group 2 Upgrade 6

 Opinion Of Probable Cost of Option 6

ILLUSTRATION OF EH-2 WORK (RISER ROOM) 7

ILLUSTRATION OF EH-2 WORK (STORAGE ROOM) 8

ADDITIONAL CONSIDERATIONS 9

APPENDIX

 Dry Pipe System Water Delivery Table 10

 Protection Area and Maximum Spacing of Standard Pendent and
 Upright Spray Sprinklers for Ordinary Hazard 11

NARRATIVE

LHB was approached by the Duluth Transit Authority (DTA) to evaluate the existing fire protection system at their Bus Storage Room within their facility at 2402 W. Michigan Street, Duluth, MN. The existing dry fire protection system within the room provides coverage that is equivalent to an Ordinary Hazard occupancy and the insurance body that covers the facility is requesting that the system be upgraded to Extra Hazard Group 1 protection. The goal of this report is to illustrate the system changes that are necessary to accomplish that coverage upgrade.

The current fleet at the Duluth Transit Authority facility includes 68 heavy duty diesel buses, 7 heavy duty electric buses, 12 gasoline paratransit vehicles, several service vehicles/dump trucks and a Caterpillar loader. The storage area is roughly 100,000 square feet and is served by 3 dry sprinkler zones. All existing FP Main piping is 4" from the building service entry, through the main riser and out to the dry systems. Branch piping reduces to approximately 2" and feeds sprinklers spread at 130 square feet of floor coverage per sprinkler head.

The concern and the initiative for an upgrade follows along well with what fire protection professionals and governing bodies such as the NFPA are advising in recent years. Enclosed parking areas are being pushed into higher hazard categories because of the wide variety of vehicles being parked in them and increasing hazards contained within each vehicle. The discussion stems from a few findings such as an increase in plastic used in most vehicle manufacturing, which acts as fuel to vehicle fires and leads to elevated heat release rates and fast-developing fires. As well as an increase in electric vehicles which contain electric motors and batteries which can lead to fires that take days to extinguish, rather than minutes or hours. Due to the ongoing changes with this type of occupancy, analysis is provided in the following pages to outline the changes necessary to upgrade to both an Extra Hazard Group 1 and an Extra Hazard Group 2 Occupancy. Depending upon the desire of the DTA to future-proof the system either option may be selected. In general, LHB agrees with the insurance agency that the space should be classified as Extra Hazard Group 1 based on industry knowledge as it stands.

EXTRA HAZARD GROUP 1 SYSTEM CHANGE SUMMARY

For further breakdown of the system changes considered see the table below. To upgrade the fire protection system to an Extra Hazard Group 1 classification LHB would expect the following changes to be necessary:

1. Perform new hydrant flow test to document available water supply at site.
2. Upsize Fire Service pipe and Dry zone risers from 4" to 6" to allow increased water flow.
 - a. Provide new 6" Backflow Prevention device, main piping, dry valves, shut-off valves etc. for upsized riser assemblies.
 - b. Provide new calculation showing the existing dry system air compressor is still capable of filling the new sized system within required time or provide a larger air compressor.
3. Ensure Branch piping is minimum of 2", replace any piping smaller with 2".
4. Upgrade dry valve, air vents, accelerators and other specialties associated with dry pipe system to lower the water transit time to 45 seconds or less.
5. Ensure all Fire Protection sprinklers are a K8.0 rating, any k factor sprinklers of lesser rating are to be replaced.
6. Replace any system components on riser that do not meet new flow rating.
7. Perform testing on new system to confirm new water transit time, compressed air system refill time.

The following table includes the Existing Condition Vs. Required new conditions, the prescribing code language and the action that will be required to upgrade the system from Ordinary Hazard to Extra Hazard Group 1.

EXTRA HAZARD GROUP 1 UPGRADE

	Code Language	Existing Condition	Upgraded Condition	Corrective Action to be taken
1	<u>NFPA-13 Table 7.2.3.6.1</u> (included in appendices) Dictates maximum water delivery time in Dry Fire Protection Systems.	Water Delivery time in latest inspection report is listed as 1 minute and 21 seconds.	Water Delivery must occur in 45 seconds or less.	System components (Dry valve, air vents, accelerators) must be upgraded to allow faster dry valve actuation and air bleed during system operation and water delivery test must be done to confirm new water delivery time.
2	<u>NFPA-13 8.2.1</u> Dictates the maximum zone area for Extra Hazard systems = 40,000 square feet.	Storage room (100,000sq ft) is broken into 3 zones, roughly 33,000 sq ft per zone.	Same as existing.	No action required.
3	<u>NFPA-13 Table 8.6.2.2.1</u> (included in appendices) Dictate the maximum allowable area of sprinkler coverage for differing Occupancy classifications.	Sprinkler Coverage is 130 square feet per sprinkler, equivalent to requirement for Ordinary Hazard occupancy.	At Extra Hazard Group-1 the maximum sprinkler operation is allowed to remain 130 square feet if the system is hydraulically calculated.	No action required, pending a new full system hydraulic calculation.
4	<u>NFPA-13 11.2.3.2.2.2</u> Bans the usage of "Quick Response" sprinklers in Extra Hazard Occupancies.	Existing Sprinkler Type Unknown, but given the age of the system it is unlikely any Quick Response Sprinklers are used.	No Quick Response Sprinklers, Minimum K8.0 sprinklers.	Remove and replace all quick response sprinklers with standard response sprinklers of a minimum size = K8.0.
5	<u>Fire Flow Test</u> New System hydraulic calculation and design will require a renewed hydrant flow test.	Existing Summit FP maintenance documents list an incoming water pressure of between 120-130# with unknown flow capacity.	EH-1 system with 6" main piping is expected to require 74# of pressure and 1800 gpm of water flow.	Replace all 4" main piping with 6" main Fire Protection Piping throughout system. Branch piping to be a minimum of 2".
6	<u>Equipment / Valve Listing</u> All new valves, pipes, equipment must be listed for new fire flow.	Unknown	BFPD listed to 1800 gpm flow, Dry Valve listed to 1300 gpm flow, all flow switches, inspectors test connections, FDC listed to 1300 gpm flow.	Upgrade Backflow prevention device, dry valve, inspectors test connection, fire department connection and all other valving as necessary to handle new water flow requirements.

Opinion of Probable Cost of Option:

940 feet of 4" pipe demolition and replacement with 6" pipe, 770 new K8.0 sprinkler heads, new 6" valves and BFPD. = \$200,000 in 2022 dollars before testing procedures.

ILLUSTRATION OF EH-1 WORK (RISER ROOM)

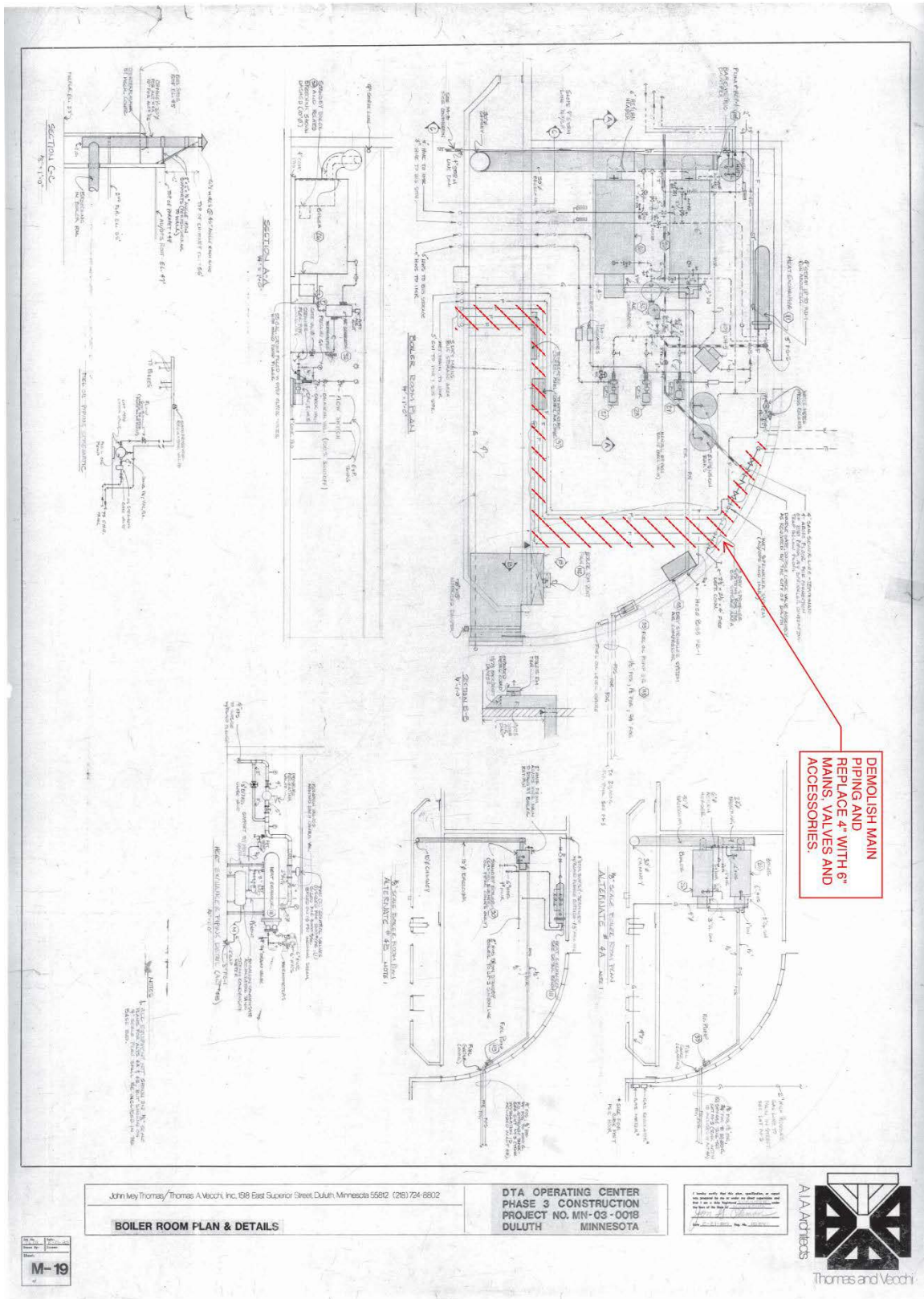
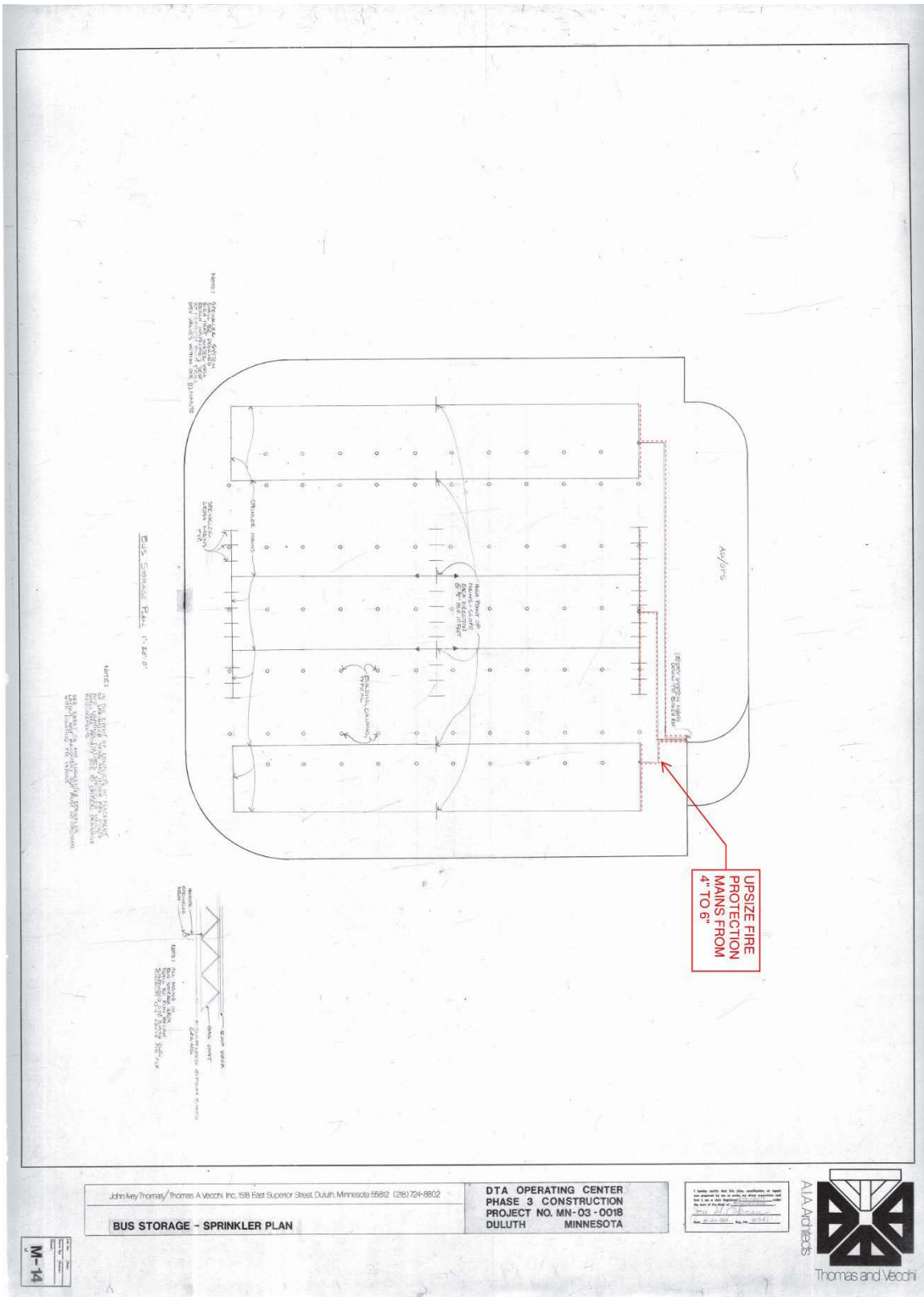


ILLUSTRATION OF EH-1 WORK (STORAGE ROOM)



John A. Thomas/Thomas A. Vecchi, Inc. 138 East Superior Street, Duluth, Minnesota 55802 (261) 724-8802

BUS STORAGE - SPRINKLER PLAN

**DTA OPERATING CENTER
 PHASE 3 CONSTRUCTION
 PROJECT NO. MN-03-0018
 DULUTH MINNESOTA**

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer in the State of Minnesota. My License No. is 123456789.

Date: 10/10/2018



M-14

EXTRA HAZARD GROUP 2 SYSTEM CHANGE SUMMARY

For further breakdown of the system changes considered see the table below. To upgrade the fire protection system to an Extra Hazard Group 2 classification LHB would expect the following changes to be necessary:

1. Perform new hydrant flow test to document available water supply at site.
2. Upsize Fire Service pipe and Dry zone risers from 4" to 8" to allow increased water flow.
 - a. Provide new 8" Backflow Prevention device, main piping, dry valves, shut-off valves etc. for upsized riser assemblies.
 - b. Provide new calculation showing the existing dry system air compressor is still capable of filling the new sized system within required time or provide a larger air compressor.
3. Replace all branch piping with new 3" main piping.
4. Install new sprinklers at 100 square feet spacing, need approximately 231 more sprinklers than the existing layout.
5. Upgrade dry valve, air vents, accelerators and other specialties associated with dry pipe system to lower the water transit time to 45 seconds or less.
6. Ensure all Fire Protection sprinklers are a K8.0 rating, any k factor sprinklers of lesser rating are to be replaced.
7. Replace any system components on riser that do not meet new flow rating.
8. Perform testing on new system to confirm new water transit time, compressed air system refill time.

The following table includes the Existing Condition Vs. Required new conditions, the prescribing code language and the action that will be required to upgrade the system from Ordinary Hazard to Extra Hazard Group 2.

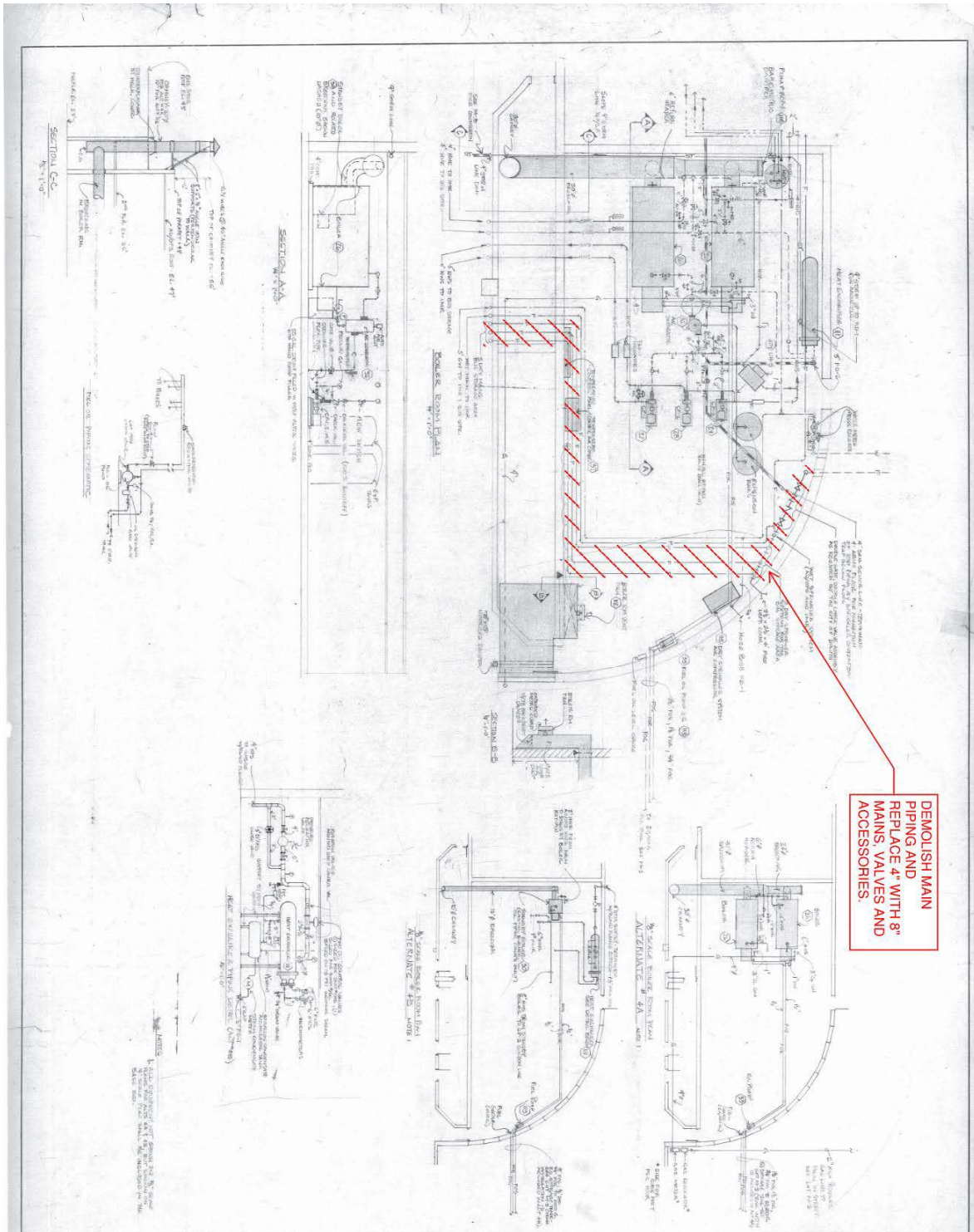
EXTRA HAZARD GROUP 2 UPGRADE

	Code Language	Existing Condition	Upgraded Condition	Corrective Action to be taken
1	<u>NFPA-13 Table 7.2.3.6.1</u> (included in appendices) Dictates maximum water delivery time in Dry Fire Protection Systems.	Water Delivery time in latest inspection report is listed as 1 minute and 21 seconds.	Water Delivery must occur in 45 seconds or less.	System components (Dry valve, air vents) must be upgraded to allow faster dry valve actuation and air bleed during system operation and water delivery test must be done to confirm new water delivery time.
2	<u>NFPA-13 8.2.1</u> Dictates the maximum zone area for Extra Hazard systems = 40,000 square feet.	Storage room (100,000sq ft) is broken into 3 zones, roughly 33,000 sq ft per zone.	Same as existing.	No action required.
3	<u>NFPA-13 Table 8.6.2.2.1</u> (included in appendices) Dictate the maximum allowable area of sprinkler coverage for differing Occupancy classifications.	Sprinkler Coverage is 130 square feet per sprinkler, equivalent to requirement for Ordinary Hazard occupancy.	At Extra Hazard Group-2 the maximum sprinkler operation is allowed to remain 100 square feet if the system is hydraulically calculated.	Re-layout all sprinklers in Fire Protection system to reduce area of coverage from 130 to 100 square feet per head. Additional 231 sprinkler heads needed approximately.
4	<u>NFPA-13 11.2.3.2.2.2</u> Bans the usage of "Quick Response" sprinklers in Extra Hazard Occupancies.	Existing Sprinkler Type Unknown, but given the age of the system it is unlikely any Quick Response Sprinklers are used.	No Quick Response Sprinklers	Remove and replace all quick response sprinklers with standard response sprinklers
5	<u>Fire Flow Test</u> New System hydraulic calculation and design will require a renewed hydrant flow test.	Existing Summit FP maintenance documents list an incoming water pressure of between 120-130# with unknown flow capacity.	EH-2 system with 6" main piping is expected to require 74# of pressure and 2450 gpm of water flow.	Replace all 4" main piping with 8" Riser piping, 8" main piping and 3" branch piping throughout system.
6	<u>Equipment / Valve Listing</u> All new valves, pipes, equipment must be listed for new fire flow.	Unknown	BFPD listed to 1800 gpm flow, Dry Valve listed to 1950 gpm flow, all flow switches, inspectors test connections, FDC listed to 1950 gpm flow.	Upgrade Backflow prevention device, dry valve, inspectors test connection, fire department connection and all other valving as necessary to handle new water flow requirements.

Opinion of Probable Cost of Option:

940 feet of 4" pipe demolition and replacement with 8" pipe, 1000 new K8.0 sprinkler heads, new 8" valves and BFPD, Demolition of 2" branch lines and all new (24) 3" branch lines at 300' each = \$690,000 in 2022 dollars before testing procedures.

ILLUSTRATION OF EH-2 WORK (RISER ROOM)



John Key Thomas/Thomas A Vecchi, Inc. 69 East Superior Street, Duluth, Minnesota 55812 (26) 724-8802

BOILER ROOM PLAN & DETAILS

DTA OPERATING CENTER
PHASE 3 CONSTRUCTION
PROJECT NO. MN-03-0018
DULUTH MINNESOTA

1. Under the terms of the contract, the contractor shall be responsible for the cost of any and all materials and labor required for the work shown on this drawing and for the cost of any and all permits required for the work shown on this drawing.

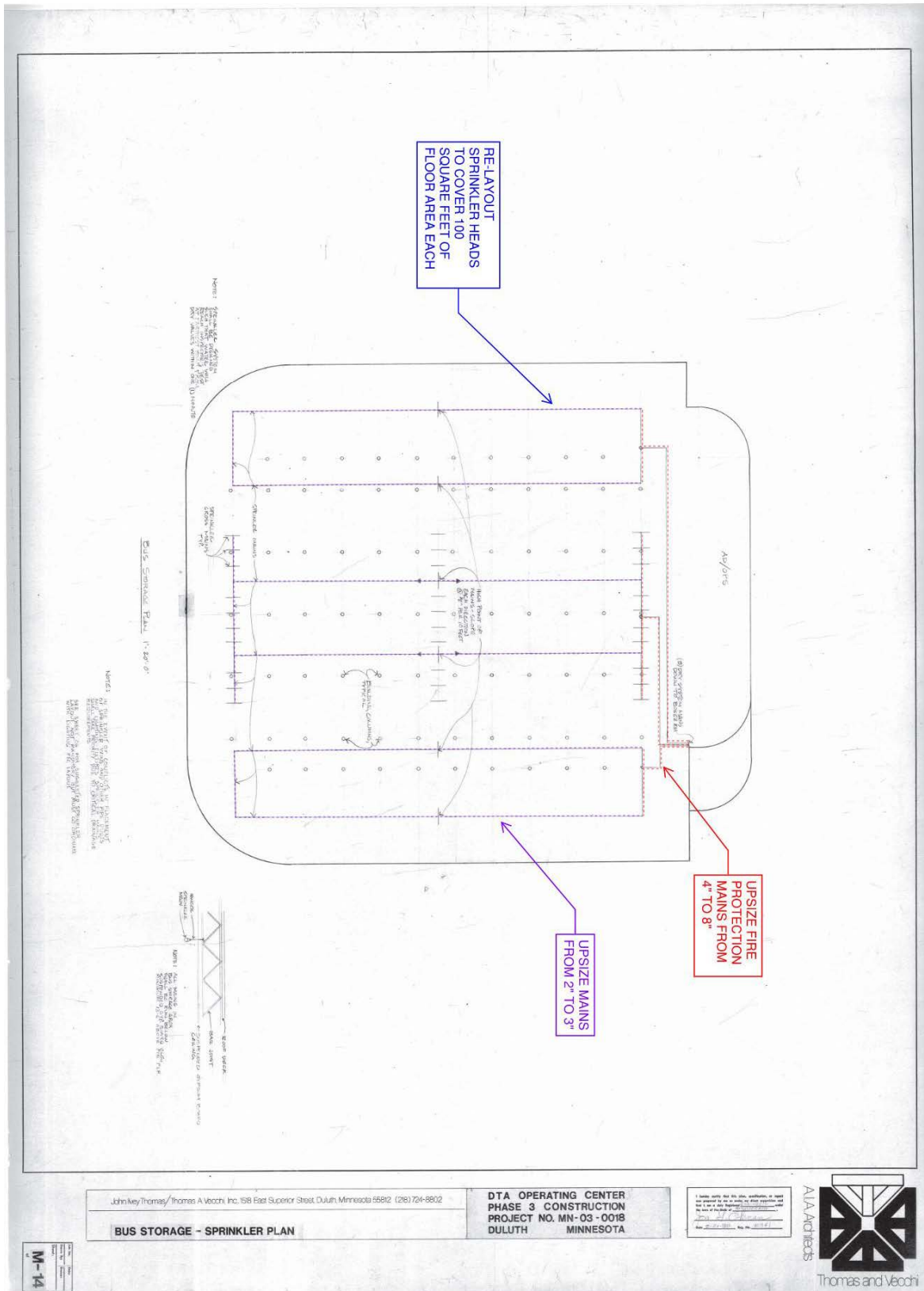
AIA ARCHITECTS



Thomas and Vecchi

M-19

ILLUSTRATION OF EH-2 WORK (STORAGE ROOM)



ADDITIONAL CONSIDERATIONS

Some additional considerations for work that could occur during the upgrade period include:

1. Changing the Dry System air compressor out for a Nitrogen Generator.
 - a. A nitrogen generator performs the same duty of pressurizing the system piping, but it takes the standard air at atmospheric conditions and filters out most other particles aside from Nitrogen. Nitrogen is an inert gas which will not corrode the inside of the dry system piping, greatly increasing the longevity of the system.
 - b. A nitrogen pressurized system benefits from different pipe roughness factors in hydraulic calculations, which could lead to reduced system rework.
 - c. A nitrogen generator is essentially a specialized air compressor and thus cost can be expected to be anywhere from \$X,XXX-\$XX,XXX for the equipment and installation based on system size.
2. When the hydraulic calculation is done by the installing contractor, some consideration should be given to splitting the mains further to keep most of the main piping at 4". Upsizing the mains in a dry system comes with some complications. Bigger mains mean more pipe volume, which will increase fill time both of water and compressed air. NFPA dictates maximum fill times or delivery times for both water and air to put a system back in service.
3. Taking a "pipe sample" to see how much corrosion has occurred on the inside surfaces of the system piping.
 - a. This sample is required on systems 50 years of older, the system is at 40 years old right now so if there is down time associated with this work it would be the perfect time to perform the test.
4. Temporary Fire Protection
 - a. The facility is key to storing, fueling, and charging the buses that keep the DTA running daily. When the upgrade work occurs the Fire Protection system will be brought offline for weeks, and work will need to occur in the storage room itself. Thought must be given to temporary fire protection systems if the facility is to maintain its service during the construction. A temporary water service would be required as the riser is replaced, and the branch piping will need to be fed from a different source as the mains are replaced. NFPA 241 outlines acceptable practices for Fire Protection of Construction and Renovation projects and this work would warrant the creation of a temporary FP plan that should be created with input from the Duluth FD and the local Authority Having Jurisdiction. The opinions of costs above do not take into account this additional work, but LHB would assume that this would amount to 10's of thousands of dollars of added cost, depending on how it is achieved and how long the temporary system will be in place.

Table 7.2.3.6.1 Dry Pipe System Water Delivery

Hazard	Number of Most Remote Sprinklers Initially Open	Maximum Time of Water Delivery (seconds)
Light	1	60
Ordinary I	2	50
Ordinary II	2	50
Extra I	4	45
Extra II	4	45
High piled	4	40

Table 8.6.2.2.1(b) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Ordinary Hazard

Construction Type	System Type	Protection Area		Maximum Spacing	
		ft ²	m ²	ft	m
All	All	130	12.1	15	4.6

Table 8.6.2.2.1(c) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Extra Hazard

Construction Type	System Type	Protection Area		Maximum Spacing	
		ft ²	m ²	ft	m
All	Pipe schedule	90	8.4	12*	3.7*
All	Hydraulically calculated with density ≥ 0.25	100	9.3	12*	3.7*
All	Hydraulically calculated with density < 0.25	130	12.1	15	4.6

*In buildings where solid structural members create bays up to 25 ft (7.6 m) wide, maximum spacing between sprinklers is permitted up to 12 ft 6 in. (3.8 m).