

Lessons Learned from a 60" CIPP Storm Sewer Liner Installation



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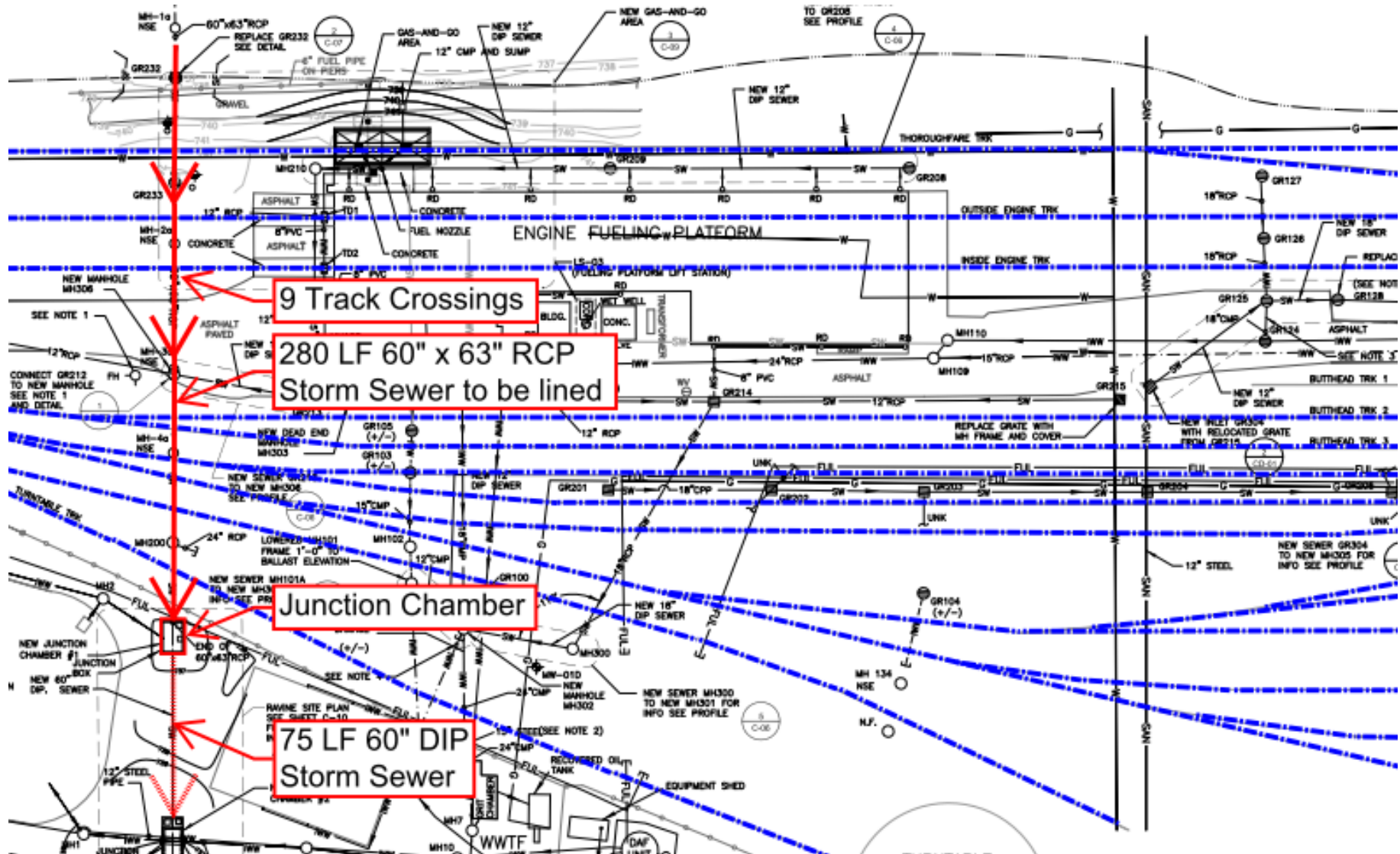
Presentation Outline

1. CIPP Project Scope
2. CIPP Liner Installation
3. Defects Identified
4. Warranty Repairs
5. Lessons Learned
6. Questions

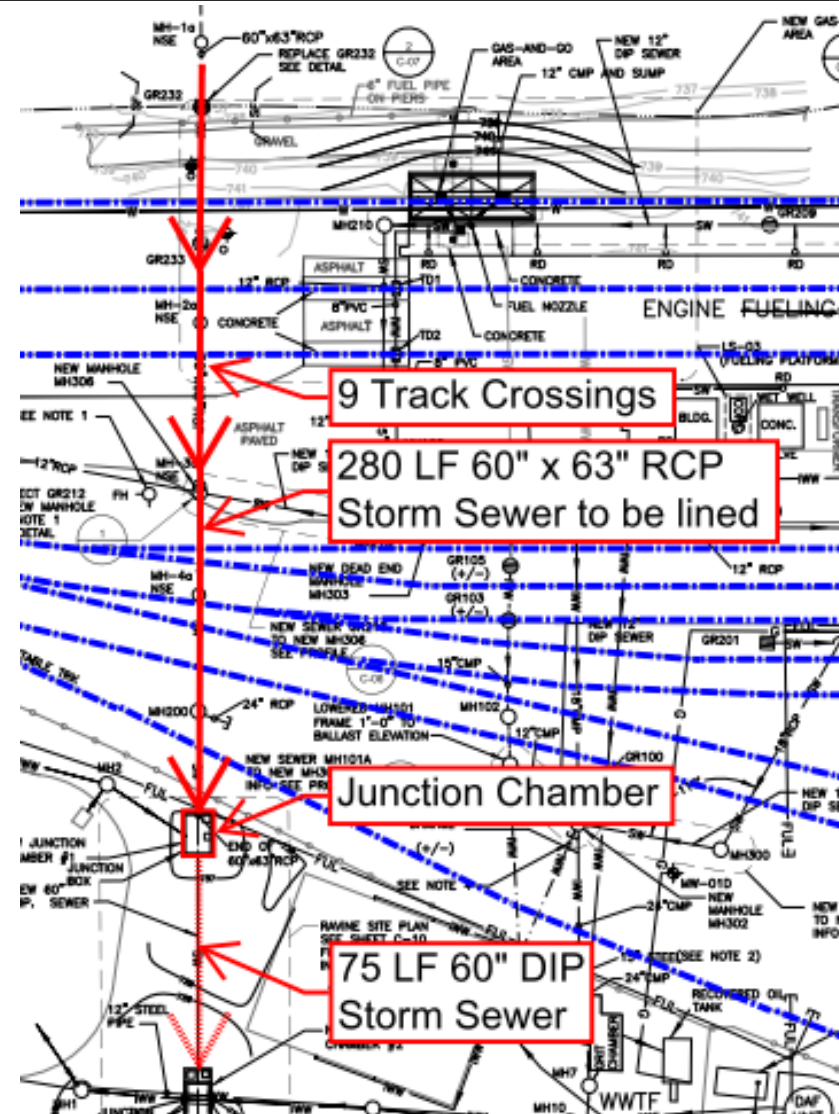
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CIPP Project Scope: Norris Yard, Irondale, AL

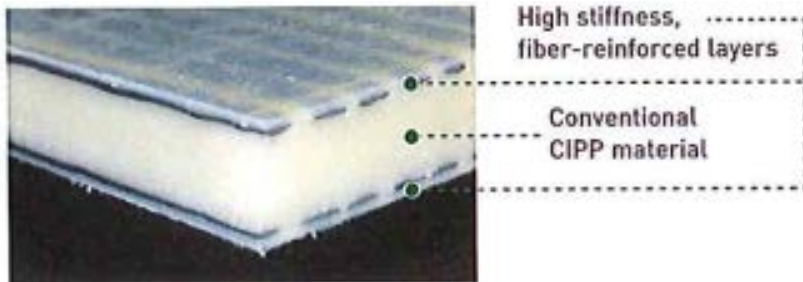


CIPP Project Scope



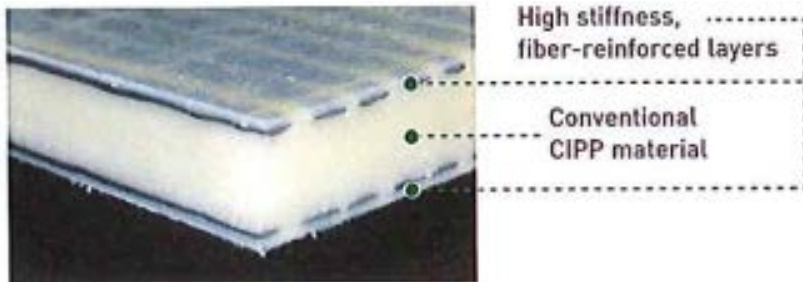
- 60" x 63" RCP storm sewer:
 - Multiple cracks and joint leaks (20+) allowing petroleum-impacted groundwater to seep into the pipe
- Clean pipe
- Plug upstream pipe
- Install bypass pumps, if required
- Grout soil behind pipe, if required
- Install a CIPP liner
- Cure CIPP liner
- Provide a 1-year liner warranty

CIPP Project Scope



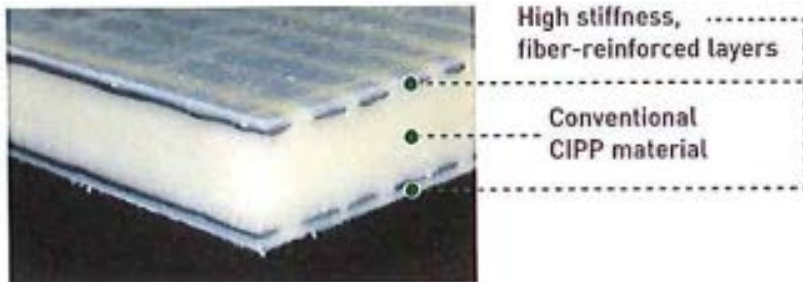
- CIPP Liner:
 - 1" thick composite material
 - Glass fiber-reinforced felt material impregnated with resin
 - Resin cured with heat
- Resin Options:
 - Polyester
 - Vinyl Ester
- Heat Curing Methods:
 - Steam
 - Hot Water

CIPP Project Scope



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2. CIPP Liner Installation: 12/5/2013 (after extended dry period)
3. Defects Identified
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CIPP Liner Installation: Junction Chamber



CIPP Liner Installation: 60"x 63" RCP Prior to Installation



CIPP Liner Installation: 60" x 63" RCP Prior to Installation



CIPP Liner Installation: Inversion Frame



CIPP Liner Installation: CIPP & Refrigeration Tractor Trailer



CIPP Liner Installation: Steam Curing of Liner (12/5/2013)



CIPP Liner Installation: End of Cured Liner (12/10/2013)



CIPP Liner Installation: End of Cured Liner (12/27/2013)



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2. CIPP Liner Installation
3. Defects Identified: 1/15/2014 (following 5-6 rain events after liner installation)
4. Warranty Repairs
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Defects Identified: Raised Invert or Bubble (1/15/2014)



Defects Identified: Raised Invert or Bubble (1/15/2014)



Defects Identified: Comparison Before/After



12/27/2013



1/15/2014

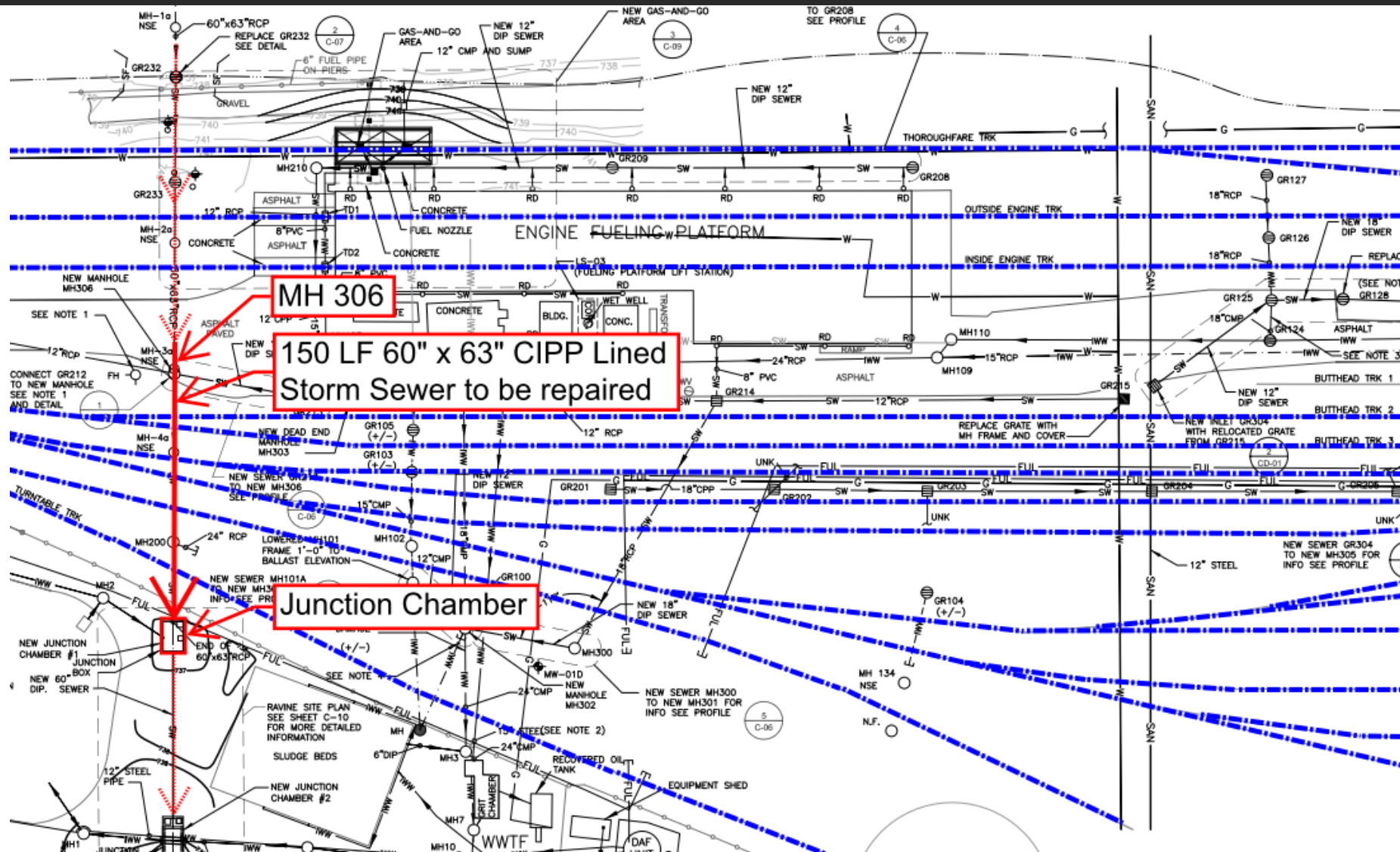
Defects Identified: CIPP Liner Inspection (6/6/2014)



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4. Warranty Repairs: 1/23/2017 to 2/3/2017 (wet period with high groundwater levels)
5. Lessons Learned
6. Questions

Warranty Repairs



Warranty Repairs

- Removed raised top layer of CIPP liner (3/16" thick) with pneumatic tools from 4 o'clock to 8 o'clock from Junction Chamber to MH 306
- Several major water leaks identified, approx. 50 gpm
- Drilled holes through CIPP liner and RCP into surrounding soil; injected approx. 65 gal. of expanding, hydrophilic, polyurethane foam grout to stop leaks
- Filled remaining holes with hydraulic cement
- Applied 100 mils of Raven 405 primer on repaired surfaces
- Applied 300-700 mils of Raven 512 top coat
- Total liner repair thickness: 7/16"-9/16"

Warranty Repairs

- Polyurethane Foam Grout

- Avanti AV-333 Injectaflex: Single component, mid-range viscosity, moisture activated polyurethane injection resin. Expands 400%-600%

- Raven Products

- 405 Primer: 100% solids, ultra high build epoxy coating
- 512 Top Coat: Polyurea protective coating, chemically resistant to petroleum products

Warranty Repairs: Removal of defective top layer of liner



Warranty Repairs: Completed Liner Repair



Warranty Repairs: Completed MH 306 Repair



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Lessons Learned

- Critical Specification Items

- The project specification allowed the CIPP Liner Company to use their expertise of their product to select the following items:
 - Type of Resin (specification identified diesel fuel and petroleum in groundwater)
 - Resin Curing Method
 - Installation Conditions
- These three items are believed to be the main reasons for the liner defects.

Lessons Learned

- Type of Resin:
 - Polyester resin was chosen by the CIPP Liner Company.
 - Polyester resin is not as compatible with petroleum products and diesel fuels as vinyl ester resin.
 - The project specification stated groundwater was impacted by diesel fuel and oil.
 - Require the CIPP Liner Company to provide vinyl ester resin for any installations where the liner will come into contact with petroleum products such as oils and diesel fuels.

Lessons Learned

- Resin Curing Method:
 - The CIPP Liner Company decided to use steam to cure the liner resin as it is more cost effective.
 - For large pipe diameters, steam may not provide a uniform heating source.
 - Require the CIPP Liner Company to use hot water curing, as it provides a more uniform distribution of heat.

Lessons Learned

- Installation Conditions:

- The CIPP liner was installed after an extended dry period and no grouting was done before the liner was installed.
- Liner repairs were performed during a wet period with active leaks.
- The liner repair company was forced to stop leaks prior to actual liner repairs were made.
- Require the CIPP Liner Company to install the liner during a wet period and stop all active leaks prior to the liner installation.

Questions

