



Memorandum

To: Deerfield Regional Storm Water District

From: Chris Calpin & Andrew Bohlen

Date: July 22, 2008

Subject: Greenfield Place Storm Sewer Repair Cost Estimate

Background

The intent of this memorandum is to provide the District with a conservative range of planning level estimated probable engineering and construction costs for several alternatives to repair the storm sewer collapses in the Greenfield Place subdivision. In late 2006, the ADS HDPE storm sewer in this subdivision experienced failure at two separate locations – one to the south of Storm Structure #12 and one to the east of Storm Structure #11, as seen in **Figure 1**. These failures led to the subsequent formation of sinkholes at these two locations. These failures have since impeded the proper conveyance of storm water from the area and have resulted in street flooding, basement flooding and safety concerns. Whatever the ultimate repair, the intent should be to eliminate the sink holes by replacing the failed and degraded sections of pipe - thus restoring the necessary storm sewer system conveyance capacity - and repair the ancillary erosion problems that have occurred since the pipe failures at Storm Structures #6 and #7.

Extent of Proposed Repairs

Figure 1 describes the extent of the proposed repairs, which includes replacing the 650 linear feet of existing storm sewer between Storm Structures #8 and #11, replacing 350 linear feet of existing storm sewer between Storm Structures #11 and #12, and repairing the erosion at Structures #6 and #7. This is a more comprehensive solution than what was proposed by Kevin Jehl of Advanced Drainage Systems, Inc. (ADS) in March 2007 upon reviewing the results of the investigation conducted by Deerfield Township. At that time, Mr. Jehl suggested a repair strategy that included the replacement of storm pipe only in the vicinity of each collapse and only for that portion of storm pipe that did not show a consistent shape and acceptable deflection. ADS recommended that connections between new and existing pipe be made with a mastic coupler, in lieu of replacing complete sections of pipe between manhole structures. The results of the 2007 investigation showed that between Storm Structures #11 and #12 there were several joints of the HDPE pipe that did not appear to be pushed home properly. ADS recommended that internal seals be used in these locations as an alternative to complete and full replacement of this pipe.



Deerfield Regional Storm Water District
July 16, 2008
Page 2

As described in the June 10, 2008 memorandum to the District, the data that has been collected indicates that a complete repair is necessary for all pipe between Structure #8 and Structure #11 as well as all pipe between Structure #11 and Structure #12.

Assumptions

The following assumptions were made to prepare conservative planning level estimated probable engineering and construction costs:

1. the system as designed meets current Warren County Storm Water Regulations (i.e, the existing storm sewer sizes are adequate),
2. no elements of the existing storm sewer system can be reused in the area of concern,
3. existing bedding material is unacceptable and needs to be hauled off-site, and
4. new bedding material will need to be purchased and delivered to the site.

Alternatives

The planning level estimated probable engineering and construction costs were prepared for four separate viable alternatives. Alternatives 1 through 3 share in common the extent of repairs and assumptions described previously. Alternative 4 is a trenchless technology and therefore has its own unique set of assumptions. A fifth alternative was considered non-viable and an estimated probable engineering and construction cost was not prepared.

Alternative 1 - Replace Existing ADS HDPE Pipe with Reinforced Concrete Pipe (RCP)

Table 1 provides an estimate of probable engineering and construction costs associated with a complete replacement of all existing ADS HDPE pipe with reinforced concrete pipe (RCP). This alternative uses replacement pipe material that is stronger and thus more expensive than the existing pipe material. As shown in Table 1, the total estimated probable engineering and construction cost for this alternative is \$380,000.

Alternative 2 - Replace Existing ADS HDPE Pipe with Newly Manufactured HDPE Pipe

Table 2 provides an estimate of probable engineering and construction costs associated with a complete replacement of all existing ADS HDPE pipe with newly manufactured HDPE pipe. This alternative uses the same pipe material that is currently in the ground



with the exception that it is newly manufactured. As shown in Table 2, the total estimated probable engineering and construction cost for this alternative is \$342,000.

Alternative 3 - ADS Provides HDPE Pipe at No Charge

Table 3 provides an estimate of probable engineering and construction costs associated with a complete replacement of all existing ADS HDPE pipe with newly manufactured ADS HDPE pipe. The primary difference between this alternative and Alternative 2 is that ADS provides the HDPE pipe at no charge. In March of 2007, Mr. Jehl indicated that ADS would be willing to discuss providing the pipe material at no charge for only those limited sections of pipe not showing a consistent shape and acceptable deflection. CDM has not communicated or corresponded with ADS regarding this alternative, which is larger in scope; therefore, the feasibility of proceeding with this option as presented must still be confirmed with ADS. As shown in Table 3, the total estimated probable engineering and construction cost for this alternative is \$240,000. If ADS is willing to provide at no charge the bedding and backfill material costs, the total estimated probable engineering and construction cost for this alternative would be reduced by \$37,000 for a revised total of \$203,000. This cost estimate is detailed in Table 3a.

Alternative 4 - Installation of a CIPP Liner

A fourth alternative is cured-in-place plastic pipe (CIPP), which is installed as a liner inside the existing HDPE storm sewer. While this is a relatively new technology (since 1990), it has been reported that over 65 million feet of CIPP has been installed worldwide. The installation of this alternative would come with a one-year bonding warranty and be specified for a minimum 50-year design life. This option includes the structural reinforcement and rebuilding of the storm pipe between Structures #8 through #12 with a minimal amount of excavation and disruption to property owners along the length of the storm sewer. CDM has confirmed that CIPP is a viable option for this repair when paired with a complete pipe replacement at each of the two sinkhole locations. The primary purpose of this alternative is to provide the District and impacted property owners an option that is minimally disruptive. Therefore, the assumptions unique to this alternative are included at the bottom of Table 4. If these assumptions are found to be untrue, the advantages of this alternative are diminished and proceeding with this alternative may be cost prohibitive as compared to the other alternatives. As shown in Table 4, the total estimated probable engineering and construction cost for this alternative is \$425,000.

Alternative 5 - ADS Recommended Repair Strategy

A fifth alternative is to proceed with repairs per Mr. Jehl's repair strategy suggestions from March 2007. This included the replacement of storm pipe only in the vicinity of



Deerfield Regional Storm Water District
July 16, 2008
Page 4

each collapse and only for that portion of storm pipe that did not show a consistent shape and acceptable deflection. ADS recommended that connections between new and existing pipe be made with a mastic coupler, in lieu of replacing complete sections of pipe between manhole structures. Additionally, Mr. Jehl recommended using an internal seal at points in the existing pipe to prevent the intrusion of backfill material at joints that may not have been fully pushed home during initial installation. Based upon the results of the televising conducted in March and May of 2008, CDM does not recommend proceeding with this alternative.

Conclusions

As the District and/or others considers and evaluates the aforementioned alternatives, it might be helpful to keep the following risk criteria in mind: public acceptability, economic reasonability, and system reliability.

It might be reasonable to characterize Alternative 1 as the lowest overall risk with a high level of public acceptance and reliability that comes with a high cost.

Alternatives 2 and 3 both include proposed repairs utilizing HDPE pipe material with Alternative 3 specifically utilizing ADS HDPE pipe material at no cost. To use the same material (albeit newly manufactured) that is associated with the existing failures could spark significant debate and/or objection to all those affected. It might be reasonable to characterize Alternatives 2 and 3 as a higher level of risk than Alternative 1 with perhaps a lower level of public acceptance and reliability that comes at a lower overall cost.

Alternative 4 includes the installation of a CIPP liner within the existing storm sewer. The use of this trenchless technology would minimize the duration of construction and soil excavation needed for the project; therefore, this alternative may have a higher level of public acceptance than the other alternatives. Additionally, because this option does not include excavation and trenching there are environmental benefits such as reduced sediment runoff during construction and the preservation of existing trees and bushes. This option does not however, include the replacement of the existing bedding and backfill material. If the existing bedding and backfill material was not compacted properly, additional settling may still occur along the alignment of this pipe. It might be reasonable to characterize Alternative 4 as the least disruptive with perhaps a higher level of public acceptance that comes at a higher overall cost with a risk factor greater than Alternative 1 and less than Alternatives 2 and 3. This risk conclusion is reached by comparing a repeated incidence of full pipe failure associated with Alternatives 2 and 3 versus the potential for continued settling of the backfill material in Alternative 4.



Deerfield Regional Storm Water District
July 16, 2008
Page 5

Due to the amount and extent of pipe deflection throughout the system in question, which is beyond the CPPA limit of 7.5%, CDM does not consider Alternative 5 a viable option.

In order to meet the full intent of these potential repairs, which is to return the storm sewer system to its necessary conveyance capacity, the sediment and debris that has accumulated in the system since the collapses have occurred must also be removed, regardless of which alternative is deemed most appropriate.

cc: File



FIGURE 1
Greenfield Place Stormwater Investigation
Extent of Proposed Repair
Deerfield Township Regional Stormwater District

Table 1
Greenfield Place
Storm Sewer Replacement
Estimated Probable Engineering and Construction Cost



Alternative 1 - Replace Existing ADS HDPE Pipe with Reinforced Concrete Pipe (RCP)

Description	Estimated Quantities	Unit	Unit Cost	Total Cost
Demo Existing ADS Pipe and Manholes	1.0	LS	\$ 9,606	\$ 9,606
Site Finish Grade	0.6	AC	\$ 6,132	\$ 3,679
Manhole Excavation	100	CY	\$ 11	\$ 1,050
Trenching	3,036	CY	\$ 22	\$ 66,185
Excavation Spoils	1,673	CY	\$ 11	\$ 19,055
Rip Rap & Rock Lining	20	CY	\$ 204	\$ 4,084
Storm Drainage Manholes	4.0	EA	\$ 3,721	\$ 14,883
Restore Disturbed Area	0.6	AC	\$ 1,406	\$ 844
Vactor Truck	16	HRS	\$ 120	\$ 1,920
3-Man Vactor Crew	16	HRS	\$ 40	\$ 1,920
Concrete Pipe (RCP)	1,000	LF	\$ 162	\$ 161,750
<i>Subtotal 1</i>				<i>\$ 285,000</i>
10% Contingency				\$ 29,000
Engineering, Surveying, & Legal (15%)				\$ 43,000
General Construction and Resident Project Representative Services (8%)				\$ 23,000
Total Estimated Probable Engineering & Construction Cost				\$ 380,000

Assumptions:

1. The existing storm system as designed meets the County's current storm water regulations.
2. Existing catch basins and manholes will be replaced as part of the storm sewer replacement.
3. Existing bedding material is unfit for backfill and will need to be hauled off-site
4. Acceptable bedding material will need to be delivered to the site.
5. Unit costs include contractor mobilization of 5%.
6. General construction and RPR services assumes a labor effort of 2 days/week for 12 weeks.

Table 2
Greenfield Place
Storm Sewer Replacement
Estimated Probable Engineering and Construction Cost
Alternative 2 - Replace Existing ADS HDPE Pipe with Newly Manufactured HDPE Pipe



Description	Estimated Quantities	Unit	Unit Cost	Total Cost
Demo Existing ADS Pipe and Manholes	1.0	LS	\$ 9,606	\$ 9,606
Site Finish Grade	0.6	AC	\$ 6,132	\$ 3,679
Manhole Excavation	100	CY	\$ 11	\$ 1,050
Trenching	2,769	CY	\$ 31	\$ 85,534
Excavation Spoils	1,432	CY	\$ 23	\$ 32,365
Rip Rap & Rock Lining	20	CY	\$ 102	\$ 2,042
Storm Drainage Manholes	4.0	EA	\$ 3,721	\$ 14,883
Restore Disturbed Area	0.6	AC	\$ 1,406	\$ 844
Vactor Truck	16	HRS	\$ 120	\$ 1,920
3-Man Vactor Crew	16	HRS	\$ 40	\$ 1,920
HDPE Pipe	1,000	LF	\$ 102	\$ 102,034
<i>Subtotal 1</i>				\$ 256,000
10% Contingency				\$ 26,000
Engineering, Surveying, & Legal (15%)				\$ 39,000
General Construction and Resident Project Representative Services (8%)				\$ 21,000
Total Estimated Probable Engineering & Construction Cost				\$ 342,000

Assumptions:

1. The existing storm system as designed meets the County's current storm water regulations.
2. Existing catch basins and manholes will be replaced as part of the storm sewer replacement.
3. Existing bedding material is unfit for backfill and will need to be hauled off-site
4. Acceptable bedding material will need to be delivered to the site.
5. Unit costs include contractor mobilization of 5%.
6. General construction and RPR services assumes a labor effort of 2 days/week for 12 weeks.

Table 3
Greenfield Place
Storm Sewer Replacement
Estimated Probable Engineering and Construction Cost
Alternative 3 - ADS Provides HDPE Pipe at No Charge



Description	Estimated Quantities	Unit	Unit Cost	Total Cost
Demo Existing ADS Pipe and Manholes	1.0	LS	\$ 9,606	\$ 9,606
Site Finish Grade	0.6	AC	\$ 6,132	\$ 3,679
Manhole Excavation	100	CY	\$ 11	\$ 1,050
Trenching	2,769	CY	\$ 31	\$ 85,534
Excavation Spoils	1,432	CY	\$ 23	\$ 32,365
Rip Rap & Rock Lining	20	CY	\$ 102	\$ 2,042
Storm Drainage Manholes	4.0	EA	\$ 3,721	\$ 14,883
Restore Disturbed Area	0.6	AC	\$ 1,406	\$ 844
Vactor Truck	16	HRS	\$ 120	\$ 1,920
3-Man Vactor Crew	16	HRS	\$ 40	\$ 1,920
ADS HDPE Pipe Contractor Installation	1,000	LF	\$ 26	\$ 25,910
<i>Subtotal 1</i>				\$ 180,000
10% Contingency				\$ 18,000
Engineering, Surveying, & Legal (15%)				\$ 27,000
General Construction and Resident Project Representative Services (8%)				\$ 15,000
Total Estimated Probable Engineering & Construction Cost				\$ 240,000

Assumptions:

1. The existing storm system as designed meets the County's current storm water regulations.
2. Existing catch basins and manholes will be replaced as part of the storm sewer replacement.
3. Existing bedding material is unfit for backfill and will need to be hauled off-site
4. Acceptable bedding material will need to be delivered to the site.
5. Unit costs include contractor mobilization of 5%.
6. General construction and RPR services assumes a labor effort of 2 days/week for 12 weeks.

Table 3a
Greenfield Place
Storm Sewer Replacement
Estimated Probable Engineering and Construction Cost
Alternative 3 - ADS Provides HDPE Pipe at No Charge



Description	Estimated Quantities	Unit	Unit Cost	Total Cost
Demo Existing ADS Pipe and Manholes	1.0	LS	\$ 9,606	\$ 9,606
Site Finish Grade	0.6	AC	\$ 6,132	\$ 3,679
Manhole Excavation	100	CY	\$ 11	\$ 1,050
Trenching	2,769	CY	\$ 20	\$ 56,017
Excavation Spoils	1,432	CY	\$ 23	\$ 32,365
Rip Rap & Rock Lining	20	CY	\$ 102	\$ 2,042
Storm Drainage Manholes	4.0	EA	\$ 3,721	\$ 14,883
Restore Disturbed Area	0.6	AC	\$ 1,406	\$ 844
Vactor Truck	16	HRS	\$ 120	\$ 1,920
3-Man Vactor Crew	16	HRS	\$ 40	\$ 1,920
ADS HDPE Pipe Contractor Installation	1,000	LF	\$ 26	\$ 25,910
<i>Subtotal 1</i>				\$ 151,000
10% Contingency				\$ 16,000
Engineering, Surveying, & Legal (15%)				\$ 23,000
General Construction and Resident Project Representative Services (8%)				\$ 13,000
Total Estimated Probable Engineering & Construction Cost				\$ 203,000

Assumptions:

1. The existing storm system as designed meets the County's current storm water regulations.
2. Existing catch basins and manholes will be replaced as part of the storm sewer replacement.
3. Existing bedding material is unfit for backfill and will need to be hauled off-site
4. Acceptable bedding material will need to be delivered to the site.
5. Unit costs include contractor mobilization of 5%.
6. General construction and RPR services assumes a labor effort of 2 days/week for 12 weeks.

Table 4
Greenfield Place
Storm Sewer Replacement
Estimated Probable Engineering and Construction Cost
Alternative 4 – Cured-In-Place Plastic Pipe (CIPP) Trenchless Technology



Deerfield Regional Storm Water District

July 16, 2008

Page 11

Description	Estimated Quantities	Unit	Unit Cost	Total Cost
42" Storm Sewer Cleaning	630	LF	\$ 17	\$ 10,710
48" Storm Sewer Cleaning	340	LF	\$ 17	\$ 5,780
36"x48"x24mm CIPP	630	LF	\$ 240	\$ 151,200
41"x57"x28.5mm CIPP	340	LF	\$ 358	\$ 121,720
42" HDPE Point Repair	50	LF	\$ 270	\$ 13,500
48" HDEP Point Repair	50	LF	\$ 280	\$ 14,000
Rip Rap and Rock Lining	20	CY	\$ 102	\$ 2,040
<i>Subtotal 1</i>				\$ 319,000
10% Contingency				\$ 32,000
Engineering, Surveying, & Legal (15%)				\$ 48,000
General Construction and Resident Project Representative Services (8%)				\$ 26,000
Total Estimated Probable Engineering & Construction Cost				\$ 425,000

Assumptions:

1. The existing storm system as designed meets the County's current storm water regulations.
2. Existing manholes do not need to be replaced.
3. Existing bedding and backfill material is adequate.
4. General construction and RPR services assumes a labor effort of 2 days/week for 12 weeks.