APPENDIX G

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Memo

Date: February 8, 2006	Number of pages: 3 plus attached Tables and Figures
To: Gary Brandt, Gary Thalken, Brian Kramer, Dave Beyersdorf	
Firm: Lincoln Wastewater System	
Project: Oak Creek Trunk Sewer Study	
From: Kent Prior, Scott Aurit	Job No: 20843

RE: Additional Analysis of Capacity in Segment E-2 (West Mathis Street from NW 41st Street to NW 36th Street)

The existing sewer segment E-2 (West Mathis Street from NW 41st Street to NW 36th Street) was identified in the Oak Creek Basin Sewer Study Preliminary Design Report as having an existing capacity of only 5.2 cfs based on no surcharging. This small capacity for the 27 inch sewer is directly related to the negative grades that resulted from the sewer construction between Manholes AA7-7 and AA7-6. To overcome the negative grade, surcharging of the pipe will occur at higher flows. This memorandum discusses modeling of Segments E-2 (West Mathis from NW 41st Street to NW 36th Street), E-2 (NW 41st Street from West Mathis Street to Airpark Road), and the existing Siphon for near future flow conditions

Basis for Modeling

The Segments E-2, E-3, and existing Siphon were modeled to determine the maximum capacity of Segment E-2 with limited surcharging. It was assumed for the modeling that the existing Segment E-3 was replaced with a 36 inch sewer along NW 41st Street from West Mathis Street to Air Park Road and the existing Siphon had an additional 24 inch barrel installed beneath Oak Creek.

The existing flows from the west side of Oak Creek, through the siphon, and from the east side of Oak Creek through Segment E-3 were identified using flow meters in the trunk sewer at MH 279. The average flow rate metered in the system is approximately 0.0126 cfs/acre with a recorded peaking factor of 2.34. To provide a factor of safety, the peaking factor used for these calculations was increased to 3.0 to provide a resultant flow rate per area of 0.0038 cfs/acre.

The areas of the Oak Creek basin were delineated to determine the contributing areas (in acres) on the east side of Oak Creek and on the west side of Oak Creek. The following table indicates the acres and resultant flow contribution based on the metered flow rate with a 3.0 cfs peaking factor.

Metered Flow Data from the Oak Creek Basin			
Contributing Segment	**Area (acres)**	**Peak Flowrate/Area (cfs/ac)**	**Peak Flow (cfs)**
East Side of Oak Creek **(Segment E-3)**	274	0.0038	1.03
West Side of Oak Creek **(Siphon)**	902	0.0038	3.41
Total (Segment E-2)	**1,176**	**0.0038**	**4.44**

The 2025 City of Lincoln/Lancaster County Comprehensive Plan has identified the Existing + Tier I growth areas that will contribute flows to the collection system by 2025. The resultant areas were identified in the Oak Creek Basin Study on Figure 1-1 and Table 4-1. Table 4-1 included future Tier III (future) area that is not included in this evaluation. Therefore, the revised Table 4-1 is provided below to identify the final build out acres for the Basin in Year 2025.

Rev. Table 4-1: Oak Creek Basin Areas (revised for Existing and Tier I areas only)			
	West of Oak Creek (ac) [Siphon]	**East of Oak Creek (ac) [Segment E-3]**	**Basin Total (ac) [Segment E-2]**
Existing Areas	1,550	1,234	2,784
Tier IA	195	322	517
Tier IB	725	353	1,078
Total	**2,470**	**1,909**	**4,379**

With the Metered Flow Data identified for the existing (2005) flow condition in the sewer and the revised Table 4-1 which identifies the future (2025) flow condition in the sewer, growth curves can be created to illustrate the projected growth which is anticipated to occur from Year 2005 to 2025 in Segment E-3, the Siphon, and Segment E-2. The projected growth scenarios are indicated in the attached table. Note that the Peak Flows (cfs) indicated for a Year 2025 condition are based on using the City of Lincoln Design Flow Equation. Growth rates were identified for Segment E-2, Segment E-3, and the Siphon for both the areas served and the peak flow contributions which are less than the value derived when using the City of Lincoln Design Flow Equation.

In the attached table, it should be noted that the Peak Flow/Area (cfs/ac) calculation begins with the metered flow value with a 3.0 peaking factor to create a resultant 0.0038 cfs/acre contribution for Year 2005. The 2025 contribution of approximately 0.0062 – 0.0068 cfs/acre is a resultant of the City Design Flow Equation. Therefore, as additional acres are added to the system each year, the resultant flow contribution continues to increase as indicated in the attached graphic.

Analysis of Modeling Data

Three different flow conditions from the attached table were modeled with SWMM Version 5.0 with the improvements to Segment E-3 (36 inch sewer) and Siphon (additional 24 inch barrel). The results of the

modeling in Segment E-3/Segment E-2 (MH AA7-5 to AA7-26) and Siphon/Segment E-2 (MH AA7-5 to AA8-154) are attached and described below:

- **Year 2012**. The flow contribution from Segment E-3 is 2.54 cfs and from the Siphon is 5.99 cfs. Segment E-2 has only one foot of surcharge from MH AA7-7 to MH AA7-21 and no surcharging is indicated west of the improved Siphon. Segment E-3 has no surcharging. No connections should be impacted with the minimal surcharging.
- **Year 2015**. The flow contribution from Segment E-3 is 3.73 cfs and from the Siphon is 7.64 cfs. Segment E-2 has approximately two feet of surcharging from MH AA7-7 to MH AA7-21 and approximately two feet of surcharging is indicated west of the improved Siphon. Segment E-3 has only one foot of surcharging in the southern most 1,000 feet. Connections to the sewer will only have minimal surcharging with no expected impacts to the system.
- **Year 2018**. The flow contribution from Segment E-3 is 5.49 cfs and from the Siphon is 9.73 cfs. Segment E-2 has between 2 and 6 feet of surcharging from MH AA7-7 to MH AA7-21 and seven feet of surcharging west of the improved Siphon. Segment E-3 is surcharged completely from West Mathis Street to Air Park Road. Connections to the sewers would have excessive surcharging along West Mathis Street and west of the improved Siphon.

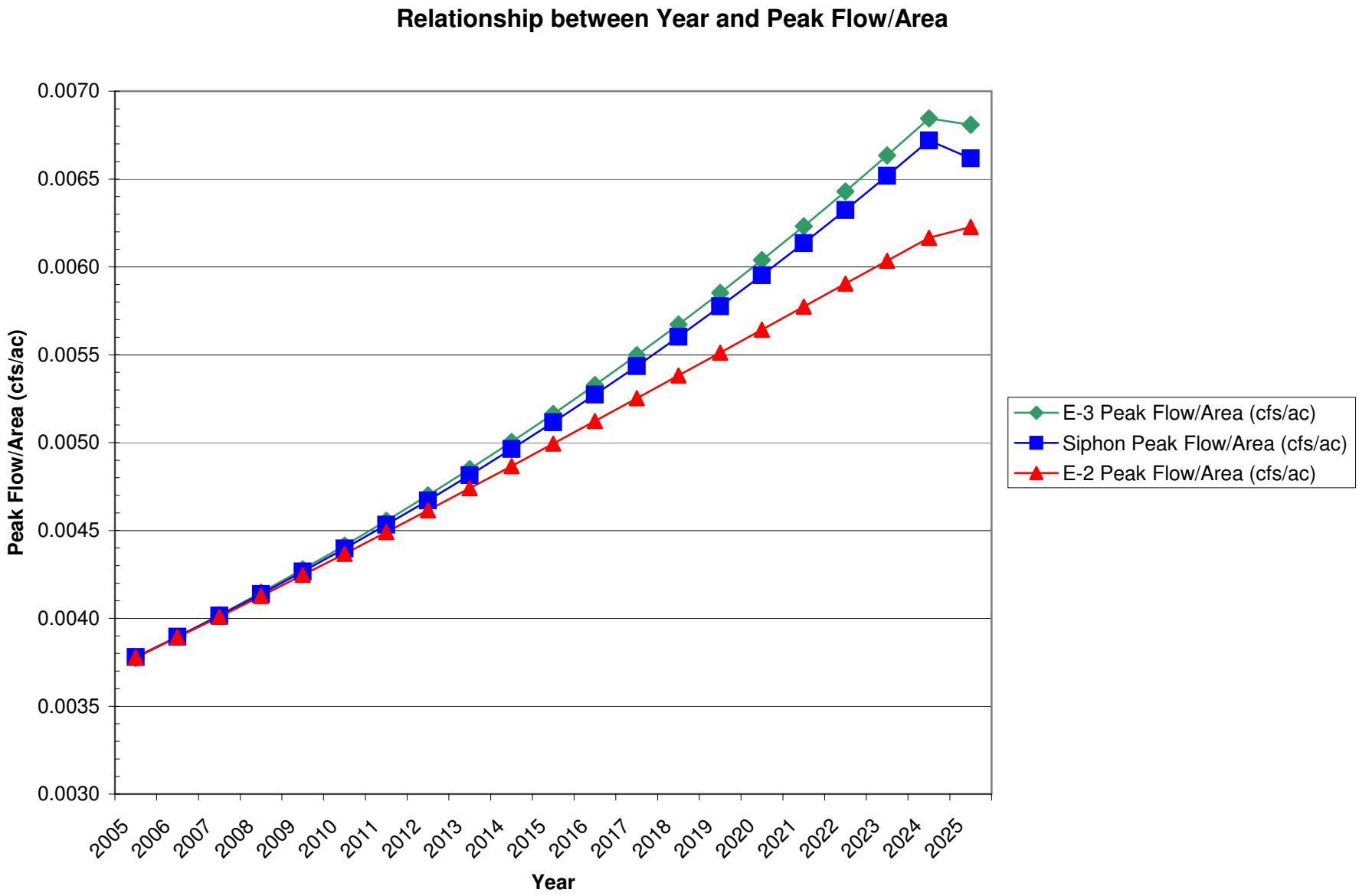
Conclusions and Recommendations

Based on the surcharging analysis indicated in the attached figures, replacement of Segment E-2 could potentially be delayed until approximately 2015. The surcharging becomes critical in Segment E-2 and the improved Siphon, after 2015, based on the Peak Flows (cfs) indicated in the attached table.

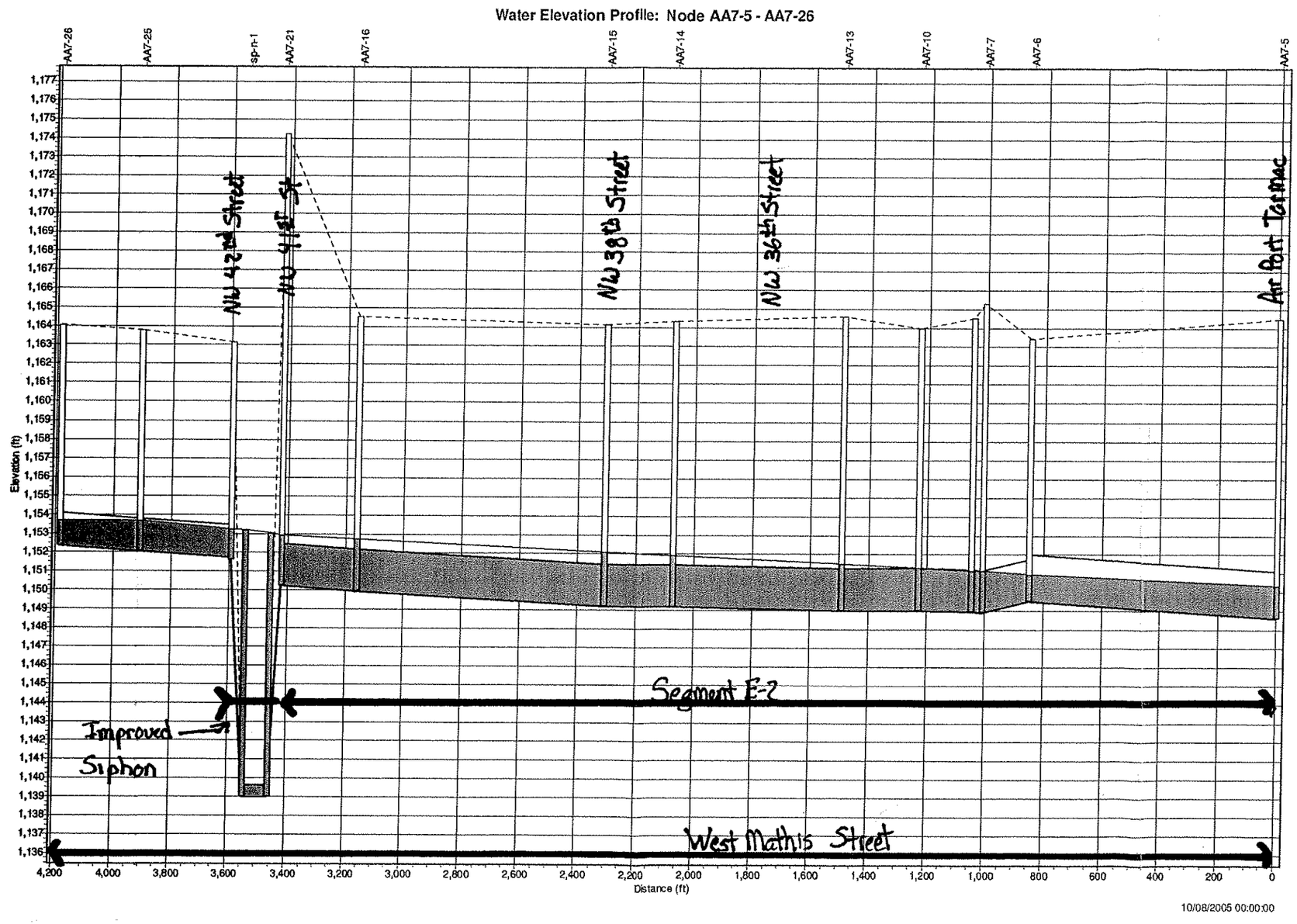
Allowable Areas for Development for Indicated Flow Conditions			
	West of Oak Creek (ac) [Siphon]	**East of Oak Creek (ac) [Segment E-3]**	**Basin Total (ac) [Segment E-2]**
Year 2012 Condition	541-274 = **267 ac**	1283-902 = **381 ac**	1824-1176 = **648 ac**
Year 2015 Condition	723-274 = **449 ac**	1493-902 = **591 ac**	2216-1176 = **1040 ac**
Year 2018 Condition	968 – 274 = **694 ac**	1736-902 = **834 ac**	2704-1176 = **1528 ac**

It is therefore concluded that with the replacement of Segment E-3 with a 36 inch trunk sewer and with the installation of an additional 24 inch barrel in the existing Siphon the useful life of Segment E-2 can be extende to year 2015. A that time, improvements would be required to eliminate capacity deficiencies. The recommended improvements of Segments R-1 and R-2 would be required when flows comparable to the identified Year 2015 flow condition are metered in the basin. These improvements would eliminate the surcharging on Segment E-2. It is recommended that the flow meters in the basin should be continually monitored to track the growth within the basin and the corresponding flows in the collection system as it occurs.

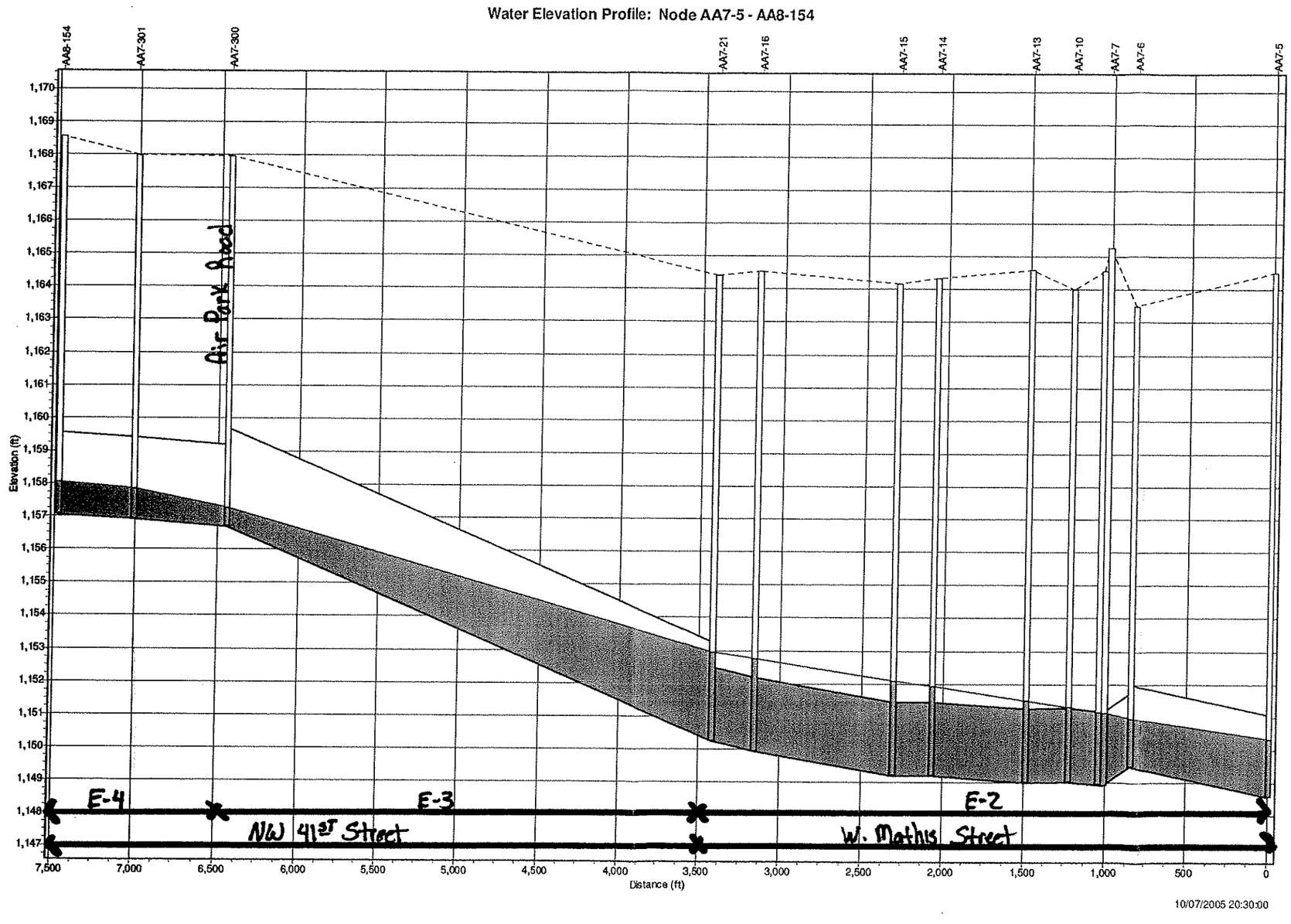
	E-3 (East Side of Oak Creek)			Siphon (West Side of Oak Creek)			E-2 (West Mathis Street)		
Year	**Peak Flows From North (cfs)**	**Area Served From North (ac)**	**Peak Flow/Area (cfs/ac)**	**Peak Flows From West (cfs)**	**Area Served From West (ac)**	**Peak Flow/Area (cfs/ac)**	**Peak Flows (cfs)**	**Area Served**	**Peak Flow/Area (cfs/ac)**
2005	**1.03**	**274**	0.0038	**3.41**	**902**	0.0038	**4.44**	**1176**	0.0038
2006	1.18	302	0.0039	3.69	949	0.0039	4.87	1251	0.0039
2007	1.34	333	0.0040	4.01	998	0.0040	5.33	1330	0.0040
2008	1.52	367	0.0041	4.34	1049	0.0041	5.84	1416	0.0041
2009	1.73	404	0.0043	4.71	1103	0.0043	6.40	1507	0.0042
2010	1.97	445	0.0044	5.10	1160	0.0044	7.01	1605	0.0044
2011	2.23	491	0.0046	5.53	1220	0.0045	7.68	1711	0.0045
2012	2.54	541	0.0047	5.99	1283	0.0047	8.42	1824	0.0046
2013	2.89	596	0.0048	6.50	1350	0.0048	9.22	1945	0.0047
2014	3.28	656	0.0050	7.04	1419	0.0050	10.10	2076	0.0049
2015	3.73	723	0.0052	7.64	1493	0.0051	11.07	2216	0.0050
2016	4.25	797	0.0053	8.28	1570	0.0053	12.12	2367	0.0051
2017	4.83	878	0.0055	8.97	1651	0.0054	13.28	2529	0.0053
2018	5.49	968	0.0057	9.73	1736	0.0056	14.55	2704	0.0054
2019	6.24	1066	0.0059	10.54	1826	0.0058	15.94	2892	0.0055
2020	7.10	1175	0.0060	11.43	1920	0.0060	17.47	3095	0.0056
2021	8.07	1295	0.0062	12.39	2019	0.0061	19.13	3314	0.0058
2022	9.17	1427	0.0064	13.43	2124	0.0063	20.96	3550	0.0059
2023	10.43	1572	0.0066	14.56	2233	0.0065	22.97	3805	0.0060
2024	11.86	1732	0.0068	15.78	2349	0.0067	25.16	4081	0.0062
2025	**13.00**	**1909**	0.0068	**16.35**	**2470**	0.0066	**27.3**	**4379**	0.0062
Growth Rate (%)	**13.7%**	**10.2%**		**8.4%**	**5.2%**		**9.6%**	**6.8%**	


Relationship between Year and Peak Flow/Area
Peak Flow/Area (cfs/ac)
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Year
E-3 Peak Flow/Area (cfs/ac)
Siphon Peak Flow/Area (cfs/ac)
E-2 Peak Flow/Area (cfs/ac)

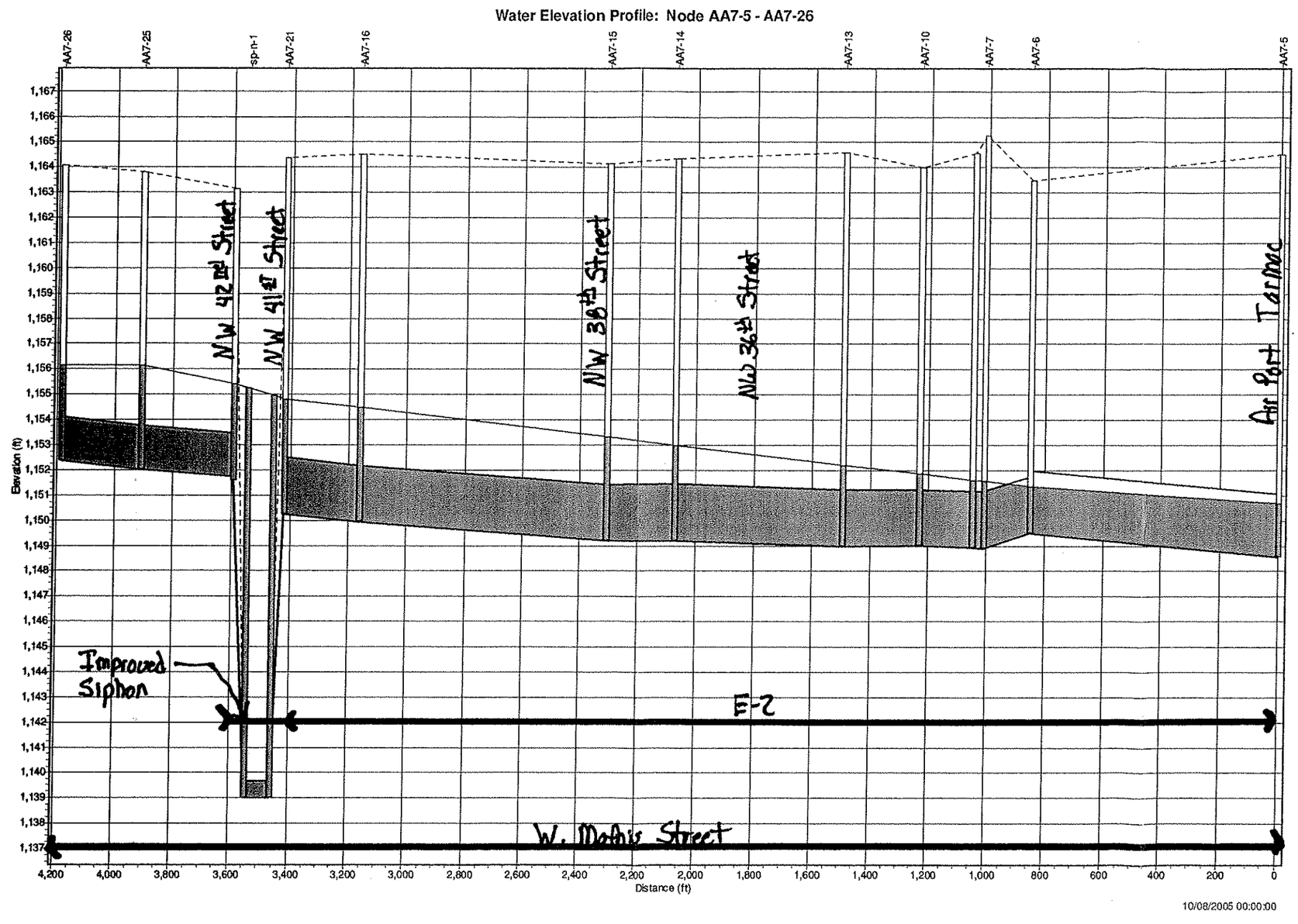
Oak Creek Trunk Sewer - MH AA7-5 to AA7-26 (2012)



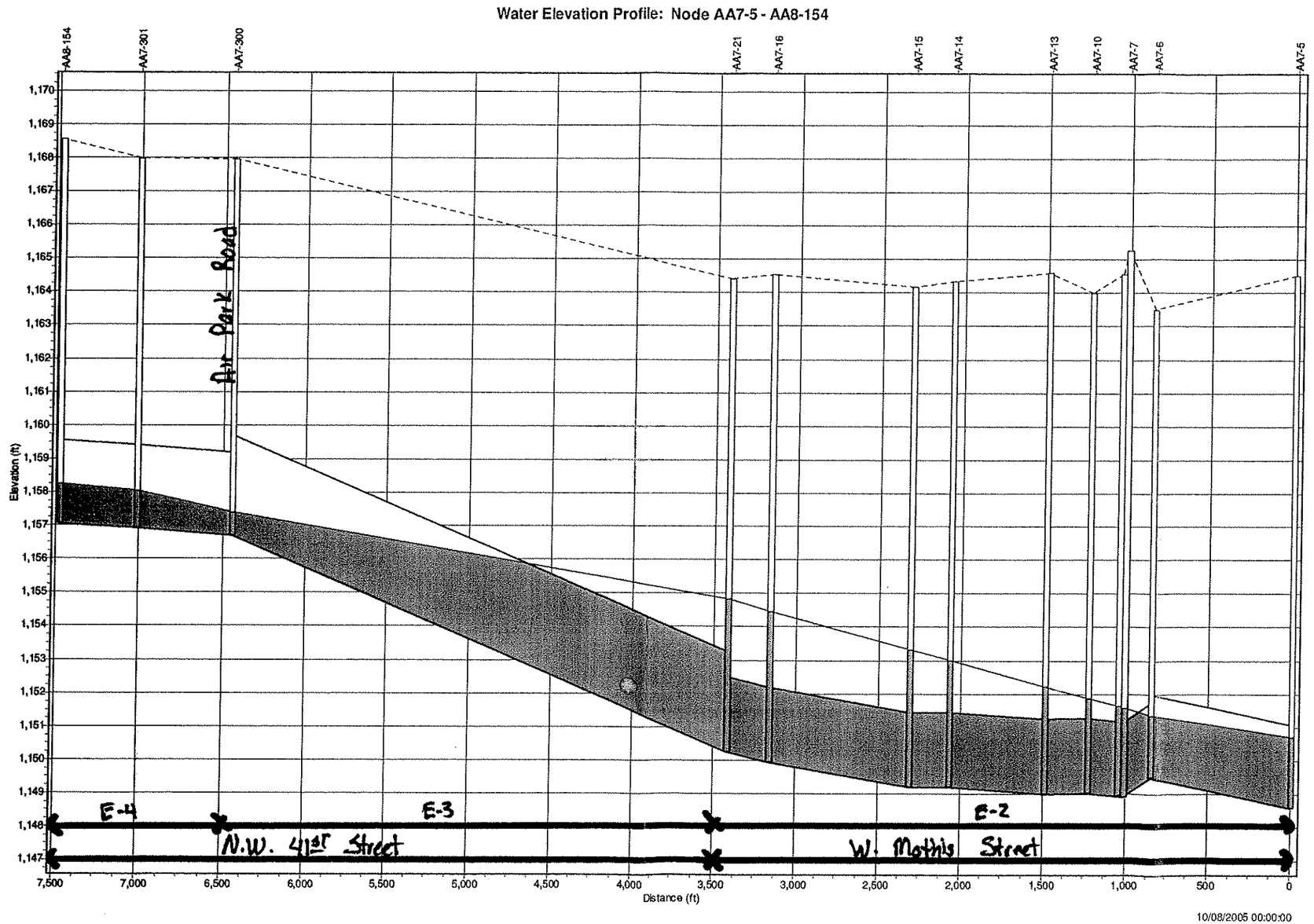
Oak Creek Trunk Sewer - MH AA7-5 to AA8-154 (2012)



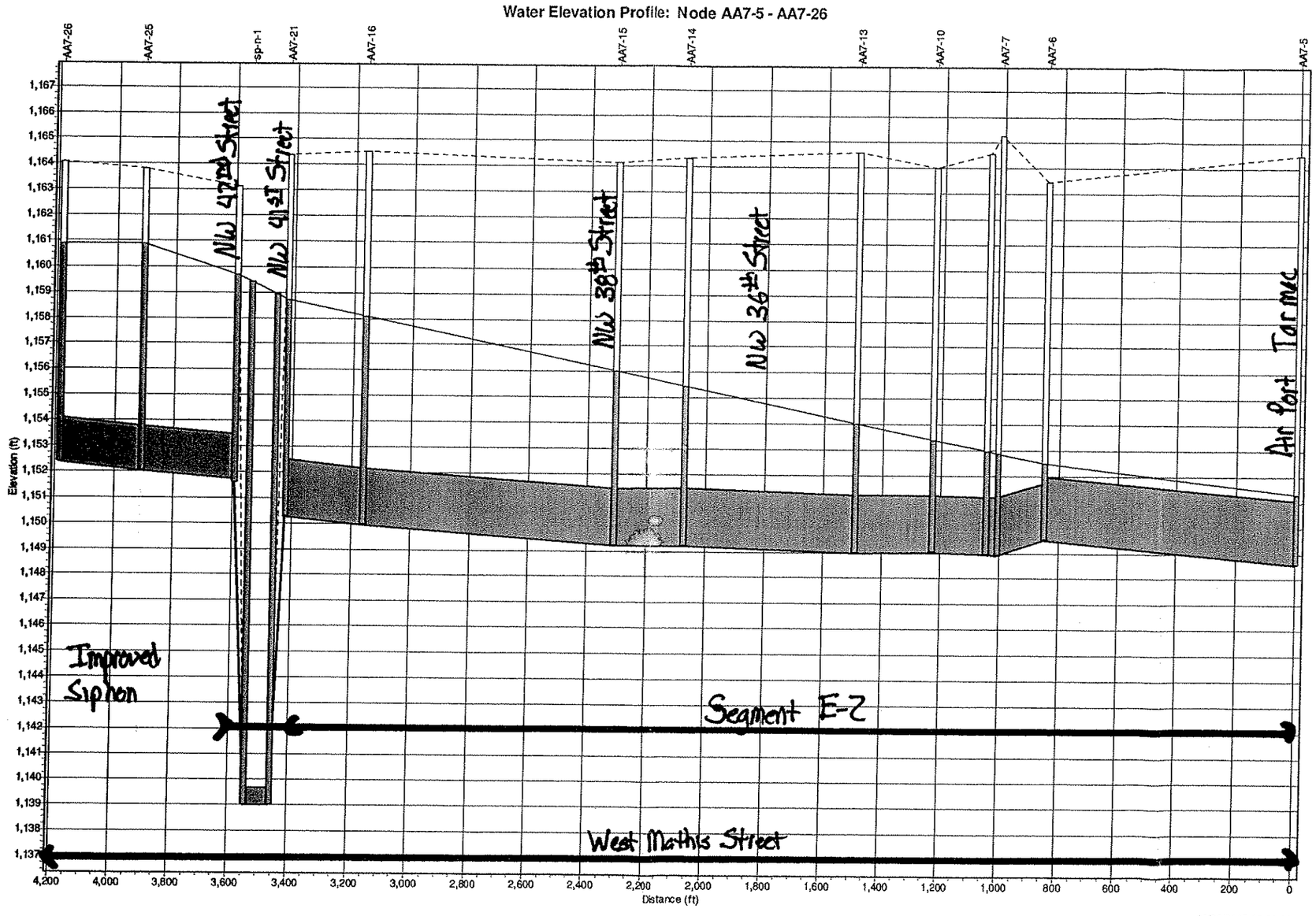
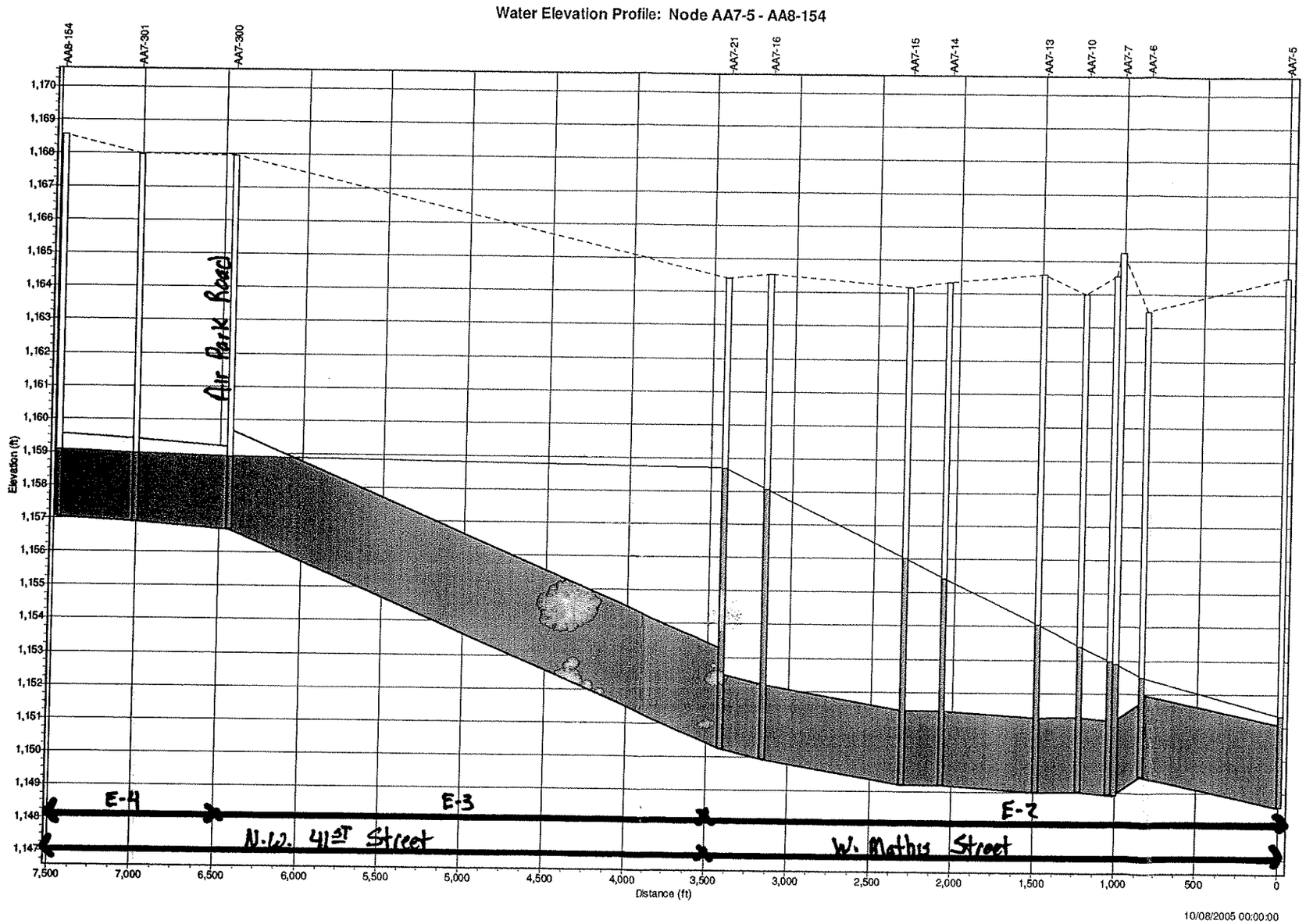
Oak Creek Trunk Sewer - MH AA7-5 to MH AA7-26 (2015)



Oak Creek Trunk Sewer - MH AA7-5 to MH AA8-154 (2015)



Oak Creek Trunk Sewer - MH AA7-5 to MH AA7-26 (2018)



Oak Creek Trunk Sewer - MH AA7-5 to MH AA8-158 (2018)