The Pointe at Hills Farm

Shrewsbury, Massachusetts

Presentation Agenda

Pursuant to M.G.L. Chapter 40B Comprehensive Permit Process

Project Presentation

I Smart Growth Design, LLC

II Preliminary Water Study
Onsite Engineering
Susan Hunnewell, P.E., Director of Water Engineering

III Sewer Hydraulic Capacity Analysis
AECOM
Jami B. Walsh, P.E.

VI Completion of Presentation – Public Hearing #5
Smart Growth Design, LLC

V Questions and Answers

Preliminary Water Study

Onsite Engineering

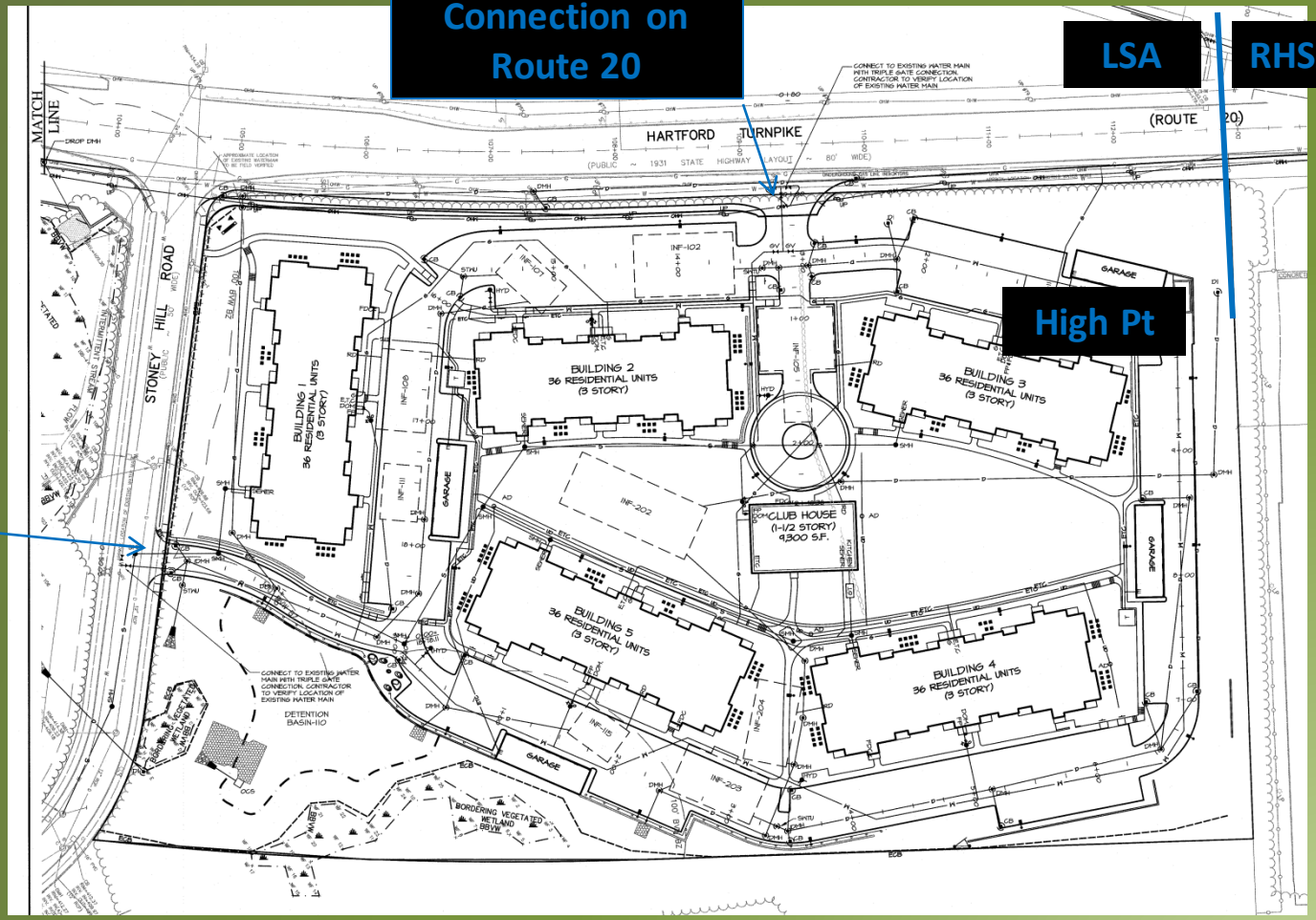
Susan Hunnewell, P.E., Director of Water Engineering

- Basis of Evaluation
- Phase 1 Evaluation
- Phase 2 Evaluation
- Tata & Howard Peer Review
- Recommendations/Conclusions

Basis of Evaluation

- Estimated Water Demand = 35,000 gpd
  - Phase 1 (156 dwelling units), Phase 2 (92 dwelling units)
  - Demand based on an estimated sewer use of 141 gpd per unit (as identified in the "New Sewer Service Evaluation" by AECOM dated August 2015)
- Hydrant Flow Tests conducted on February 3, 2016
- Static Pressure Requirements
  - 60 to 80 psi under normal operating conditions, 35 psi minimum
- Fire Flow Requirement
  - 1,000 gpm at 20 psi
  - Reference Insurance Services Office (ISO) Guide for Determination of Needed Fire Flows (Edition 05-2998) for residential occupancies up to and including four stories in height with an automatic fire sprinkler system

Phase 1 Evaluation



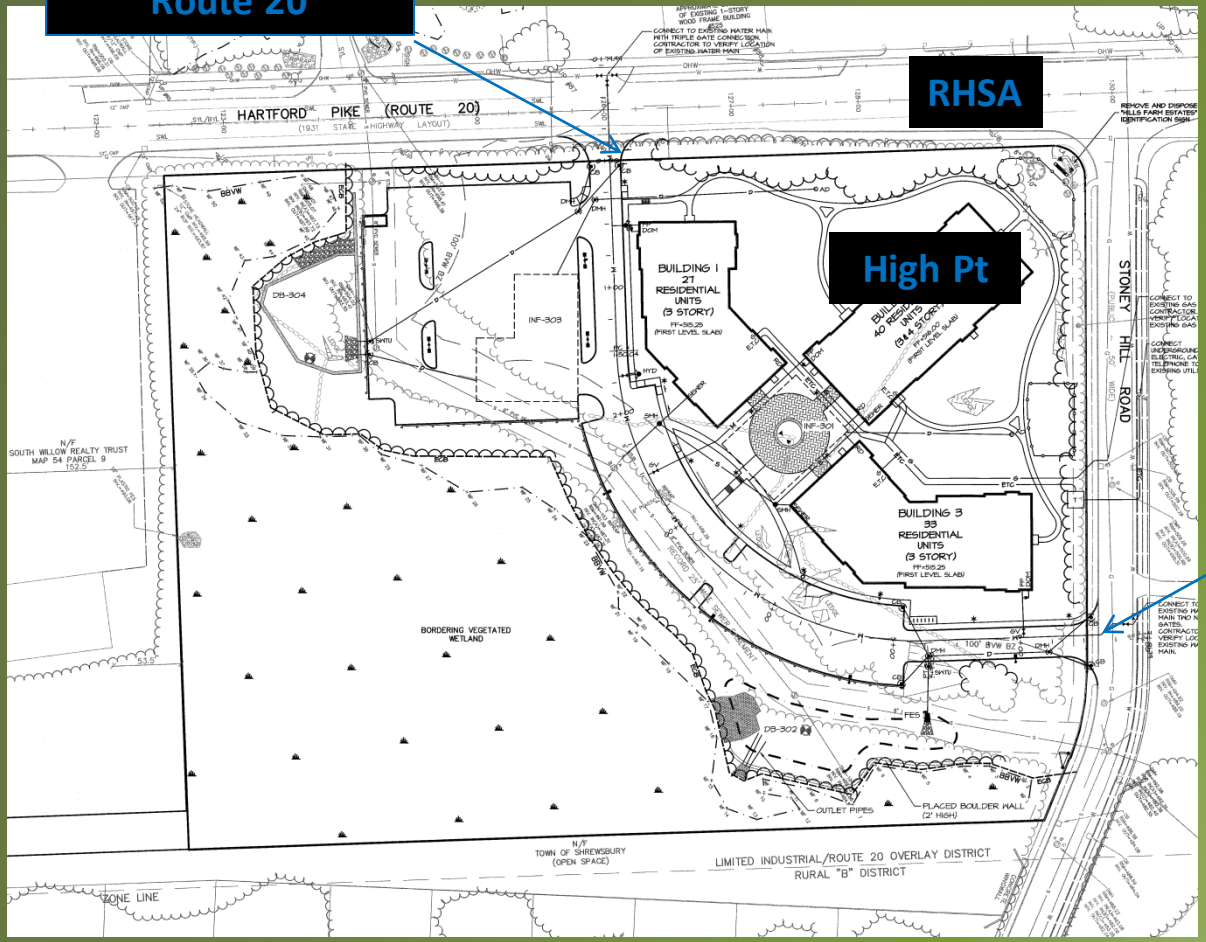
Phase 1 Evaluation

- As currently configured connects to the Low Service Area (LSA)
- Highest proposed ground elevation = 478 feet

Condition	Requirement	Onsite Estimated Results	T&H Estimated Results	Requirement Met?
Static (LSA)	60-80 psi normal, 35 psi minimum	46 psi	45 psi	**YES**
Fire Flow (LSA)	1,000 gpm at 20 psi	810 gpm at 20 psi	750 gpm at 20 psi	NO
Fire Flow (RHSA)	1,000 gpm at 20 psi	1,500 gpm at 20 psi	1,200 gpm at 20 psi	**YES**

Phase 2 Evaluation

Connection on Route 20



Connection on Stoney Hill Road

Phase 2 Evaluation

- Connects to the Reduced High Service Area (RHSA)
- Highest proposed ground elevation = 516 feet

Condition	Requirement	Onsite Estimated Results	T&H Estimated Results	Requirement Met?
Static (RHSA)	60-80 psi normal, 35 psi minimum	66 psi	65 psi	**YES**
Fire Flow (RHSA)	1,000 gpm at 20 psi	1,400 gpm at 20 psi	1,200 gpm at 20 psi	**YES**

Tata & Howard Peer Review

- Determination of Flow – Concurs with methodology of 141 gpd per unit
- Site Plans – Minor corrections with regard to pipe materials, labeling, valve and hydrant locations
- Hydrant Flow Tests - Hydraulic model results generally matched the hydrant flow test field results
- Hydraulic Evaluation
  - Concurs with static and fire flow pressure estimates (as demonstrated on previous slides)
  - Acknowledges that connection of Phase 1 to RHSA allows for fire flow demand to be met
  - Raises potential issues with high pressures on Stoney Hill Road if Phase 1 is connected to the RHSA
- Water Management Act Permit – ADD=3.mgd, MDD=5.76 mgd. Project has no impact on permit.

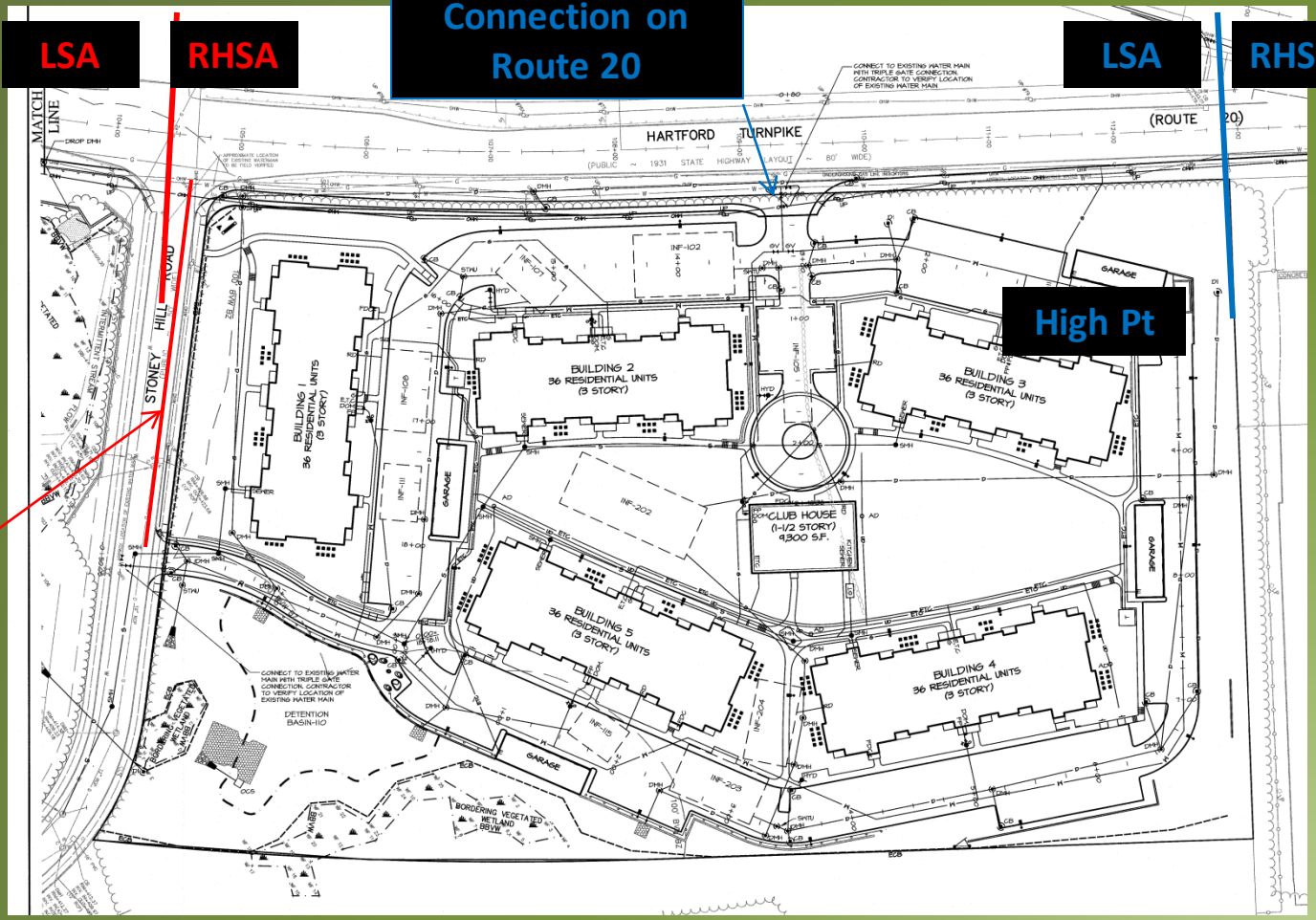
Recommendations/Conclusions

- Confirm fire flow requirement with Fire Protection Engineer
- If necessary, connect Phase 1 to RHSA
  - In order to minimize impact to existing customers on Stoney Hill Road, we recommend that approximately 300 lf of parallel water main be installed on Stoney Hill Road between the Phase 1 entrance and Route 20.
- Phase 2 meets all flow and pressure requirements as currently designed

Recommendations/Conclusions

Proposed Phase 1 Connection to RHSA

Parallel Main on Stoney Hill Road



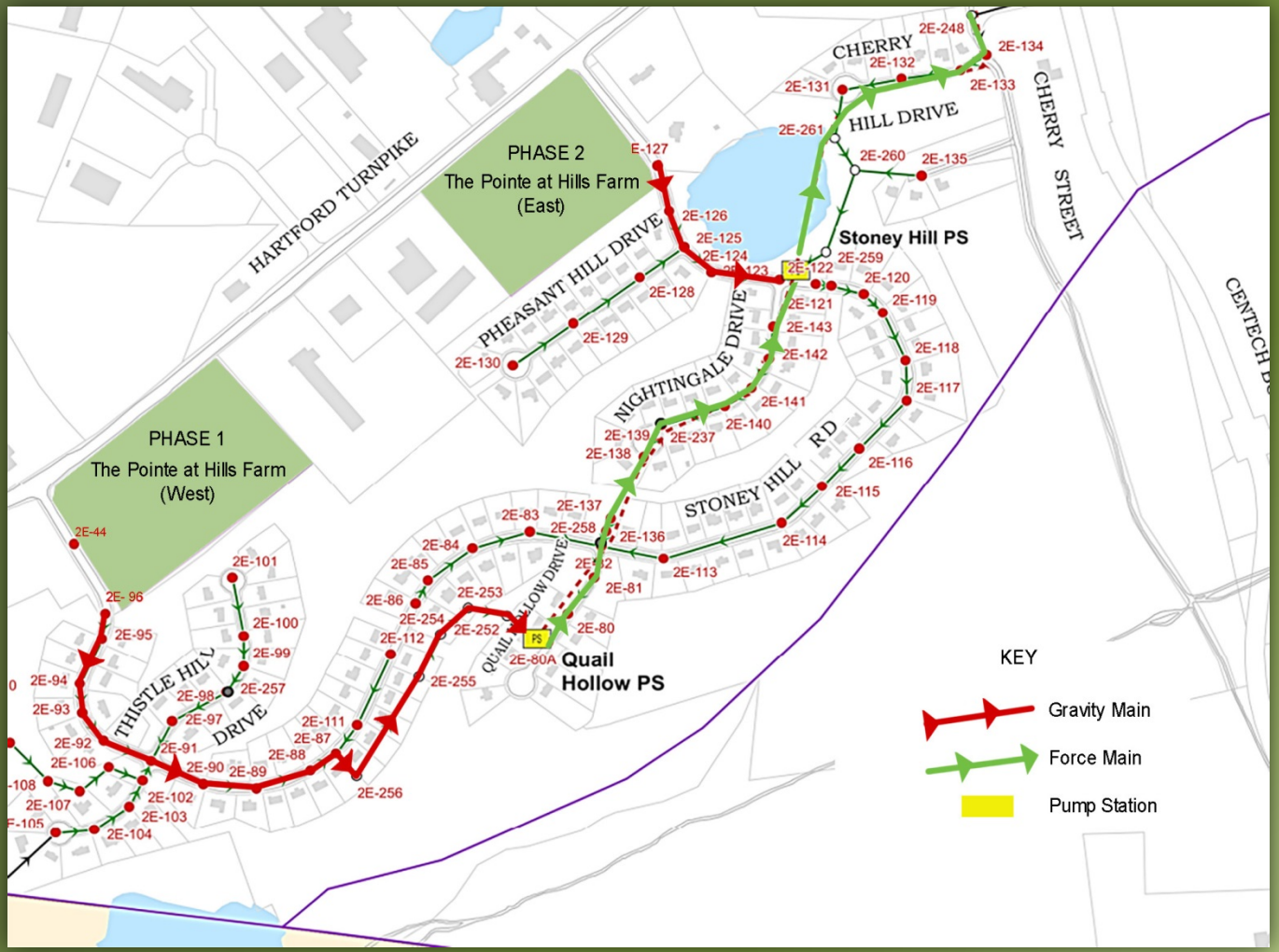
Sewer Hydraulic Capacity Analysis

AECOM
Jami B. Walsh, P.E.

- Capacity Analysis Approach
- Flow Estimate for the Pointe at Hills Farm
- Field Verification
- Document Review
- Capacity Analysis
- Areas of Concern Identified by the Town
- Results of the Hydraulic Capacity Analysis

- Recommendations/Conclusions

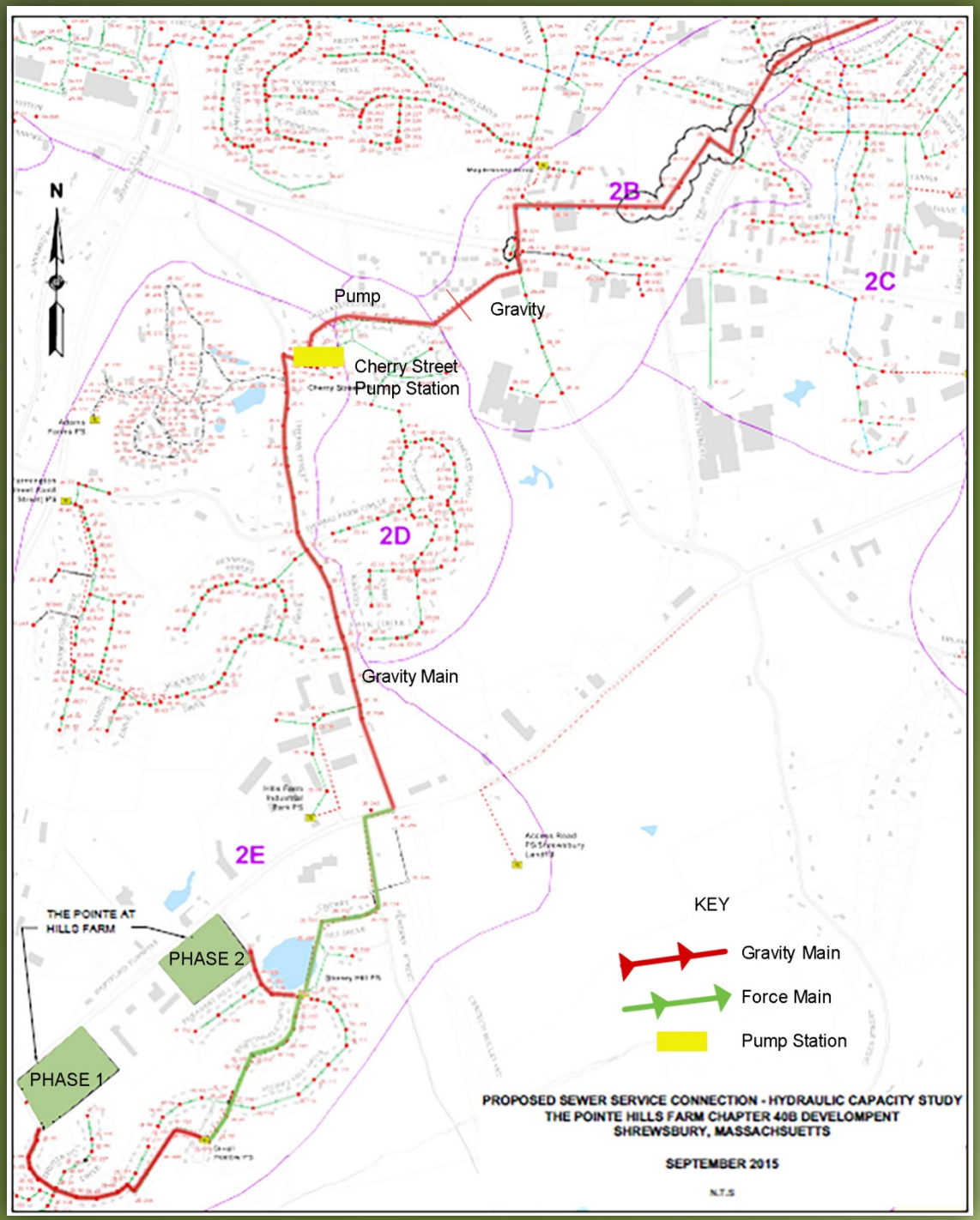
WASTEWATER SYSTEM CAPACITY ANALYSIS



Jami Walsh, P.E., AECOM Technical Services, Inc., Chelmsford, MA

CAPACITY ANALYSIS APPROACH

- ESTIMATED FLOWS FOR DEVELOPMENT BASED ON TR-16 PER THE TOWN'S SEWER CONNECTION RULES AND REGULATIONS
- CONDUCTED FIELD VERIFICATION
  - FIELD SURVEY
  - DRAWDOWN TESTS
- CONDUCTED DOCUMENT REVIEWS
  - REVIEWED DOCUMENTS FROM TOWN
  - OBTAINED AND REVIEWED DOCUMENTS FROM OTHER ENGINEERING FIRMS
- CALCULATED CAPACITY FROM THE POINTE AT HILLS FARM DEVELOPMENT TO INTERCEPTOR

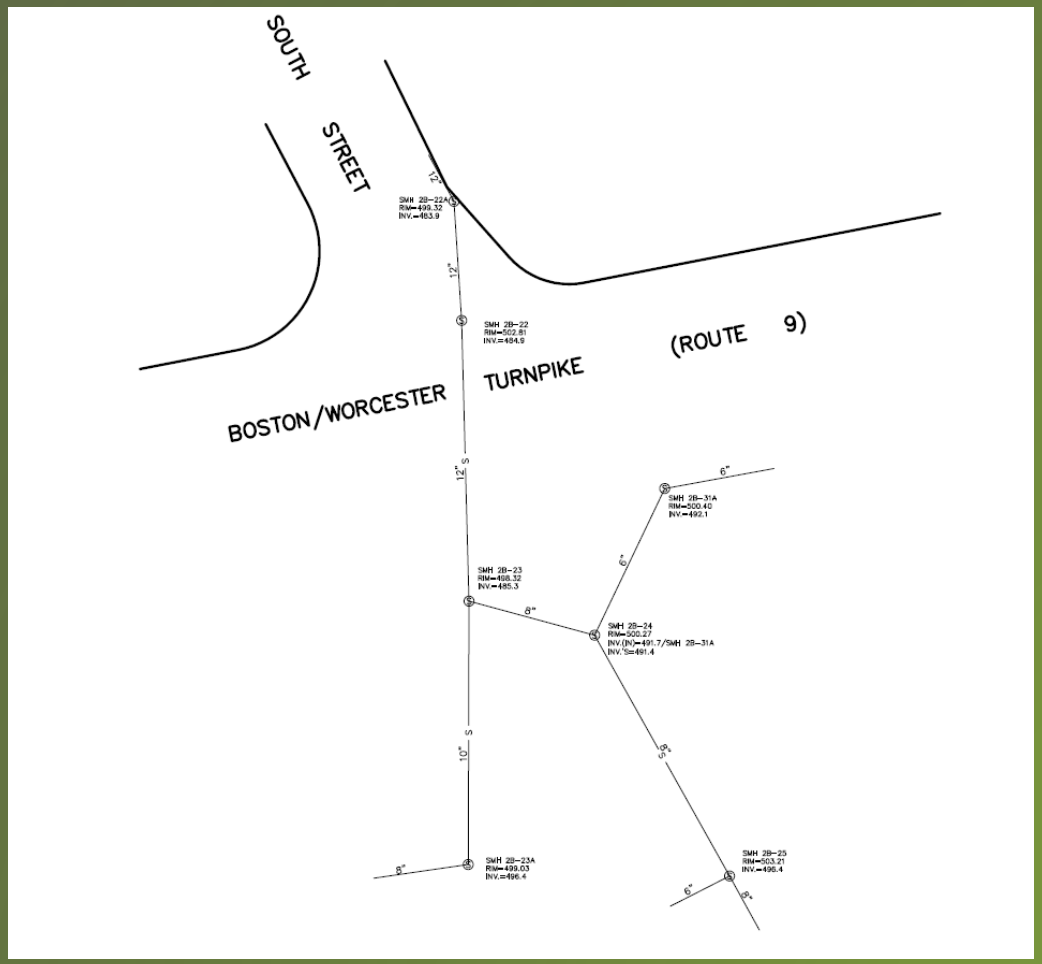

N
2B
2C
Pump
Gravity
Cherry Street
Pump Station
2D
Gravity Main
2E
THE POINTE AT
HILLO FARM
PHASE 2
PHASE 1
KEY
Gravity Main
Force Main
Pump Station
PROPOSED SEWER SERVICE CONNECTION - HYDRAULIC CAPACITY STUDY
THE POINTE HILLS FARM CHAPTER 40B DEVELOMPENT
SHREWSBURY, MASSACHSUETTS
SEPTEMBER 2015
N.T.S

FLOW ESTIMATE FOR THE POINTE AT HILLS FARM

- PER TR-16 REVIEWED COMPARABLE DEVELOPMENTS (ARBOR AND AVALON) TO OBTAIN ESTIMATE OF FLOW PER UNIT.
- UTILIZED HIGHER FLOW RATE (141 GALLONS PER DAY PER UNIT) IN FLOW CALCULATIONS.
- DID NOT REDUCE FLOW FROM WATER RECORDS ASSUMED 100% OF WATER USED WENT TO WASTEWATER SYSTEM.
- 300 UNITS = 42,300 GALLONS PER DAY (GPD)

FIELD VERIFICATION

- CONDUCTED SURVEY OF ACCESSIBLE MANHOLES AND PIPES WHERE RECORD PLANS WERE NOT AVAILABLE AND THE TOWN HAD EXPRESSED CAPACITY CONCERNS.
- SURVEY USED TO VERIFY PIPE SLOPE AND PIPE DIAMETER.
- VERIFIED PUMPING RATES AT THE THREE (3) PUMP STATIONS EFFECTED BY THE ADDITION OF THE POINTE DEVELOPMENT.



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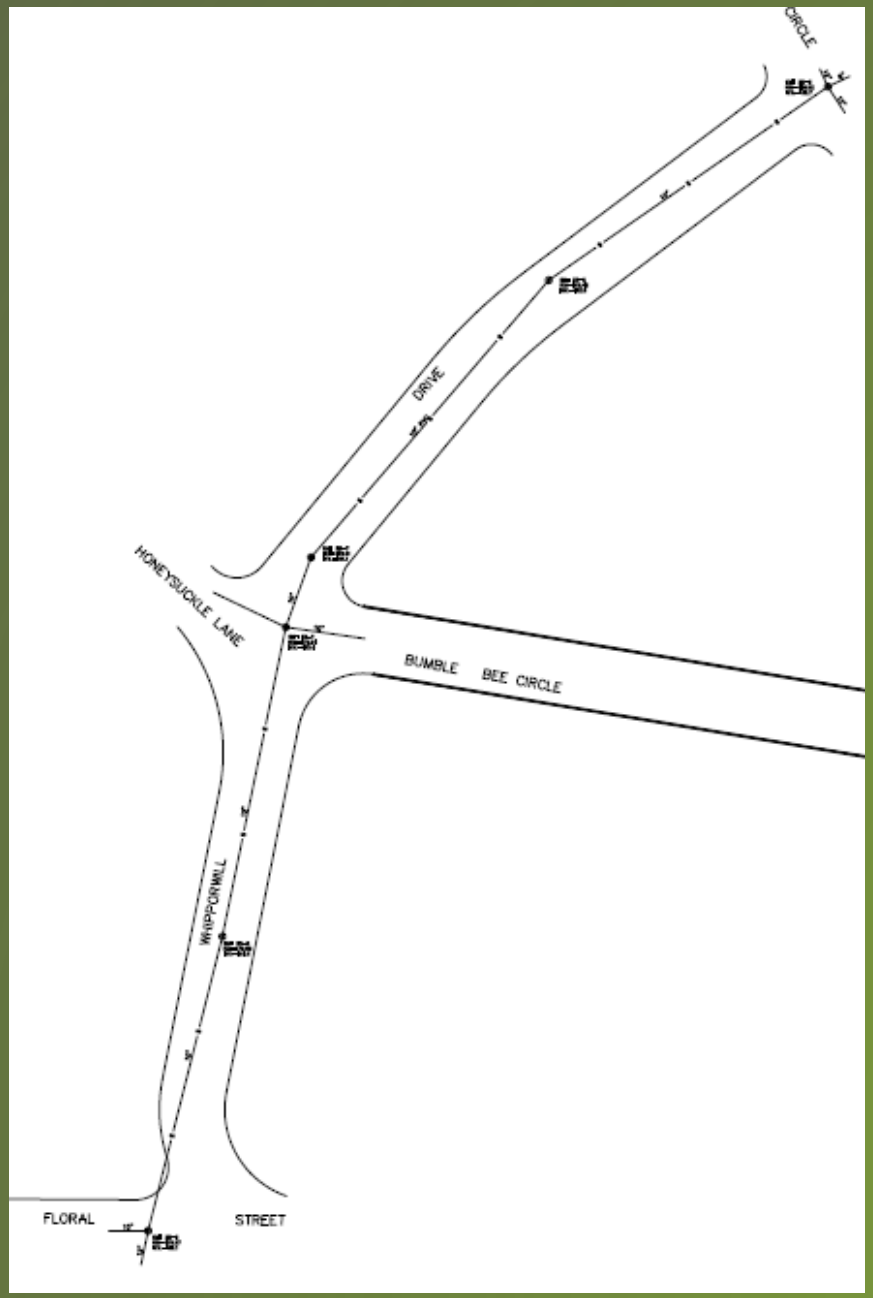
TITLE:

SEWER INFRASTRUCTURE SKETCH

Shrewsbury, MA
(Worcester County)



BASIS OF BEARINGS
1931 ROUTE 20 LAYOUT

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SEWER INFRASTRUCTURE SKETCH

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DOCUMENT REVIEW

- CONDUCTED DOCUMENT REVIEWS
  - REVIEWED DOCUMENTS FROM TOWN
    - FLOW RECORDS FOR PUMP STATIONS
    - RECORD DRAWINGS FOR PUMP STATIONS
    - RECORD DRAWINGS FOR MISCELLANEOUS SEWER SEGMENTS
    - TV INSPECTION REPORTS
  - OBTAINED DOCUMENTS FROM OTHER ENGINEERING FIRMS
    - RECORD INFORMATION FOR CHERRY STREET PUMP STATION

CAPACITY ANALYSIS

- CONDUCTED FROM POINTE AT HILLS FARM TO INTERCEPTOR.
- UTILIZED 95% FOR PIPE CAPACITY CALCULATIONS FOR PIPES 10-INCH AND LARGER.
- UTILIZED 90% FOR 6 AND 8-INCH PIPES.
- UTILIZED FLOWS PROVIDED BY W&S FOR ALL SEGMENTS.
- ADJUSTED FLOWS PROVIDED BY W&S UP BASED ON PUMP DRAW DOWN TESTS.
- ADJUSTED FLOWS PROVIDED BY W&S TO INCLUDE PROJECTED FLOW FROM THE POINTE DEVELOPMENT.
- UTILIZED PIPE DIAMETERS AND SLOPES OBTAINED THROUGH FIELD SURVEY.

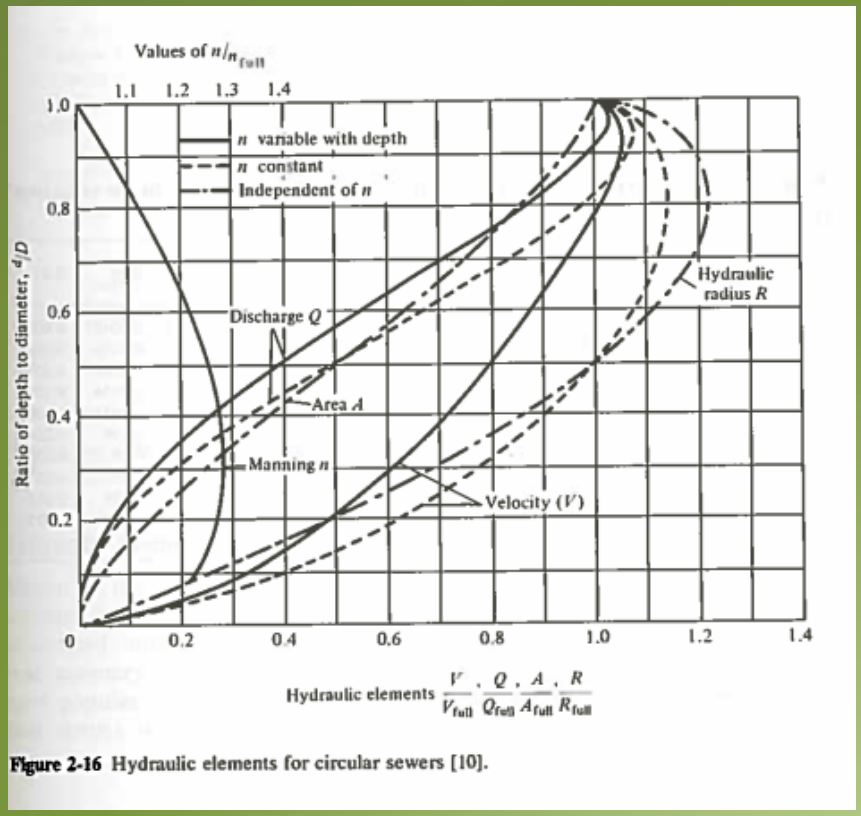
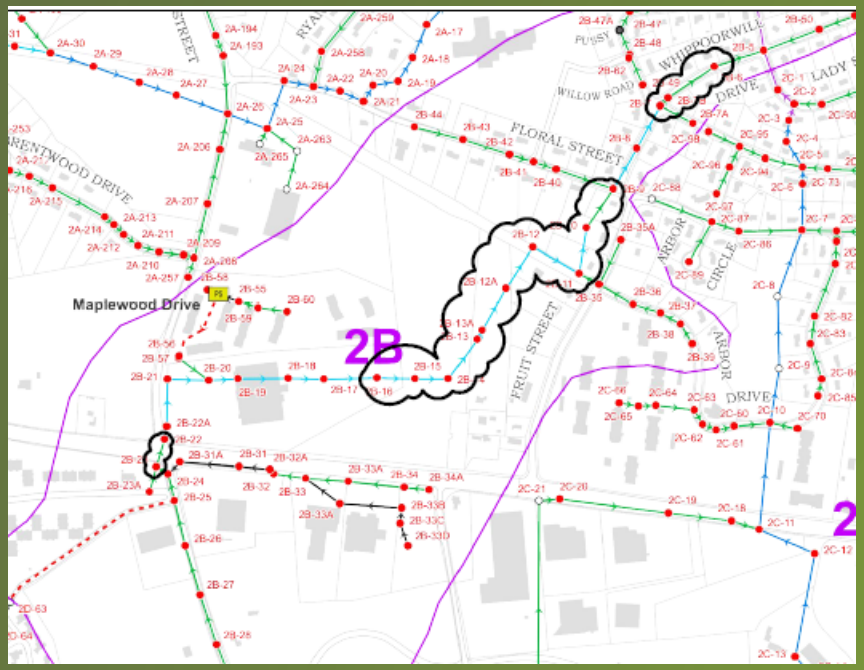


Figure 2-16 Hydraulic elements for circular sewers [10].

Graphic Taken From Metcalf & Eddy Collection and Pumping of Wastewater

AREAS OF CONCERN IDENTIFIED BY TOWN



- IDENTIFIED 3 AREAS WITH INSUFFICIENT CAPACITY
  - CROSSING UNDER ROUTE 9
  - CROSS COUNTRY SEWER BEHIND PRICE CHOPPER TO FRUIT AND FLORAL STREET
  - WHIPPORWILL DRIVE NORTHEAST OF BUMBLEBEE CIRCLE

CAPACITY COMPARISON FOR SEGMENTS OF CONCERN

AECOM Capacity Analysis For Segments of Concern								
Segments IDed By Town To Have Capacity Problems		Pipe Dia.	Pipe Slope	Exist. Peak Flow Plus Proposed Flow	Pipe Capacity as Calc'd by Town	Pipe Capacity As Calc'd by AECOM	% Pipe Capacity	Remaining Pipe Capacity
Start MH	End MH	(Inches)	(ft/ft)	(GPD)	GPD	(GPD)	Remaining	(GPD)
2B-23	2B-22	12*	0.0072*	788,100	523,083	**2,414,027**	67%	1,625,927
2B-16	2B-15	10**	0.028**	788,100	706,649	**841,222**	6%	53,122
2B15	2B-14	10**	0.028**	788,100	706,649	**841,222**	6%	53,122
2B-14	2B-13	10**	0.028**	788,100	706,649	**841,222**	6%	53,122
2B-13	2B-12	10**	0.028**	788,100	706,649	**841,222**	6%	53,122
2B-12	2B-11	10**	0.028**	788,100	706,649	**841,222**	6%	53,122
2B-11	2B-10	10**	0.028**	788,100	706,649	**841,222**	6%	53,122
2B-10	2B-9	10**	0.028**	788,100	465,484	**841,222**	6%	53,122
2B-7	2B-6	10*	0.0297*	825,000	568,925	**3,013,718**	73%	2,188,718
2B-6	2B-5	10*	0.0546*	825,000	568,925	**4,086,777**	80%	3,261,777

*From Survey

**Assumed (Minimum slope per TR-16; Pipe diameter from Record Drawings)

BOLD= Sufficient Capacity

NOTE:

1. Where Pipe Diameter and Slope are assumed, manholes were inaccessible
2. Where Pipe Diameters and Slopes are assumed, pipe capacity and remaining capacity (GPD and %) are our best approximation

WHY THE DIFFERENCE IN CAPACITY?

- CAPACITY FOR A PIPE IS DETERMINED BASED PRIMARILY ON ITS SLOPE AND DIAMETER.
  - TOWN ASSUMED MINIMUM PIPE SLOPES WHEN SLOPES WERE UNKNOWN. AECOM FIELD VERIFIED PIPE SLOPES WHERE POSSIBLE.
  - TOWN UTILIZED PIPE DIAMETERS PROVIDED IN GIS SYSTEM. AECOM FIELD VERIFIED PIPE DIAMETERS WHERE POSSIBLE AND USED RECORD DRAWINGS WHERE NOT POSSIBLE.
- TOWN CALCULATED CAPACITY USING 80% OF FLOW DEPTH. AECOM USED A CAPACITY OF 95% (IN ACCORDANCE WITH PUBLISHED DATA) FOR PIPES 10-INCH AND LARGER AND 90% FOR SMALLER PIPES TO ACCOUNT FOR POTENTIAL REDUCTION IN DIAMETER DUE TO BUILD UP THROUGHOUT THE YEARS.

RESULTS OF HYDRAULIC CAPACITY ANALYSIS

- AECOM DID NOT IDENTIFY ANY SEWER SEGMENTS WITH INSUFFICIENT HYDRAULIC CAPACITY.
- THE QUAIL HOLLOW PUMP STATION APPEARS TO HAVE SUFFICIENT CAPACITY TO ACCOMMODATE THE POINTE AT HILLS FARM.
- STONEY HILL PUMP STATION APPEARS TO HAVE SUFFICIENT CAPACITY TO ACCOMMODATE THE POINTE AT HILLS FARM.
- WITH THE USE OF THE EXISTING STORAGE TANK AND PROPER MAINTENANCE THE CHERRY STREET PUMP STATION APPEARS TO HAVE SUFFICIENT CAPACITY TO ACCOMMODATE THE POINTE AT HILLS FARM.

CAPACITY ANALYSIS UPDATE

- THE POINTE AT HILLS FARM REDUCED THE NUMBER OF UNITS FROM 300 TO 248.
- THIS RESULTED IN A ESTIMATED WASTEWATER FLOW REDUCTION OF 7,300 GPD WHICH IS A 17.3% REDUCTION IN FLOW FOR THE DEVELOPMENT.

CAPACITY COMPARISON FOR SEGMENTS OF CONCERN WITH REDUCED FLOW

AECOM Capacity Analysis For Segments of Concern								
Segments IDed By Town To Have Capacity Problems		Pipe Dia.	Pipe Slope	Estimated Peak Flow	Pipe Capacity as Calc'd by Town	Pipe Capacity As Calc'd by AECOM	% Pipe Capacity	Remaining Pipe Capacity
Start MH	End MH	(Inches)	(ft/ft)	(GPD)	GPD	(GPD)	Remaining	(GPD)
2B-23	2B-22	12*	0.0072*	771,778	523,083	**2,414,027**	68%	1,642,249
2B-16	2B-15	10**	0.028**	771,778	706,649	**841,222**	8%	69,444
2B15	2B-14	10**	0.028**	771,778	706,649	**841,222**	8%	69,444
2B-14	2B-13	10**	0.028**	771,778	706,649	**841,222**	8%	69,444
2B-13	2B-12	10**	0.028**	771,778	706,649	**841,222**	8%	69,444
2B-12	2B-11	10**	0.028**	771,778	706,649	**841,222**	8%	69,444
2B-11	2B-10	10**	0.028**	771,778	706,649	**841,222**	8%	69,444
2B-10	2B-9	10**	0.028**	771,778	465,484	**841,222**	8%	69,444
2B-7	2B-6	10*	0.0297*	782,606	568,925	**3,013,718**	74%	2,231,112
2B-6	2B-5	10*	0.0546*	782,605	568,925	**4,086,777**	81%	3,304,172

*From Survey

**Assumed (Minimum slope per TR-16; Pipe diameter from Record Drawings)

BOLD= Sufficient Capacity

NOTE:

1. Where Pipe Diameter and Slope are assumed, manholes were inaccessible
2. Where Pipe Diameters and Slopes are assumed, pipe capacity and remaining capacity (GPD and %) are our best approximation

QUESTIONS?

FLOW FROM 2B-16 to 2B-9

- LENGTH OF PIPE ~2,000 LF
- DIAMETER OF PIPE 10” AT 2B-16 AND 12” AT 2B-9.
- AECOM ASSUMED 10”, PER GIS INFO AND SIZE AT 2B-16.
- DROP FROM 2B-16 TO 2B-9 IS ~9.5 FEET.
- HYDRAULIC GRADE LINE THEREFORE HAS A SLOPE OF ~ 0.00475 FT/FT
- IF HGL ASSUMED THROUGH SECTION, NO CAPACITY ISSUES USING 95%. NO CAPACITY ISSUES USING 80%.

CAPACITY ANALYSIS USING HYDRAULIC GRADE LINE 2B-16 to 2B-9

AECOM Capacity Analysis For Segments of Concern						
Segments IDed By Town To Have Capacity Problems		Pipe Dia.	Pipe Slope	Estimated Peak Flow	Pipe Capacity Using 80%	Pipe Capacity Using 95%
Start MH	End MH	(Inches)	(ft/ft)	(GPD)	GPD	(GPD)
2B-23	2B-22	12*	0.0072*	774,778	**2,032,865**	**2,414,027**
2B-16	2B-15	10**	0.048**	771,778	**927,510**	**1,101,418**
2B15	2B-14	10**	0.048**	771,778	**927,510**	**1,101,418**
2B-14	2B-13	10**	0.048**	771,778	**927,510**	**1,101,418**
2B-13	2B-12	10**	0.048**	771,778	**927,510**	**1,101,418**
2B-12	2B-11	10**	0.048**	771,778	**927,510**	**1,101,418**
2B-11	2B-10	10**	0.048**	771,778	**927,510**	**1,101,418**
2B-10	2B-9	10**	0.048**	771,778	**927,510**	**1,101,418**
2B-7	2B-6	10*	0.0297*	782,605	**2,537,867**	**3,013,718**
2B-6	2B-5	10*	0.0546*	782,605	**3,441,497**	**4,086,777**

*From Survey

**Using Hydraulic Grade Line as Slope

BOLD= Sufficient Capacity