Flood Mitigation Study

Bowman Avenue Dam Site

City of Rye and the Village of Rye Brook

Westchester County

Presentation

October 17 , 2007

CHAS. H. SELLS, INC.

Consulting Engineers, Surveyors & Photogrammetrists

Presentation Outline

- Project Overview
- Existing Conditions
- Alternatives Analysis
- Preferred Alternatives
- Conclusions and Recommendations
- Next Steps
- Questions and Answers

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PROJECT OVERVIEW

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Project Overview

Project Objective:

1. To compare existing water surface elevations with proposed water surface elevations resulting from flood reduction measures at the Bowman Avenue Dam Site
2. Determine impact/benefit on reach between I-287 and I-95.

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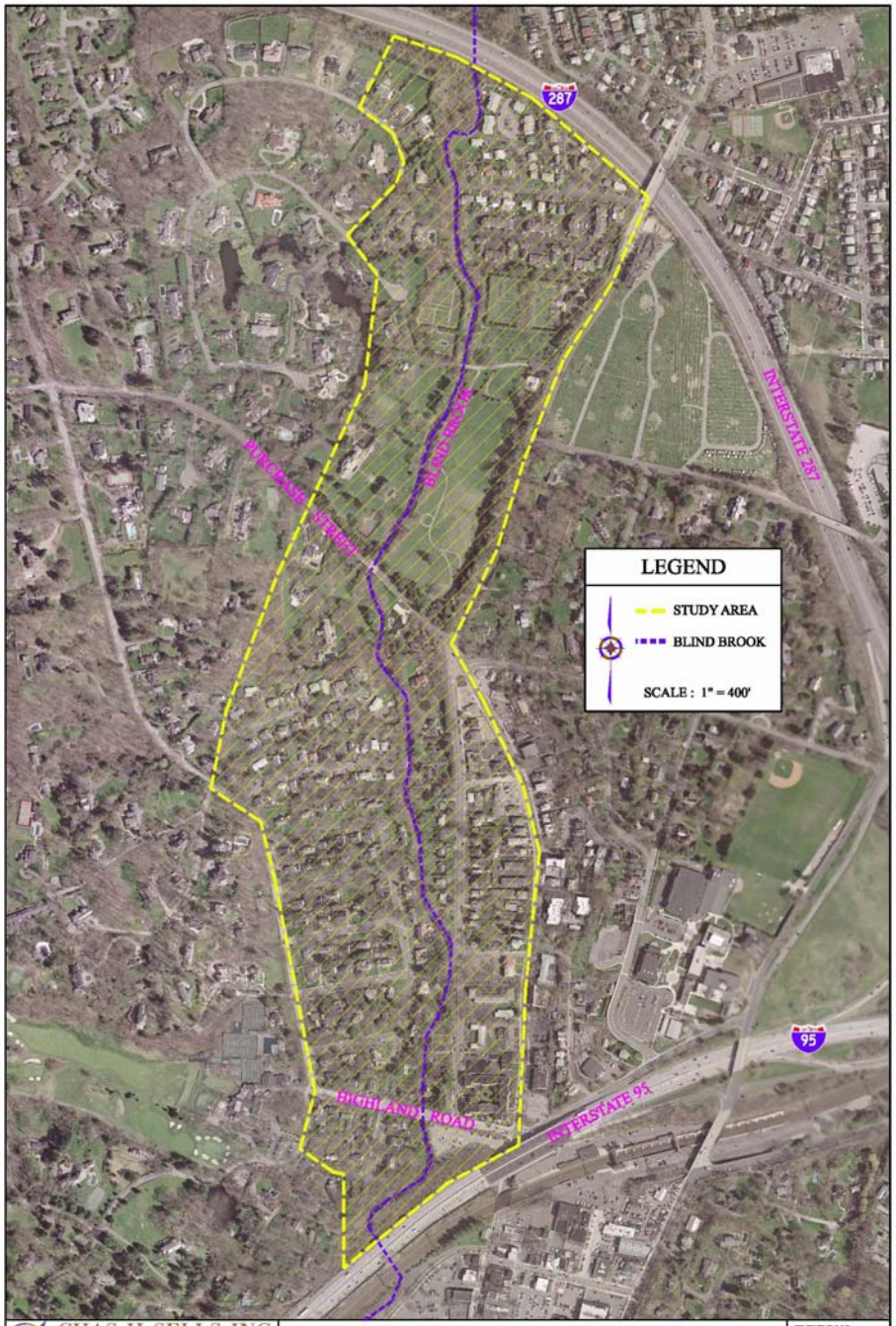

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CITY OF RYE FLOOD MITIGATION MEASURES
STUDY LOCATION MAP

FIGURE NO.
2

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Project Overview (cont'd)

Our Scope: 2-phases

- Phase 1: Preliminary Investigation and Analysis
- Phase 2: Alternatives Analysis and Recommendations

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Project Overview (cont'd)

Phase 1:

- Data Collection
- Field Survey and Mapping
- Determine Existing Conditions
- Hydrologic and Hydraulic Analysis

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Project Overview (cont'd)

Phase 2:

- Mitigation Alternatives Analysis
- Report and Recommendations

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EXISTING CONDITIONS

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Existing Conditions

Blind Brook Watershed

- City of Rye, Villages of Harrison, Rye Brook and Port Chester, Town of Greenwich
- Suburban in upper and middle third, urbanized in lower third
- Low-medium density residential/commercial
- Watershed area is 9.6 sq.m. delineated at I-95
- Floodplain is wide compared to the channel

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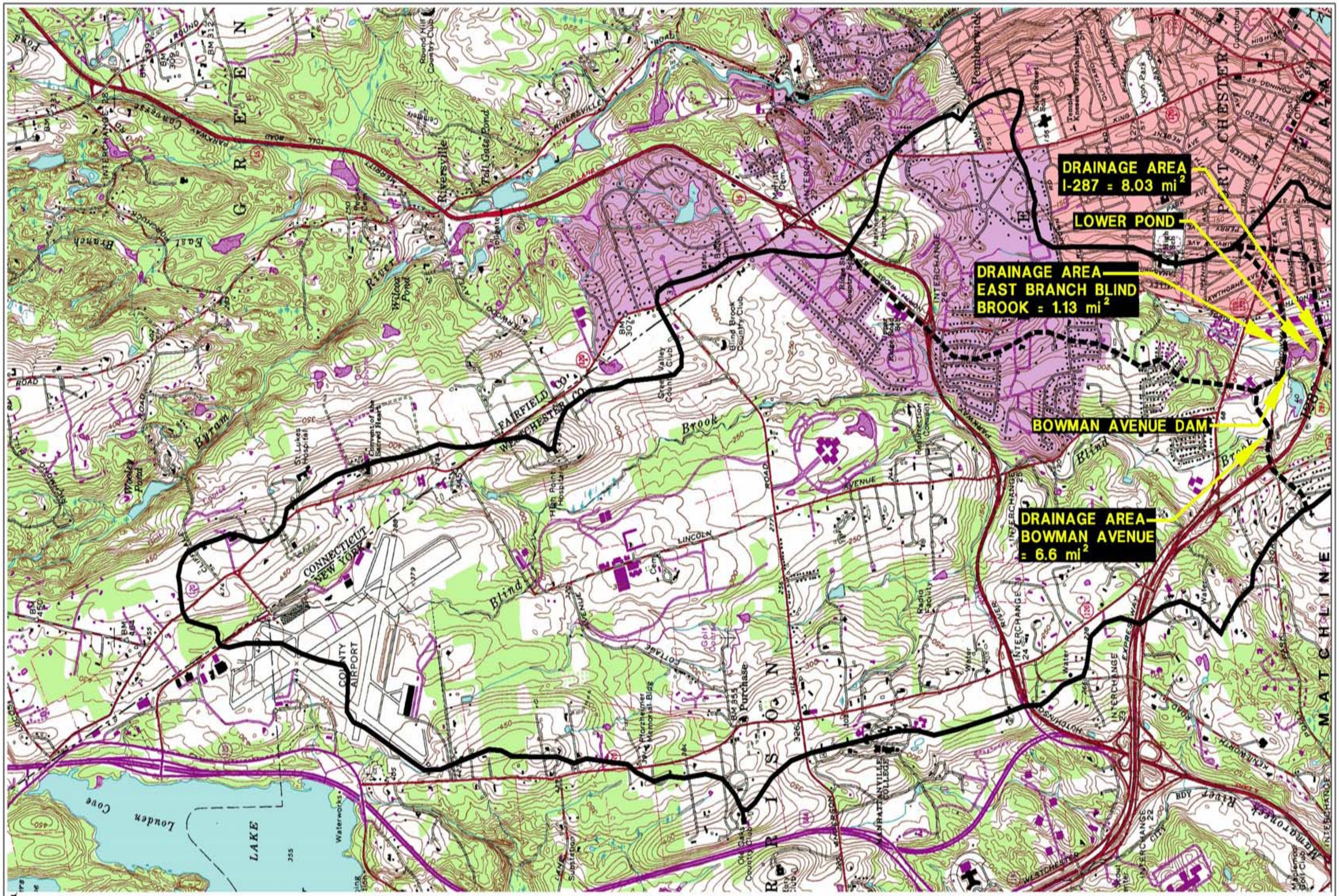

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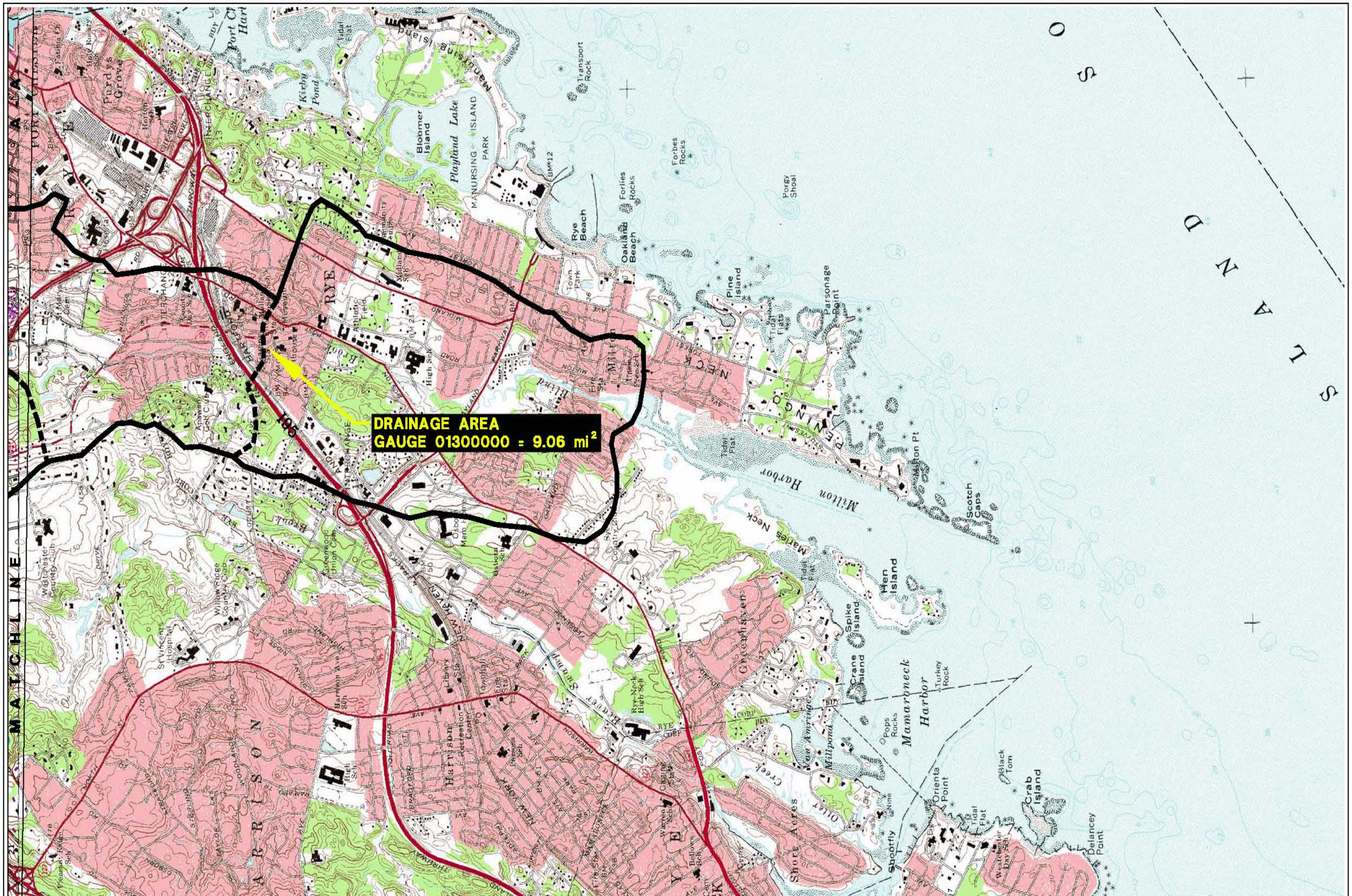
WATERSHED MAP

SCALE: 1" = 2,000'

FIGURE 1

SHEET 1 OF 2



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WATERSHED MAP

SCALE: 1" = 2,000'

FIGURE 1

SHEET 2 OF 2

Existing Conditions (cont'd)

- Based on ACOE, 20% of properties located within FEMA flood zone
- Based on ACOE, 1,500 structures located within Blind Brook watershed
- 140 structures in 100-year floodplain between I-287 and I-95

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Existing Conditions (cont'd)

Explanation Flood Frequency

- 100-year event (lower frequency storm) = 1% chance in any given year
- 10-year event (higher frequency storm) = 10% chance in any given year

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Existing Conditions (cont'd)

Historical Storm Events

- Hurricane Agnes – June 1972 - 2,320 cfs (20-year)
- Hurricane Eloise – Sept. 1975 -2,280 cfs (20-year)

Other notable events:

- November 1978 - 1,440 cfs (5-year)
- January 1979 - 2,120 cfs (15-year)
- April 1984 - 1,380 cfs (7-year)
- December 1992
- April 2007 Nor'easter (approx. 100-year storm)

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Existing Conditions (cont'd)

April 17, 2007 Nor'easter:

TABLE 1 April 15, 2007 Nor'easter Summary of Damages	
Damage Description	Total Cost
Private Property[1]	
Minor Damage	$4,691,670
Moderate Damage	$20,863,350
Major Damage	$57,675,620
Total Private Property Damage	**$83,230,640**
Public Property[2]	
Debris Removal	$24,560
Elm Place Retaining Wall	$1,032,000
Emergency Services	$128,160
Theodore Fremd Retaining Wall	$880,000
Locust Avenue Firehouse	$153,840
Parking Paystation	$12,490
Total Public Property Damages	**$2,231,050**
Grand Total	**$85,461,690**

[1] Damage report for Westchester County. Damage amounts are based on building assessed values (minor-15%, moderate-40%, major – 63%)

[2] According to FEMA PA FA forms prepared by the City of Rye

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Existing Conditions (cont'd)

Based on 2007 ACOE report, flooding problems due to:

- Narrow channel
- Obstructed flows
- Overgrowth within stream banks
- Constricted bridge openings
- Low banks
- Sedimentation in tidal reaches
- Wetland filling
- Floodplain encroachment

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Existing Conditions (cont'd)

Bowman Avenue Dam

- Dam is only flood control facility on the Blind Brook
- Dam originally constructed in 1900's for ice production
- Reconstructed in 1941 after collapse
- Overall dimensions: 119 ft long x 19 ft high (max)
- Outlet dimensions: 15 ft wide x 2.5 ft high
- Upper pond heavily silted (145 acre-feet current capacity)

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Existing Conditions (cont'd)

Bowman Avenue Dam Upstream Face

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Existing Conditions (cont'd)

Bowman Avenue Dam Downstream Face

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ALTERNATIVES ANALYSIS

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Alternatives Analysis

Use of FEMA Data

- Use of baseline data
- Sells performed more detailed routing analysis at flood control structures to better account for storage capacity
- Flood routing through structures is time-dependent

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Alternatives Analysis (cont'd)

Comparison Between the FIS and Sells Anaysis						
	Existing Conditions					
	FIS		Sells			
	Discharge (cfs)	WS Elev. (ft.)	Discharge (cfs)	difference (%)	WS Elev. (ft.)	difference (inches)
10-Year Storm						
I-95 (U/S)	1,521	22.93	1,982	30%	24.59	19.92
Highland Rd. (U/S)	1,521	24.15	1,982	30%	25.88	20.76
Purchase St. (U/S)	1,434	27.35	1,663	16%	28.33	11.76
I-287 (D/S)	1,374	32.32	1,663	21%	32.73	4.92
50-Year Storm						
I-95 (U/S)	2,497	26.55	3,078	23%	30.56	48.12
Highland Rd. (U/S)	2,497	27.49	3,078	23%	31.01	42.24
Purchase St. (U/S)	2,353	30.12	2,767	18%	31.91	21.48
I-287 (D/S)	2,255	33.45	2,767	23%	34.11	7.92
100-Year Storm						
I-95 (U/S)	2,984	30.33	3,583	20%	32.17	22.08
Highland Rd. (U/S)	2,984	30.78	3,583	20%	32.60	21.84
Purchase St. (U/S)	2,812	31.71	3,346	19%	33.44	20.76
I-287 (D/S)	2,694	34.01	3,346	24%	34.97	11.52

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Alternatives Analysis

Initial Alternatives – 5 categories

1. No-build
2. Resizing the Upper Pond
3. Optimizing the outlet of the dam
4. Raising the crest of the dam
5. Resizing the Upper Pond and optimizing the outlet of the dam

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Alternatives Analysis (cont'd)

Initial Alternatives – 5 categories

1. No-build
   a. Description of existing condition
   b. Used as basis of comparison for alternatives

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Alternatives Analysis (cont'd)

2. Resizing the Upper Pond
   a. Provide increased storage capacity
      - Enlargement through excavation
      - Silt removal through dredging
   b. Analyzed various limits of excavation with and without dredging
      - Alt. 1: Excavate pond to 1925 size w/o dredging (36,000 c.y.)
      - Alt. 2: Excavate pond to 1925 size with 2 feet of dredging (53,000 c.y.)
      - Alt. 3: Maximize size of pond w/o dredging (160,000 c.y.)
      - Alt. 4: Maximize size of pond with dredging (190,000 c.y.)
   c. Preliminarily estimated impact due to rock and contaminated soils

   Results:
      - Meaningful flow reductions were achieved
      - Increase storage from 145 to 245 acre-feet

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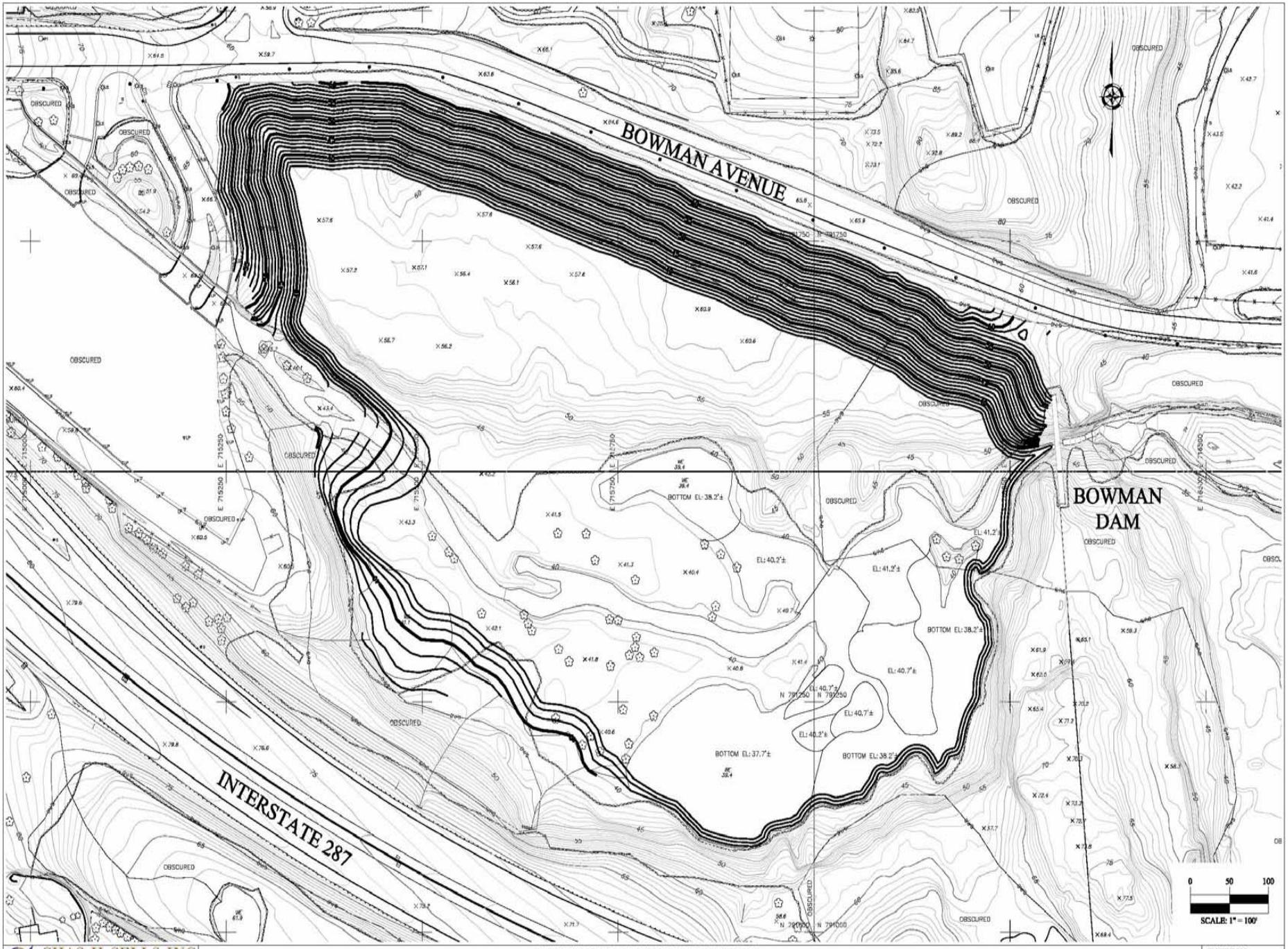

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CITY OF RYE FLOOD MITIGATION MEASURES
BOWMAN AVENUE DAM RESERVOIR - MAXIMIZED RESERVOIR AREA - BOTTOM ELEVATION 37.0

FIGURE NO.
5

Alternatives Analysis (cont'd)

Reduction in Discharges - Alternatives 1 - 4				
Storm Event/Location	**Alt. 1 % Red.**	**Alt. 2 % Red.**	**Alt. 3 % Red.**	**Alt. 4 % Red.**
2-Year Storm				
D/S I-287	3.7%	5.3%	6.9%	11.0%
D/S I-95	3.4%	6.5%	3.8%	13.1%
5-Year Storm				
D/S I-287	11.5%	13.8%	45.5%	50.5%
D/S I-95	10.0%	12.0%	22.2%	26.6%
10-Year Storm				
D/S I-287	6.2%	7.4%	27.8%	31.0%
D/S I-95	6.7%	8.0%	27.7%	30.7%
25-Year Storm				
D/S I-287	2.3%	2.7%	12.6%	14.1%
D/S I-95	2.4%	2.9%	12.3%	13.6%
50-Year Storm				
D/S I-287	0.4%	0.5%	4.7%	5.4%
D/S I-95	0.9%	1.0%	7.2%	8.3%
100-Year Storm				
D/S I-287	0.4%	0.5%	3.3%	3.8%
D/S I-95	0.6%	0.8%	4.5%	5.0%

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Alternatives Analysis (cont'd)

3. Optimizing the outlet of the dam

   a. Examined effects of variable size openings

   20.2 s.f. (15%), 45.6 s.f. (30%), 72.1 s.f. (50%),

   105.6 s.f. (75%), 139.1 s.f. (100%)

   Results:

   - Smaller opening reduced flow for higher frequency events
   - Larger opening reduced flow for lower frequency events
   - More significant reductions in flow for 25-, 50-, and 100-year as compared to upper pond resizing
   - Retrofit dam with automated sluice gate to achieve optimum opening during given storm event

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Alternatives Analysis (cont'd)

Reduction in Discharges - Alternatives 5 - 8	
Storm Event/Location	**Optimized Reductions**
5-Year Storm	
Orifice Opening (sf)	**45.6**
D/S Bowman Dam	22.7%
D/S I-287	21.7%
D/S I-95	12.4%
10-Year Storm	
Orifice Opening (sf)	**72.1**
D/S Bowman Dam	30.9%
D/S I-287	15.9%
D/S I-95	9.5%
25-Year Storm	
Orifice Opening (sf)	**105.6**
D/S Bowman Dam	19.1%
D/S I-287	21.2%
D/S I-95	7.4%
50-Year Storm	
Orifice Opening (sf)	**139.1**
D/S Bowman Dam	10.0%
D/S I-287	11.2%
D/S I-95	20.0%
100-Year Storm	
Orifice Opening (sf)	**139.1**
D/S Bowman Dam	5.6%
D/S I-287	6.8%
D/S I-95	8.6%

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Alternatives Analysis (cont'd)

4. Raising the elevation of the dam crest
   a. Increase storage capacity behind dam
   b. 2-foot increase in height with berms along Bowman Ave.

   Results:

   - Dam fails based on stability analysis, would require major reconstruction
   - Results in further flooding of upstream properties due to backwater effect from Bowman Dam Reservoir

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Alternatives Analysis (cont'd)

5. Resizing upper pond with outlet optimization
   a. Combination of Alternatives 2 and 3

   Results:

   - Maximum flow reduction during various frequency storms

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Alternatives Analysis (cont'd)

	Optimized Reductions, max. size no dredging	Optmized Reductions, max. size with dredging
5-Year Storm		
Orifice Opening (sf)	**45.6**	**45.6**
D/S Bowman Dam	37.9%	38.7%
D/S I-287	32.1%	33.4%
D/S I-95	20.2%	21.7%
10-Year Storm		
Orifice Opening (sf)	**45.6**	**45.6**
D/S Bowman Dam	44.4%	45.9%
D/S I-287	43.9%	45.4%
D/S I-95	34.9%	43.9%
25-Year Storm		
Orifice Opening (sf)	**72.1**	**72.1**
D/S Bowman Dam	31.3%	32.4%
D/S I-287	33.4%	34.5%
D/S I-95	22.1%	23.2%
50-Year Storm		
Orifice Opening (sf)	**139.1**	**139.1**
D/S Bowman Dam	24.8%	25.0%
D/S I-287	25.9%	26.2%
D/S I-95	29.3%	29.6%
100-Year Storm		
Orifice Opening (sf)	**139.1**	**139.1**
D/S Bowman Dam	15.3%	15.6%
D/S I-287	16.4%	16.7%
D/S I-95	19.7%	20.1%

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PREFERRED ALTERNATIVES

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Preferred Alternatives

- Three alternatives further studied to develop water surface elevations
  - Alternative A: Optimizing Outlet
  - Alternative B: Optimize Outlet with maximizing Upper Pond Area
  - Alternative C: Optimizing Outlet, maximizing Upper Pond Area and 2-feet of dredging

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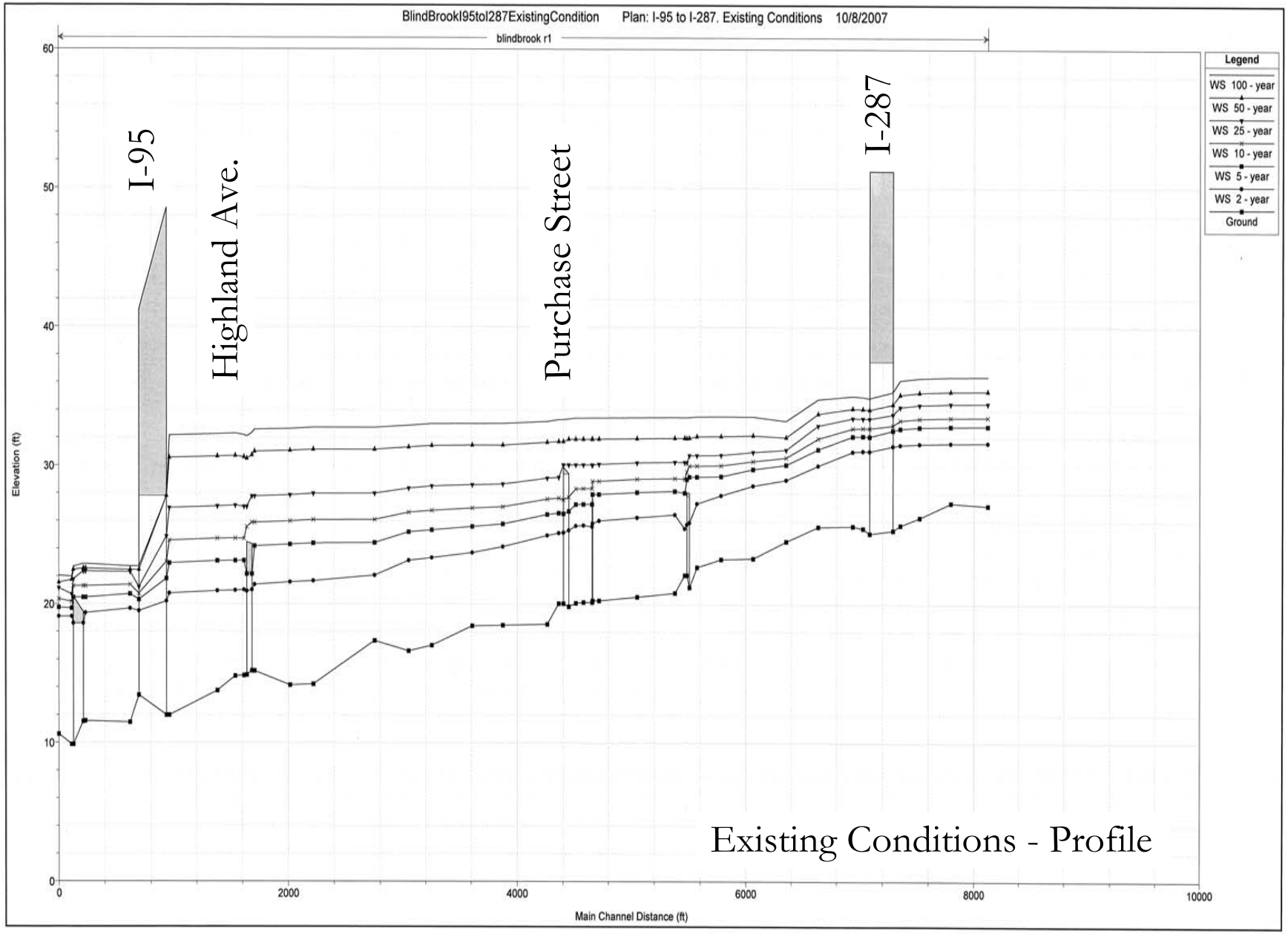

Existing Conditions - Profile

Alternative A - Optimizing Outlet Opening

ALTERNATIVE A	Orifice Size	Water Surface Elevation (ft-NAVD)		
		Existing Cond.	Proposed Cond.	Difference
2-Year Storm	**20.2**			
D/S I-287		31.07	31.07	0.00
Purchase Street		25.65	25.65	0.00
Highland Road		21.41	21.43	0.02
U/S I-95		20.77	20.80	0.03
5-Year Storm	**45.6**			
D/S I-287		32.15	31.62	-0.53
Purchase Street		27.20	26.61	-0.59
Highland Road		24.19	23.35	-0.84
U/S I-95		22.95	22.36	-0.59
10-Year Storm	**72.1**			
D/S I-287		32.73	32.27	-0.46
Purchase Street		28.33	27.73	-0.60
Highland Road		25.88	25.24	-0.64
U/S I-95		24.59	23.89	-0.70
25-Year Storm	**105.6**			
D/S I-287		33.44	32.87	-0.57
Purchase Street		30.06	29.21	-0.85
Highland Road		27.78	27.20	-0.58
U/S I-95		26.93	26.19	-0.74
50-Year Storm	**139.1**			
D/S I-287		34.11	33.66	-0.45
Purchase Street		31.91	30.18	-1.73
Highland Road		31.01	27.39	-3.62
U/S I-95		30.56	26.41	-4.15
100-Year Storm	**139.1**			
D/S I-287		34.97	34.54	-0.43
Purchase Street		33.44	32.55	-0.89
Highland Road		32.60	31.57	-1.03
U/S I-95		32.17	31.12	-1.05

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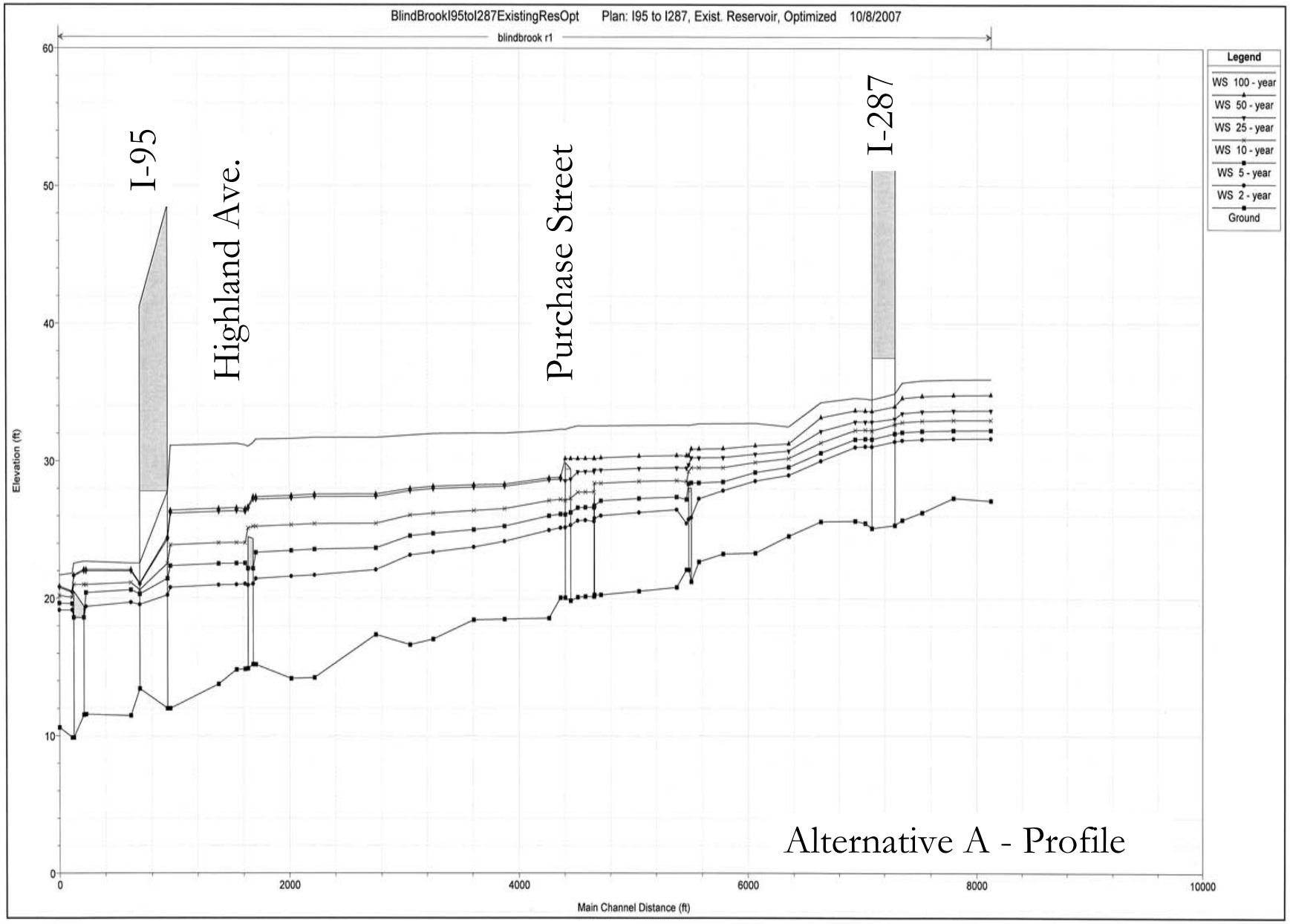

Alternative A - Profile

ALTERNATIVE B	Orifice Size	Water Surface Elevation (ft-NAVD)		
		Existing Cond.	Proposed Cond.	Difference
2-Year Storm	**20.2**			
D/S I-287		31.07	30.90	-0.17
Purchase Street		25.65	25.52	-0.13
Highland Road		21.41	21.29	-0.12
U/S I-95		20.77	20.66	-0.11
5-Year Storm	**45.6**			
D/S I-287		32.15	31.29	-0.86
Purchase Street		27.20	26.27	-0.93
Highland Road		24.19	22.72	-1.47
U/S I-95		22.95	21.89	-1.06
10-Year Storm	**45.6**			
D/S I-287		32.73	31.47	-1.26
Purchase Street		28.33	26.45	-1.88
Highland Road		25.88	23.04	-2.84
U/S I-95		24.59	22.12	-2.47
25-Year Storm	**72.1**			
D/S I-287		33.44	32.51	-0.93
Purchase Street		30.06	28.28	-1.78
Highland Road		27.78	26.01	-1.77
U/S I-95		26.93	24.73	-2.20
50-Year Storm	**139.1**			
D/S I-287		34.11	33.20	-0.91
Purchase Street		31.91	29.00	-2.91
Highland Road		31.01	26.51	-4.50
U/S I-95		30.56	25.32	-5.24
100-Year Storm	**139.1**			
D/S I-287		34.97	34.08	-0.89
Purchase Street		33.44	31.54	-1.90
Highland Road		32.60	30.52	-2.08
U/S I-95		32.17	30.07	-2.10

Alternative B – Optimize Outlet with maximizing Upper Pond Area

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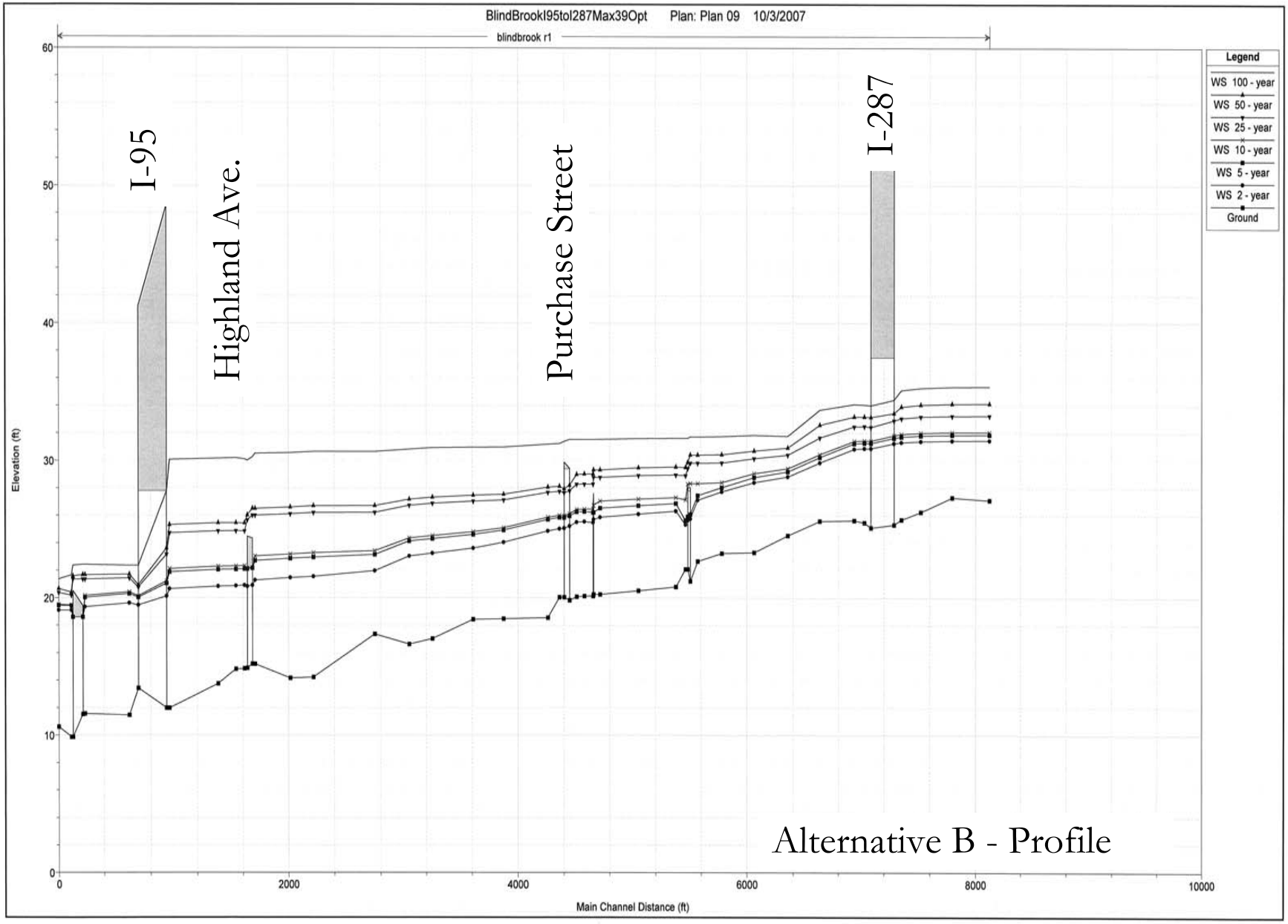
BlindBrookI95toI287Max39Opt Plan: Plan 09 10/3/2007
blindbrook r1
I-95
Highland Ave.
Purchase Street
I-287
Legend
WS 100 - year
WS 50 - year
WS 25 - year
WS 10 - year
WS 5 - year
WS 2 - year
Ground
Elevation (ft)
Main Channel Distance (ft)
0
10
20
30
40
50
60
0
2000
4000
6000
8000
10000
Alternative B - Profile

ALTERNATIVE C	Orifice Size	Water Surface Elevation (ft-NAVD)		
		Existing Cond.	Proposed Cond.	Difference
2-Year Storm	**20.2**			
D/S I-287		31.07	30.79	-0.28
Purchase Street		25.65	25.32	-0.33
Highland Road		21.41	20.93	-0.48
U/S I-95		20.77	20.32	-0.45
5-Year Storm	**45.6**			
D/S I-287		32.15	31.25	-0.90
Purchase Street		27.20	26.22	-0.98
Highland Road		24.19	22.70	-1.49
U/S I-95		22.95	21.79	-1.16
10-Year Storm	**45.6**			
D/S I-287		32.73	31.41	-1.32
Purchase Street		28.33	26.14	-2.19
Highland Road		25.88	22.62	-3.26
U/S I-95		24.59	21.48	-3.11
25-Year Storm	**72.1**			
D/S I-287		33.44	32.47	-0.97
Purchase Street		30.06	28.20	-1.86
Highland Road		27.78	25.92	-1.86
U/S I-95		26.93	24.62	-2.31
50-Year Storm	**139.1**			
D/S I-287		34.11	33.19	-0.92
Purchase Street		31.91	28.98	-2.93
Highland Road		31.01	26.48	-4.53
U/S I-95		30.56	25.29	-5.27
100-Year Storm	**139.1**			
D/S I-287		34.97	34.06	-0.91
Purchase Street		33.44	31.51	-1.93
Highland Road		32.60	30.48	-2.12
U/S I-95		32.17	30.04	-2.13

Alternative C –
Optimize Outlet with maximizing Upper Pond Area and dredging

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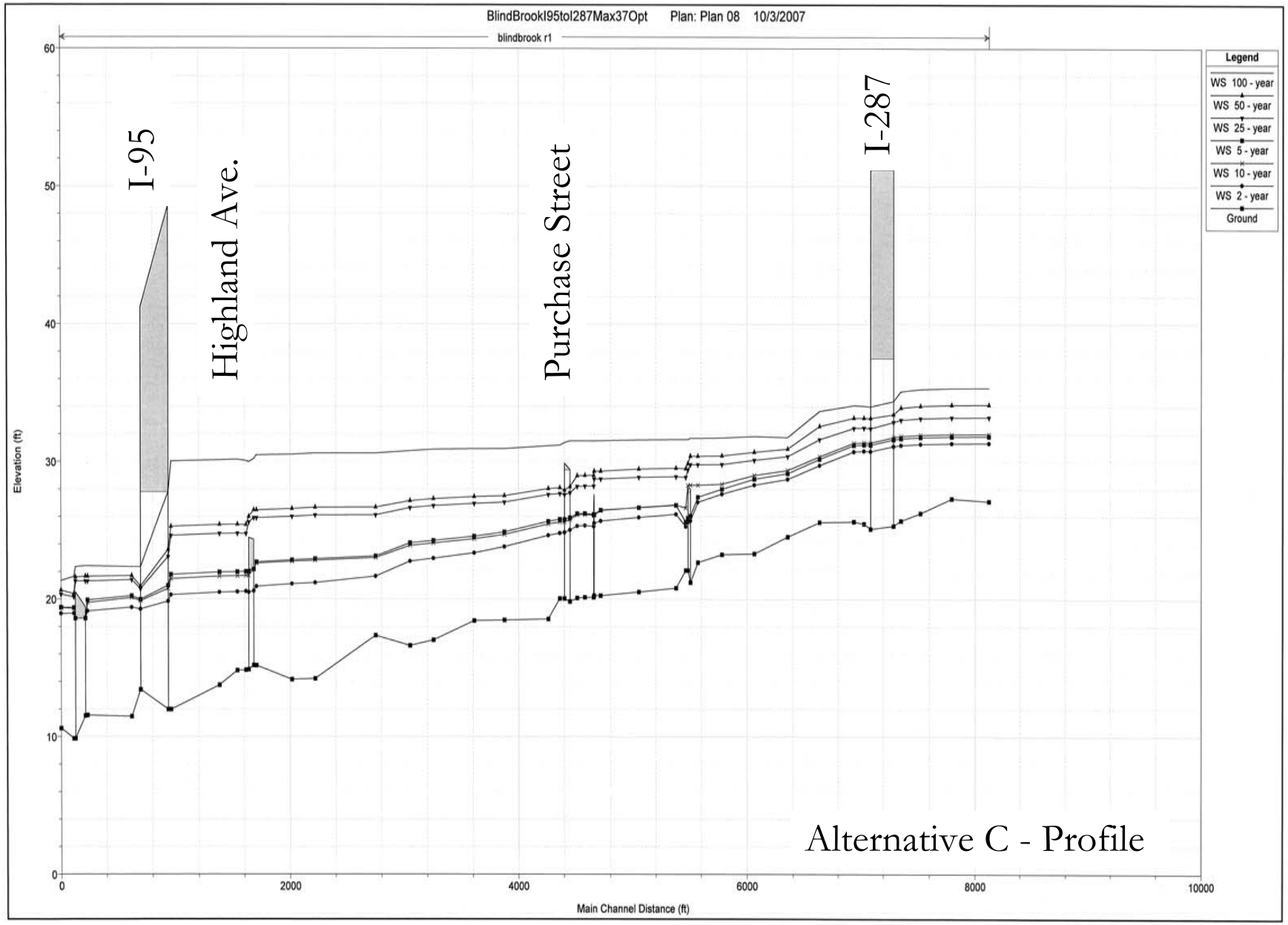
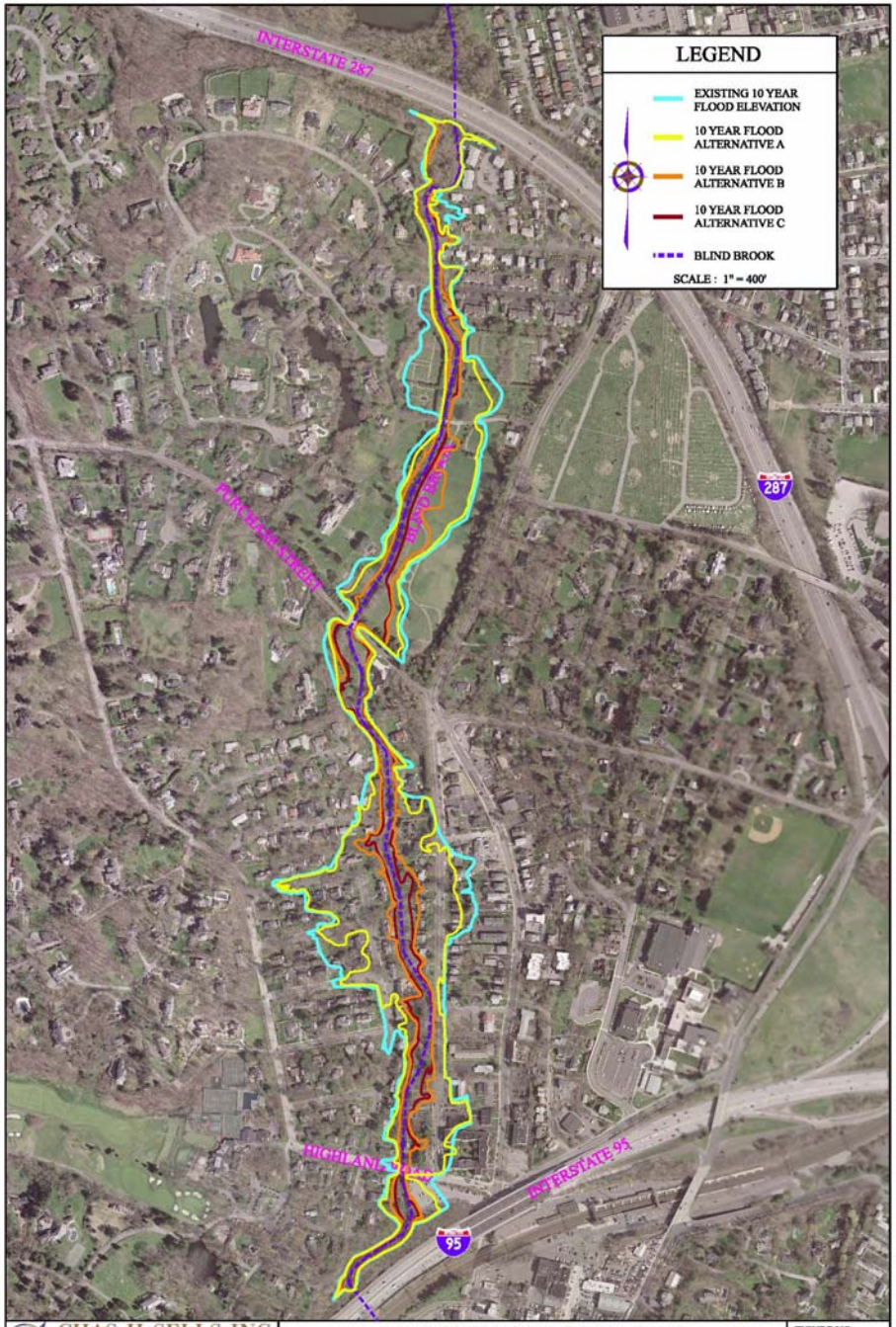

BlindBrookI95toI287Max37Opt Plan: Plan 08 10/3/2007
blindbrook r1
I-95
Highland Ave.
Purchase Street
I-287
Legend
WS 100 - year
WS 50 - year
WS 25 - year
WS 5 - year
WS 10 - year
WS 2 - year
Ground
Elevation (ft)
Main Channel Distance (ft)
0
10
20
30
40
50
60
2000
4000
6000
8000
10000
Alternative C - Profile



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CITY OF RYE FLOOD MITIGATION MEASURES
10 YEAR STORM LIMITS - EXISTING CONDITIONS AND ALTERNATIVES

FIGURE NO. 6

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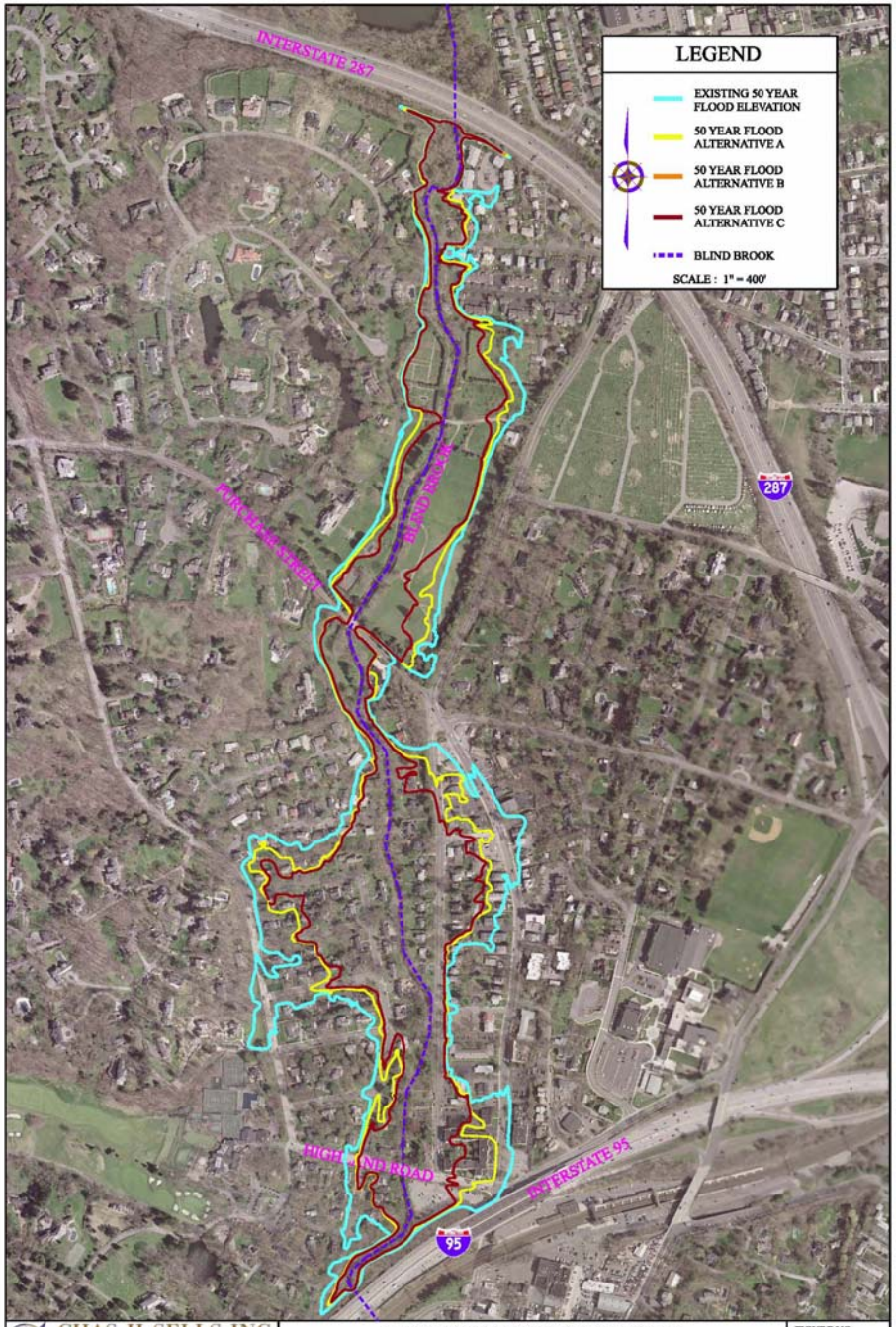

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CITY OF RYE FLOOD MITIGATION MEASURES
50 YEAR STORM LIMITS - EXISTING CONDITIONS AND ALTERNATIVES

FIGURE NO.
7

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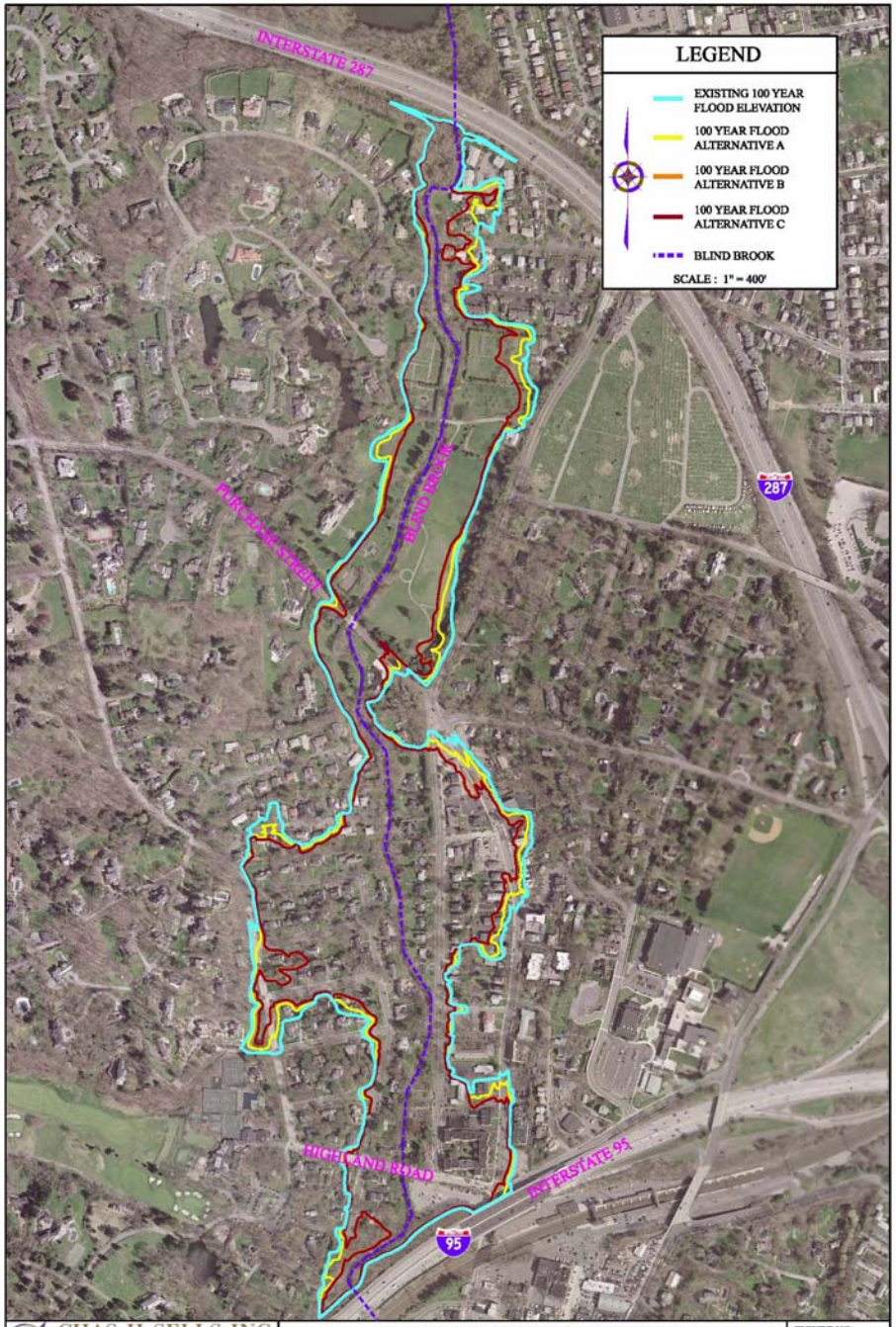

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CITY OF RYE FLOOD MITIGATION MEASURES
100 YEAR STORM LIMITS - EXISTING CONDITIONS AND ALTERNATIVES

FIGURE NO.
8

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Preferred Alternatives (cont'd)

- Impacts to Upstream Properties
  - Bowman Avenue (upstream of dam)
  - Westchester Avenue (u/s, d/s of culvert)
  - Deer Run Area
  - Longledge Court
- No increase in upstream water surface elevations

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CONCLUSIONS & RECOMMENDATIONS

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Conclusions and Recommendations

Outlet Optimization

- ***Results***
  - Provides the greatest cost-benefit ratio
  - At Highland Road: Over 3-ft reduction in w.s.e. for 50-year storm
- ***Recommendation***
  - Install automated sluice gate system at Bowman Avenue Dam
  - Cost-effective solution: $1 - $2 million (budgetary construction cost)
  - Dynamic solution: system may be adjusted based on future needs
  - Secure funding for sluice gate design and construction (HMGP application)

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Conclusions and Recommendations

Typical sluice gate

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Conclusions and Recommendations

Maximize Storage Capacity at Upper Pond

- ***Results***
  - provides largest overall reduction in w.s.e. in conjunction with sluice gate
  - At Highland Road: over 1-ft for 5-year storm, over 4.5-ft for 50-year storm

  Recommendations
  - Further study required: subsurface investigation and soil testing
  - Re-evaluate cost effectiveness $10 - $22 million (budgetary construction cost)
  - Evaluate maintenance access methods and develop long-term maintenance plan

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Conclusions and Recommendations

- Revise FIS and FIRM Mapping
  - Based on this study's discharges
  - Accurately reflect constructed mitigated measures in compliance with regulatory requirements
  - Engage the State and FEMA with proactive approach to Map Modernization to maximize benefits
  - Better defined floodplain

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Conclusions and Recommendations

- Provide hydraulic improvements at upstream locations
  - Avon Circle: Increase hydraulic opening from existing twin CMP to new structure with min. 12’ x 6’ opening.

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Next Steps

- Submit Hazard Mitigation Grant Application (HMGP) for sluice gate alternative – due November 9, 2007
  - Statewide competitive
  - $10 million available in this round
  - Questionnaire to be distributed
- Continue investigation of upper pond resizing
  - Conduct subsurface investigation
  - Refine model and costs

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Flood Mitigation Study
Bowman Avenue Dam Site
Blind Brook

QUESTION AND ANSWER SESSION

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