FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE CROTON WATER TREATMENT PLANT
WATER RESOURCES

5.15. WATER RESOURCES

5.15.1. Introduction

This section examines the existing and potential impacts of the proposed Croton Water Treatment Plant project (Croton project) on the existing surface water, stormwater runoff, and groundwater resources. The study area encompasses the stormwater drainage basins that contribute runoff to the Eastview Site. The methodology used to prepare this analysis is presented in Section 4.15, Data Collection and Impact Methodologies, Water Resources.

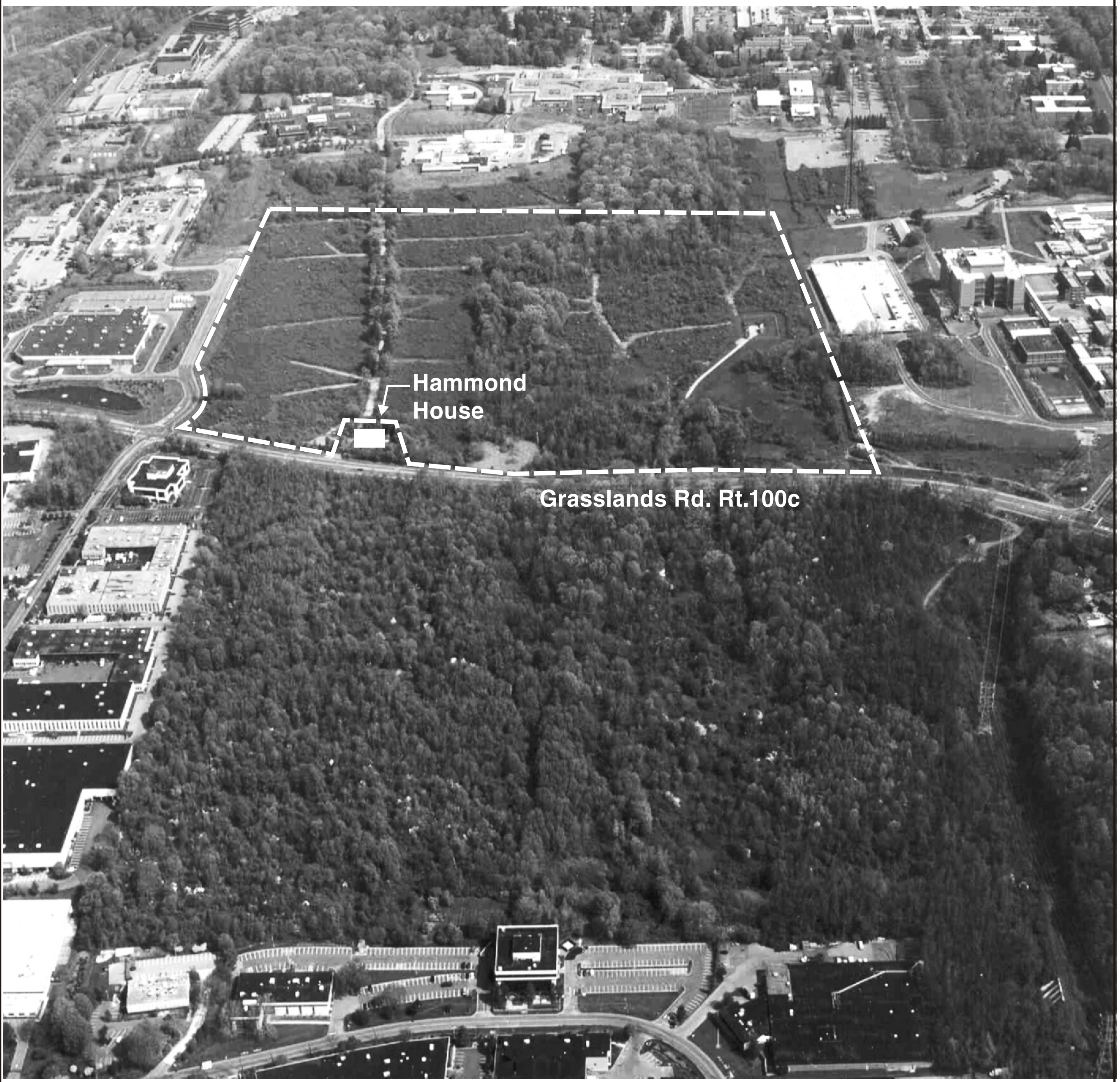
5.15.2. Baseline Conditions

5.15.2.1. Existing Condition

A complete description of the land uses at the water treatment plant site and study area is presented in Section 5.2, Land Use, Zoning and Public Policy. The study area consists of varied slopes, low-lying areas adjacent to small streams, and gently sloping uplands. The Mine Brook corridor bisects the central portion of the study area (Figure 5.15-1 and Figure 5.15-2). The elevations range from a low of 310 feet Mean Sea Level (MSL) along the stream corridor, with a relatively low rise to a ridge west of Hammond Road, approximately 320 feet to the west, and a rise to a ridge approximately 360 feet to the east. The northwestern portion of the study area, where the proposed project would be located, is relatively level at Elevation 320 feet MSL. The topography on the southern portion shows similar characteristics, with elevations ranging from 260 feet near the stream corridor to 360 feet on the eastern border and 320 feet on the western border.

5.15.2.1.1. Surface Water

Mine Brook, the north to south flowing stream bisecting the study area, and numerous smaller unnamed tributaries (many of them intermittent), which contribute flows to Mine Brook, characterize the surface waters in the study area (Figure 5.15-2). Mine Brook enters the study area at the northern property boundary through three closely spaced culverts and one principle tributary that convey flows from developed land on the Westchester County Valhalla Campus (Grasslands Reservation) located to the north, west and east of the Eastview Site. A fourth culvert, located on the west side of Mine Brook delivers storm runoff from the Public Health Laboratory on Dana Road. As Mine Brook flows through the study area, it picks up groundwater and surface water from smaller tributaries on-site. The primary tributaries also serve as conduits for stormwater runoff during storm events. Stream flows measurements obtained from August through October 2000 during dry flow periods (versus storm driven flows) indicated an average base flow of 118 gallons per minute (gpm) (0.3 cubic feet per second, cfs). This flow was measured at the point where Mine Brook passes through the culvert below Route 100C. These are steady state stream flow conditions that increase during storm events as described below under Existing Conditions, Stormwater Runoff. For example, based on modeling results, during the three-month storm event the flow reaches approximately 20 cfs at this location.



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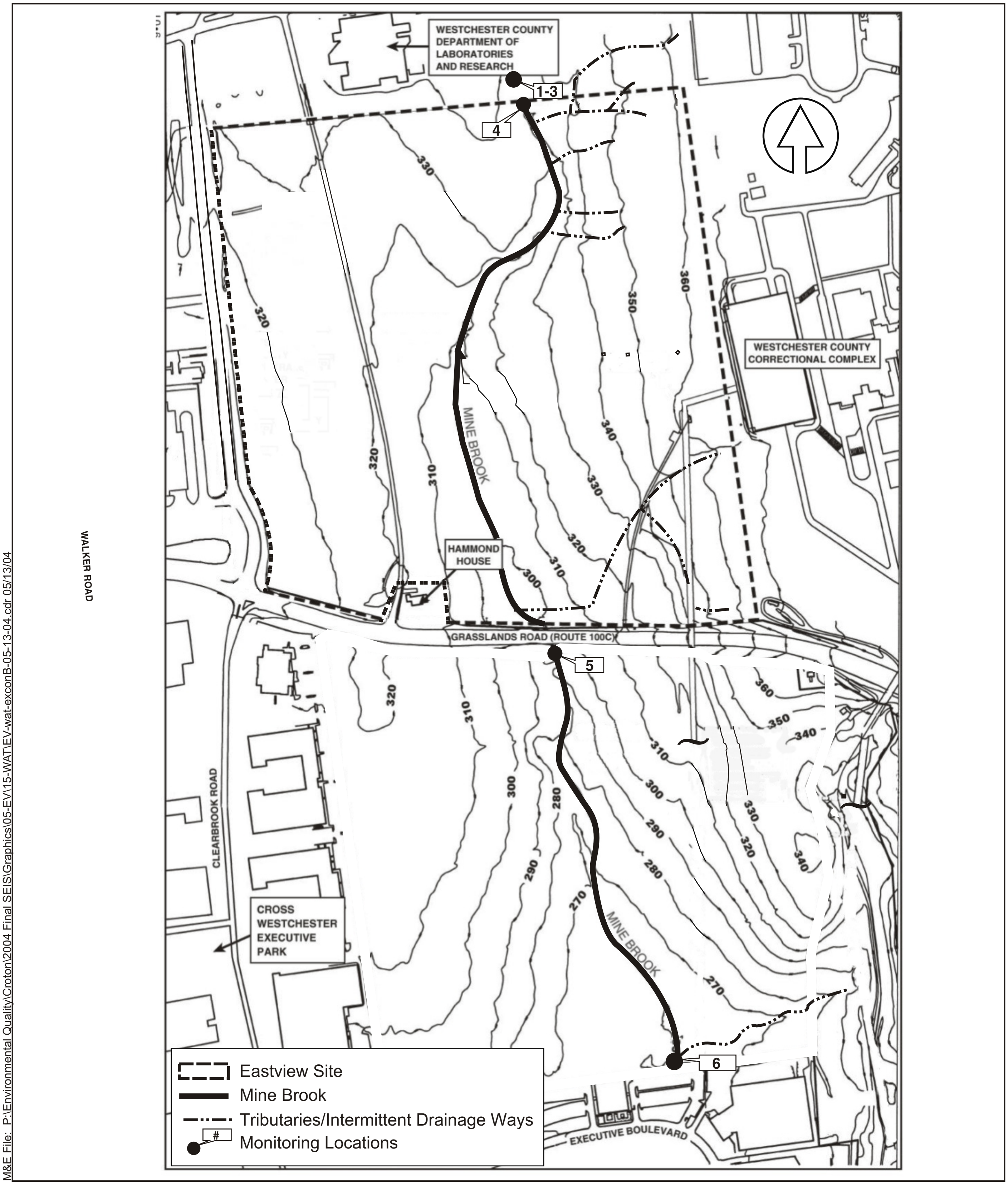
Aerial View of the Eastview Site

Croton Water Treatment Plant

Figure 5.15-1



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Not To Scale

Water Quality Monitoring Stations Eastview Site

Croton Water Treatment Plant

Figure 5.15-2

Mine Brook is classified by New York State Department of Environmental Conservation (NYSDEC) as a Class C stream, indicating that the NYSDEC has determined that its best use is for fishing, and other uses except primary contact recreation and shell fishing for market purposes. NYSDEC water quality standards for Class C streams are presented in Table 5.15-1.

TABLE 5.15-1. NYSDEC WATER QUALITY STANDARDS (6 NYCRR PART 703) FOR A CLASS C WATER BODY

Parameter	Units	Standard
Temperature	°C	N/A
Dissolved Oxygen	mg/L	> 4.0 mg/L (min daily avg > 5.0 mg/L)
DO Saturation	%	N/A
BOD_5	mg/L	
Fecal Coliform	cfu/100 mL	< 200 cfu/100 mL
Nitrate-Nitrogen	mg/L	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.
Oil & Grease	mg/L	No residue attributable to sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease.
pH		6.5 < pH < 8.5
Total Dissolved Solids	mg/L	< 500 mg/L
Total Phosphorous	mg/L	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.
Total Suspended Solids	mg/L	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Turbidity	NTU	No increase that will cause a substantial visible contrast to natural conditions.

In order to assess existing water quality within the surface waters of the Eastview Site, samples were taken at six locations along Mine Brook and its tributaries in October 2000. Figure 5.15-2 depicts the location of each of the six sampling locations, and Table 5.15-2 shows the measured concentrations of each pollutant at the six stream sampling locations. Laboratory analyses were conducted for those parameters typically used to gauge water quality, including pH, 5-day biochemical oxygen demand (BOD_5), fecal coliform, oil and grease, turbidity, nitrate-nitrogen, total phosphorus, total suspended solids (TSS), and total dissolved solids (TDS).

TABLE 5.15-2. WATER QUALITY SAMPLING RESULTS, OCTOBER, 2000

Parameter	**Sampling Points**						
	Units	**WQ-1**	**WQ-2**	**WQ-3**	**WQ-4**	**WQ-5**	**WQ-6**
Temperature	ºC	18.8	17.7	13.7	12.9	14.1	15.1
Dissolved Oxygen (DO)	mg/l	7.8	6.3	8.7	10.0	8.9	10.4
DO Saturation	Percent	84.0	65.0	84.1	94.3	86.5	103.3
BOD_5	mg/l	<4	<4	<4	<4	<4	<4
Fecal Coliform	cfu/100 ml	**6800**	**670**	**1110**	**350**	**620**	**210**
Nitrate-Nitrogen	mg/l	1.60	2.10	1.60	1.20	1.00	1.00
Oil & Grease	mg/l	<1.6	<1.5	<1.5	<1.6	<1.6	<1.5
pH	SU	7.40	7.50	7.70	7.50	7.60	7.60
Total Dissolved Solids	mg/l	**615**	**576**	**533**	**546**	296	348
Total Phosphorus	mg/l	0.16	0.29	0.10	0.08	0.05	0.06
Total Suspended Solids	mg/l	<3.0	34	<3.0	<3.0	3.2	3.6
Turbidity	NTU	2.8	0.5	0.9	2.6	0.9	1.1
NSF-WQI	0-100	**56.9**	**56.4**	**60.2**	**63.7**	**65.5**	**68.9**

Note: Measurements shown in bold do not meet the Class C stream water quality standards.
mg/l= milligrams per liter
NTU = Nephelometric Turbidity Units

Also listed is each parameter's composite index number as per the National Sanitation Foundation's Water Quality Index (NSF-WQI). Composite index values greater than 70 generally indicate good water quality. Parameters which yielded index values characteristic of good water quality include pH, dissolved oxygen saturation, turbidity, and total phosphorus. Although oil and grease is not a measurement incorporated into the NSF-WQI, it is notable that no quantifiable concentrations of oil and grease were detected in any of the water samples.

The results indicate that several parameters exceed concentrations that are considered indicative of good water quality. Most significantly, concentrations of fecal coliform and total dissolved solids indicate that water quality is impaired. Other parameters were not significantly degraded, although nitrate and BOD_5 levels were also found to be somewhat depressed below the preferred conditions in a freshwater stream.

The origin of the elevated fecal coliform counts is not pinpointed by the samples that were collected. However, the highest counts were found in the most upstream (northern) samples on the Eastview Site and the lowest counts were found at the downstream end of the study area. This trend may indicate that a loading source for fecal coliform is located off-site. TDS concentrations also exhibited a decline (improvement) toward the downstream end of the Eastview Site. The data indicate that the stream water quality entering the Eastview Site is somewhat degraded and that the on-site wetlands along the Mine brook corridor and the associated vegetation provide some water quality improvement. The presence of dry weather flows from the stormwater culverts that drain into the study area from the Grasslands Reservation (noted during the survey) indicates that some infiltration of sewer flows into the stormwater system may be occurring.

5.15.2.1.2. Stormwater Runoff

Model Description. Existing stormwater runoff at the Eastview Site was simulated using HydroCAD® Version 7 stormwater modeling software.[1] The model provides hydrograph generation and routing based on the Soil Conservation Service (SCS, now known as Natural Resources Conservation Service) TR-20 procedures. In order to model stormwater flows, the drainage area of the Eastview Site was divided into twelve sub-catchments or basins (Figure 5.15-3). Stormwater runoff volumes and rates were estimated for both on-site and off-site areas within the Mine Brook watershed so that the contributions of stormwater from the adjacent Grasslands Reservation and office parks northeast of the Eastview Site could be assessed. These off-site areas currently discharge stormwater through a system of subsurface drainage conduits, thereby using the Eastview Site for both stormwater detention and conveyance. These off-site flows make up a majority of the stormwater that enters Mine Brook under existing conditions. The InfoWorks model was used to estimate surface water elevation at several locations along the brook to further assess potential impacts to Mine Brook resulting from stormwater runoff during various rainfall events.

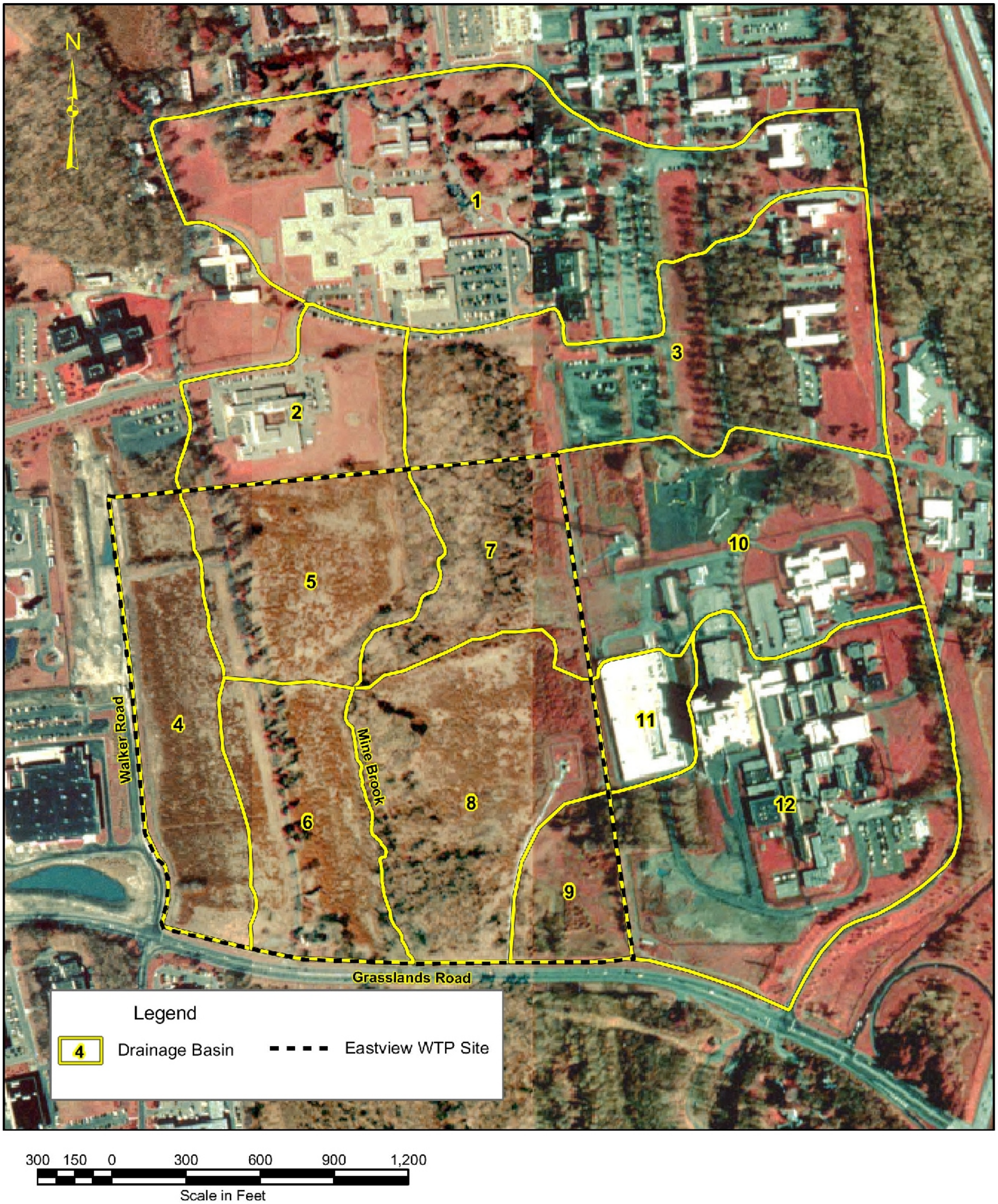
Soils are classified into hydrologic soil groups (HSGs) to indicate the minimum rate of infiltration obtained for bare soils after prolonged wetting. The HSGs, which are A, B, C, and D, are one element used in determining runoff curve numbers (CN). Based on the recently completed geotechnical boring program, all on- and off-site soils were considered to be Type C. These soils have low infiltration rates when thoroughly wetted, and consist chiefly of soils with a layer that impedes downward movement of water, and soils with moderately-fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).[2] Infiltration and runoff rates were calculated using runoff curve numbers for each cover type, as provided in the Soil Conservation Service Technical Release 55 (SCS TR-55) and reprinted in the model manual[3].

The on-site watershed draining the water treatment plant under existing conditions was delineated based on topographic survey data identifying two-foot contour intervals. The two-foot contours were first converted into a digital elevation model, and then a Geographical Information System (GIS) (ArcView 3-D Analyst) was used to delineate drainage areas, and determine slopes and hydraulic lengths (i.e. the longest distance stormwater runoff would travel in each basin). In addition to the overall area of each basin, the area of various cover types in each basin was determined with GIS in order to facilitate an assessment of infiltration and runoff rates for each cover type. For the existing conditions model, the acreages of wetland, wooded, grass, brush, and impervious areas were approximated using the GIS database.

[1] Applied Microcomputer Systems (AMS). 2001. HydroCAD Stormwater Modeling System. Owners Manual, Version 7. Chocorua, New Hampshire.

[2] AMS,2001

[3] AMS,2001



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Stormwater Drainage Basins for the Eastview Site

Figure 5.15-3

Mine Brook, and its associated wetlands, is a sensitive resource; therefore, the basins contributing directly and indirectly to the brook were assessed. As such, the model was constructed to estimate runoff contributing to the brook from within the Eastview Site, and from off-site basins. Stormwater runoff from development in the Grasslands Reservation (Basin 1) enters Mine Brook via three closely spaced culverts, located approximately 500 feet north of the Eastview Site. A fourth culvert, located on the west side of Mine Brook (Basin 2) delivers storm runoff from the Public Health Laboratory on Dana Road. On-site, several unnamed brooks tributaries to Mine Brook originate in the swampy area at higher elevations in the eastern portion of the site (Basin 7).

A Type III storm was used to model each of the five storm events. This is the most common type of storm in the New York City area and is typical of eastern coastal areas of the U.S. where large 24-hour rain events are typically associated with tropical storms. As stipulated by Westchester County,[4] the 24-hour design storms that were modeled included the 2-year (3.3 inches), the 5-year (4.3 inches), the 10-year (5.0 inches), and the 100-year (7.2 inches).[5] Although analysis of the 3-month storm (1.5 inches) is not required from a regulatory basis, this storm was modeled because the return period represents a storm event that will generally provide water at frequent enough intervals to support a surface water dependent wetland.

For each of the modeled storms existing peak flows and 24-hour runoff volumes were estimated. Assessment of peak flow rates is important because an increase in peak flows could result in erosion along drainage paths in both upland and wetland areas. The 2-year and 5-year storms were simulated to determine the existing peak flows and 24-hour runoff volumes under these conditions, which are parameters relevant to both wetlands and upland resource areas in the basins draining from the water treatment plant site. The 5-year design storm is also the standard design storm used by the NYCDEP to size infrastructure needed to dissipate peak flows and maintain existing 24-hour runoff volumes. The 10-year storm was analyzed for potential water resource impacts because this storm is anticipated to have a greater influence on the site natural resources. In order to comply with SPDES requirements, the modeling effort also included the 100-year storm in order to assess the potential for downstream flooding.

Existing Stormwater Runoff. As illustrated in Figure 5.15-3, the overall watershed draining to Mine Brook was subdivided into 12 basins. The study area was subdivided into six basins based on hydrologic divisions (Figure 5.15-4), with Mine Brook forming the boundary between Basins 5 and 6 to the west, and Basins 7 and 8 to the east. Each basin within the study area receives storm flow from off-site with the exception of Basin 4 on the western side of the study area. Stormwater runoff from Basin 4 flows to the west and therefore does not contribute to Mine Brook. The six off-site basins within the Mine Brook watershed were delineated to provide an estimate of the stormwater runoff entering the study area. Basins 1 and 2 discharge more or less directly into Mine Brook, while runoff from Basins 3, 10, and 11 flows overland to the border of the Eastview Site. The majority of Basin 12 discharges to the roadside ditch along Route 100C, while a small portion flows on-site (Basin 9). Most of the runoff from Basin 9

[4] Stormwater Management, Best Management Practices, Westchester County Department of Planning. (Westchester, 1984).
[5] This rainfall data is from the U.S. Weather Bureau. 1961. Technical Paper No. 40-Rainfall Frequency Atlas of the United States (TP 40).

appears to be intercepted by a series of man-made ditches that run generally parallel to and east of the Shaft No. 19 access road. The input parameters used to simulate existing stormwater flows in the basins are summarized in Table 5.15-3.

Table 5.15-4 summarizes the peak runoff rate and total runoff volume for each basin for the 3-month, 2-year, 5-year, and 10-year storm events under existing conditions. The results are presented in terms of on-site basins which discharge to Mine Brook (Basins 5 through 9), and off-site basins tributary to Mine Brook (Basins 1 - 3, and 10 - 12). The model indicates that within the Eastview Site during the 3-month storm, the runoff volume entering Mine Brook is approximately 0.9 acre-feet. The majority of this runoff comes from Basin 7 (0.5 acre-feet), which contains several wetland streams tributary to Mine Brook, and Basin 8 (0.2 acre-feet), which is the largest basin on-site. Since only a small amount of overland runoff reaches the brook during the 3-month storm event, the stormwater model results confirm that stormwater runoff from within the Eastview Site is not the primary source of water supporting the hydrology of Mine Brook. The large contribution of stormwater runoff to Mine Brook from off-site (upstream) basins is clearly demonstrated by the existing condition model results. For example, the model indicates that during the 3-month storm, runoff volume from Basin 1 alone is approximately 1.6 acre-feet.

As noted previously, the InfoWorks model was used to estimate surface water elevation at several locations along the brook (Figure 5.15-5). Figure 5.15-6 (A and B) presents the stream invert profile along with the maximum water surface elevations for the various storms modeled using InfoWorks. As illustrated by the profile, the sections of streams with a significant slope are more channelized while the gentler sloped and flatter sections demonstrate more floodplain and adjacent area ponding.

5.15.2.1.3. Groundwater

Groundwater beneath the study area occurs within the saturated portions of the overburden and bedrock. The groundwater originates either as precipitation that falls directly on the study area and infiltrates; as inflowing groundwater from topographically higher terrain to the north and east of the study area; and possibly as periodic infiltration of surface water from Mine Brook; the stream that flows through the study area from north to south.

Existing Conditions at the Eastview Site

Croton Water Treatment Plant

Figure 5.15-4

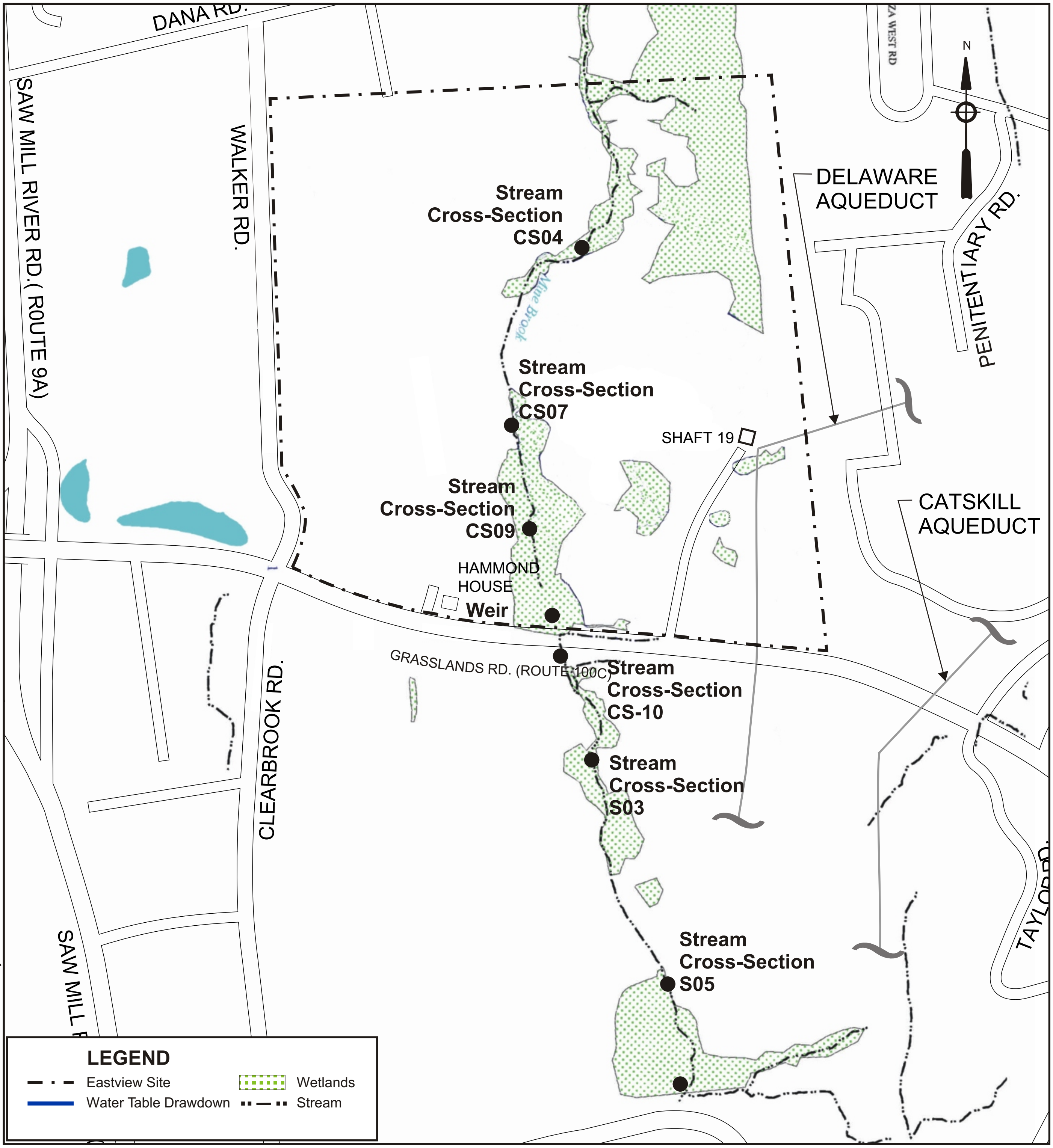
TABLE 5.15-3. BASIN CHARACTERISTICS FOR EASTVIEW SITE

Basin	Grass/Trees		Woods		Trees/Brush		Wetlands		Gravel Road		Buildings/Paved		Composite		
	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Total Area (ac)	Composite CN	Tc (min)
On-Site Basins Tributary to Mine Brook															
5	-	-	2.48	70	12.59	65	0.63	98	0.28	89	-	-	15.98	67	25.5
6	0.42	74	1.30	70	10.26	65	1.33	98	0.38	89	0.17	98	13.86	70	27.6
7	-	-	3.92	70	0.93	65	6.42	98	-	-	-	-	11.27	86	11.8
8	-	-	5.53	70	12.74	65	3.17	98	-	-	0.23	98	21.67	71	20.4
9	2.56	74	3.16	70	-	-	0.20	98	-	-	-	-	5.92	73	7.5
Total													68.70		
Off-Site Basins Tributary to Mine Brook															
1	15.56	74	9.19	70	-	-	-	-	-	-	21.13	98	45.88	84	16.1
2	5.19	74	1.28	70	0.42	65	0.18	98	2.45	89	1.72	98	11.24	81	14.8
3	7.84	74	8.41	70	2.18	65	3.36	98	-	-	8.56	98	30.35	82	51.0
10	8.55	74	1.79	70	2.01	65	-	-	-	-	12.46	98	24.81	85	17.0
11	0.41	74	0.03	70	-	-	-	-	-	-	4.11	98	4.55	96	3.2
12	15.81	74	3.11	70	-	-	-	-	-	-	16.84	98	35.76	85	18.6
Total													152.59		
Other Basins															
4	-	-	0.40	70	14.16	65	0.01	98	-	-	-	-	14.60	65	9.2

Notes
CN = Curve Number, a factor describing the surface permeability; higher numbers are assigned to areas of lower permeability
Tc = Time of Concentration, the time in minutes for a particle of water to flow from the most hydrologically remote point in the watershed to the receiving area

TABLE 5.15-4. EXISTING RUNOFF CHARACTERISTICS IN 3-MONTH, 2-YEAR, 5-YEAR, AND 10-YEAR STORMS

Basin	3-Month Storm		2-Year Storm		5-Year Storm		10-Year Storm	
	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)
On-Site Basins Tributary to Mine Brook								
5	0.1	0.06	7.2	0.98	14.2	1.77	19.7	2.39
6	0.3	0.10	7.6	1.02	14.0	1.76	19.0	2.34
7	5.0	0.46	20.8	1.80	30.3	2.64	37.0	3.25
8	0.6	0.18	14.5	1.89	26.2	2.88	35.2	3.81
9	0.3	0.06	6.4	0.52	11.1	0.86	14.6	1.12
Total		0.86		6.21		9.91		12.91
Off-Site Basins Tributary to Mine Brook								
1	14.8	1.58	69.6	6.74	103.8	10.06	128.3	12.47
2	2.6	0.29	15.3	1.45	23.6	2.22	29.7	2.79
3	4.6	0.86	24.7	4.05	37.8	6.16	47.3	7.71
10	8.7	0.93	38.5	3.80	56.8	5.62	69.9	6.95
11	6.0	0.42	14.9	1.08	19.8	1.46	23.1	1.72
12	12.1	1.34	53.4	5.48	78.9	8.10	96.9	10.00
Total		5.42		22.60		33.62		41.64
Other Basins								
4	0.1	0.04	7.7	0.79	16.7	1.46	23.8	2.00



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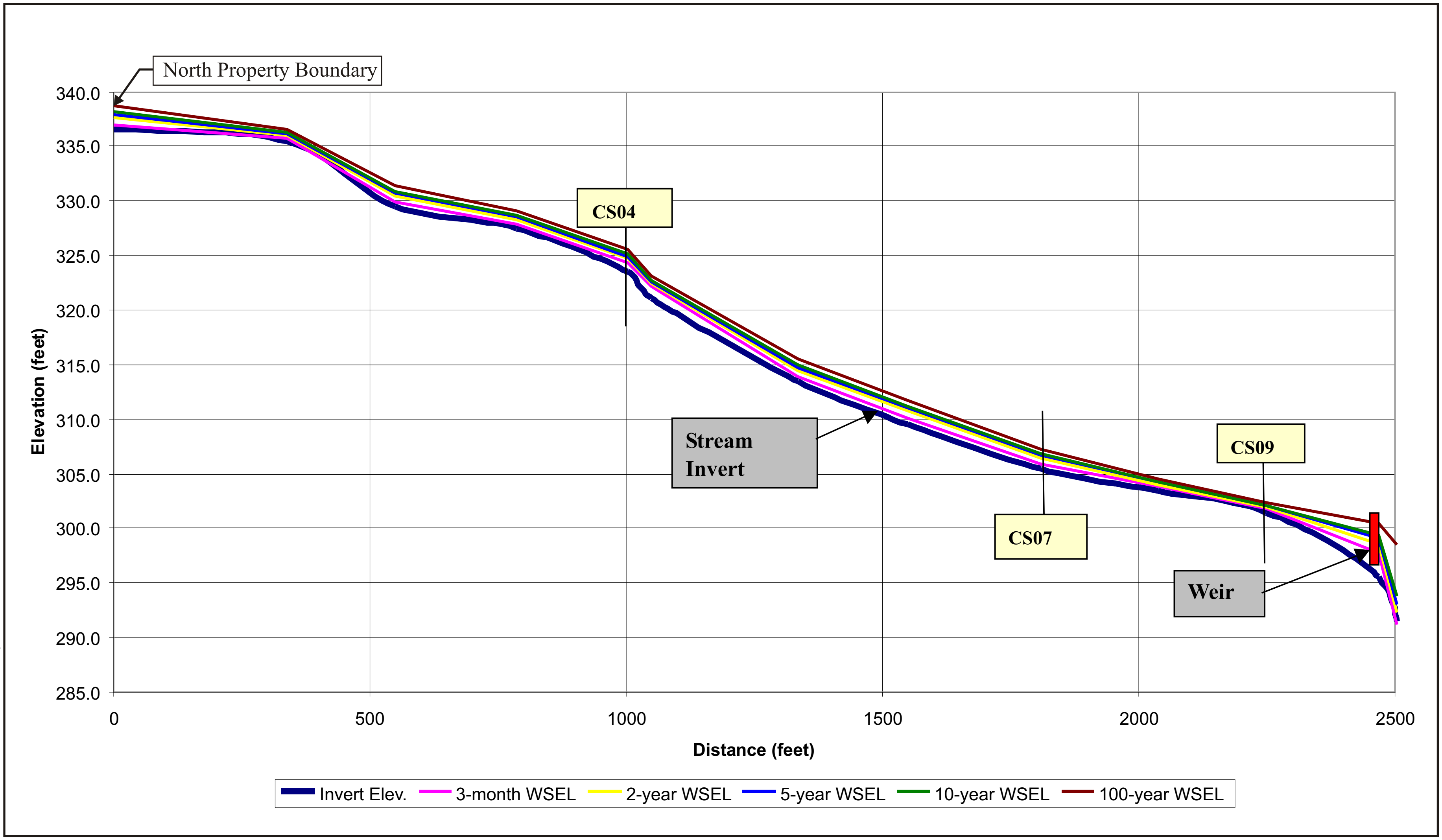
WSEL Cross-Section Locations Along Mine Brook

Croton Water Treatment Plant

Figure 5.15-5



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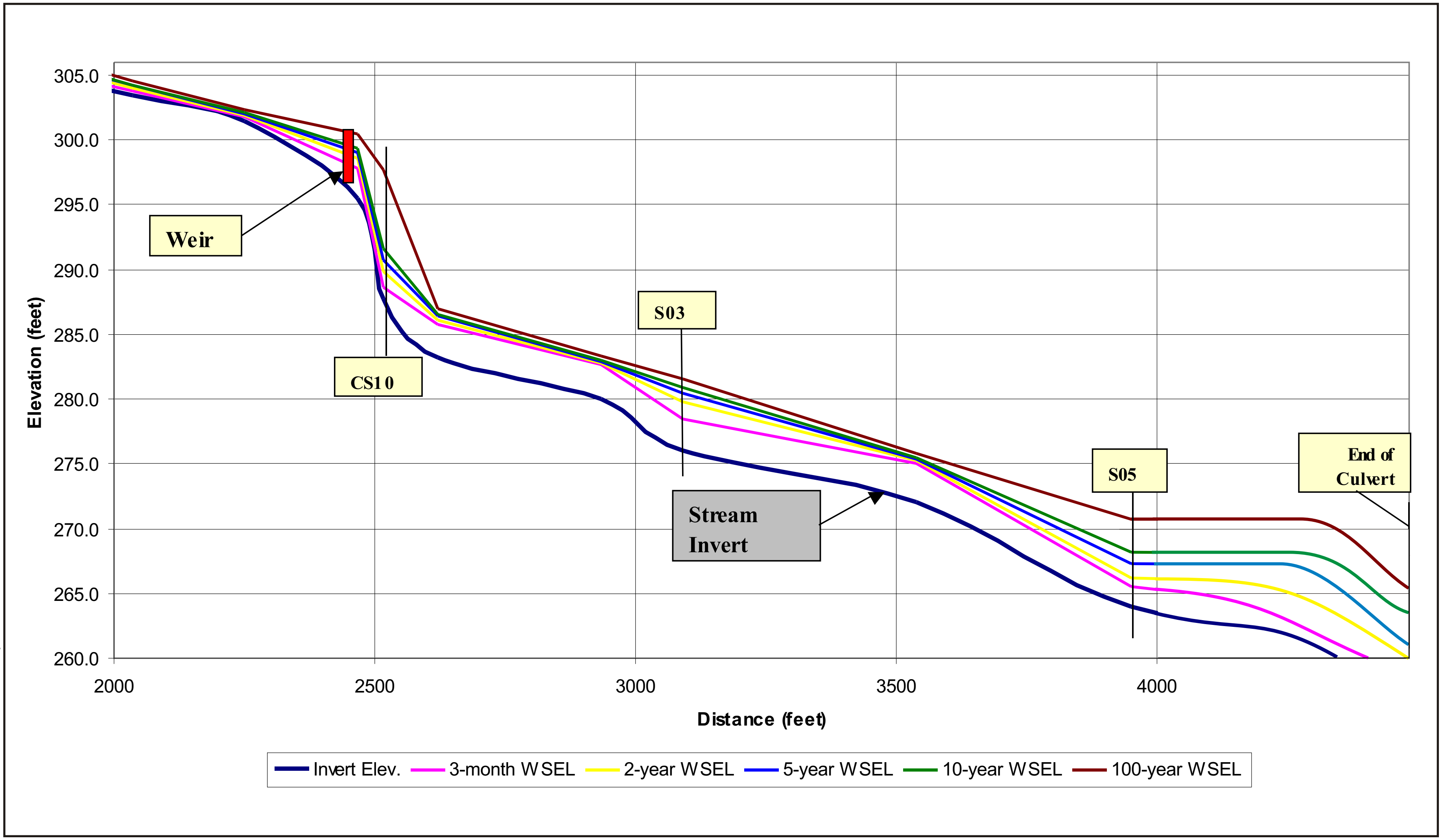
Existing Water Surface Elevations (WSELs) for 3 month, 2-year, 5-year, 10-year and 100-year Return Frequency Storm Events

Croton Water Treatment Plant

Figure 5.15-6A



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Existing Water Surface Elevations (WSELs) for 3 month, 2-year, 5-year, 10-year and 100-year Return Frequency Storm Events

Croton Water Treatment Plant

Figure 5.15-6B

Geology. Most of the surficial geologic (unconsolidated) materials that underlie the site were deposited during an episode of continental glaciation that concluded about 10,000 years ago in this area. These materials have been modified in several ways since their original deposition, including the formation of topsoil and subsoil layers at and just below the ground surface; anthropomorphic disturbances such as excavation, backfilling, or burial; and natural burial by alluvial and wetland deposits along streams and in low areas.

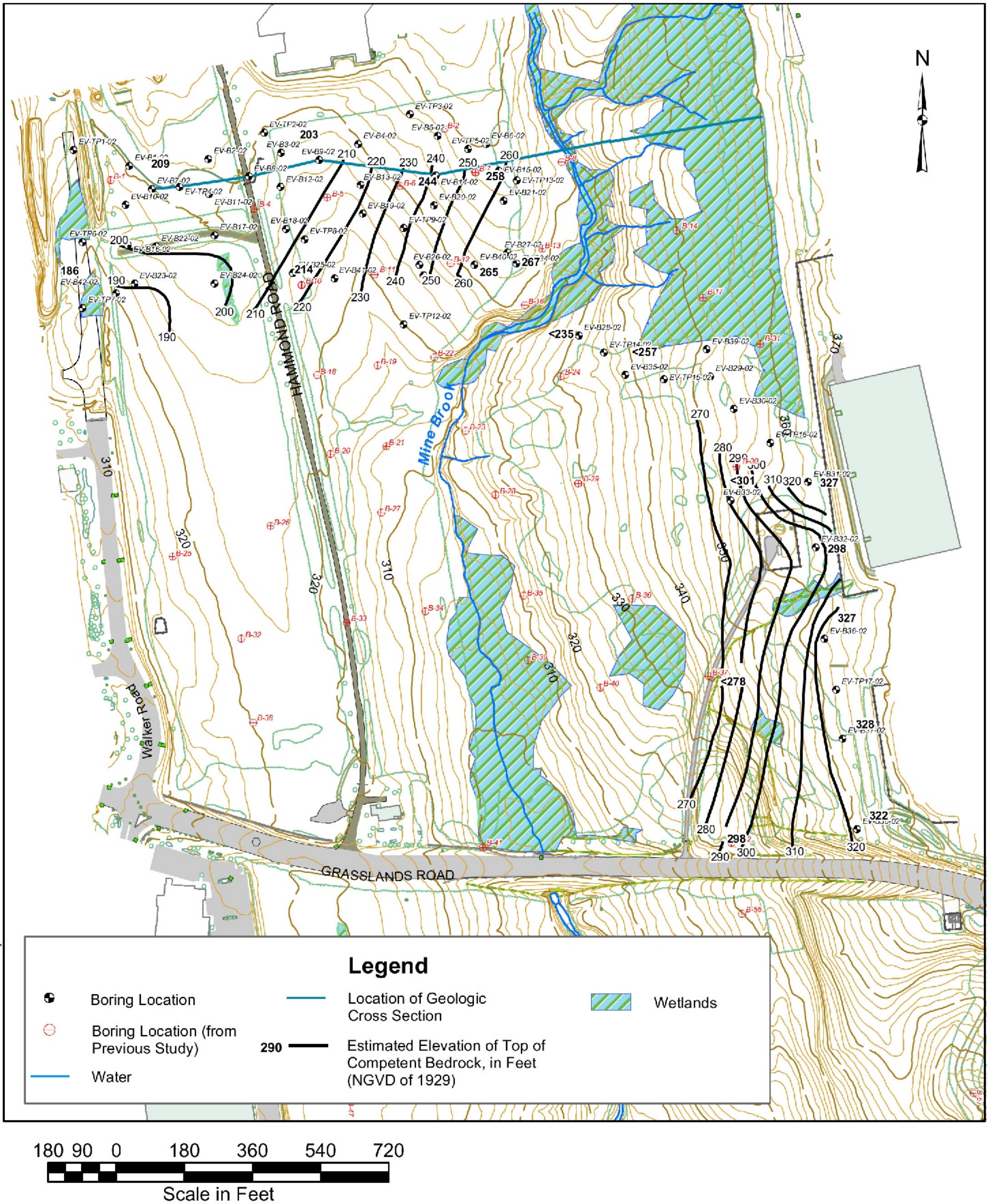
The bedrock that underlies the unconsolidated deposits is metamorphic rock of Cambrian or Ordovician age. In the extensive time since the formation of these rocks, they have experienced numerous changes that have affected rock properties. For example, jointing and faulting have produced fractures along which groundwater can move, and weathering has caused partial disintegration of the rock at the rock surface and at depths up to 100 feet below the top of rock.

Except for minor amounts of recent alluvium, wetland deposits, and fill on the surface, the unconsolidated deposits on the Eastview Site consist of glacial till. Till is generally a relatively dense, unsorted deposit of soil particles that can range in size from boulders to silt and clay. Till is unsorted because of its non-fluvial origin, either being deposited beneath a glacier as it moves across the bedrock surface or being left as an in-place residual on top of the ice as it melts away.

As shown on Figure 5.15-7, the bedrock surface beneath the till slopes from east to west. The overlying till was found to vary in thickness from 23 to 120 feet in borings drilled across the Eastview Site. Within the footprint of the proposed main treatment building on the west side of Mine Brook, the till is relatively thick, varying from about 70 feet near the brook to about 120 feet near the west side of the site. The till is thinner on the east side of Mine Brook, varying from about 70 feet near the brook to 25 feet near the eastern boundary of the proposed site. The results of standard penetration tests, performed during soil sampling in the borings, indicate that the upper 10 to 20 feet of till is less dense than the underlying material. The till was generally described as dense or very dense silty fine sand, with varying amounts of gravel, sandier zones, and occasional boulders.

Available mapping indicates that the bedrock underlying the Eastview Site is mostly the Manhattan Formation, with the Inwood Marble occurring beneath the westernmost portion of the proposed site. In the borings drilled at the site, only schist and gneiss of the Manhattan Formation were encountered.

On the western side of Mine Brook, the bedrock was found to be mica schist. A layer of highly weathered rock, or saprolite, was found at the top of the schist. In most of the borings that penetrated it, the saprolite was less than 10 feet thick. Based on standard penetration test values, the saprolite is less dense than the overlying till. Beneath the layer of saprolite, the rock itself was found to have closely spaced fractures. Layers of highly weathered, soft and friable rock were found interspersed with harder, more intact layers at depths up to 100 feet below the top of rock.



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Geological Cross Sections at the Eastview Site

Croton Water Treatment Plant

Figure 5.15-7

East of Mine Brook, the bedrock was found to be gneiss. The gneiss was generally less weathered and less fractured than the schist, although the upper several feet were typically moderately weathered.

Farther south on the Eastview Site, the presence of a groundwater divide to the west of the brook has been inferred from previous groundwater modeling results and from observations of groundwater levels in open boreholes during previous episodes of drilling. East of the divide, groundwater flows toward Mine Brook, while to the west the flow is toward the Saw Mill River.

Hydraulic Conductivities. In previous investigations at the Eastview Site, hydraulic conductivity tests were performed in wells screened in the till. The values from the testing ranged from 0.01 to 0.17 feet per day (feet/day). A groundwater flow model of the study area was developed as part of the earlier studies. In the model, the till was divided on the basis of density and composition into an upper and a lower layer. The upper layer, ranging in thickness from about five to 20 feet across the study area, was described as a brown to yellow brown, medium dense, sandy silt or silty sand with varying amounts of gravel. The lower layer was described as a dense to very dense, gray to brown, sand or sandy silt with occasional cobbles and boulders. The calibrated model had hydraulic conductivity values of 0.05 feet/day for the lower, dense till and 10 feet/day for the upper till. A hydraulic conductivity value of 0.1 feet/day was assigned to the bedrock in the calibrated model.

Hydraulic conductivity testing was conducted in the till and in the bedrock during the recent subsurface investigations. Based on 20 falling head tests that were conducted in 13 of the borings during drilling, values ranging from 1.8E-06 to 1.1E-03 cm/sec (0.005 to 3 feet/day) were calculated for the till. The arithmetic mean value was 1.1E-04 cm/sec (0.3 feet/day), and the geometric mean value was 2.2E-05 cm/sec (0.06 feet/day).

Packer testing was performed in the bedrock portions of three of the borings in the western part of the proposed main treatment building location. In eight of the 30 tests performed, no water flowed into the rock, indicating a hydraulic conductivity value of zero. For the other tests, the hydraulic conductivity values ranged from 0.008 to 4.8 ft/day. Ignoring the zero values results in a geometric mean value of 0.13 ft/day for the non-zero values. Assuming a value of 2.8E-06 ft/day for the zero values results in a geometric mean value of 0.007 ft/day. These measured conductivities support the values used in the model.

Groundwater Flow. Figure 5.15-8 shows a water table contour map for the study area based on water levels measured on October 8, 2002. The contours indicate that the groundwater to the east of Mine Brook was flowing toward the brook, and it is likely that at least some of that westward-moving groundwater was discharging to the brook and contributing to its base flow. West of the brook, the groundwater was flowing southwest, in a direction that would take it off the site and toward the Saw Mill River.

Water Table Elevations at the Eastview Site

Figure 5.15-8

At three locations (EV-B7-02, EV-B22-02, and EV-B42-02) on the western side of the study area, two wells were installed at different depths to determine the piezometric head in different geologic units. In all three cases, an upper well was installed in the saprolite layer at the top of bedrock, and a lower well was installed about 60 to 90 feet below the top of competent rock. Water level measurements during the late summer and fall of 2002 and winter of 2003 showed downward hydraulic gradients at two of the three locations. Downward vertical gradients seem reasonable, considering the topographic position of the wells on a hillside recharge area. At EV-B22-02, the vertical gradients were consistently upward. The reason for the relatively high piezometric head in the deeper bedrock at this location is unknown.

5.15.2.2. Future Without the Project

The Future Without the Project conditions were developed for the anticipated peak year of construction (2008) and the anticipated year of operation (2010) for the proposed plant. The anticipated peak year of construction is based on the peak number of workers. For each year, two scenarios are assessed: one Without the Catskill/Delaware Ultraviolet Light Disinfection Facility (Cat/Del UV Facility) at the Eastview Site and another With the Cat/Del UV Facility at the Eastview Site. Specifically the Cat/Del UV Facility would be located in the southeastern area of the Eastview Site. It should be noted that the Eastview Site is the only location under consideration for the Cat/Del UV Facility. By the peak construction year, two additional NYCDEP projects could be located on the Eastview Site, namely a Police Precinct and possibly an Administration Building.[6] The Police Precinct may be located in the southwest corner of the proposed site. The Administration Building is less certain; however, as the Eastview Site is one of several properties currently being evaluated for use as a possible site for that particular building. In addition to these projects, NYCDEP's Kensico-City Tunnel may be under construction at the Eastview Site starting in 2009. All of these NYCDEP projects are analyzed in this Final SEIS to the extent to which information is available. They are all separate actions subject to independent decision-making from the proposed project and each will undergo their own environmental reviews.

5.15.2.2.1. Without Cat/Del UV Facility at Eastview Site

In the Future Without the Project, structures currently located on-site would remain, including Hammond House and Shaft No. 19. Grasslands Reservation, which bounds the Eastview Site to the north, west and east, has planned several developments that are anticipated to be completed before year 2008.

As previously mentioned, by the Operation Year of 2010, several projects could share the Eastview Site. These include the planned construction of a NYCDEP Police Precinct, and the Kensico-City Tunnel (KCT) project. The police precinct site would consist of ±20,500 square-foot precinct building, and the KCT shaft site could potentially occupy approximately one half acre. The staging areas for these projects could overlap with each other. The location and size of KCT project has not been determined. The potential impacts would be assessed as part of this

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[6] This depends on the results of a siting evaluation which is currently ongoing. The siting decision will be evaluated and discussed as part of a separate independent environmental review.

project and within their own environmental reviews. See Section 3.8.2 for generic impacts associated with the KCT.

An increase in the impervious ground cover at the Grasslands Reservation and on the Eastview Site would be minimal and therefore the stormwater runoff impacts on surface water and groundwater conditions in the proposed site are anticipated to remain similar to the existing conditions. Section 5.2, Land Use, Zoning and Public Policy examines the proposed development project both on and off-site.

5.15.2.2.2. With Cat/Del UV Facility at Eastview Site

The first full year of operation for the Cat/Del UV Facility is anticipated to be 2010. With the Cat/Del UV Facility, approximately nine acres of the site would be occupied by the facility infrastructure such as buildings, offices, roads, parking areas and other associated impervious areas.

Stormwater Runoff. As part of the stormwater management plan, a storm sewer collection system would be designed to protect the infrastructure from storm-related flooding damage. For this project, all pipes would be designed for the 50-year storm including “critical path” pipes. Critical path pipes are defined as the main collector pipes of the storm sewer network, which convey off-site flows through the site as well as on-site runoff. These pipes would be designed for a larger design storm to account for any unanticipated flows that may drain to the associated catch basins from off-site. With the storm sewer network in place, the runoff would be directed to a stormwater detention basin.

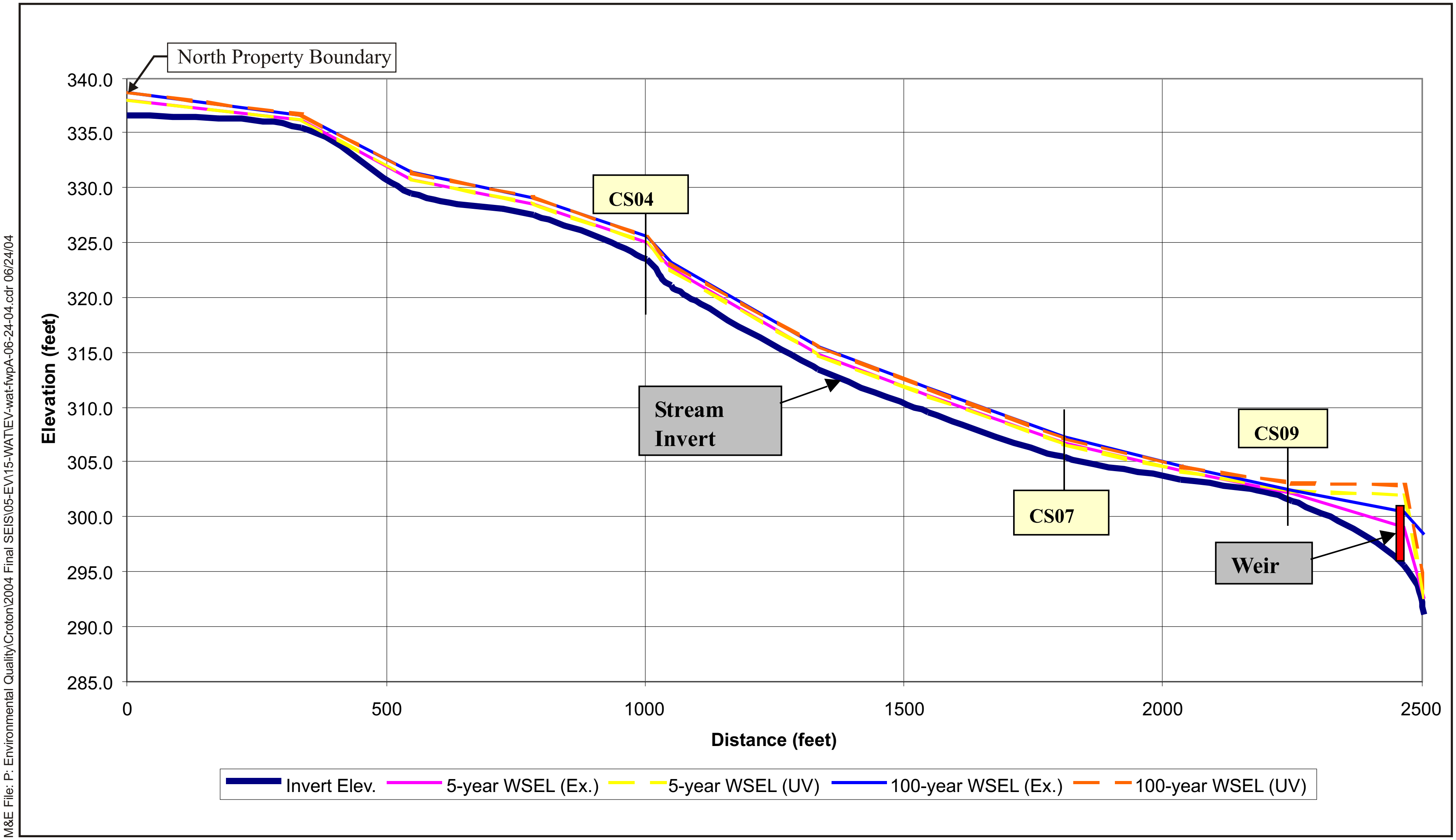
As specified by the Town of Mount Pleasant, the basin would be sized to provide on-site detention of stormwater runoff generated from the 100-year storm so that the post-developed peak runoff flows do not exceed the pre-developed peak runoff flows. Approximately 4.5 acre-feet of stormwater storage would be needed to meet these requirements. This would be achieved by designing a basin that uses the existing topographic features and optimizes the available in-stream storage. The degraded reed grass marsh upstream of Route 100C presents a unique opportunity to expand and enhance the existing wetland while providing the necessary storage and natural attenuation of stormwater flows. The detention basin, consisting of a pretreatment forebay, extended detention wetland, and a created stream channel, would attenuate the untreated storm water runoff by attenuating peak flows and reducing pollutant loads to downstream reaches. The pretreatment forebay would be located just south of the facility and would be adequately sized to detain stormwater volumes up to the 3-month storm. The pretreatment forebay can also provide for the water quality treatment by way of removal of sediment, nutrients, and bacteria. Approximately 80 percent sediment removal can be achieved and 50 percent removal of nutrients, such as phosphorus and nitrogen. Once the water surface elevation in the forebay exceeds that of the weir (El. 301), the flow would spill over the weir into a newly created stream segment, and flow towards the existing wetland.

Under the Cat/Del UV Facility, the existing reed marsh would be removed, the area excavated and regraded, and the weir north of Route 100C reconstructed to optimize the upstream storage and creation of a diversely vegetated wetland. Model results for the 5-year and 100-year storms indicate no significant change to the water surface (floodplain) elevation across the stream profile, except the area just upstream of the weir (Figure 5.15-9). This difference is localized and contained within the in-stream storage extent and occurs due to the modification and raising the weir to optimize the upstream storage and sustain the enhanced wetland.

Groundwater. Groundwater flow model simulations were performed to estimate the changes to groundwater-related resources that would result from construction of the Cat/Del UV Facility without the Croton project (Figure 5.15-10). The simulations were run assuming that the main disinfection building would have a perimeter underdrain set at an elevation of 300 feet. No dewatering or underdrains were simulated for the other buildings associated with the Cat/Del UV Facility, as these structures would not require sub-slab drainage.

Simulated long-term average water table elevations, water table drawdowns, dewatering flow rates and groundwater base flow to Mine Brook were used to evaluate potential changes. In general, the changes in the water table were restricted to the immediate area surrounding and including the main disinfection building. Based on the model results, a dewatering rate of 15 gpm was required to maintain the groundwater elevation at 300 feet within the building footprint. The simulated groundwater base flow in Mine Brook at Grassland Road is 64 gpm. The simulated base flow reduction at this point was therefore approximately 18 percent. This reduction in the base flow would be replenished with the routing of the surface stormwater runoff and the online storage.

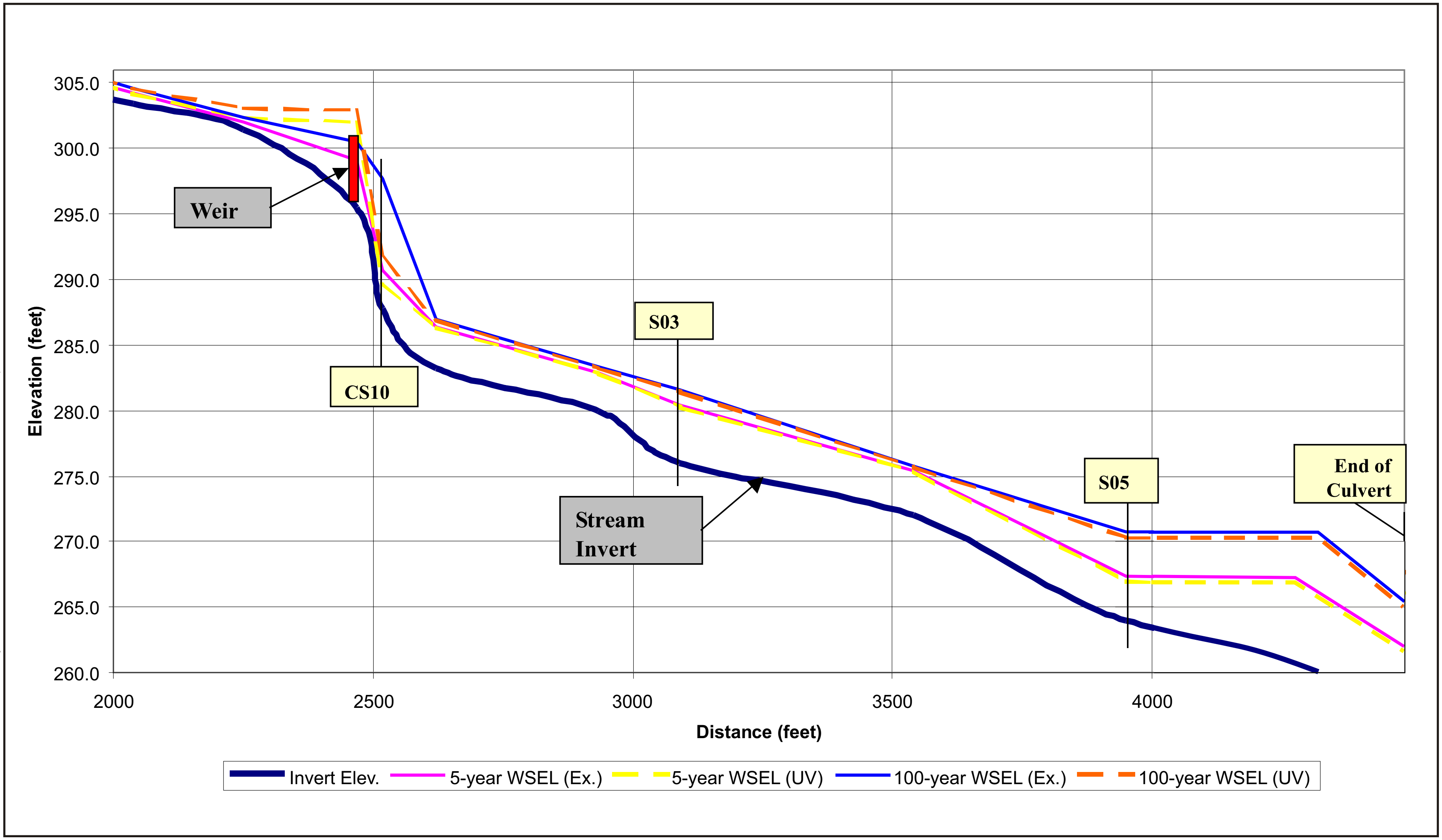
Drawdown from the drains extended into some of the Mine Brook wetlands to the west of the facility, and the simulation suggested that the drawdown at the upstream end of this wetland would approach or slightly exceed the limit to sustain the wetland. However, the presence of the stream with its high spring flows would probably mitigate the drawdown and maintain saturation at a shallow depth. Therefore, the simulation results suggest that, in general, the nearby wetlands would not be affected by significant changes in depth to water. No portion of the northeast wetland, which is east of the proposed Croton project site, or the wetland area along Mine Brook south of Route 100C experienced significant drawdown.



Comparison Between WSELs for Existing and Cat/Del UV Facility Only for the 5-year and 100-year Storms

Croton Water Treatment Plant

Figure 5.15-9A



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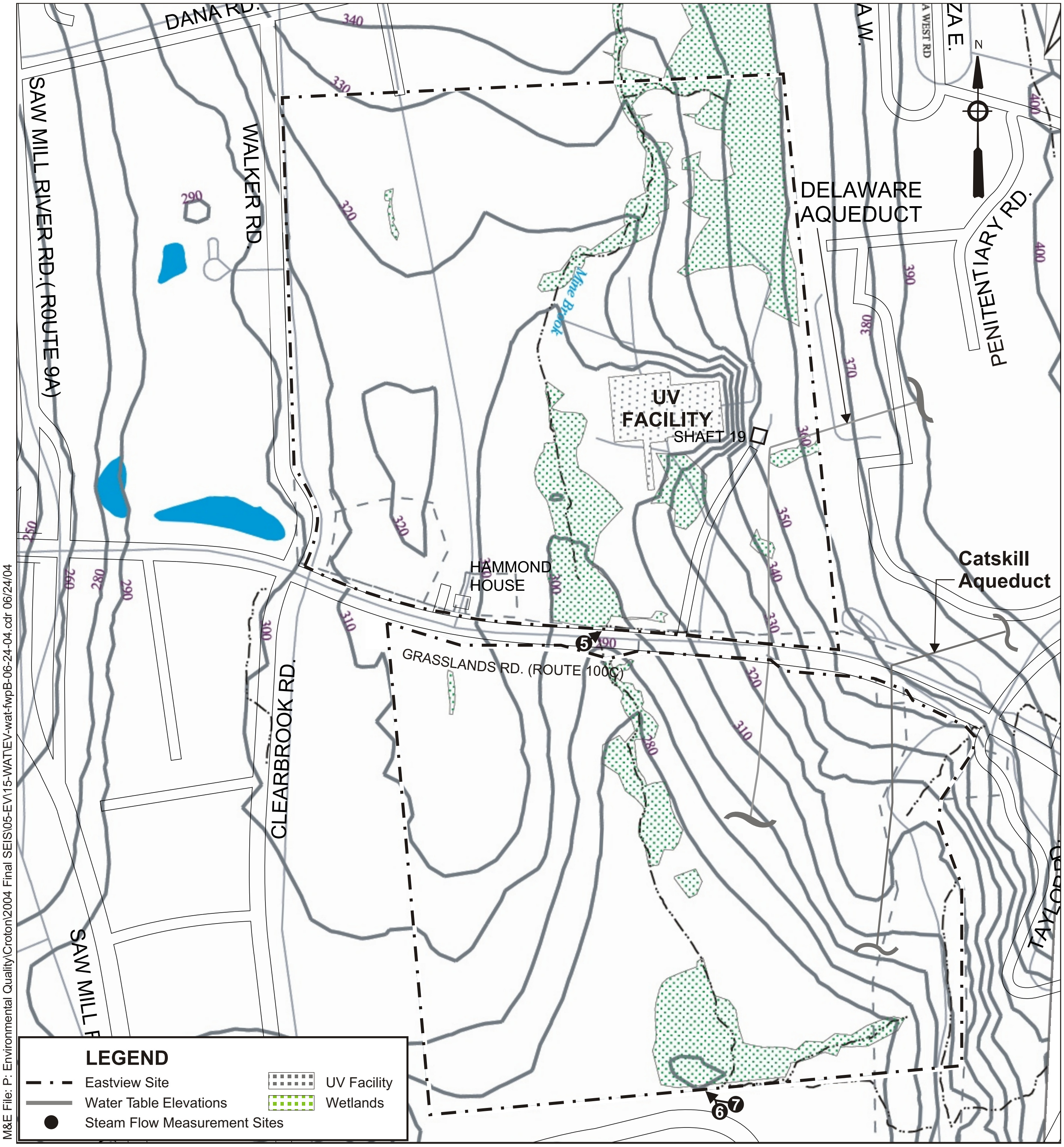
Comparison Between WSELs for Existing and Cat/Del UV Facility Only for the 5-year and 100-year Storms

Croton Water Treatment Plant

Figure 5.15-9B



Not To Scale

Simulated Water Table Elevations for Cat/Del UV Facility Operations

Croton Water Treatment Plant

Figure 5.15-10

Surface Water. Mine Brook was modeled for a variety of storm conditions to evaluate the potential stormwater impacts on the stream. Results indicate that the routed runoff volume and the water surface elevations in the proposed conditions are very similar to the existing conditions for all locations upstream and downstream of the in-stream storage. This indicates that no significant change to the surface water characteristics are anticipated for those reaches of Mine Brook. At the in-stream storage just upstream of the weir and north of Route 100C the water surface elevations for all the storms are higher in the proposed conditions since the weir elevations were modified to optimize upstream storage. However, the extent of open water for the more frequent storms was maintained and this was achieved by additional excavation and some regrading. These modifications were necessary to remove the phragmites monoculture and replace it with microtopography that supports vegetative diversity while still maintaining a surface water feature comparable to the existing conditions with an enhanced wetland component.

Groundwater induced impacts to surface water were modeled using a predicted average outflow of 27 gpm; this flow would otherwise have been part of the base flow in Mine Brook under existing conditions. The decrease in streamflow would persist in a 450 linear feet section of the stream between the access way crossing and the weir at Route 100C. This groundwater outflow would be redirected into Mine Brook via the facility foundation drain that would outlet just upstream of Route 100C to maintain base flows downstream of Route 100C. In addition, the decrease in streamflow upstream of the weir would be partially mitigated by reconstructing the weir and optimizing the upstream on-line storage of the drainage corridor. The added detention of water during wet weather on a consistent basis would augment the recharge characteristics thereby maintaining a water balance, more or less similar to the existing conditions.

In addition to the facility foundation drain, an emergency overflow may be required at the Cat/Del UV Facility to provide a means of alleviating flood conditions that could result from catastrophic failure of process piping and Cat/Del UV equipment inside the building. While the potential for an overflow condition at the Cat/Del UV Facility is considered extremely remote, provision to reduce flooding within the facility would be included as a safety measure for employees working at the facility and as a preventative measure to reduce potential damage to UV equipment. This emergency overflow from the Cat/Del UV Facility would be discharged to Mine Brook just upstream of Route 100C on the Eastview Site. In an emergency scenario due to the catastrophic failure of a process train, a total volume of approximately 1.5 acre-feet with a maximum flowrate of 50,000 gpm (112 cfs) could occur. This instantaneous discharge would equate to a peak flow rate generated at the culvert crossing on Route 100C from a 1 to 2 year storm. The total volume discharged (1.5 acre-feet) is 15 percent of the runoff generated at the culvert crossing on Route 100C from a 3-month storm.

5.15.3. Potential Impacts

The potential impacts from project and construction activities are represented for the two scenarios described in the Future Without the Project: Without the Cat/Del UV Facility at the Eastview Site, and With the Cat/Del UV Facility at the Eastview Site. Both include the proposed

NYCDEP Police Precinct, Administration Building, and KCT projects[7], but only one scenario includes the Cat/Del UV Facility to account for the as yet undetermined siting decision regarding the site selection of the Cat/Del UV Facility. The scenario With the Cat/Del UV Facility at the Eastview Site describes the incremental impacts that would result from the construction and operation of the proposed Croton project if the Cat/Del UV Facility were under construction or in operation. The impacts of the construction and operation of the Cat/Del UV Facility by itself are described in the Draft EIS for that project issued by NYCDEP June 1, 2004. Should the Eastview Site be selected for the Cat/Del UV Facility, both the facility and the proposed Croton project would be under construction at the same time.

The potential impacts associated with the KCT are too speculative to assess in any great level of detail and are discussed in Section 3.8.2, Treated Water Conveyance Alternatives. The relocation of the historic Hammond House is being considered by NYCDEP. The area where this building currently resides would be available for construction staging during construction, and would be restored as a natural habitat during operation. The potential impacts of this action are described in Section 5.12, Historic and Archaeological Resources.

5.15.3.1. Potential Project Impacts

The anticipated year of operation for the proposed project is 2010. Therefore, potential project impacts have been assessed by comparing the Future With the Project conditions against the Future Without the Project conditions for the year 2010. The potential project impact analysis includes the police precinct in the Future Without the Project conditions.

5.15.3.1.1. Without Cat/Del UV Facility at Eastview Site

Stormwater Runoff. The stormwater management plan would provide long-term control and treatment of stormwater runoff from the Eastview Site, to the maximum extent practicable. This includes landscaping to provide proper stabilization of the proposed site, providing treatment of stormwater runoff from all impervious services, and maintaining flows to adjacent natural resource areas at or near the existing conditions rates and volumes.

The key component of the stormwater management at the Eastview Site is the stormwater detention basin. The runoff from the main facility roof, as well as the perimeter and access roads, and main parking area, would be collected via a storm drainage system and directed to a stormwater detention basin as shown in Figure 5.15-11. The detention basin is located to the southeast of the main treatment building. The stormwater detention basin is designed to contain the runoff generated from the 100-year 24-hour storm (7.2 inches of rainfall). The detention basin would provide temporary storage of storm runoff from the proposed plant and help maintain flow in Mine Brook during the operation, so that flow does not exceed the existing conditions during storm events.

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[7] In addition, both scenarios will include a qualitative assessment of effects during construction and operation of the proposed Croton project if the proposed Administration Building is located on the Eastview Site. This project is separate from and independent of the proposed Croton project and will be evaluated as part of an independent environmental review.

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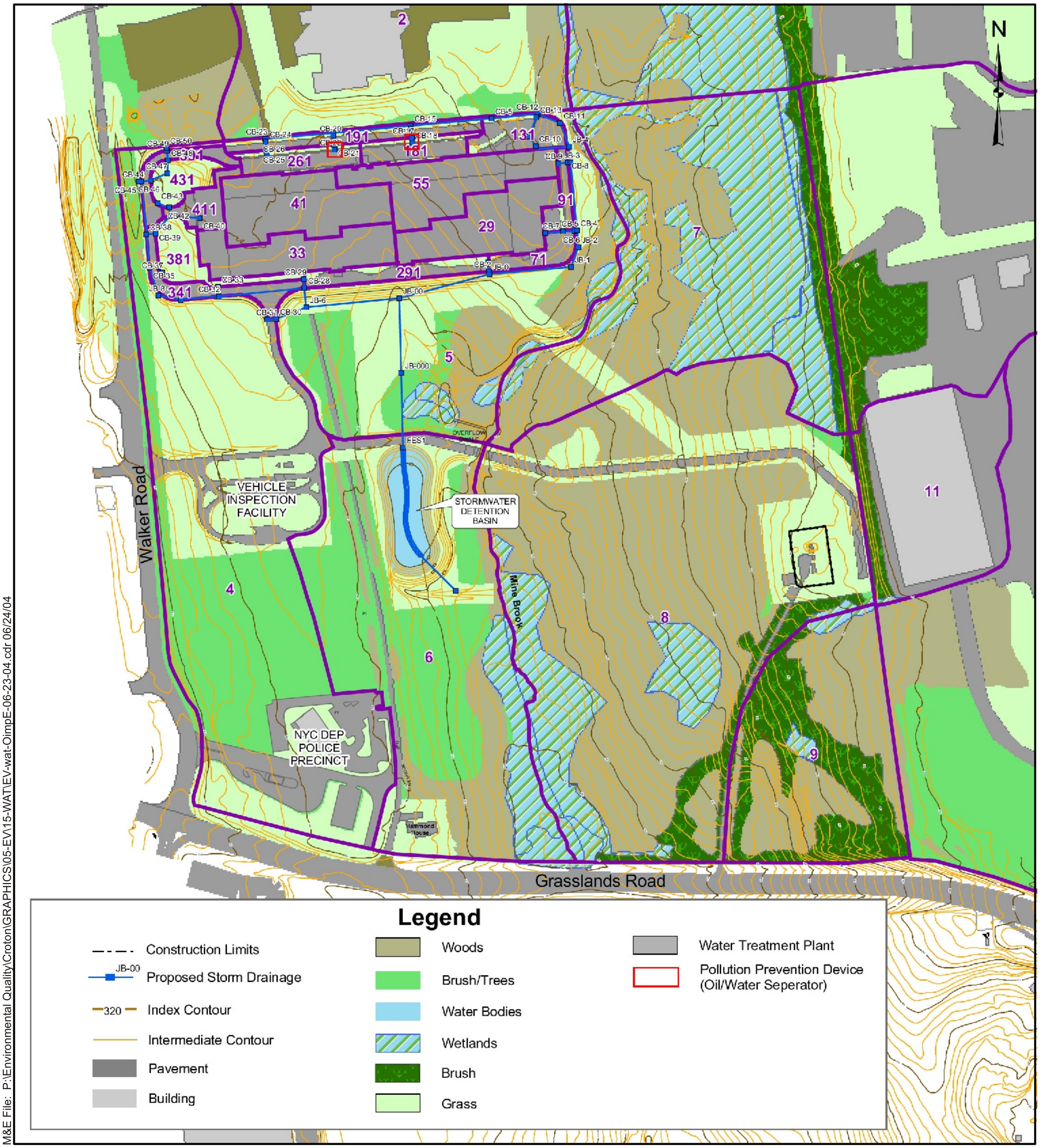
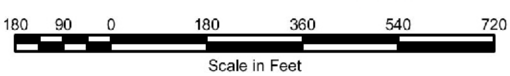




Stormwater Basins During Operating Conditions at the Eastview Site

Croton Water Treatment Plant

Figure 5.15-11

The stormwater detention basin would have a 42-inch riser with the overflow set at 315.5 foot elevation above the mean sea level (MSL). Primary discharge to Mine Brook would be via an 18-inch pipe, equipped with a flared end-section and riprap apron to dissipate the flow before discharge to the brook. The riser pipe may be perforated to help the basin drain fully between storm events. The detention basin also would include an emergency spillway with a weir crest elevation set at 316 feet MSL. The overflow weir would be protected with riprap. The secondary flow would be conveyed to Mine Brook via a 20-foot wide grass-lined channel. This channel would also receive a constant groundwater flow from the facility underdrain system of approximately eight gallons per minute (gpm).

Additional facilities located on the Eastview Site, associated with the proposed plant, include a vehicle inspection facility in the western part of the site adjacent to Walker Road, and the Delaware Aqueduct Shaft No. 19 access road from the proposed plant. Stormwater runoff from the vehicle inspection facility, south of the proposed water treatment plant, would be directed to vegetated swales. These swales would provide infiltration surfaces to replenish the groundwater adjacent to the roadways.

Model Description and Results. The HydroCAD® stormwater model was used to predict runoff from the Eastview Site for similar design storms, as shown in the existing conditions section above (3-month [1.5 inches], the 2-year [3.3 inches], the 5-year [4.3 inches], the 10-year [5.0 inches], and the 100-year [7.2 inches])[8], and also to size individual long-term pollution prevention devices, located to treat runoff from impervious areas.

The future conditions at the Eastview Site were simulated by modifying the curve numbers and acreages in the HydroCAD® model to reflect the conditions illustrated in Figure 5.15-11. Table 5.15-5 summarizes the input parameters used in the model to simulate future stormwater conditions.

Generally, when compared to the existing conditions, the Stormwater model predicts (with the exception of the 3-month storm) a very slight decrease in peak runoff flows and volumes to Mine Brook during the operation of the proposed plant.

3-Month Storm. The model results indicate that there are no significant changes in the 3-month storm flow rate or total runoff volume are anticipated when comparing with the existing conditions (1.0 acre-foot shown on Table 5.15-4). The total volume to Mine Brook is predicted to increase by approximately 0.1 acre-feet (ten percent).

2-Year Storm. The HydroCAD® results indicate that the operation of the proposed plant would result in no significant changes in the total runoff volume to Mine Brook resulting from the 2-year, 24-hour storm when compared to existing conditions. During operation, a significant amount of stormwater runoff is redirected by the facility drainage system within Basin 5 to the permanent detention basin in Basin 6. This results in a decrease in runoff from Basin 5 to Mine Brook, and a predicted increase in wet weather flow from Basin 6 to Mine Brook. However, since the wetlands along Mine Brook are sustained by the much larger stormwater flows from

[8] This rainfall data is from the U.S. Weather Bureau. 1961. Technical Paper No. 40-Rainfall Frequency Atlas of the United States (TP 40).

upstream Basins 1, 2 and 3 (12.2 acre-feet in the 2-year storm), the impact to these wetlands resulting from operation of the water treatment plant is insignificant. The predicted increase in both peak runoff rate and runoff volume from Basin 4 is due to the increase in impervious area within the basin resulting from the proposed police precinct. Current model results indicate a decrease in peak runoff volume, from the on-site basins tributary to Mine Brook, from 6.2 acre-feet during existing conditions (Table 5.15-4) to 6.1 acre-feet during the operation of the proposed plant (two percent) (Table 5.15-6). This minor decrease is due to the diversion of water from the proposed plant area to the stormwater detention basin. Considering flows within Mine Brook itself, the peak runoff rate at the culvert above Route 100C decreases from 134 cfs during existing conditions to 129 cfs during the operation phase. However, as described previously, the water detained within the detention basin would be discharged over time to Mine Brook to maintain pre-construction flows in the brook.

5-Year Storm. The stormwater model results indicate that the operation of the proposed plant would result in no significant changes in total stormwater runoff volume to Mine Brook resulting from the 5-year storm. As noted in the above discussion of operation impacts resulting from the 2-year storm, the predicted changes in stormwater runoff volume from Basins 5 and 6 during the 5-year storm are due to the proposed long-term stormwater management plan. The resulting localized changes in runoff to Mine Brook from Basins 5 and 6 are not significant due to the large stormwater contribution from upstream (off-site) basins. As described previously the increase in predicted peak runoff rate and runoff volume from Basin 4 is the result of the proposed vehicle inspection facility and a proposed NYCDEP Police Precinct (see Section 5.15.2.2.1. Future Without the Project, Without Cat/Del UV Facility at Eastview Site). As a result of the diversion of wet weather flows from the area of the proposed plant, peak runoff volumes to Mine Brook would decrease during operation as compared to existing conditions. Overall peak runoff volume from the on-site basins tributary to Mine Brook would decrease by approximately one percent or from 9.9 acre-feet (Table 5.15-4) to 9.8 acre-feet (Table 5.15-6).

TABLE 5.15-5. BASIN CHARACTERISTICS FOR EASTVIEW SITE – OPERATION CONDITIONS

Basin	Grass/Trees		Woods		Trees/Brush		Wetlands		Gravel Road		Buildings/Paved		Composite		
	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Area (ac)	CN	Total Area (ac)	Composite CN	Tc (min)
On-Site Basins Tributary to Mine Brook															
5	3.26	74	1.9	70	1.37	65	0.78	98	-	-	0.13	98	7.44	75	14.5
6	2.60	74	1.17	70	5.58	65	2.33	98	-	-	0.71	98	12.39	74	15.8
7	0.44	74	3.75	70	0.73	65	6.46	98	-	-	-	-	11.38	86	11.8
8	3.09	74	5.37	70	9.05	65	3.11	98	-	-	0.94	98	21.56	74	18.8
9	2.56	74	3.16	70	-	-	0.20	98	-	-	-	-	5.92	68	8.6
WTP	1.68	74	-	-	-	-	-	-	-	-	8.95	98	10.63	94	16.5
Total													69.32		
Off-Site Basins Tributary to Mine Brook															
1	15.56	74	9.19	70	-	-	-	-	-	-	21.12	98	45.88	84	16.1
2	5.19	74	1.28	70	0.42	65	0.18	98	2.45	89	1.72	98	11.24	81	14.8
3	7.84	74	8.41	70	2.18	65	3.36	98	-	-	8.56	98	30.35	82	51.0
10	8.55	74	1.79	70	2.01	65	-	-	-	-	12.46	98	24.81	85	16.4
11	0.41	74	0.03	70	-	-	-	-	-	-	4.11	98	4.55	96	3.2
12	15.81	74	3.11	70	-	-	-	-	-	-	16.84	98	35.76	85	18.6
Total													152.59		
Other Basins															
4	6.65	74	0.01	70	4.13	65	0.33	98	-	-	2.83	98	13.95		

Note: CN = Curve Number; a factor describing the surface permeability; higher numbers are assigned to areas of lower permeability

Tc = Time of Concentration; the time in minutes required for a particle of water to flow from the most hydrologically remote point in the watershed to the receiving area

* = The impervious surface does not include the Catskill/Delaware Ultraviolet Facility

TABLE 5.15-6. RUNOFF CHARACTERISTICS IN 3-MONTH, AND 2-, 5-, 10-YEAR STORM[1]

Basin	3-Month Storm		2-Year Storm		5-Year Storm		10-Year Storm	
	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)	Peak Runoff Rate (cfs)	Runoff Volume (acre-ft)
On-Site Basins Tributary to Mine Brook								
5	0.5	0.09	6.9	0.68	11.7	1.13	15.4	1.46
6	1.0	0.17	12.1	1.20	20.3	2.0	24.6	2.52
7	5.1	0.47	21.0	1.82	30.6	2.7	37.4	3.28
8	1.3	0.26	18.2	1.98	31.1	3.26	40.9	4.23
9	0.1	0.04	4.7	0.41	8.9	0.72	12.1	0.96
Total		1.03		6.09		9.81		12.45
Proposed plant[2]		0.88		2.30		3.12		3.71
Off-Site Basins Tributary to Mine Brook								
1	14.8	1.58	69.6	6.74	103.8	10.06	128.3	12.47
2	2.6	0.29	15.3	1.45	23.6	2.22	29.7	2.79
3	4.6	0.86	24.7	4.05	37.8	6.16	47.3	7.71
10	8.7	0.93	38.5	3.80	56.8	5.62	69.9	6.95
11	6.0	0.42	14.9	1.08	19.8	1.46	23.1	1.72
12	12.1	1.34	53.4	5.48	78.9	8.10	96.9	10.00
Total		5.42		22.6		33.6		41.6
Other Basins								
4	2.1	0.24	19.5	1.49	32.0	2.38	41.2	3.05

Note:
1. The runoff characteristics do not include the Catskill/Delaware Ultraviolet Facility.
2. Runoff from the proposed roof and access roads would be collected in the stormwater detention pond in Basin 6 before being discharged to Mine Brook.

10-Year Storm. Under the 10-year 24-hour storm, the total runoff volume entering Mine Brook from on-site basins tributary to the brook is predicted to decrease slightly as compared to existing conditions, from 12.9 acre-feet (Table 5.15-4) to 12.5 acre-feet (three percent) (Table 5.15-6). However, as noted in the previous discussion, some storm runoff would be detained within the detention basin for discharge over time to Mine Brook to help maintain pre-construction flows in the brook. Considering flows within Mine Brook itself, the peak runoff rate at the culvert above Route 100C would decrease slightly (four percent) from 270 cfs during existing conditions to 260 cfs during the operation phase. As anticipated, for the reasons noted previously, runoff from Basin 4 would be directed toward the west and would increase in volume.

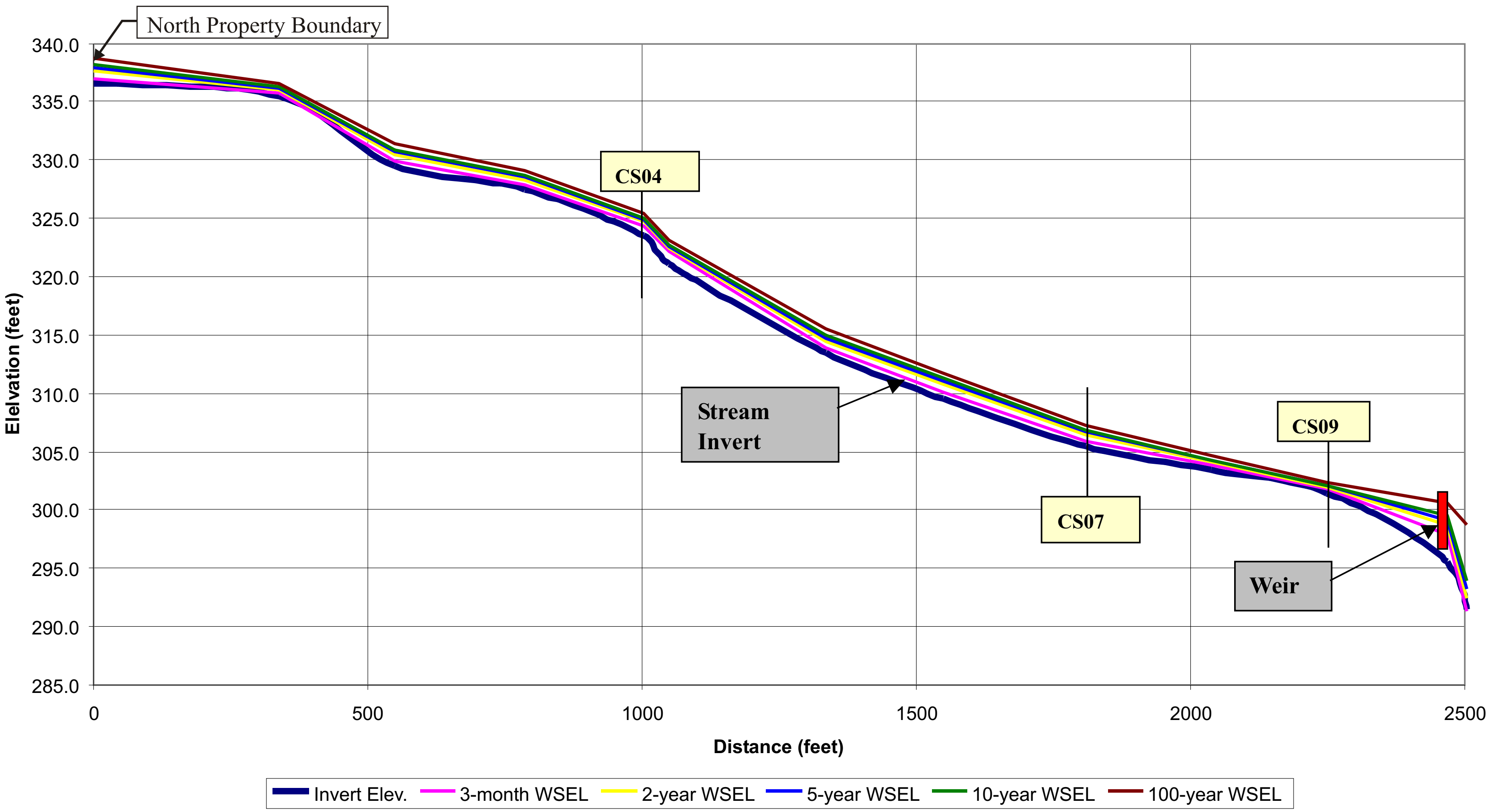
100-Year Storm. The 100-year 24-hour storm was also modeled for the post-construction phase of the project to assess the potential for downstream flooding of roadways and impacts to Mine Brook. As anticipated, when compared to existing conditions under the same rainfall event, the total flow rate entering Mine Brook during this event is predicted to decrease slightly during operation. The peak runoff volume from the on-site basins tributary to Mine Brook is predicted to decrease during the 100-year storm from 23.1 acre-feet to 21.7 acre-feet (six percent). However, as noted in the previous discussion, some storm runoff would be detained within the detention basin for discharge over time to Mine Brook to help maintain pre-construction flows in the brook. Therefore, no increase in erosion is anticipated in Mine Brook or the adjacent wetlands during operation. Additionally HydroCAD® results for this storm event indicate that there would be no downstream flooding during construction as a result of this project.

This conclusion is further confirmed by the InfoWorks model results which indicate no significant change to the surface water characteristics in the downstream reaches of Mine Brook (Figure 5.15-12)

The preliminary design of the Cat/Del UV Facility, proposed for the southeast corner of the proposed site (Basin 9), has not yet been completed. A detailed analysis of stormwater runoff resulting from this project, as well as stormwater management for the Cat/Del UV Facility is presented in Section 5.15.2.2.2. Future Without the Project, With Cat/Del UV Facility at Eastview Site.

Structural BMPs. The runoff from the proposed plant, access roads and parking area would be conveyed through a structural BMP to remove oil and sediment before discharging to the detention basin. This structural BMP unit would be sized to treat the peak runoff from the 2-year storm (approximately 22 cfs). In addition, street sweeping would also be utilized to treat the new pavement. Stormwater runoff from the vehicle inspection facility would also be discharged to the vegetative swales. No significant adverse impacts are anticipated from the quality of the stormwater runoff into the Mine Brook following the pre-treatment by the structural BMP.

Groundwater. Three features associated with the proposed plant have the potential to impact the groundwater system at the Eastview Site. First, a system of underdrains beneath the proposed plant has been proposed, to dissipate hydrostatic pressure and to maintain groundwater levels below the slab (i.e. to isolate the treated water wetwell from the groundwater). The water table beneath the footprint of the main treatment building slopes from an elevation of about 305 feet MSL at the western end to about 330 feet MSL at the eastern end. Since the bottom of the building slab is proposed to be at an elevation of 317 feet MSL, the eastern half would be below the water table under existing conditions. The underdrain system would be placed within a layer of clean crushed stone, 1.5 feet thick, between elevations 315.5 and 317 feet MSL. The underdrains within the stone layer would slope toward localized sumps, from which the water would be directed to the stormwater detention basin or the overflow swale (a 20-foot wide grass-lined channel). This permanent lowering of the water table may locally decrease streamflow in Mine Brook. Its associated wetlands would not be affected because the wetlands all border the



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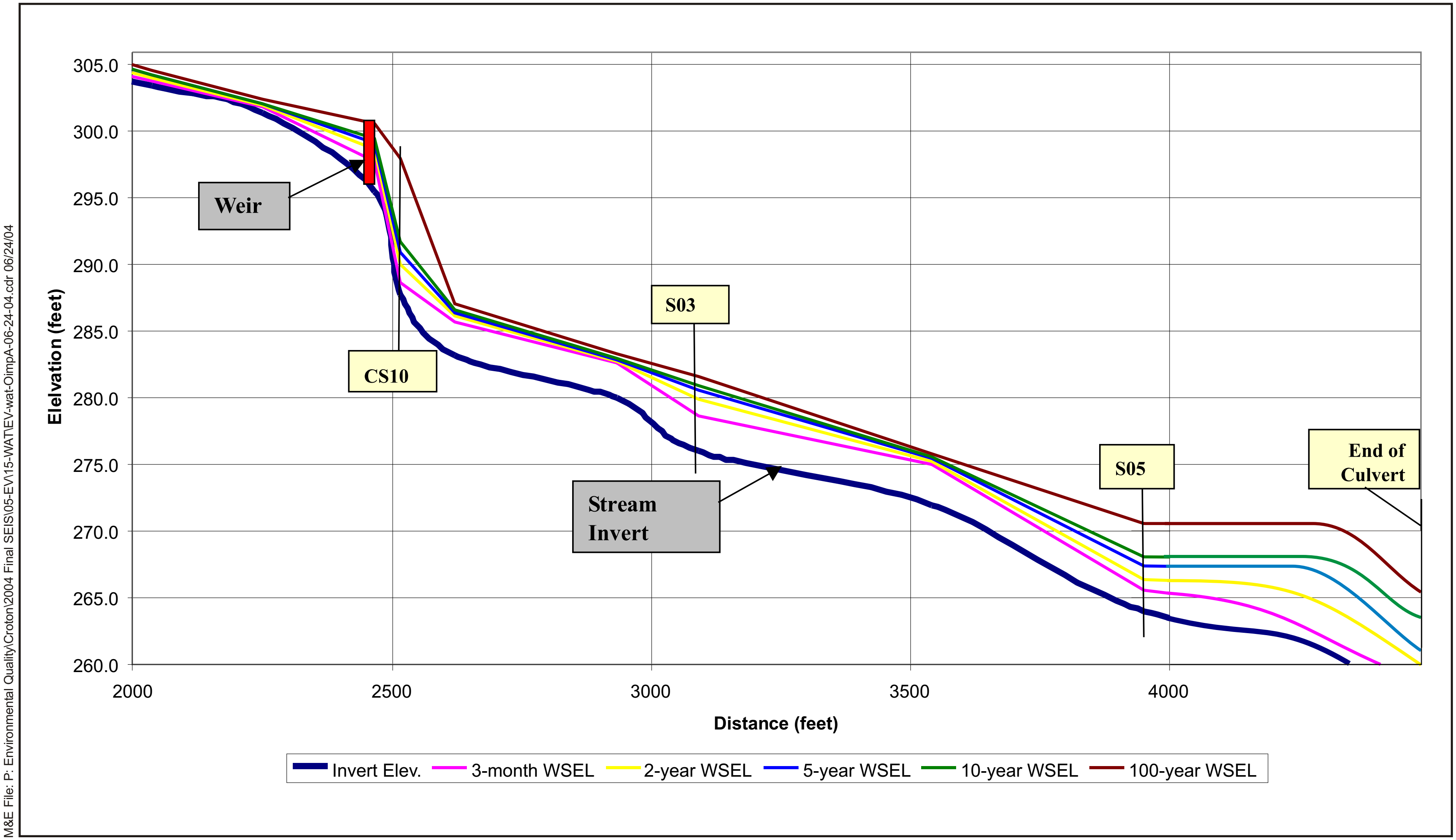
WSELs for Future with Croton Project for 3-month, 2-year, 5-year, 10-year and 100-year Return Frequency Storm Events

Croton Water Treatment Plant

Figure 5.15-12A



WSELs for Future with Croton Project for 3-month, 2-year, 5-year, 10-year and 100-year Return Frequency Storm Events

Croton Water Treatment Plant

Figure 5.15-12B

stream and are near the elevation of the stream. The water level in the stream controls the water level in the adjacent land and would not change as a result of the small diversion of eight gpm to the underdrain system (see the existing conditions section above).

The second project feature with the potential to affect groundwater levels is the proposed, stormwater detention basin south of the proposed plant. Runoff from impervious surfaces associated with the project, including roofs and paved areas, would be directed to this basin. In addition, flows from the proposed plant underdrain system may be discharged to this basin. Since the basin would be designed to attenuate runoff from the 100-year storm, all runoff and other miscellaneous flows that are discharged to the basin under normal operating conditions would be retained and allowed to seep into the underlying soil and to discharge slowly to Mine Brook. The slow seepage of water from the basin into the ground would create a mound on the water table in this area. Since the wetlands that are close to the basin all border Mine Brook, including the constructed wetland just to the north, the higher groundwater levels are not anticipated to adversely affect them. However, the basin was included in the groundwater model, since the associated recharge and groundwater mounding may have a mitigating effect on long-term drawdowns caused by the underdrain system and on short-term drawdowns during construction.

The third project feature with the potential to affect groundwater levels is the deep raw water pumping station and associated vertical shaft at the western end of the proposed main treatment building. These structures, with a combined depth of 212 feet below existing grade, would extend from the ground surface to an elevation of 118 feet MSL. Since they would not be designed with permanent dewatering, the groundwater levels would rise following construction to a new equilibrium elevation similar to that found under existing conditions. The only net change to the groundwater system caused by the pumping station and the associated vertical structure would be that the westward-flowing groundwater would have to pass around what would essentially be an impermeable vertical column, 212 feet deep and about 125 feet in diameter. Although the effects of this diversion are anticipated to be small and too far from any water resources to have significant adverse impacts, these structures were nonetheless included in the model for completeness.

The groundwater model was run to steady state conditions with 1) underdrains beneath the footprint of the proposed plant at an elevation of 316 feet MSL; 2) the pumping station and associated vertical shaft simulated as a low permeability wall across all three model layers; 3) no recharge within the footprint of the proposed plant; and 4) precipitation from the 10 acres of impermeable surface area associated with the proposed plant recharged at the detention basin. The underdrains beneath the proposed plant produced large drawdowns at the eastern end of the main treatment building, while the detention basin caused groundwater mounding and flooding in that part of the site. The effects of the pumping station and the associated vertical structure were small. Figure 5.15-8 shows the water table contours under existing conditions, while Figure 5.15-13 shows the contours with the proposed plant in operation. Figure 5.15-14 shows the difference between the two scenarios, or the net changes in groundwater levels due to the proposed project.

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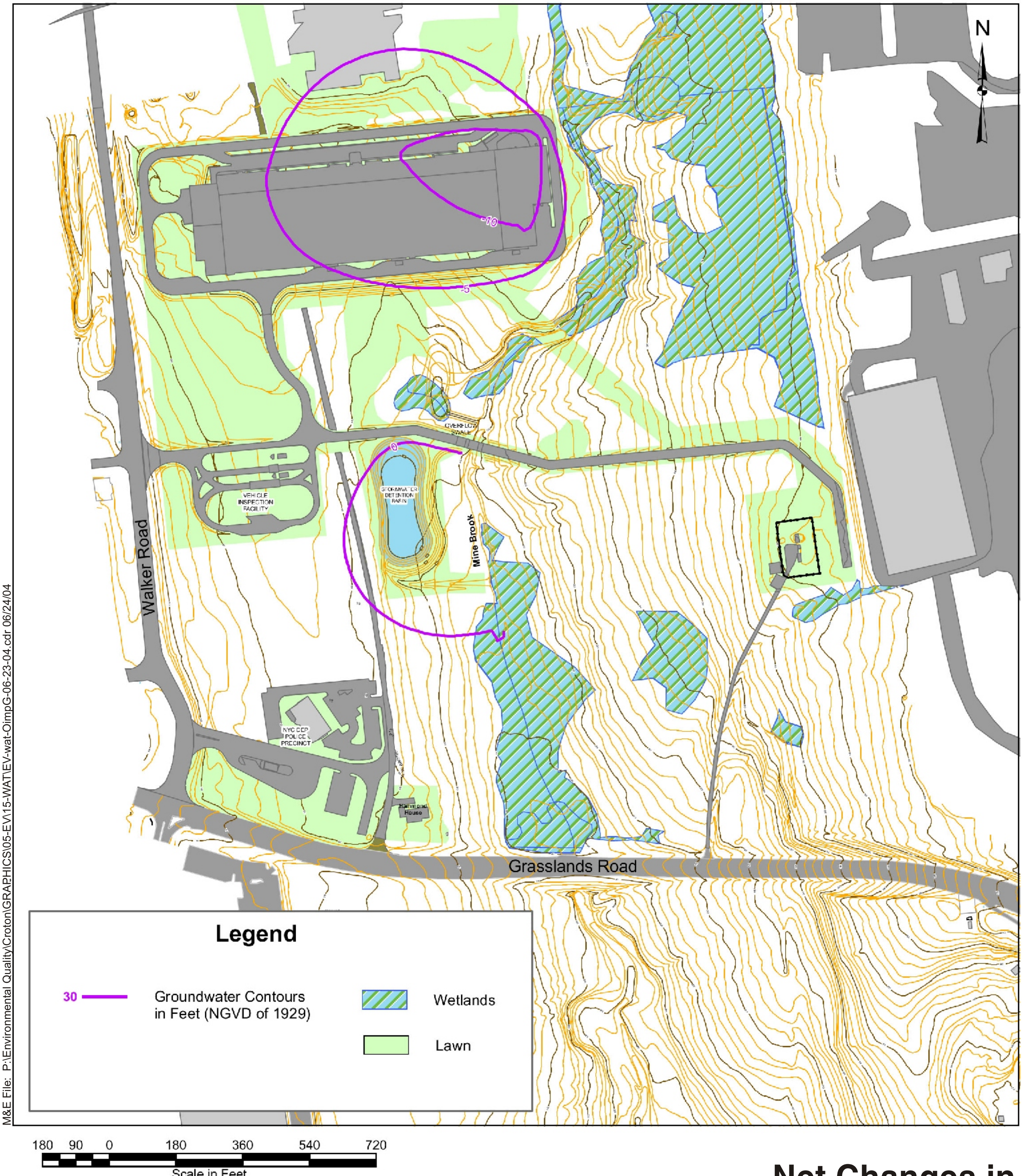
Groundwater Contours During Operating Conditions at the Eastview Site

Croton Water Treatment Plant

Figure 5.15-13



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Net Changes in Groundwater Levels During Operating Conditions at the Eastview Site

Croton Water Treatment Plant

Figure 5.15-14

The existing steady state groundwater contours show that a groundwater divide exists just to the west of Mine Brook, separating water that is flowing to the brook from water that flows west toward the Saw Mill River. Water levels measured at the proposed site in the summer and fall of 2002 and the winter of 2003 indicate that the position of that divide moves seasonally. The divide shifted to the west as water levels rose, essentially increasing the groundwater drainage area that contributes to Mine Brook and decreasing that of the Saw Mill River. Since the average annual recharge is relatively low at an estimated seven inches per year, and the subsurface materials are poorly permeable, the amount of groundwater in circulation in the area is small. Therefore, while the apparent seasonal shift of the groundwater divide decreases the flow to Mine Brook in the summer, the actual amount of the flow reduction is probably very small.

In the northeast corner of the proposed main treatment building, the underdrains would cause the water table to decline by about 14 feet, from an elevation of 330 to 316 feet MSL. At the northwest corner of the proposed main treatment building, the net drawdown is about 4 feet. Even though the drains would be above the water table beneath most of the western part of the proposed plant, the removal of water by the drains beneath the eastern part of main treatment building would nevertheless cause a net decline in the water levels in the down gradient area.

The average model-predicted flow from the underdrain system would be about 8 gpm. In the segment of the brook immediately east of the proposed plant, the water level decline would cause stream water to seep into the ground. Therefore, the underdrains have the potential to cause minor streamflow depletion in the brook upstream of the proposed plant. However, the portion of Mine Brook upstream of the plant and downstream from its origin at the Grasslands Reservation discharge culverts is only about 400 feet long. The baseflow in this section of the brook is a combination of groundwater and stormwater runoff from the Grasslands Reservation, and the brook would naturally have low flows in dry weather. The additional depletion of groundwater by the underdrain system might prolong the periods of low flow, but this effect would be very minor and would occur over a short length of the stream channel. No significant adverse impact is anticipated from the reduction in groundwater supply to the Mine Brook.

The lowering of the water table in this area is also not expected to adversely affect the wetlands along Mine Brook. The seepage from the brook would limit the drawdown of the water table and thereby limit the effects on those wetlands. During the summer and early fall, when groundwater levels are normally lowest, the water levels beneath the wetlands might be slightly lower than they would be under natural conditions. However, seepage from the stream would limit that drawdown, and when water levels then rose in the winter and spring in response to the normal annual hydrologic cycle, the saturated conditions necessary to sustain the wetland would return. Therefore, the small diversion of 8 gpm to the underdrain system would not adversely affect the wetlands along or east of the brook.

Due to the presence of the brook, the decline of the water table caused by the underdrains does not extend beneath and to the east of the brook. The wetlands on the hillside east of the brook would therefore not be affected. Those hillside wetlands are a result of a seasonally high water table. A monitoring well (EV-B39-02) was installed just outside of the delineated wetland, with the screen set from a depth of 8 feet to 18 feet. In the summer and fall of 2002 and winter of 2003, the water table was about 9 feet below the land surface at this location. In early February, the water table had risen to a depth of less than 3 feet, suggesting that the water table in the hillside wetlands would rise to the surface by March or April. Even though the wetlands may be a result of a seasonally high water table, the lack of any drawdown on the east side of Mine Brook as a result of the underdrains precludes any long-term significant adverse impacts.

Since the actual rate at which water would seep into the ground beneath the detention basin is untested, the model was run assuming that all of the water that enters the basin recharges the groundwater system at a steady-state rate. Assuming a total annual runoff of about 42 inches from 10.7 acres of impermeable surface would enter the basin, a steady-state recharge rate of 1.2 inches per day was applied within the basin area. This recharge rate is about 60 times greater than the general recharge rate of 7 inches per year that was applied in undeveloped areas within the model. The model results indicated that the gradient necessary to carry the seepage away from the basin would result in a groundwater mound significantly higher than the land surface. Therefore, seepage into the ground would be slower than the rate of water inflow to the basin, the basin would not drain between precipitation events, and breakouts of seepage on the slopes below the basin would likely occur. As a result, a system for slowly draining the basin directly to the brook would be incorporated into the design (see Section 5.15.2.1.2 Existing Conditions, Stormwater Runoff).

To better simulate the effect of the detention basin on groundwater levels, the amount of water that seeps from the basin into the ground was adjusted until the groundwater mound was approximately one foot high. This condition is represented in Figure 5.16-13 and Figure 5.16-14.

Surface Water. As stated in the existing conditions, Mine Brook is the north to south flowing stream bisecting the Eastview Site, which has an average base flow of 118 gpm (0.3 cfs). During the three-month storm event the flow reaches approximately 2.0 cfs. The model-predicted average groundwater flow from the underdrain system is approximately 8 gpm. In the brook immediately east of the proposed plant, all of this flow is water that would otherwise have been part of the base flow in Mine Brook. The decrease in streamflow would persist downstream to the detention basin, although some groundwater would discharge to the brook between the basin and the proposed plant. Water from the stormwater basin would support pre-construction flow in the Mine Brook south of the stormwater basin; therefore, no significant adverse impact is anticipated south of the basin. The upstream reach is supplied primarily by storm drains that discharge into the Mine Brook channel from the Grasslands Reservation to the north. Without these flows, which include constant dry weather flows, the stream would naturally dry out in dry weather. The base flow in Mine Brook through the site was 118 gpm in August of 2000 during a dry weather period. The removal of 8 gpm from the upper reach of the basin as a result of the underdrain system would represent a reduction of less than 7 percent of the total flow. Therefore, no significant adverse impact is anticipated from the potential reduction of groundwater flow into Mine Brook.

Groundwater Impacts from Pressurization of the NCA. In the current condition, with open channel flow in the aqueduct, pressures are higher in the surrounding aquifer than in the aqueduct, and groundwater discharges to the aqueduct through weep holes. This condition has resulted in a stable decrease in the water table that has been in place for over one hundred years.

This section examines two conditions: 1) If the NCA would be pressurized, it would cease to serve as a drain and the groundwater could rise; and 2) if the pressure lining were to fail additional groundwater rise could occur. In addition, the potential is considered for the crushed rock and stone that surrounds the NCA to serve as a drain, thereby counteracting the other mechanisms that would raise the water table.

Groundwater Impacts from the Filling of Weep Holes. With the existing weep holes and other faults in the NCA that allow the inflow of water, significant amounts of groundwater discharge to the New Croton Aqueduct. Pressurization would block the weep holes downstream of Shaft 10 where the Eastview water treatment plant would be built. If all the discharges to the aqueduct were eliminated, groundwater levels would rise. Groundwater conditions currently change significantly over the 12.6-mile length of aqueduct between Shaft No. 10 and Gate House No.1, downstream of which the tunnel is currently under pressure. Because of this variability, and because only limited information is available on soil and rock conditions over this distance, the following assessment can only approximately estimate the potential for changes in groundwater levels as a result of the pressurization of the NCA.

Monitoring wells installed near the NCA generally indicate that groundwater levels are higher than the tunnel invert elevation. The monitoring wells are up to 400 feet away from the aqueduct; nevertheless, the separation is small enough that the monitoring well observations can be assumed to apply to the aqueduct. An exception to the groundwater being higher than the aqueduct is in an area near NCA Shaft No. 18, where the groundwater and tunnel invert are about the same. A potential reason for this is that the aqueduct elevation at the location is very close to the elevation of a groundwater discharge point, Tibbets Brook.

Groundwater currently leaks into the NCA through weep holes present over much of the length of the aqueduct, as well as through fissures and other breaches of the tunnel liner. Inflow was measured by estimates of flow through leaks and by measurements of flow in the tunnel when it was dewatered for inspection in 1995-1996. Aqueduct flow measurements were made at three locations, upstream of NCA Shafts No. 9, 14 and 18. Based on these, rates of inflow per unit length of aquifer were developed. The inflow estimate for the section downstream of NCA Shaft No. 18 is an extrapolation of the upstream data.

Significant inflow was found between NCA Shaft No. 9 and 14, but a major element of that inflow was found to occur in a localized shear zone upstream of NCA Shaft No. 14 and possibly in the Gould Swamp siphon area. Thus, the average inflow of 11.9 gpd/ft found between NCA Shaft No. 14 and 18 may be more representative of average conditions along this segment of the aqueduct, with localized areas of higher inflow. The actual conditions along this segment are probably represented by high inflows at the shear zone and the Gould Swamp siphon, with much lower inflows along the remainder of the aqueduct. The inflow was also found to vary in time. In particular, larger inflow was found after large rainstorms. This would likely be the case for inflow in areas where the aqueduct is near the ground surface.

Over significant portions of the aqueduct, groundwater can be inferred to discharge to a stream or other surface water feature on one side of the aqueduct, with a groundwater divide on the other side. This situation is illustrated in Figure 5.15-15, which shows a schematic cross section perpendicular to the aqueduct.

The theoretical analysis presented in Appendix G1-3 indicates that in any region, if inflows to the NCA are eliminated, groundwater would gradually rise above current conditions from a stream to the aqueduct up to a maximum, Δh_1, (given by Equation (8) in Appendix G1-3), and that groundwater between the aqueduct and the divide would uniformly rise by this amount.

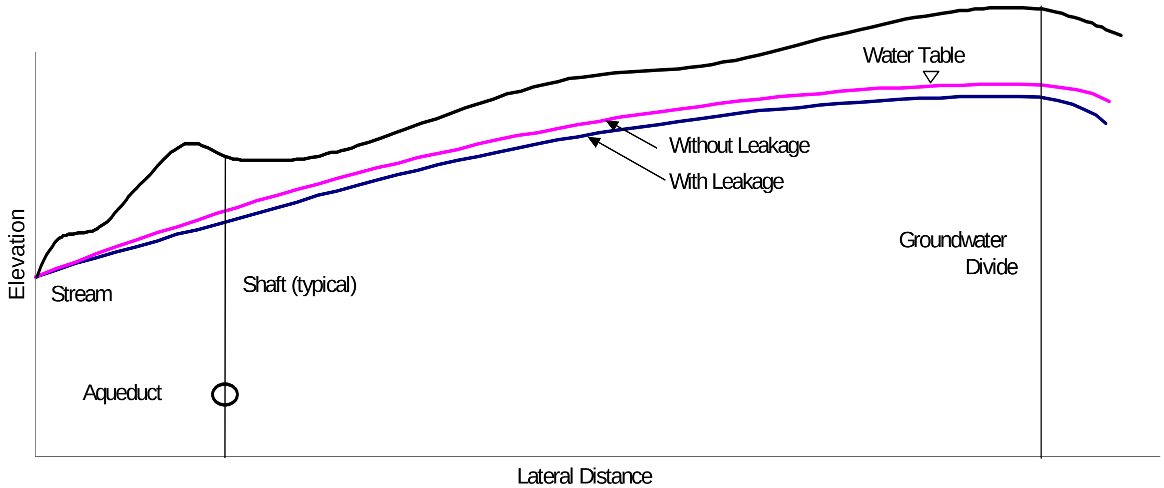


Figure 5.15-15. Schematic Cross-Section Perpendicular To Aqueduct

This estimate involves the transmissivity of the aquifer, which can be estimated using the groundwater elevation at the aqueduct (through Equation (6) of Appendix G1-3). The estimate of groundwater rise, Δh_1, also involves the flow rate out of the aqueduct, Q'_L. The latter, however, is only known as an average over long sections of the aqueduct. The local rate of inflow (given by Equation (9) of Appendix G1-3) depends on the hydraulic conductivity of the aquifer, and the groundwater elevation above the aqueduct. As an approximation, these two parameters can be related to the aquifer transmissivity, yielding an equation for the groundwater rise (Equation (12) of Appendix G1-3).

Thus, the analysis presented in Appendix G1-3 concludes that, as a first degree of approximation, the groundwater would rise as a result of the elimination of weepholes in the aqueduct. The rise would be proportional to the distance between the aqueduct and the stream. The coefficient of proportionality is estimated to be 8×10^{-3}, or the groundwater would rise at a maximum of 0.008 feet for each foot between the aqueduct and the closest stream or surface drain. Corresponding estimates of groundwater rise based on the above are presented in Table 5.15-7. These are for locations along the aqueduct where monitoring wells have been installed, as those are locations where groundwater levels are known. However, the calculation method can be applied at any point along the aqueduct, since it only uses the distance to the stream.

TABLE 5.15-7. NEW CROTON AQUEDUCT AND GROUNDWATER CHARACTERISTICS

Shaft	Station, Distance From CLGH (ft)	Aqueduct Invert Elevation (ft)	Ground Elevation (ft)	Monitoring Well	Groundwater Elevation at Aqueduct h_1 (ft)	Measured Hydraulic Conductivity (ft/day)	Measured Inflow Rate Q'_L (gpd/ft)	Distance from Stream to Aqueduct x_1 (ft)	Distance from Stream to Groundwater Divide x_2(ft)	Stream Elevation h_0 (ft)	Calculated Leakage Rate (gpd/ft)	Trans-missivity T (ft^2/day)	Groundwater Rise from Leak Elimination Δh_1
					(a)	(a) (b)	(c)	(d)	(d)		Eq. (9)	Eq.(6) (e)	Eq.(13)
10	56,151	132.6	283					0		252			0.0
11A	65,000	131.6	185	NCA-3	161	0.15	44.2			160	51	0	0.0
11C	64,866	131.0	191	NCA-4	160	0.55		600	800	159	185		4.8
12A	72,468	130.5	199	NCA-5	138.3	0.09		200	1,400	169	12	N/A[f]	1.6
13	77,352	129.8	304					1,200	3,000	164			9.6
14	82,600	129.1	168.0	NCA-6	154	0		900	2,400	145	0	374	7.2
15½	92,735	127.8	260.0					1,500	2,000	121			12.0
16	96,902	127.2	215.0				12	1,300	1,500	116			10.4
16.5	101,800	126.6	182.0					1,200	2,100	106			9.6
17½	104,400	126.2	178	NCA-8	168	0.78		1,600	2,100	105	346	50	12.8
18	112,100	125.2	133	NCA-9	126			1	2,000	125		4	0.008
	113,700	125	150	NCA-10	146			400	2,400	100		38	
18¼	114,200	124.7	147	NCA-11	141		12.9	1,000	3,000	90		103	8.0
19	121,700	123.9	208	NCA-12	167	0.055		1,600	2,500	32	25	36	12.8
GH-1	126,618	123.2	162	NCA-13	148	0.065		1,500	2,700	20	19	44	12.0

Precipitation Recharge Rate 12 inches/year r =1ft

(a) From Phase III – Final Report. A Detailed Investigation to Determine the Work Required to Pressurize and Restore the New Croton Aqueduct. Harza. December 2000

(b) Average of measured conductivities in bedrock

(c) Estimated from measured leaks determined during inspections

(d) From Plan for Protection of Treated Water in the New Croton Aqueduct. M&E/Hazen & Sawyer, October 2001.

(e) Using Q'_L = 12 gpd/ft

(f) Not Applicable. Low groundwater level above aqueduct indicates high inflow nearby, which contradicts low hydraulic conductivity measured.

Clearly, these estimates of groundwater rise are approximate, and only represent orders of magnitude. The potential rise in groundwater could be negated by another mechanism. The NCA is surrounded by loose rock and rubble left from its construction. This material transmits water very rapidly, and the groundwater that currently finds its way into the NCA through the weepholes may, in the future with the weepholes sealed, find a path along the outside of the NCA to a point where the NCA is above the groundwater table and then drain to a stream.

If the NCA pressurization alternative is chosen, these potential increases in groundwater elevations would be investigated and considered along with the even greater increases that could occur in the event of a leak in the pressurized section of the NCA, as described below. Plans to avoid or mitigate these potential impacts are discussed at the end of the next section

Groundwater Impacts from a Possible Leak in the Pressurized Aqueduct. If the New Croton Aqueduct is pressurized, leakage of water out of the aqueduct is possible, if deterioration of the liner occurs. An evaluation was conducted of the potential for leakage from the aqueduct to cause the water table to rise and create localized flooding. In residential areas, flooding would first be observed in basements.

The potential risk of flooding, and its severity are dependent on a number of factors, which are reviewed below:

- Liner material. Portions of the NCA would be lined with steel, and leakage in those portions is considered extremely unlikely. Thus, only the portions to be concrete lined were addressed.
- Aquifer material. Large sections of the NCA run through bedrock, where the magnitude of a leak would be reduced by the low transmissivity of the aquifer material.
- Land Use. Undeveloped or park areas are less problematic, inasmuch as flooding has less potential for damage compared to residential or commercial areas.
- NCA pressure. Only those areas where the pressure in the NCA is above, or close to ground level offer the potential for flooding.

Based on the above factors, a first level assessment can be conducted. Results are presented in Table 5.15-8. The tunnel improvements would be designed not to leak at all, so this analysis represents a “worst case” model.

TABLE 5.15-8. POTENTIAL FLOODING IMPACTS DUE TO PRESSURIZATION

Station	Location	Monitoring Well	Land Use	Cover	Liner	Ground EL (ft)	NCA Invert EL (ft)	NCA Cover (ft)	NCA Head (ft)	NCA Head (ft-BGS)	Water Table Elev. (ft)	Distance to Stream (ft)	Trans- missivity (ft^2/day)	Leakage Rate (mgd)	Water Table Rise (ft)	Raised Water Table (ft-BGS)	Net Potential Impact
56,151	Shaft 10		Wetland	Gneiss (w/soft seams)	Concrete	283	132		347	-64		0					Low
60,000			School; Track; Undev	Gneiss (w/soft seams)	Concrete	490	132	345	345	145		N/A					Low
62,500			Baseball fld; Residential	Gneiss (w/soft seams)	Concrete	280	131	136	343	-63		N/A					Medium
64,300	Sheldon Brook		Indust/Comm (Goulds Siphon)	Gneiss (w/soft seams)	Steel	155	71	71	342	-187	160	N/A					Low
65,500		NCA-3	Rt 87	Gneiss (w/soft seams)	Concrete	215	131	71	341	-126	161	400	10	0.03	180	-126	Medium
66,200			Undeveloped	Gneiss (w/soft seams)	Concrete	341	131	197	341	0		N/A					Low
70,800			Sparse residential	Gneiss (w/soft seams)	Concrete	520	131	376	338	182		N/A					Low
71,200			Undeveloped	Gneiss (w/soft seams)	Concrete	339	131	195	338	1		1,200					Medium
72,468		NCA-5	Park	Soil (Cut/Cover)	Steel	138	130.5	-5.5	337	-199	138	200					Low
73,800	Saw Mill River		Rt 87	Soil (Cut/Cover)	Steel	168	130	25	336	-168		0					Low
74,100			Sparse residential	Limestone	Concrete	180	130	37	336	-156		200					Medium
79,700			School	Limestone	Concrete	270	129	128	333	-63		1,400					Medium
82,500	Shaft 14	NCA-6	Residential, Commercial	Soft gneiss;clay (Cut/Cover)	Steel	175	128	34	331	-156	154	900					Low
89,700			Rt 87	Gneiss (w/sand,clay,limestn)	Concrete	200	128	59	326	-126		1,400					Medium
93,200	Jackson Rd		Residential	Gneiss (w/sand,clay,limestn)	Concrete	230	127	90	324	-94		1,400					Medium
95,900	Austin Ave		Residential	Gneiss (w/sand,clay,limestn)	Concrete	215	127	75	322	-107		1,400					Medium
98,900			Residential	Gneiss (w/sand,clay,limestn)	Steel	170	126	31	321	-151		1,100					Low
101,200			Residential	Gneiss (w/sand,clay,limestn)	Steel	150	126	11	319	-169		1,500					Low
104,400	Shaft 17½	NCA-8	Residential	Gneiss (w/sand,clay,limestn)	Concrete	178	126.2	38.8	317	-139	168	1,600	50	0.08	149	-139	Medium
108,800			Residential	Soft gneiss and sand	Concrete	330	125	192	314	16		2,000					Medium
112,100	Tibbetts Brook	NCA-9	Park	Soil	Steel	133	124	-4	312	-179	126	0					Low
113,900		NC-10	Park	Soil	Steel	150	124	13	311	-161	146	400					Low
118,000			Residential	Gneiss	Concrete	250	124	113	309	-59		1,600					Medium
121,700		NCA-12	Residential	Gneiss	Concrete	208	123.9	71.1	306	-98	167	1,600	36	0.06	139	-98	Medium
126,500		NCA-13	Park	Gneiss	Steel	160	123	24	303	-143	148	1,500					Low

Should deterioration of the liner occur, water from the NCA would leak out if the pressure in the NCA were greater than the pressure in the surrounding aquifer, measured by the water table elevation. The leaking water would eventually discharge to the closest surface water body, where groundwater currently discharges. Over much of its length, the NCA runs along a stream, separated by a distance of essentially zero (in areas where the NCA crosses the stream) to a few thousand feet. Because the flow of groundwater to the discharge area would be increased, the hydraulic gradient would increase and the water table would rise. Assuming a localized leak, the situation is comparable to an injection well in an aquifer discharging to a river. The increase of head is given by:

$$\Delta h = \frac{Q}{4\pi T} \ln\left(\frac{(x+2x_R)^2 + y^2}{x^2+y^2}\right)$$

where Δh = water table rise, ft
Q = flowrate, ft^3/day
T = aquifer transmissivity, ft^2/day
x = distance from aqueduct leak, away from stream, ft
y = distance from aqueduct leak, parallel to stream, ft
x_R = distance from leak to stream, ft

The highest water table rise would be just above the leak:

$$\Delta h = \frac{Q}{2\pi T} \ln\left(\frac{2x_R - D}{D}\right)$$

where D = near field length scale, such as the NCA depth, ft

The above equation is approximate, inasmuch as D, which is dependant on the local three-dimensional groundwater flow, is not well defined. However, the formula indicates that the water table rise would increase with distance to the groundwater discharge feature. The formula also provides an estimate of the water table rise, for any assumed value of the leakage flow rate. The latter can be estimated based on an assumed break area:

$$Q = A\sqrt{\frac{2g\Delta H}{K}}$$

where A = leak area, ft^2
g = acceleration of gravity, ft/day^2
ΔH = NCA head above water table elevation, ft
K = head loss coefficient, assume 2.0

The head difference, ΔH, should include the water table rise estimate above, which reduces the initial NCA head relative to the aquifer:

$$\Delta H = H_{NCA} - (H_{GW} + \Delta h)$$

where: H_{NCA} =head in New Croton Aqueduct, ft
H_{GW} = Water table elevation at location of leak, ft
Δh = water table rise due to leak, ft

Because Δh depends on Q, which in turns depends on Δh, an iterative calculation is necessary. The calculation can only be made where information on water table elevation is available, which is the case at several monitoring wells that have been installed near the NCA.

Results of the quantitative flooding evaluation are presented in Table 5.15-8 at locations where water table information is available, for a hypothetical leak of 0.2 ft^2 cross-section area. These results indicate that except when the aqueduct is very close to a stream, or other groundwater discharge feature, a leak would cause a rise in water table. In all cases, the calculated water table rise would exceed ground level. The leak flow rate would be quite small, but the leak would raise the pressure in the aquifer to that of the aqueduct, which would cause the rise in water table.

The analysis indicates that even a small leak would cause a rise in water table and could have the potential to cause flooding. As a result, some residential areas are at risk of flooding, if the concrete liner deteriorates.

However, the NCA is surrounded by crushed stone and debris generated during its construction. This loose material would provide a conduit for draining any water that collects along the NCA to a point where it would drain to a stream. The ability for the channels around the NCA to serve as a drain cannot be measured, but it could be in excess of the groundwater that currently infiltrates and could accommodate minor leaks after pressurization.

Thus there are two competing mechanisms that could affect groundwater levels along the NCA conduit: 1) groundwater could rise due to the closing of the weep holes or the leakage of water under pressure; and 2) the water could drain along the bottom and sides of the NCA through the layer of loose fill that surrounds the Aqueduct. This leaves considerable uncertainty regarding the future conditions of groundwater along the NCA if the pressurization treated water conveyance is selected.

If the NCA were used to convey Croton water, NYCDEP would undertake to install monitoring wells at locations where the groundwater could rise to threaten structures, whether this rise would be caused by the blockage of the existing weep holes or by a leak in the pressurized NCA. During the construction required for the pressurization, the weepholes would be sealed, and any effects on groundwater would be detected. As construction is underway, if the water levels in the monitoring wells rise, drainage pipes could be installed parallel to the aqueduct to accelerate the drainage to natural stream channels. After construction, these wells would provide an early warning of a leak, so that the aqueduct could be depressurized and the leak could be repaired before any structures would be damaged.

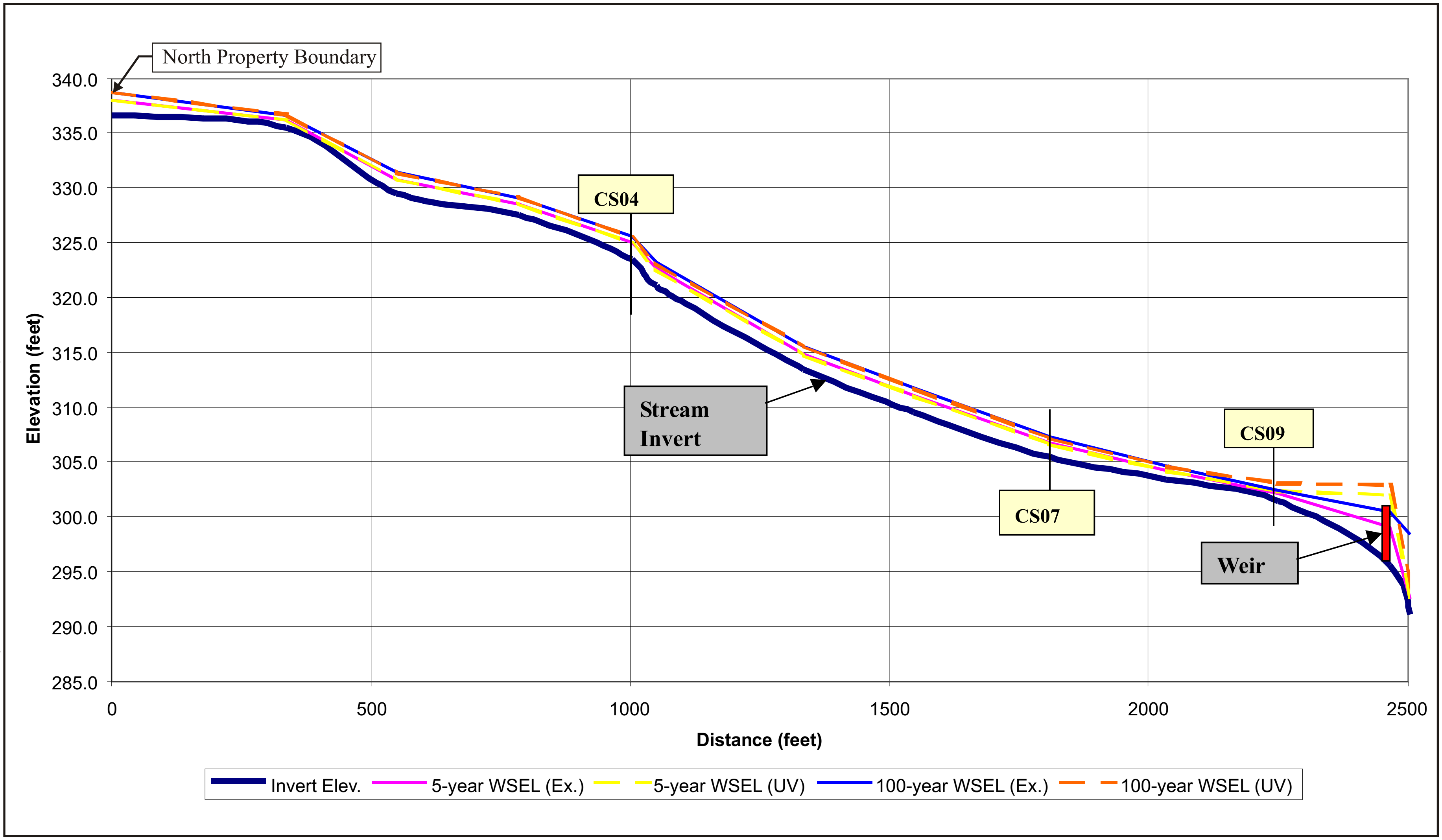
5.15.3.1.2. With Cat/Del UV Facility at Eastview Site

Stormwater Runoff. The stormwater management plans for the Eastview Site would introduce long-term control and treatment of stormwater runoff to the maximum extent practicable. Measures would include landscaping to provide proper stabilization of the site and treatment of stormwater runoff from all impervious services, while maintaining flows to adjacent natural resource areas at or near the existing conditions rates and volumes. Both the proposed Croton project and the Cat/Del UV Facility would require the installation of stormwater detention basins. The runoff from each of the projects, as well as the perimeter and access roads, and parking area, would be collected via independent storm drainage systems and be directed to their stormwater detention basins. As discussed previously, the proposed Croton project stormwater detention basin would be located directly south of the southeastern corner of the plant while the Cat/Del UV Facility pretreatment forebay and online storage would be located south of the southwestern corner of the Cat/Del UV Facility.

The peak runoff flow, total routed runoff volume, and the water surface elevation, was estimated at a number of cross sections along the Mine Brook drainage corridor for the 3-month, 2-year, 5-year, 10-year and 100-year storm events with the Cat/Del UV Facility. The model indicated that within the Eastview Site and during the 2-year storm, the peak flow in lower Mine Brook is approximately 114.6 cfs. The majority of this runoff comes from off-site basins. Of the on-site basins, Basin 7, which contains several wetland tributaries to Mine Brook, and Basin 8, which is the largest on-site basin, are the major contributors. As observed previously, these model results confirmed that stormwater runoff from within the Eastview Site is not the primary source of water supporting the hydrology of Mine Brook but includes a significant contribution of stormwater runoff from off-site (upstream) basins.

Under operating conditions, with the Cat/Del UV Facility, a decrease in the peak flow rate in lower Mine Brook from 132.6 cfs to 114.6 cfs is predicted. This decrease would result from the flood attenuation provided by the independent detention basins. With no incremental change in the routed runoff volumes or water surface elevations predicted, no significant detriment is anticipated to the stream flows is anticipated. As described previously, the water detained within the detention basin would be discharged over time to the Mine Brook to maintain pre-construction flows in the brook, so that adjacent wetlands are not affected.

Figure 5.15-16 presents the stream invert profile along with the maximum water surface elevations for the various storms modeled. The profile compares the water surface elevations for the 5-year and 100-year storms. No significant change to the water surface (floodplain) elevations was observed across the stream profile, except the area just upstream of the weir. This difference was localized and contained within the on-line storage extent and occurs due to the modification and raising of the weir to optimize the upstream storage and sustain the enhanced wetland. These findings determine that there would not be a significant incremental impact to Mine Brook surface water elevations due to the proposed Croton project with the Cat/Del UV Facility.



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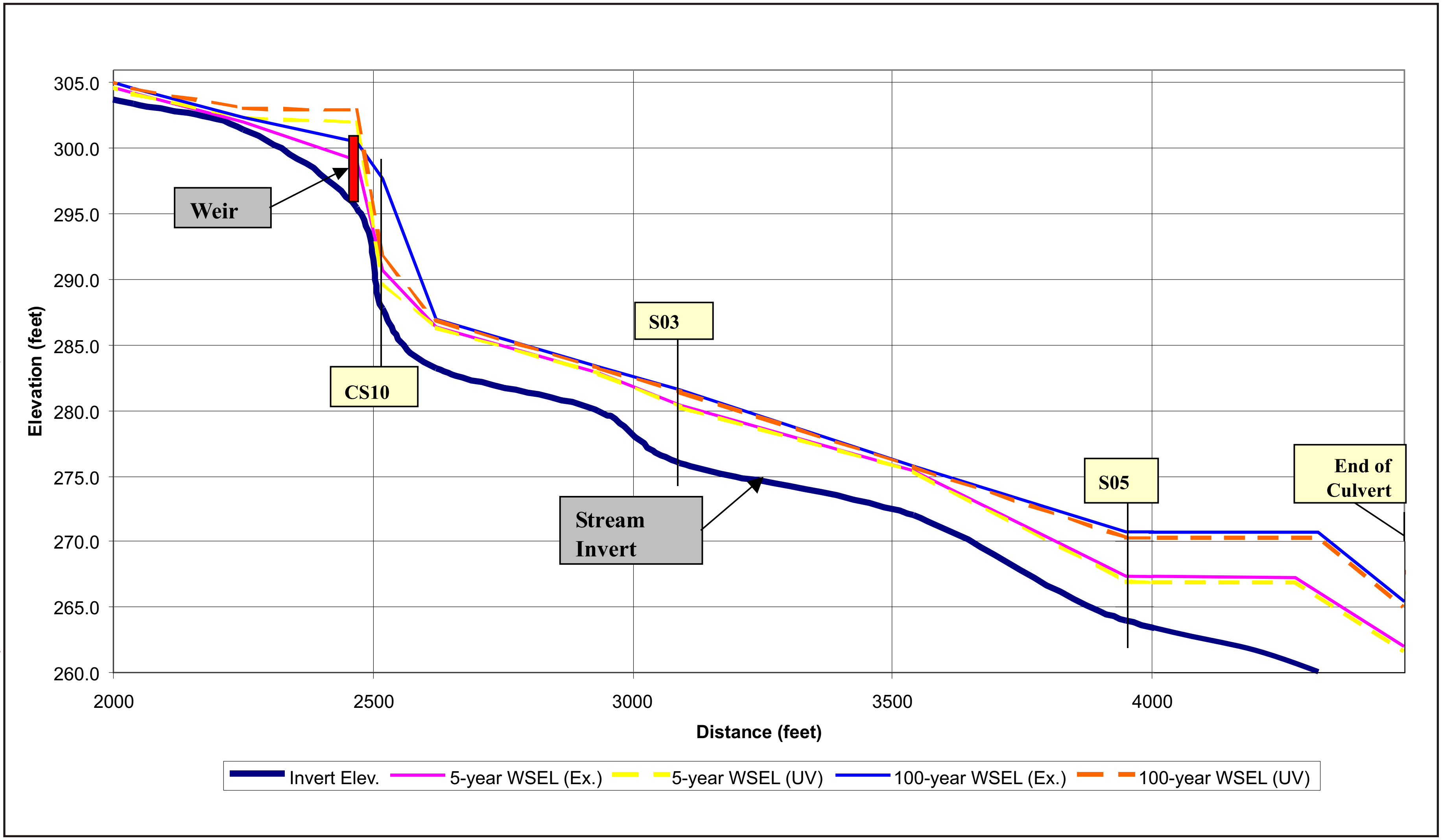
Comparison Between WSELs for Future with Croton and Croton + Cat/Del UV Facility for the 5-year and 100-year Storms

Croton Water Treatment Plant

Figure 5.15-16A



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Comparison Between WSELs for Future with Croton and Croton + Cat/Del UV Facility for the 5-year and 100-year Storms

Croton Water Treatment Plant

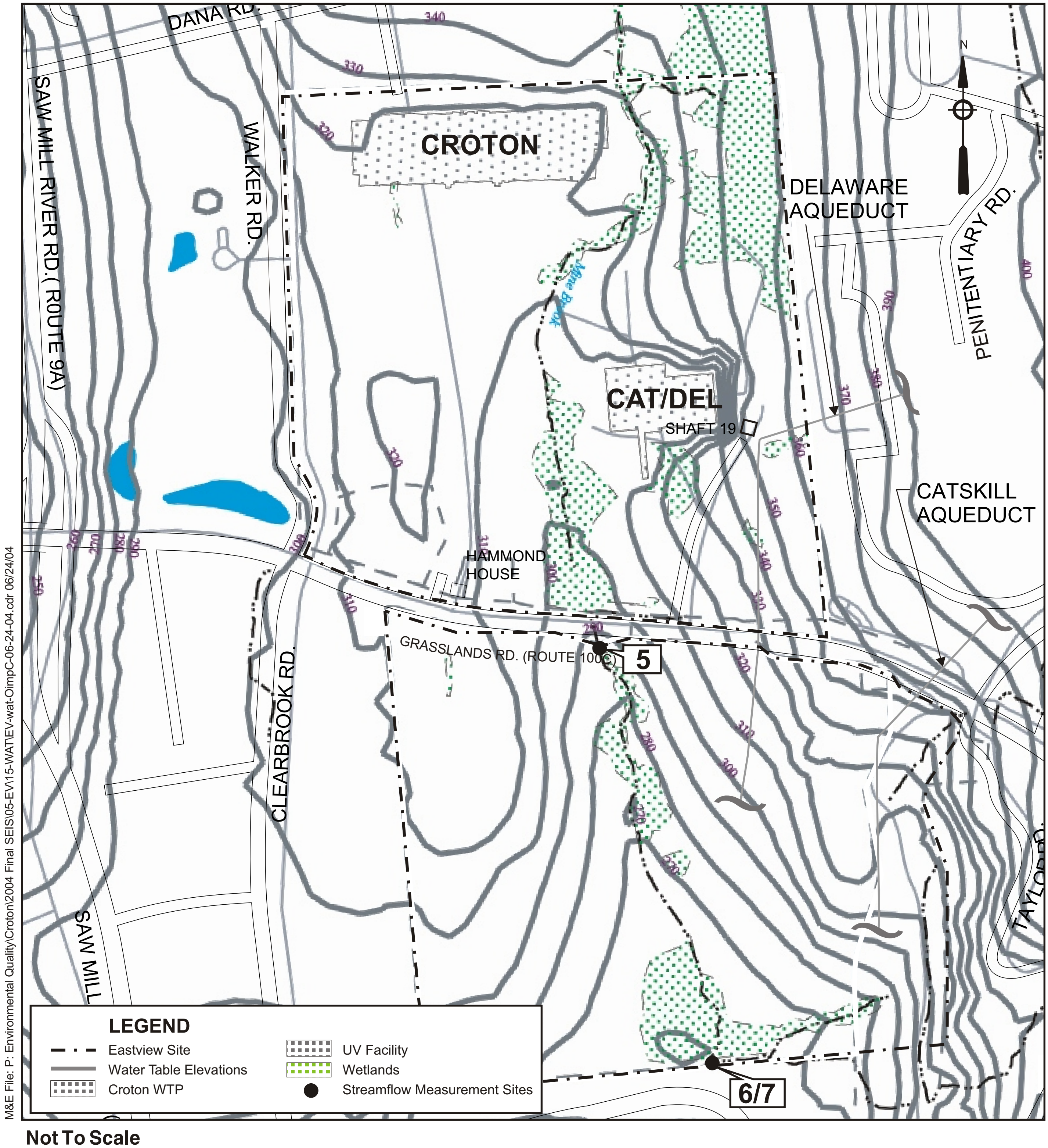
Figure 5.15-16B

Groundwater. Steady state and transient simulations were performed to evaluate the potential project impacts to groundwater-related resources with the Cat/Del UV Facility. Since the building underdrains are the primary features that affect groundwater levels at both facilities, the groundwater simulations were run with only those drains. The drain elevation was 300 feet at the Cat/Del UV Facility and as previously described without the Cat/Del UV Facility.

Figure 5.15-17 shows the simulated steady state water table elevation with both facilities in operation. The effects of the drainage systems for the main Cat/Del UV Facility building and for the proposed Croton project are evident in the tightly spaced contours surrounding those features. In particular, the steep gradients to the east of the Cat/Del UV Facility main building reflect the relatively low hydraulic conductivity of the till. In general, for both the proposed Croton project and Cat/Del UV Facility, the water table impacts are restricted to the immediate areas surrounding and including the structures with drains.

The simulated dewatering rate required to maintain the groundwater elevation at 300 feet within the Cat/Del UV Facility footprint is eight gpm. As discussed in Section 5.15.3.1.1, the simulated dewatering rate required to control groundwater elevations at that facility footprint is eight gpm. The simulated groundwater base flow in Mine Brook at Route 100C is 53 gpm, so the simulated base flow reduction was approximately 32 percent. This reduction in the base groundwater flow would be replenished with the routing of the surface stormwater runoff and the online storage.

Simulated steady state water table drawdown from the baseline conditions is shown in Figure 5.15-18. East of Mine Brook, near the Cat/Del UV Facility footprint, the extent of the simulated one-foot drawdown line is similar to that projected for the operation conditions without the proposed Croton project also in operation. The simulated one-foot drawdown line extends into some of the Mine Brook wetlands to the west. No portion of the northeast or northwest wetlands appears to be within the one-foot drawdown line. The water table drawdown associated with the proposed Croton project, as described in that section of the report, extends east to Mine Brook.

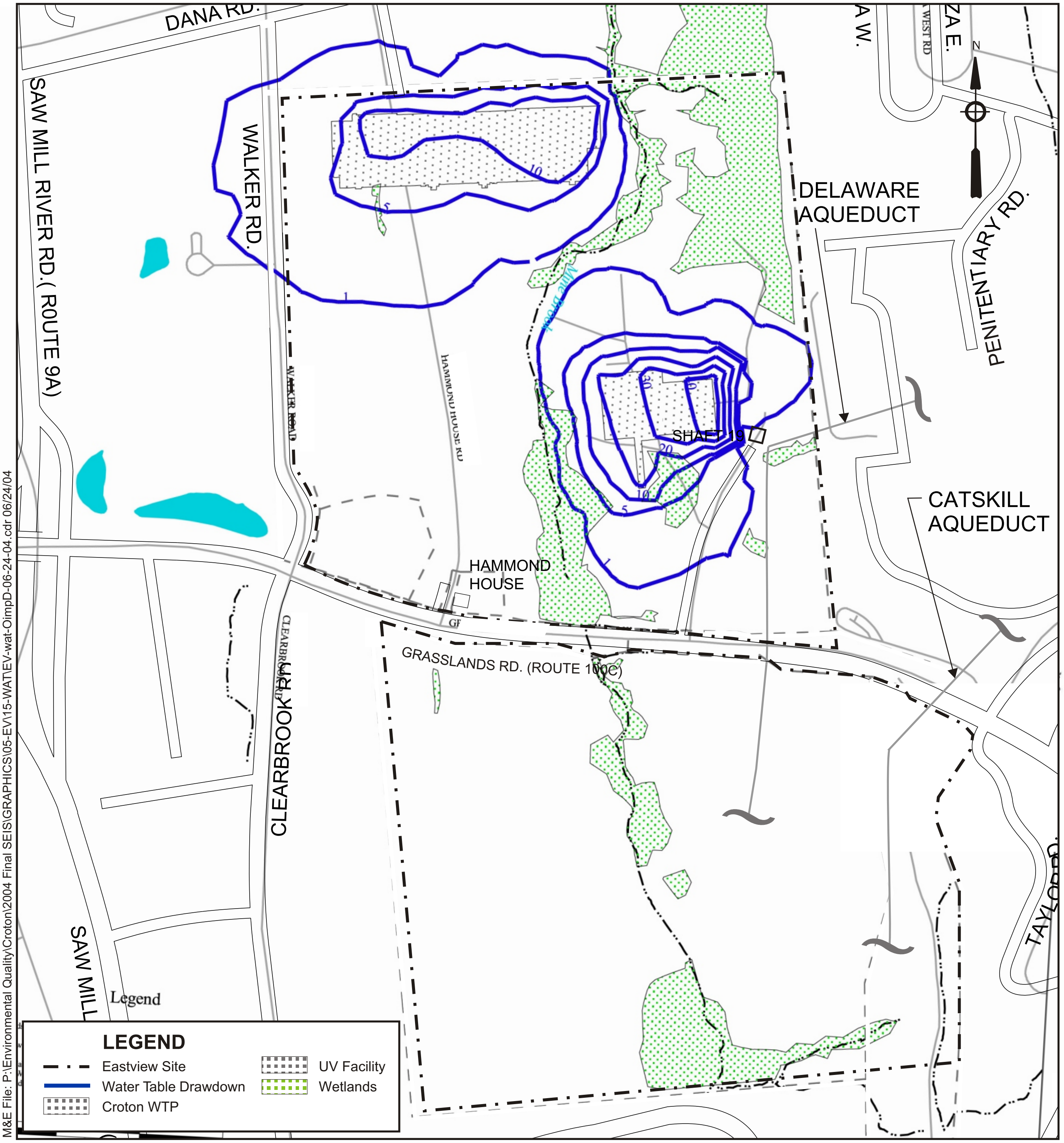


Not To Scale

Simulated Steady State Water Table Elevations for Croton with Cat/Del UV Facility Operations

Croton Water Treatment Plant

Figure 5.15-17



Not To Scale

Simulated Water Table Drawdown for Croton with Cat/Del UV Facility Operations

Croton Water Treatment Plant

Figure 5.15-18

Most wetlands require that the groundwater be one foot or less below land surface during part of the growing season so that upland species are prevented from becoming established. In order to minimize impacts to wetlands, it is therefore desirable to maintain a high water table for two weeks or so during the April to June growing period. Transient simulations were run to evaluate changes in water level with time within the delineated wetland areas during operation conditions of the proposed Croton project and the Cat/Del UV Facility. The transient simulation results suggest an insignificant change in water table elevations during the critical growing season months April to June in the wetlands, except in the area at the upstream end of the wetland along Mine Brook, directly west of the Cat/Del UV Facility. At this location, although the groundwater model predicts that the depth to water would slightly exceed the limit to sustain the wetland, the presence of the stream with its high spring flows would probably mitigate the drawdown and maintain saturation at a shallow depth. The simulation results therefore suggest that, in general, the nearby wetlands would not be affected by significant changes in depth to water during operation conditions.

Surface Water. The impacts to the surface water features within the Eastview Site are based on three factors: direct impacts due to encroachment/grading and excavation, impacts induced by changes to stormwater runoff, and impacts induced by changes to groundwater. The locations of the proposed Croton project and the proposed Cat/Del UV Facility would introduce two separate developments that would result in effects upon the existing surface waters on the site.

Mine Brook was modeled and simulations were conducted for a variety of storm conditions to evaluate the potential stormwater impacts on the stream. The routed runoff volume and the water surface elevations with the Cat/Del UV Facility are very similar to the existing conditions for all locations upstream and downstream of the Route 100C culvert. This indicates that no significant change to the surface water characteristics are anticipated for those reaches of Mine Brook. Within the wetland just upstream of the weir and north of Route 100C the water surface elevations for all the storms are higher in the proposed conditions since the weir elevations were modified to optimize upstream storage. However the extent of open water for the more frequent storms was maintained by additional excavation and some regrading. These modifications were necessary to remove the phragmites monoculture and replace it with microtopography that supports vegetative diversity while still maintaining a surface water feature comparable to the existing conditions with an enhanced wetland component.

Groundwater induced impacts to surface water were modeled for this project using a predicted average outflow of 27 gpm. This flow would otherwise have been part of the base flow in Mine Brook under existing conditions. The decrease in streamflow would persist in a 450 foot section of the stream between the access way crossing and the weir at Route 100C. This groundwater outflow would be redirected into Mine Brook via the facility foundation drain that would outlet just upstream of Route 100C to maintain base flows downstream of Route 100C. In addition, the decrease in streamflow upstream of the weir would be partially mitigated by reconstructing the weir and optimizing the upstream storage of the drainage corridor. The added detention of water during wet weather on a consistent basis would augment the recharge characteristics thereby maintaining a water balance similar to the existing conditions.

As noted previously, no significant change to the water surface elevations was observed across the stream profile, except the area just upstream of the weir. This difference was localized and occurs due to the modification and raising of the weir to optimize the upstream storage and sustain the enhanced wetland. These findings determine that there would not be a significant incremental impact with the Cat/Del UV Facility at the Eastview Site.

5.15.3.2. Potential Construction Impacts

The anticipated peak year of construction for the proposed project is 2008. Therefore, potential construction impacts have been assessed by comparing the Future With the Project conditions against the Future Without the Project conditions for the year 2008.

The potential construction impact area including the potential staging area for the proposed plant would be approximately 30 acres. The approximate finished water treatment plant site area would be 12 acres. During construction, the construction impact area would be cleared and graded to accommodate the storage and daily activities of construction vehicles and equipment.

5.15.3.2.1. Without Cat/Del UV Facility at Eastview Site

Stormwater Runoff. The proposed stormwater controls for construction of the proposed plant would incorporate measures specified by New York State[9,10,11], USEPA,[12] and the requirements of the New York State general permit for stormwater discharges associated with industrial activity from construction activities[13]. Stabilization and structural best management practices (BMPs) would be included in the project design to dissipate peak flows and to avoid on-site erosion, and that total storm volumes would be maintained to avoid significant adverse impacts on surface water and wetland hydrology.

Construction Sequencing. The anticipated construction period for the proposed project would be a five-year period from September 2005, through the start of operations by September 2010. Stormwater management, erosion and sedimentation control measures would be implemented in a phased approach during construction. Phase I of construction would include installation of fencing, temporary erosion and sedimentation controls, construction of site access roads, and site clearing and grubbing; Phase II would include construction of a stormwater detention basin, and the building excavation; and Phase III would include building construction. For each phase of construction, the following topics are described: the sequence of construction and a summary of work to be conducted; erosion and sediment control measures to be implemented; and a description of on-site activities. Operation and maintenance of the proposed controls is described in Potential Project Impacts above.

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[9] New York Guidelines for Urban Erosion and Sediment Control, (NY, 1997).

[10] New York State Stormwater Management Design Manual, New York City DEC, (NY, 2001)

[11] Draft New York Standards and Specifications for Erosion and Sedimentation Control Engineering Schematics, January, 2004.

[12] Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices (EPA B32-R-92-005)

[13] New York State Department of Environmental Conservation. State Pollution Discharge Elimination System (SPDES). 2003.

Phase I (Initial Site Preparation). Prior to the start of significant construction activities at the Eastview Site, the entrance to the project area from Walker Road (adjacent to the future vehicle inspection facility) would be developed, and modifications to local traffic signal timing would be made to facilitate site access. Early in this phase of construction, the construction area would be fenced, noise barriers erected, and concrete jersey barriers placed to demarcate the limits of construction and protect designated trees. A silt fence and double row of hay bales, as well as temporary sedimentation basins, would be installed along the perimeter of the construction area to assist in erosion and sedimentation control. Temporary site utilities (electrical power. site lighting, telephones, water and wastewater), and resident engineer's field office would be installed in anticipation of the excavation work. The final step before excavation is initiated is the clearing and grubbing of trees within the proposed building footprint.

Other Phase I features include construction of the temporary site access roadways, storm drainage, and vehicle inspection area, as well as parking and the contractor lay down and storage areas. These areas would be covered with porous pavement. During this initial construction phase of the proposed project, structural BMPs, such as oil/water separators and sediment removal devices would be installed. All existing and/or proposed catch basin inlets would be protected with hay bales and/or a sediment filter over the inlet. Dust generation would be minimized by the use of water trucks and street sweeping.

Phase II (Building Excavation). Following the clearing and grubbing of vegetation within the construction and lay down areas, topsoil will be removed from the building footprint. The permeable material would be stored on-site for use during construction. Stabilization of open soil surfaces would be initiated immediately after clearing and would be done when seeding or mulch applications would be effective in stabilizing slopes. Stabilization of exposed areas and stockpiled soils would consist of hydroseeding, or straw or grass mulch.

Before the excavation process begins, a stormwater detention basin would be constructed southeast of the proposed main treatment building. The detention basin would be an integral component of stormwater management for both the construction and long-term phases of the proposed project. As described in potential project impacts above, the stormwater detention basin would be designed to contain the runoff generated from the 100-year 24-hour storm (7.2 inches of rainfall). In addition to providing temporary storage of storm runoff from the construction area, the detention basin would also help prevent flow in Mine Brook during construction, resulting from storm events, from exceeding existing conditions.

Because the proposed detention basin would also be part of the long-term stormwater control plan, ensuring that the basin functions as designed throughout the course of construction would be critical to the effective control of stormwater runoff from the site during construction. In particular, making sure that the underlying soils do not get clogged with construction-site sediment would be crucial to sustaining the design life of the permanent detention basin. A regular cleaning and maintenance program would be implemented to enable the proper operation of the basin.

Excavation of the building footprint and treated water conveyance to Delaware Aqueduct Shaft No. 19 would occur from February 2006 through October 2007. During excavation (to an approximate depth of 10 to 30 feet below grade), portable pumps would be used to remove water from the deeper parts of the excavated area. These pumps would convey water through hoses to a temporary manifold system along the south side of the water treatment plant site. This excavation water would be pumped through portable settling tanks and oil/grease separators before discharging to the detention basin. During heavy rains, the deepest part of the excavation would detain the flows so the oil/water separator would not be overwhelmed. Storm flows into the excavation would be the major source of water to be discharged to the detention basin during construction. The excavation of the shaft and the treated and raw water tunnels are not included in this discussion, as water would not be pumped from those holes. The groundwater discussion below explains the reason behind the minimal groundwater that would be removed from the excavation areas.

Phase III (Building Construction). After the excavation is completed, the building construction would proceed, with underdrain installation and initial concrete construction (rebar and form placement at the foundation level). In general, building construction would proceed both horizontally and vertically starting at the northwest section, moving to the southeast section, and proceed in a similar fashion westward. Where practicable, the general contractor would maintain existing erosion and sedimentation measures from the previous construction phases, and where necessary establish new controls in accordance with the SWPPP.

As building construction continues, the general, electrical, HVAC and plumbing contractor would begin placing and connecting their equipment within the structure. The permanent site road system would be constructed during the last year of this period, the above grade structures constructed, and the final landscaping would be initiated. Testing and start-up of the plant would be conducted for a six-month period, culminating in the operation of the plant.

Erosion and Sediment Control Measures. During construction, the sedimentation and erosion controls and stormwater management practices described in this section may potentially be employed to minimize erosion, and prevent sedimentation of Mine Brook and adjacent wetlands. However, the final design of the erosion and sedimentation control measures during construction of the proposed plant would be the responsibility of the contractor. Control measures would include stabilization for disturbed areas, and structural controls to divert runoff and remove sediment. In addition to managing stormwater runoff and erosion, BMPs would be implemented to prevent accidental releases of fuels, lubricating fluids, or other hazardous materials. More detail related to stormwater management and erosion and sediment control, during construction and post-construction phases of the project, is provided in the Stormwater Pollution Prevention Plan (SWPPP) for the Eastview site (Appendix G).

Phase I. The proposed erosion and sedimentation control plan would be developed to prevent waterborne sediment from entering surface water and wetland resource areas adjacent to the site during Phase I of construction. Before Phase I of construction is initiated, BMPs would be installed at locations around the perimeter of the site to control sedimentation and erosion associated with stormwater runoff, as well as maintain flow to Mine Brook. The location of erosion and sedimentation control measures would serve as an absolute limit of work. Under no circumstances would any work occur on the resource side of the erosion control barriers.

During this phase of construction, control of stormwater runoff to Mine Brook would be provided primarily using hay bales, sediment fences, and temporary sedimentation basins/rock filters. A line of toed-in and staked silt fence and hay bales would define the limits of work. Runoff from cleared areas would be collected via diversion berms and drainage swales, each leading to filtration devices. Check dams, hay bale or washed stone, would be placed in drainage swales to reduce stormwater runoff velocity. These check dams would be placed within the gutter of roadways where slopes are greater than five percent.

Construction laydown and staging, and truck queuing/turn around areas, would where possible be surface with porous pavement. All catch basins within the drainage system would be equipped with inlet protection. Structural BMPs would provide treatment of runoff from these impervious areas (access roadways, parking area). These devices are located in four locations: the parking area north of the footprint; at the entrance to the access roadway; the vehicle inspection facility southwest of the excavation pit; and south of the footprint. These pollution prevention devices are designed to remove oil and sediment from stormwater during frequent wet weather events. They have been sized to treat the peak flow from the 2-year 24-storm, and would provide removal of approximately 80 percent TSS. The impervious areas at the site during construction would not anticipate exceeding the proposed ground cover shown in Table 5.15-5 under potential project impacts. Therefore, the potential stormwater runoff during from the construction site would be similar to the values shown in Table 5.15-6. The pollution prevention units located at the site access and the vehicle inspection area would be removed following completion of the proposed project; the other unit would remain into the operation phase.

<u>Phase II.</u> The main activity during this phase of construction, facility excavation, would probably result in an increase in on-site traffic. The erosion and sediment control devices established in Phase I would remain in place. As noted previously, the depression created by the main excavation would create a pit, which would serve as a large detention basin to capture runoff. This stormwater, in addition to any groundwater contribution, would be pumped to the permanent detention basin via the structural BMP at JB-00 (a storm sewer junction box), south of the main treatment building. A regular program of inspections and maintenance would be conducted.

<u>Phase III.</u> By Phase III of the project, Building Construction, the site would be established and stabilized. The emphasis of stormwater management at this stage of the work would be on operation and maintenance of structural BMPs, and control of runoff from increased on-site activities.

The stormwater runoff and quality from the proposed construction areas to Mine Brook would be maintained to the pre-construction levels. The surface runoff from the proposed plant currently flows to the brook under existing conditions. No potentially significant adverse impacts are anticipated to the natural and surrounding structural resources from the quality and quantity of stormwater runoff due to the construction activities at the proposed site.

Groundwater. Construction of the proposed plant would require dewatering. Elements of the proposed project that would be constructed partially or completely below the water table include 1) the main treatment building; 2) the raw water pumping station and shaft at the west end of the proposed plant; 3) the treated water shaft, located just southwest of the pumping station shaft; 4) the raw and treated water conveyance tunnels in bedrock, between the New Croton Aqueduct and the shafts at the west end of the proposed plant; and 5) the treated water conveyance tunnel from the water treatment plant site to Shaft 19 of the Delaware Aqueduct, on the east side of the Eastview Site. The dewatering that would be required during construction of these project components would affect the groundwater system beneath the water treatment plant site to varying degrees. The creation of impermeable surfaces during construction would also affect the groundwater system somewhat, since water that would otherwise have infiltrated and become recharge would instead be removed by the stormwater control system.

The excavation for construction of the proposed main treatment building would extend to an elevation of about 315 feet beneath most of the building. In the northeastern section of the building, where groundwater levels are highest, the excavation would extend about 12 to 19 feet below the water table, depending on the season. At the southwestern corner of the main treatment building, where groundwater levels are lowest, the bottom of the excavation would be between about 10 feet above and several feet below the water table, depending on the season. During excavation and construction of the permanent underdrain system and main treatment building foundation, dewatering would be used as necessary to lower groundwater levels to two feet below the bottom of the excavation. As a consequence of the dewatering that would be required over a period of about 19 months for construction of the main treatment building, groundwater from the surrounding areas would flow toward the excavation and the dewatering system. A mechanism to redirect an appropriate amount of water back into Mine Brook and associated wetlands would be implemented, as is deemed necessary based on wetland and stream.

The dewatering for construction of the main treatment building can be thought of as a precursor to the long-term dewatering associated with the permanent underdrains beneath the structure. The dewatering during construction would lower the water table about 2.5 feet lower than the permanent underdrains (elevation 313.5 feet versus 316 feet), but the limited duration of the period between the excavation and the construction of the underdrains would offset the slightly greater drawdowns. As in the case of the permanent underdrains (see Potential Project Impacts), the decline of the water table caused by the construction dewatering would not extend beneath and to the east of the brook due to leakage from the brook. Water levels in the wetlands on the hillside east of the brook would therefore not be affected. Those hillside wetlands are a result of a seasonally high water table. A monitoring well (EV-B39-02) installed just outside of the delineated wetland, with the screen set from a depth of 8 feet to 18 feet, showed that the water table was only about a foot below the land surface at this location in early March 2003.

The two vertical shafts that would be constructed at the west end of the main treatment building would completely penetrate the till and extend down into the bedrock. The shaft for the raw water pumping station would require an excavation about 130 feet in diameter to an elevation of about 115 feet. The nearby tunneling access water drop shaft would extend to a similar depth but would be only about 30 feet in diameter. The parts of the shaft and pumping station excavations within the till would be supported with slurry walls that would be keyed into the bedrock; as a result, little water would flow laterally into the shaft excavation from the till, the saprolite, and the upper bedrock. However, since the shafts would extend about 85 feet below the bedrock surface, groundwater could flow into the shaft excavation from fractures in the rock.

Permeability testing of the bedrock in three borings drilled at and near the shaft locations indicated that the rock is an order of magnitude more permeable at the pumping station shaft. The extent of the drawdown effects in the bedrock surrounding the shafts would depend on the bulk permeability of the rock; the extent to which bedrock fractures are intercepted by the shaft below the slurry walls; and the extent to which those fractures are grouted to reduce the inflow of groundwater. To estimate the impact of the shaft construction on groundwater levels at the water treatment plant site, the groundwater model was run with drains in the pumping station shaft footprint at an elevation of 115 feet for a period of 32 months. To simulate the presence of the slurry walls, a barrier to flow was included in the model around the shaft in the till and saprolite layers. In the immediate vicinity of the shaft, the water levels in the bedrock were drawn down to the drain elevation. The geometric mean permeability of the bedrock, based on the packer testing during the drilling program, is 0.04 m/day. Using this permeability value for the bedrock layer in the model, the simulated cone of depression in the bedrock extended far from the shaft, and an extensive cone of depression also developed in the till layer. The simulated drawdown in the till layer was 40 feet at the shaft, and at the end of the simulated period, the flow of groundwater into the excavation was about 80 gpm. The assumption was then made that the regional bedrock permeability is closer to the values obtained at the two borings away from the pumping station shaft. Running the model with a bedrock permeability value of 0.01 m/day resulted in a less extensive cone of depression in the bedrock. Under these conditions, the drawdown in the till layer was only 10 feet at the shaft, and the flow of groundwater into the excavation was only about 30 gpm. In either case, without grouting of any fractures that produce large groundwater inflows, the dewatering associated with the shafts could cause drawdown beneath Mine Brook and in the wetlands along and east of Mine Brook. The drawdown would in turn induce leakage of surface water into the ground. Surface water seeping from the brook into the ground would diminish the drawdown in the immediate vicinity of the brook. Also, to some degree, the potential temporary drawdown beneath Mine Brook during construction would be offset by the influence of groundwater recharge resulting from both the created wetland and the stormwater detention basin, located on the western boundary of Mine Brook. Since inflows of water into the shafts would be controlled as much as possible by grouting to facilitate construction, inflows would probably be much less than the modeled value of 30 gpm. Therefore, dewatering associated with the shafts should not result in short-term construction related impacts to local groundwater levels.

The raw and treated (for the NCA conveyance alternative) water tunnel would extend from the vertical shafts at the proposed plant in a westerly direction to the New Croton Aqueduct. The tunnels would be constructed in the bedrock at depths of about 100 to 200 feet, beneath and west of the water treatment plant site. Since large inflows of groundwater into the tunnels are intolerable, grouting would be performed during tunnel advancement if permeable zones and large groundwater inflows were encountered in the rock. The tunnels would be lined after boring and muck removal. Therefore, little dewatering would occur during the construction of the tunnels, and this aspect of the project would have no potentially significant adverse impact on shallow groundwater levels at the water treatment plant site.

The treated water pipeline from the proposed plant to Shaft 19 of the Delaware Aqueduct would be constructed by cut and cover methods. This pipeline would be extended to the KCT downtake if the KCT is the treated water conveyance. See Section 3.8.2 for the generic impacts for this alternative. The construction trench would be no longer than approximately 100 feet long by 18 feet wide at any time. The invert elevation would rise from about 290 feet at the proposed plant to about 330 feet at the Shaft 19 connection. The pipeline would be at a depth of 20 to 35 feet below the existing ground surface, and would be up to 25 feet below the water table depending on the season. Where the pipeline would cross beneath Mine Brook, the invert would be about 20 feet below the water table. During excavation and pipeline construction, groundwater levels would be lowered to two feet below the bottom of the excavation. As a consequence of the dewatering that would be required for construction, groundwater from the surrounding areas would flow toward the excavation and the dewatering system.

To estimate the impact of the construction of the pipeline to Shaft 19 of the Delaware Aqueduct on groundwater levels at the Eastview Site, the groundwater model was run with drains along the pipeline route at elevations 2 feet below the pipe invert for a period of 12 months. The results showed that, in the immediate vicinity of the pipeline, the water levels in the till would be drawn down to the drain elevations. The simulated drawdown in the till layer was up to a 25-foot depth along the pipeline, and the model results indicated that groundwater levels would be lowered over a large area. The dewatering associated with the construction of the pipeline to Shaft 19 would result in drawdown beneath Mine Brook and in the wetlands along and east of Mine Brook. Surface water seeping from the brook into the ground would diminish the drawdown in the immediate vicinity of the brook, but drawdowns in the hillside wetlands could be as much as 5 feet. A mechanism to redirect an appropriate amount of water to Mine Brook and the wetlands would be implemented, as is deemed necessary based on wetland and stream monitoring, in order to counteract any excessive drawdowns. The potential temporary drawdown beneath Mine Brook would also be offset to some degree by the influence of groundwater recharge resulting from both the created wetland and the stormwater detention basin, located on the western boundary of Mine Brook. Therefore, dewatering associated with the construction of the pipeline to Shaft 19 would not result in impacts to local groundwater levels.

After completed construction of the treated water pipeline to Shaft 19 (12 months), it is anticipated that the water levels would return to their normal elevations. Therefore, there would be no potential long-term significant adverse impacts to the groundwater at the Eastview Site.

Surface Water. The period of construction that could have the greatest potential impacts on Mine Brook would be during the initial activities and peak excavation. Early installation of erosion control measures and other stormwater BMPs would prevent potential untreated-stormwater runoff and equipment wash water to enter Mine Brook. The erosion control measures and BMPs would include haybales, sediment fences, the proposed permanent stormwater detention basin (potential construction impacts, Stormwater Runoff), and temporary sedimentation basins/rock filters.

The three areas of excavation at the Eastview Site include: (1) the excavation of the main treatment building footprint; (2) the excavation of tunnels and shafts that would include the cut and cover activity for the treated water tunnel to Delaware Shaft No. 19; and (3) the excavation of the proposed mitigation wetland south of the proposed main treatment building (see Section 5.14, Natural Resources). The dewatered water would be treated in the same fashion as stormwater runoff prior to discharge to Mine Brook. No impacts are anticipated to the quality of water that would potentially be discharged to Mine Brook if the erosion control measures and other stormwater BMPs are appropriately installed and monitored.

The section of Mine Brook immediately east of the main treatment building excavation area and along the cut and cover treated water tunnel would potentially experience some streamflow reduction as water that would otherwise have been part of the base flow in Mine Brook would be dewatered and discharged downstream of the detention basin. The anticipated groundwater drawdowns during the excavations would be recharged by the brook base flow (see Section 5.15.3.2.1. Potential Construction Impacts, Groundwater) and as a result approximately 25 gpm of baseflow would be infiltrated to supply the groundwater. The brook's current base flow level is 118 gpm (0.3 cfs), and during the three-month storm event the flow reaches approximately 20 cfs. The decrease in streamflow would persist between the excavation areas and the downstream stormwater basin. However, water from the stormwater detention basin would be used to maintain the pre-construction flow in Mine Brook south of the basin; therefore no significant impact is anticipated south of the basin. The upstream reach is supplied primarily by storm drains that discharge into the Mine Brook channel from the Grasslands Reservation to the north. Without these flows, the stream would naturally dry out in sections during dry weather. Therefore no significant impact is anticipated as a result of the potential short-term reduction of base flow in Mine Brook during excavation.

5.15.3.2.2. With Cat/Del UV Facility at Eastview Site

With the addition of the Cat/Del UV Facility, the potential construction impact area including the staging area for the combined facilities would increase by approximately 67 acres. During construction of the Cat/Del UV Facility, the construction area would be cleared and graded to accommodate the storage and daily activities of construction vehicles and equipment. The four areas of excavation and potential dewatering and possible temporary stream diversion include: (1) the excavation of the building footprints; (2) the excavation of conduits and shafts that would include the cut and cover activity and (3) the excavation and cut and cover activities of install the treated water conduits and (4) the reconstruction of the weir north of Route 100C and replacement of the culvert across Route 100C. In addition, a roadway is proposed across the Mine Brook corridor to provide access from the Walker Road entrance to the proposed facility.

Stormwater Runoff. The stormwater controls for construction of the proposed Croton project and the Cat/Del UV Facility would incorporate measures specified by local and state environmental agencies, and referenced previously in Section 5.15.3.2.1. Existing Conditions, Stormwater Runoff. Stabilization and structural BMPs would be included in each project design to dissipated peak flows to avoid on-site erosion, and that total storm volumes would be maintained on surface water and wetland hydrology.

Erosion and Sedimentation Control Measures. A detailed SWPPP would be developed for each of the projects, describing all activities conducted at the construction sites to minimize and reduce the potential short- and long-term erosion impacts on Mine Brook and the adjacent wetlands. For example, work activities and clearing limits would be determined as part of the construction documents; no vegetation outside these limits would be disturbed. Also, no stockpiling of excavated material would be allowed in a manner that would cause erosion. "Stop work" orders would be issued to the contractor if erosion control measures were not properly installed and maintained after such contractor has been given a reasonable amount of time to correct the problem. An allotment item would be set up in each contract to provide a budget for maintenance as needed by the contractor at the direction of the resident engineer, which would enable the proper maintenance of the erosion control measures.

Another proposed technique to control erosion during construction is by using temporary sediment traps and/or temporary sediment basins. A temporary sediment trap is a settling area created by constructing an earthen embankment with a stone outlet. The purpose is to detain sediment-laden runoff from small disturbed areas (generally less than three acres), allowing the majority of the sediment to settle out. A temporary sediment basin is a barrier or dam with a controlled storm water release structure formed by constructing an embankment of compacted soil across a drainage way. The purpose is to detain sediment-laden runoff from disturbed areas larger than those upstream of traps, generally three acres or greater. These measures can be supplemented with sediment filters in a downstream location.

Any low-lying areas along the edge of the construction limit are excellent locations for these erosion control facilities, since they are at low elevations in the watershed and would subsequently be restored. As part of the project's final design documents, NYCDEP would identify locations, as appropriate, for the construction of sediment basins that may be outside the proposed BMP location. In each case, the sediment traps, basins, and/or filters would stay in place until the construction activity is complete and the ground surface stabilized. During their use, sediment traps require frequent maintenance; typically, when they are 50 percent or more full of silt, they must be cleaned. Silt intercepted by basins and filters must also be removed, especially after storms.

Another important erosion-control measure is temporary seeding or the establishment of a temporary vegetative cover on disturbed areas or soil stockpile areas by seeding with appropriate, rapidly growing annual plants. This measure provides protection to exposed soils during construction until permanent vegetation or other erosion-control measures can be established.

In summary, measures that are proposed to be part of the construction documents for erosion and sedimentation control would include:

- Installing a line of toed-in and staked silt fence and hay bales defining the limits of work;
- Using portable sediment tanks during dewatering;
- Constructing temporary sediment traps and/or basins at appropriate locations to capture sediment from runoff and from water produced by dewatering operations, with sediment filters at the exit channel to further treat sediment-laden water;

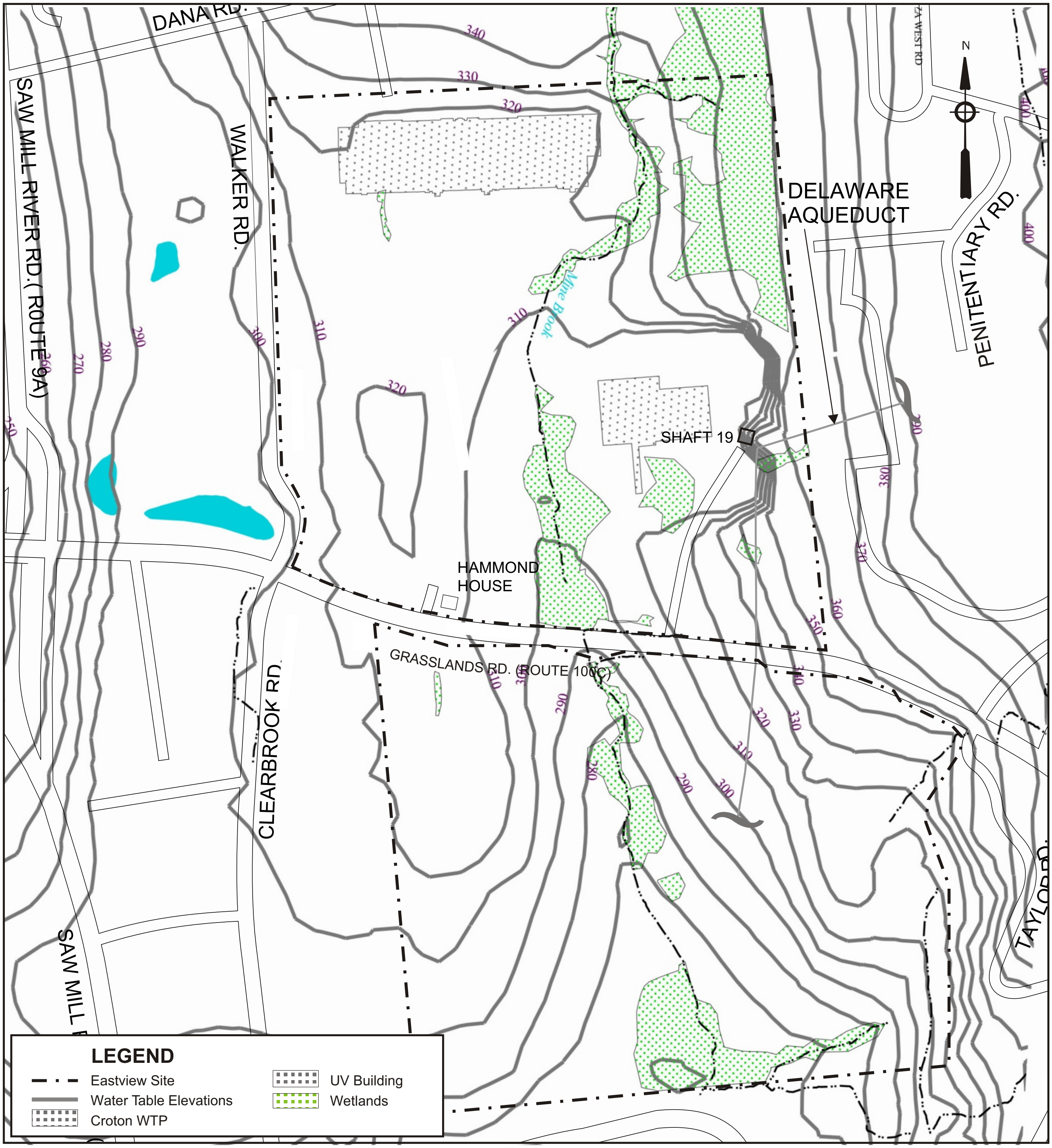
- Using block and gravel curb inlet sediment filters and gravel and wire mesh drop inlet sediment filters to protect existing storm water inlets;
- Constructing a temporary sump pit;
- Controlling sediment from areas traversed by trucks and other heavy equipment by constructing temporary construction accessways covered which would be with properly sized stone over filtering material; and
- Prior to the start of construction activities, all erosion control measures would be inspected and continually monitored, especially after each storm event.

Groundwater. Steady state and transient simulations were performed to evaluate the potential construction impacts to groundwater-related resources for the proposed Croton project with the Cat/Del UV Facility, during peak construction (2010). Since dewatering of the excavations for the main buildings are the primary features that affect groundwater levels at both facilities, the groundwater simulations were run with groundwater levels maintained at the excavation elevations (300 feet at the Cat/Del UV Facility and as previously described at the proposed Croton project). For the Cat/Del UV Facility, the assumption was made that construction dewatering would affect the proposed footprint and the surrounding area. Groundwater flow model simulations were performed by assuming dewatering over an area of approximately 11 acres. This area is much greater than the building footprint, and as such this simulation provides a worst-case estimate of the potential construction dewatering impacts.

Figure 5.15-19 shows the simulated steady state water table elevations for the concurrent projects. The effects of the dewatering systems for the construction of the Cat/Del UV Facility structures and for the proposed Croton project are evident in the tightly spaced contours surrounding the construction area. In particular, the steep gradients to the east of the Cat/Del UV Facility construction area reflect the relatively low hydraulic conductivity of the till. In general, for both the Cat/Del UV Facility and the proposed Croton project, the water table impacts are restricted to the immediate areas surrounding and including the excavation dewatering areas. However, these areas are significantly larger than for the main disinfection building or the proposed Croton project, and the construction dewatering elevations are lower than the post-construction drains. Therefore, the water table impacts are spread over a larger area during construction than following excavation and construction.

The simulated dewatering rates would be 14 gpm for the proposed Croton project and 26 gpm for the Cat/Del UV Facility. The simulated groundwater base flow in Mine Brook at Route 100C is 43 gpm, so the simulated base flow reduction at that point was approximately 45 percent.

Simulated steady state water table drawdown from baseline conditions is shown in Figure 5.15-20. The one-foot drawdown line extends west to Mine Brook, south approximately to Route 100C, and north into the southernmost portion of the northeastern wetland. The water table drawdown associated with the proposed Croton project, as delineated by the one-foot drawdown line, extends east to Mine Brook. This indicates that it is likely that the construction dewatering would create wetlands impacts, in terms of depth to water increases, in the wetlands along Mine Brook on the Eastview Site, and in limited portions of the northeast wetland. The wetlands south of Route 100C are not likely to be impacted by dewatering effects on groundwater.



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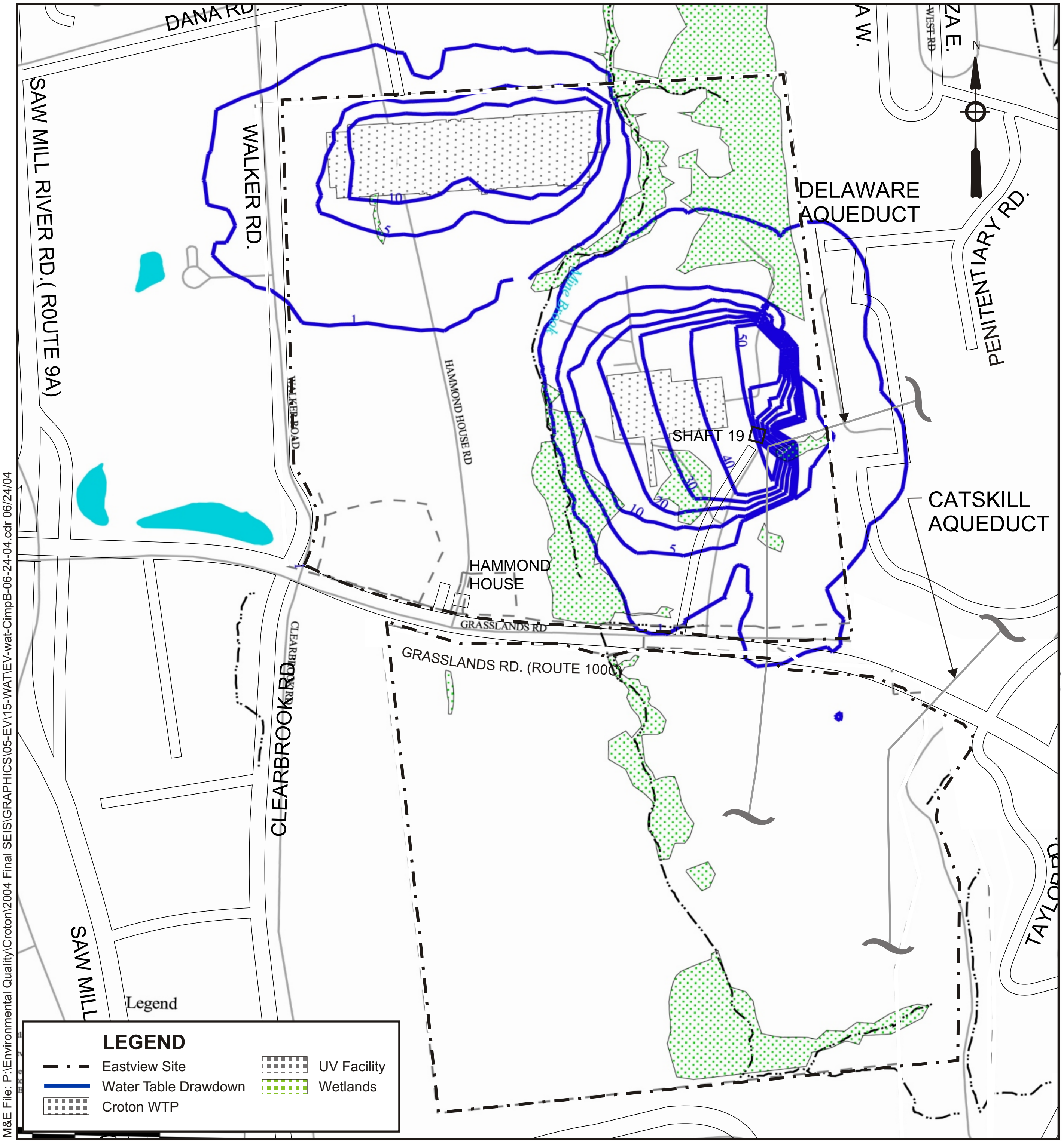
Not To Scale

Simulated Water Table Elevations for Croton with Cat/Del UV Facility Construction

Croton Water Treatment Plant

Figure 5.15-19



Not To Scale

Simulated Water Table Drawdown for Croton with Cat/Del UV Facility Construction

Croton Water Treatment Plant

Figure 5.15-20

Most wetlands require that the groundwater be one foot or less below land surface during part of the growing season so that upland species are prevented from becoming established. In order to minimize impacts to wetlands, it is therefore desirable to maintain a high water table for two weeks or so during the April to June growing period. Transient simulations were run to evaluate changes in water level with time within the delineated wetland areas during construction of the proposed Croton project and the Cat/Del UV Facility.

The transient simulation results suggest that the depth to water could slightly exceed the limit to sustain wetland conditions during the critical growing season months April to June at several locations including in the wetland along Mine Brook, directly west of the Cat/Del UV Facility; the northwest wetland area along Mine Brook; and the southwestern portion of the northeast wetland area. The extent and permanence of wetland impacts would be governed in part by the length of the construction period. Section 5.14, Natural Resources, provides further discussion of wetlands impacts and potential mitigation measures to minimize the extent of impacts.

Surface Water. The principal concern during construction activities at the Eastview Site on surface water quality is turbidity, which could come from several sources, including large unprotected excavations, stockpiled soils, stream diversions and sediment from groundwater and stormwater dewatering effluents. Contractors for the proposed Croton project and the additional Cat/Del UV Facility would institute several practices to avoid potential impacts to the Mine Brook. As discussed above, these practices would include sediment basins to settle out residuals from the dewatering activities prior to discharge and erosion and sedimentation control measures, such as: installing a construction-limiting fence; portable sediment tanks during dewatering; using block and gravel curb inlet sediment filters and gravel and wire mesh drop inlet sediment filters to protect existing storm water inlets; constructing a temporary sump pit; and constructing temporary construction accessways covered with properly sized stone over filtering material.

Dewatering Operations. During the construction of the proposed Cat/Del UV Facility continuous dewatering would be implemented for the entire construction duration. Contractors would be required to send pumped-out residual water through settling devices, such as sediment basins, sediment traps or portable sediment tanks, prior to discharge to avoid surface water impacts during dewatering. These devices allow the suspended solids to settle out prior to discharge. The captured sediments would be regularly removed by the contractor from the bottom of the tanks. In some instances, depending on the nature of the sediments augmenting the settling characteristics may be required. Construction documents would require that contractors adhere to a specific protocol for the discharge of the dewatering effluent. The protocol establishes a testing procedure whereby the turbidity of the effluent is monitored and standards are set for the maximum turbidity value permissible. The standard is based in part on the existing turbidity of the receiving pond or stream. The type of dewatering system to be used would depend on the amount of groundwater to be pumped. However, in all cases the pumped water would be returned to the surface water system only after it is collected and treated in sediment traps, filters, or portable sediment tanks. As a result, dewatering during construction is not anticipated to cause an impact on surface waters.

Stream Diversion. The reconstruction of the weir north of Route 100C and the replacement of the culvert under Route 100C would require a temporary stream diversion and fluming of Mine Brook so that the construction could occur in relatively dry conditions. Sediment impacts to surface water from stream diversion are anticipated to be limited for the following reasons:

- When such work is done in dry conditions, downstream sedimentation is also reduced.
- The work would be limited to a section of the stream, and therefore impacts on surface flows and hydrology are anticipated to be limited.
- Proper diversion strategies are planned and would be implemented. In all cases, flow-through capacity would be maintained and no flooding would occur as a result of the proposed in-water work.

There is a limited potential for impacts during a major storm event. Diversions would be designed to handle a certain level of storm; however, heavier storms could result in washout following which appropriate remedial work would be conducted to restore the affected corridor.