CALUMET AREA
HYDROLOGIC MASTER PLAN

VOLUME III

IDOT PUMP STATION NO. 27 &
OUTLET CHANNEL TO LAKE CALUMET
(PULLMAN CREEK / DOTY DITCH)

CALUMET AREA
CITY OF CHICAGO, COOK COUNTY, ILLINOIS

PREPARED FOR:

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Disclaimer: Due to ongoing activities within the study area, the information contained within this report may become obsolete after modifications by others. The information contained in this report is accurate as of August 2006.

1.0 EXECUTIVE SUMMARY

This report specifically addresses the evaluation of Illinois Department of Transportation (IDOT) Pump Station No. 27 and the conveyance capacity of the outlet channel (known as Pullman Creek or Doty Ditch) to Lake Calumet. This report is known as Task 204 of the Calumet Area Hydrologic Master Plan (HMP).

V3 obtained a copy of "Hydraulic Report For Pump Station No. 27", prepared for IDOT by Alvord, Burdick & Howson, L.L.C. (AB&H), dated May 23, 2001. On October 7, 2003, IDOT District 1 and AB&H staff confirmed that the May 23, 2001 copy of the report was the most recent version available for Pump Station No. 27.

The data contained in the report was used by V3 as the basis for estimation of the characteristic discharge hydrographs on Pullman Creek, which will be later used to evaluate the ecological impacts along the riverine corridor.

Pump Station No. 27 receives runoff from approximately 457 acres of tributary drainage area associated with I-57, I-94, and Stony Island Avenue. The pump station is the largest in IDOT District One's jurisdiction and has been operating for 40 years. It is equipped with eight (8) pumping units of 67 cfs (i.e. 30,000-gpm) each and two (2) low flow pumping units of 5.6 cfs (i.e. 2,500-gpm) each. The total pumping capacity is 536 cfs (for all eight units in function) and 469 cfs with one unit of 30,000-gpm out of service.

The outlet channel cross-section was originally designed as trapezoidal with a 7-foot bottom width and 3:1 bank slopes. However, the actual cross-section of the outlet channel is smaller than the designed section. AB&H concluded that this was due to sedimentation within the channel, as well as some cross sections were not constructed according to the original design. The outlet channel banks contain dense vegetation, which also reduces the conveyance of the channel. The conveyance capacity of the outlet channel is approximately 450 cfs, which is adequate for the 10-yr storm event, but inadequate for the 50-yr event. For high water levels in Lake Calumet, the 50-yr rainfall events would cause pavement flooding at the I-94/111th Street underpass area and on Doty Avenue between 111th Street and 115th Street.

AB&H recommended replacement of the existing pump units with pumps of the same capacity (i.e. 30,000-gpm) with higher pumping head (i.e. 52 feet) and larger motors with explosion-proof design. The new pumps can be operated at a lower water level in the wet well and; therefore, lower hydraulic grade in the highway sewer system. In addition, a new 30,000-gpm backup unit is proposed at a space near the access ladder giving the new pump station 8+1 units. The following table shows the proposed conditions water level in the wet well for 10-year, 50-year and 100-year rainfall events, as compared to the existing conditions.

	10-yr	50-yr	100-yr
Existing Pump Configuration	545.81	551.56	564.01
Improved Pump Configuration	543.63	551.13	564.74

Table: Comparison of Wet Well High Water Elevations.

According to the HEC-RAS calculations included in Appendix D (CALCULATIONS) Book I of III of the AB&H report, the maximum discharge from the pump station into the outlet channel in proposed conditions for the 10-year rainfall event will be greater than in existing conditions,

while the maximum discharge for 50-year rainfall event will be less than in existing conditions, as shown in the following table.

	10-yr	50-yr
Existing Pump Configuration (cfs)	334.34	549.88
Improved Pump Configuration (cfs)	412.28	500.09

Table: Comparison of Pump Station Peak Discharge Rates.

AB&H recommended replacing each of the existing corrugated metal pipe (CMP) culverts under the golf course access driveways (i.e. 111th and 115th Streets) with three 10' x 8' Box Culverts with the invert elevation 577.6 USGS in order to avoid reduction of the flow cross-section due to long-term sedimentation of the channel. This alternative was proposed by AB&H based upon consideration of construction cost (approximately $ 501,000) and the relatively minimum maintenance requirements.

In order to prevent flooding of I-94 between 111th Street and 115th Street for rainfall events higher than 50-yr return periods, AB&H recommended the following additional improvements:

- Install check valves on the two 8' x 8' culverts east of I-94/111th Street.
- Install a drop shaft in the swale east of I-94/111th Street and a 36" diameter connecting pipe from the shaft to the wet well of Pump Station No. 27 in order to divert storm water from the swales to the pump station when the water level in the swale exceeds elevation 584.25 USGS.
- Install a 42" diameter connecting pipe between the two swales east of I-94/111th Street for water level equalization in the swales.

On November 16, 2000 a meeting was held at the IDOT office in Springfield in order to discuss the AB&H report for Pump Station No. 27. The main conclusions of the meeting relevant to ecological improvements of the outlet channel were as follows:

- The main drains in I-57, I-94, and the outlet channel were originally designed for 10-year flood frequency events; therefore, they cannot convey the 50-year events. The system improvements to increase the system conveyance for 50-year events would cost far more than the current funding sources and would not be able to be implemented in the near future.

- The outlet channel is not able to handle the 50-year flood events due to several factors, including channel sedimentation, channel construction errors, Lake Calumet tailwater effect, and additional drainage from Harborside International Golf Course.

- The data presented in this report will be the basis of future analyses in the study area. Stream flow velocities, inundation depths and durations, and shear forces along the streambanks are the main ecological parameters of concern for analyzing the Pullman Creek riparian corridor. Future studies should consider: the intentions of IDOT to improve Pump Station No. 27, updated sewer mapping and profiles of Doty Avenue, and interviews with local, regulatory, and Illinois International Port District staff. Any ecological improvements to the outlet channel should evaluate the effect of the improvements on the channel conveyance for the critical duration rainfall events.

2.0 INTRODUCTION

This report specifically addresses the evaluation of Illinois Department of Transportation (IDOT) Pump Station No. 27 and the conveyance capacity of the outlet channel (known as Pullman Creek or Doty Ditch) to Lake Calumet. These items are known as Task 204 of the Calumet Area Hydrologic Master Plan (HMP).

V3 obtained a copy of "Hydraulic Report For Pump Station No. 27", prepared for IDOT by Alvord, Burdick & Howson, L.L.C. (AB&H), dated May 23, 2001. On October 7, 2003, IDOT District 1 and AB&H staff confirmed that the May 23, 2001 copy of the report was the most recent version available for Pump Station No.27.

The data contained in the report was used by V3 as the basis for estimation of the characteristic discharge hydrographs on Pullman Creek, which will be later used to evaluate the ecological impacts along the riverine corridor.

Figure 1: Location Map.

3.0 EXISTING CONDITIONS

3.1 Hydrology

As identified in Volume II of the HMP, Pump Station No. 27 receives runoff from approximately 457 acres of tributary drainage area associated with I-57, I-94, and Stony Island Avenue. The pump station is the largest in IDOT District One's jurisdiction. To quantify the inflow hydrographs for the pump station, AB&H utilized the TR-20 hydrologic computation model for 10-yr, 50-yr and 100-yr storm events with various rainfall durations. The critical duration peak flows and the corresponding water surface elevations in the wet well of the pump station are shown in Table 1.

Return Period (years)	Critical rainfall duration (hour)	Peak flow (cfs)	Time to peak (hour)	Max. Water Level		Time at Max. Level (hour)
				feet	USGS	
10	2	414	1.32	14.5	545.81	1.60
50	2	764	1.22	20.25	551.56	1.74
100	2	942	1.22	32.70	564.01	1.88

Table 1: Pump Station Inflow Data.

Note: Wet Well bottom floor elevation = 531.31 USGS = - 48.0 CCD (From AB&H Report)

As identified in Table 1, the lag time between the time to peak of the maximum level and time to peak of the maximum discharge is approximately 0.30 hours (i.e. 18 minutes) for the 10-yr rainfall event, of approximately 0.50 hours (i.e. 30 minutes) for the 50-yr rainfall event, and of approximately 0.66 hours (i.e. 40 minutes) for the 100-yr rainfall event.

3.2 Pump Station No. 27 Hydraulics

Pump Station No. 27 has been in function for 40 years. It is equipped with eight (8) pumping units of 67 cfs (i.e. 30,000-gpm) each and two (2) low flow pumping units of 5.6 cfs (i.e. 2,500-gpm) each. The total pumping capacity is 536 cfs (for all eight units in function) and 469 cfs with one unit of 30,000-gpm out of service. The pump station is operated by a SCADA system (i.e. Supervisory Control and Data Acquisition System) in accordance with the schedule shown in Appendix A.

Under current operations, the low flow pumping units are actuated when the water level in the wet well exceeds elevation 536.81 USGS (i.e. –42.5 CCD). If the water level reaches elevation 540.51 USGS (i.e. –38.8 CCD), the low flow units are turned off and the first 30,000-gpm pump is turned on. When the water level in the wet well will exceed elevation 542.31 USGS (i.e. –37.0 CCD), the other 30,000-gpm units will be turned on, in sequences, at 0.5 foot or 1.0 foot intervals. All eight 30,000-gpm pumps will be in function if the water level in the wet wells exceeds elevation 546.31 USGS (i.e. –33.0 CCD). A record level in the wet well of 558.31 USGS (i.e. –21.0 CCD) occurred on June 20, 1990 with 1.00 foot of water on the adjacent roadway.

Figure 2: Pump Station Discharge to Outlet Channel.

3.3 Outlet Channel (Pullman Creek/Doty Ditch)

Pump Station No. 27 discharges runoff to Lake Calumet via a mile long open channel known as Pullman Creek or Doty Ditch. The outlet channel is located at the south end of the pump station, east of South Doty Avenue and west of Harborside International Golf Course. According to the AB&H report, the channel is under City of Chicago jurisdiction and is not maintained by IDOT.

In addition to the inflow from Pump Station No. 27, the channel receives runoff from several other sources totaling approximately 300 acres.

- Overland flow from the south part of Harborside International Golf Course
- Storm water discharged from the detention ponds which collect overland flow from the north part of Harborside International Golf Course (approximately 200 acres)
- Overland flow from South Doty Avenue west of the channel
- Storm water from the culverts that drain surface runoff from I-94 and the swales between 110th Street and 115th Street

The construction of Harborside International Golf Course in the mid-1990s added approximately 200 acres of additional drainage area to the outlet channel. Golf course access driveways were

also constructed across the channel. Two 14'-5" x 10'-0" Corrugated Metal Pipe Arch culverts were provided under each access driveway.

Figure 3: Golf Course Access Driveway with Arch Culverts.

AB&H estimated the combined discharge hydrograph for the outlet channel from the golf course, highway and pump station using the computation program HYDRA. The calculations indicated that the average travel time through the channel is approximately 1 hour. The peak pump discharge, the peak overland flows from the golf course, and the peak overland flows from the highway to the outlet channel do not occur at the same time. Based on the computations, the estimated peak discharge rate for the outlet channel is approximately 344 cfs for a 10-year storm event and approximately 586 cfs for a 50-year storm event (i.e. AB&H Report page 10). Using this data, peak discharges for the 2-yr, 5-yr, 25-yr and 100-yr rainfall events could be estimated using logarithmic interpolation/extrapolation techniques, which result in the values shown in Table 2:

Discharges in (cfs) for:	2-yr	5-yr	*10-yr*	25-yr	*50-yr*	100-yr
Inflow in PS #27	50	256	*414*	619	*764*	942
Inflow in the outlet channel	49	215	*344*	485	*586*	720

Table 2: Estimated Peak Discharges for Outlet Channel.

The Pump Station Report does not contain electronic copies (CD or diskette) of the computation models used in AB&H's analysis. If such data is available, the estimated values included in Table 2 could be calculated by simulating, through the corresponding computation models, the runoff generated by the various rainfall events for the pump station and the outlet channel. However, for the purposes of this study and considering the complexity of the runoff development and flow conditions in the study area, it could be assumed that the values shown in Table 2 are within an acceptable range of accuracy for the estimation of the ecological parameters in the Pullman Creek riparian corridor.

The AB&H report notes that the outlet channel cross-section was originally designed as trapezoidal with a 7-foot bottom width and 3:1 bank slopes. However, the actual cross-section of the outlet channel is smaller than the designed section. AB&H concluded that this was due to sedimentation within the channel, as well as some cross sections were not constructed according to the original design. The outlet channel banks contain dense vegetation, which also reduces the conveyance of the channel.

Twenty cross-sections were surveyed on the outlet channel, from the pump station to Lake Calumet (5242 feet of channel), which represents an average distance between cross-sections of approximately 275 feet (see Pump Station No. 27 Report – Exhibit 9). Each cross-section contains indicators of the vegetation in the floodplain (including the estimation of the roughness coefficients) and the nature of soil in the channel. A longitudinal profile through the outlet channel is also provided in the report (i.e. Exhibit 10), including data from a field survey performed by AB&H in May 2, 2000.

From the longitudinal profile it can be observed that approximately 80% of the channel length is under the influence of tailwater from Lake Calumet. For example, at the day of the AB&H survey, the water level in Lake Calumet was at elevation 577.90 (Sta. 0+00) with a correspondent water surface level of 577.92 at Sta. 40+85[1] (this indicates that the pump station was not functioning during the time of survey). A statistical analysis of 30 years of water level records on Lake Calumet indicates that the 10-year water level (i.e. 583.52 USGS) matches the 10-year water level in Lake Michigan (i.e. 583.5). It can also be noted that the inverts of the arch culverts under 111th Street and 115th Street are approximately 1.25 – 1.60 feet lower than the bottom of the channel. This supports the AB&H observation regarding extensive sedimentation of the outlet channel, which is partially due to the backwater effect of Lake Calumet. In addition, the conveyance capacity of the existing culverts is reduced as compared to the original design conditions.

[1] The elevations used in the above mentioned cross-sections and profiles are IDOT(USGS) elevations.
IDOT (USGS) datum = CCD + 579.31

Figure 4: Outlet Channel (Looking Upstream).

The conveyance capacity of the outlet channel is approximately 450 cfs, which it is adequate for the 10-yr storm event, but inadequate for the 50-yr event. For high water levels in Lake Calumet, the 50-yr rainfall events would cause pavement flooding at the I-94/111th Street underpass area and on Doty Avenue between 111th Street and 115th Street. According to the HEC-RAS calculations included in the AB&H report, the channel flow velocities are quite low, ranging from 3.54 ft/s at the upstream end of the channel to 1.36 ft/s at the downstream end, for a 50-yr storm event.

4.0 PROPOSED IMPROVEMENTS

4.1 Pump Station No. 27 Hydraulics

AB&H recommended replacement of the existing pump units with pumps of the same capacity (i.e. 30,000-gpm) with higher pumping head (i.e. 52 feet), as well as larger motors with explosion-proof design. The new pumps can be operated at a lower water level in the wet well and; therefore, lower hydraulic grade in the highway sewer system. In addition, a new 30,000-gpm backup unit is proposed to be installed at a space near the access ladder giving the new pump station 8+1 units. Table 3 shows the proposed conditions water level in the wet well for 10-year, 50-year and 100-year rainfall events, as compared to the existing conditions. The maximum high water elevations in the wet well for the proposed conditions are also shown in Appendix A.

	10-yr	50-yr	100-yr
Existing Pump Configuration	545.81	551.56	564.01
Improved Pump Configuration	543.63	551.13	564.74

Table 3: Comparison of Wet Well High Water Elevations.

According to the HEC-RAS calculations included in Appendix D (CALCULATIONS) Book I of III of the AB&H report, the maximum discharge from the pump station into the outlet channel in proposed conditions for the 10-year rainfall event will be greater than in existing conditions,

while the maximum discharge for 50-year rainfall event will be less than in existing conditions, as shown in Table 4.[2]

	10-yr	50-yr
Existing Pump Configuration (cfs)	334.34	549.88
Improved Pump Configuration (cfs)	412.28	500.09

Table 4: Comparison of Pump Station Peak Discharge Rates.

Table 5 lists the variation of maximum flow rates along the outlet channel estimated by HEC-RAS calculations performed by AB&H.

The pump station will also be provided with a water level sensing device in the outlet channel. When the water level in the outlet channel reaches elevation 585.00 USGS, the SCADA system will call-off the 8th pump unit and will only allow seven (7) pumps in operation.

[2] The pump discharge data shown in Table 4 for existing conditions is contradicted in the AB&H report on page 10 (i.e. 344 cfs for a 10-year storm event and approximately 586 cfs for a 50-year storm event).

Station	10-year		50-year	
	EXISTING	PROPOSED	EXISTING	PROPOSED
52.42	334.34	412.28	549.88	500.09
51.58	334.46	412.34	550.17	500.43
50.67	335.91	413.18	555.35	506.46
45.67	336.49	413.51	557.76	509.26
40.85	338.44	414.64	565.03	517.73
40.46	338.51	414.68	565.28	518.02
39.41	338.91	414.92	566.73	519.71
38.98	339.34	415.16	568.21	521.43
33.98	340.11	415.61	570.91	524.58
28.98	340.82	416.02	573.45	527.54
23.98	341.46	416.39	575.74	530.20
18.98	341.72	416.54	576.66	531.27
18.30	342.49	416.98	579.40	534.46
17.62	342.55	417.02	579.61	534.70
16.93	342.84	417.18	580.67	535.94
11.93	343.64	417.64	583.68	539.45
6.86	344.07	417.89	585.29	541.32
4.11	344.26	418.00	585.95	542.08
1.46	344.36	418.06	586.27	542.46
0.00	344.38	418.07	586.35	542.55

Table 5: Peak Flow Rates Along Outlet Channel.

4.2 Outlet Channel

The AB&H report identified multiple improvement measures for the outlet channel, including:

- Replace each of the existing CMP culverts under the golf course access driveways (i.e. 111th and 115th Streets) with three 10' x 8' Box Culverts with the invert elevation 577.6 USGS in order to avoid reduction of the flow cross-section due to long-term sedimentation of the channel;
- Replace the two golf course access driveways and culverts with bridges, in order to eliminate any obstruction structure in the channel; or
- Dredge the existing channel bed to elevation 575.15 USGS, with a 32.5" x 2.58" rectangular channel below elevation 577.73 USGS, protected by gabions on both sides for erosion control. (A portion of Pullman Creek was dredged in 2005).

AB&H recommended pursuing the first alternative for the channel improvement upon consideration of construction cost (approximately $ 501,000) and the relatively minimum maintenance requirements. In order to prevent flooding of I-94 between 111th Street and 115th Street for rainfall events higher than 50-yr return periods, AB&H recommended the following additional improvements:

- Install check valves on the two 8' x 8' culverts east of I-94/111th Street;
- Install a drop shaft in the swale east of I-94/111th Street and a 36" diameter connecting pipe from the shaft to the wet well of Pump Station No. 27 in order to divert storm water from the swales to the pump station when the water level in the swale exceeds elevation 584.25 USGS; and
- Install a 42"diameter connecting pipe between the two swales east of I-94/111th Street for water level equalization in the swales.

According to the HEC-RAS calculations included in the AB&H report for 10-year and 50-year rainfall events, the flow velocities along the channel in proposed conditions will remain in the same range of magnitude as in existing conditions.

4.3 Permit Requirements

The proposed improvements will not require permits from the Illinois Department of Natural Resources – Office of Water Resources, as the site does not affect a regulatory floodway nor does the pump station drain more than one square mile of tributary area.

4.4 IDOT Review

On November 16, 2000 a meeting was held at the IDOT office in Springfield in order to discuss the AB&H report for Pump Station No. 27. The main conclusions of the meeting were as follows:

- The main drains in I-57, I-94, and the outlet channel were originally designed for 10-year flood frequency events; therefore, they cannot convey the 50-year events. The system improvements to increase the system conveyance for 50-year events would cost far

more than the current funding sources and would not be able to be implemented in the near future.

- Generally, according to the IDOT drainage criteria, the stormwater sewer systems for highways are designed for 10-yr rainfall events (except the underpasses where the design frequency is for 50-yr rainfall events) and pump stations are designed for 50-yr rainfall events and verified for 100-yr rainfall events.

- Considering the large drainage area that is tributary to Pump Station #27 (i.e. 58 sub-basins and 6.6 mile long main drain that collects the stormwater from these sub-basins), the inflow hydrograph into the pump station should consider the travel time from each sub-basin to the pump station. The current IDOT Drainage Manual does not require considering the travel time of the storm water in the main drain. Based on the AB&H report, the water levels in the wet pit calculated when travel time in the main drain is considered are less than when travel time is not considered.

- The computer program HYDRA, which AB&H used to perform the calculation of the hydraulic grade line for the highway main drains, does not handle semi-elliptical shapes of the storm sewers. AB&H converted the existing main drains into elliptical shape pipes for the analysis. This conversion introduced excessive head losses for full pipe flows, especially for sewers with long pipe lengths.

- The outlet channel is not able to handle the 50-year flood events due to the following factors:
    - Some of the channel cross-sections were not constructed as designed.

    - The channel cross-sections were reduced by sedimentation.

    - The actual 10-year water level in Lake Calumet (which represents the tailwater condition for the outlet channel) is approximately 2.00 feet higher than the original design tailwater level.

    - The Harborside International Golf Course, constructed in the mid 1990's, added approximately 200 acres of drainage area (i.e. the north part of the golf course) into the channel that originally was not tributary to the outlet channel. After the golf course construction, the runoff generated on the above-mentioned drainage area is collected by several detention ponds and, through the sewer along Doty Avenue, is discharged at the upstream end of the outlet channel. The HEC-RAS calculations included in the AB&H report indicates that part of Doty Avenue located between the channel and I-94 would be flooded by the water from the outlet channel for 50-year flood events with a 10-year tailwater level condition in Lake Calumet.

    - Another suggested alternative for solving the flooding along Doty Avenue was to elevate the roadway surface above the 50-year flood elevation in the outlet channel.

5.0 FUTURE STUDY AREAS

The data presented in this report will be the basis of future analyses in the study area. Stream flow velocities, inundation depths and durations, and shear forces along the streambanks are the main ecological parameters of concern for analyzing the Pullman Creek riparian corridor. In addition, the following items are the salient items of concern related to the ecological analysis of the Pullman Creek corridor. The list presented below is preliminary and should be revisited during the next phase of work for the Calumet Area Hydrologic Master Plan:

- The intentions of IDOT to improve Pump Station No. 27 will need to be determined to accurately understand the hydraulic conditions for proposed ecological improvements to the outlet channel.

- Updated storm and/or combined sewer system drainage maps and roadway plan & profile design drawings or survey information for Doty Avenue will be required to evaluate if overflow routes exist between the outlet channel and the I-94 drainage ditch system (overflows across Doty Avenue were observed in the field following a Fall 2003 rainfall event) and their effect on the hydraulic setting.

- Interviews with:
  (a) City of Chicago roadway design and drainage maintenance staff familiar with the Lake Calumet and Doty Avenue drainage collection system;
  (b) IDOT design and maintenance staff and/or private consultants familiar with the I-94 drainage/pump station system;
  (c) Illinois International Port District engineers (Kudrna & Associates) and maintenance staff familiar with the Harborside International Golf Course drainage system; and
  (d) Any other agency staff or consultants with information regarding the runoff collection and flood-flow discharge relationships that affect the outlet channel.

- Field visits to verify newly acquired design and/or maintenance data, if necessary.

Any ecological improvements to the outlet channel should evaluate the effect of the improvements on the channel conveyance for the critical duration rainfall events. Improvements should not adversely affect flood flow within the channel or on other properties. This material was not available for collection / review at the time of the Calumet Area Hydrologic Master Plan. Restoration of Pullman Creek through the creation of natural channel meanders will be difficult based on geometric constraints (fixed location between Doty Avenue and IIPD property – not enough space for meanders), hydraulic constraints (must convey design flow rate – not enough space for low flow channel and shelf), and ecological constraints (quality of expressway runoff may not support certain plant and wildlife species).

GLOSSARY

Automatic Staff Gage (ASG) : Apparatus installed to collect sufrace water elevations of water bodies at 15 minute intervals.

Anoxic : Water that contains little to no dissolved oxygen.

Conveyance Capacity : The maximum amount of water that can be transported downstream by a pipe or channel.

Discharge : The rate of water flowing out of a site.

Dredging : Process of removing sediment accumulation from lake and river bottoms.

Equality Formation : Tongues of glacial lake deposits that consist of silts, clays and sands.

Evapotranspiration : Proportion of waterbudget that is returned to the air through evaporation and transpiration (plant uptake).

Glacio-fluvial : Sediment or lithified sequence deposited from meltwater streams flowing from or within glaciers.

Glacio-lacustrine : Sediment or lithified sequence deposited within a glacial lake.

Gradient : Slope of a surface, generally pertaining to groundwater surfaces in these texts.

Headwater : The depth of water at the upstream end of a control structure or pipe.

HEC-RAS : Hydraulic Engineering Center – River Analysis System. A computation program widely used for developing water surface profiles for streams and ditches.

Hummock : Micro-topographic mounds that usually form from soil consolidation and poor surface water drainage.

Hydraulics : The determination of water surface elevations through relationships of flow and physical geography.

Hydrology : The determination of stormwater runoff rates and volumes for a study area based on rainfall data and physical geography.

Hydroperiod : A simulated or measured time duration of water elevations.

Infiltration : The downward movement of water through pores or small openings in soil or rock.

Inudation : Standing surface water.

Manual Staff Gage (MSG) : Apparatus installed within surface water body to visually observe surface water elevations (observations conducted once per month).

*All words are not necessarily referred to in text.

Mottles : Soil discolorations usually caused by chemical interactions between water and chemicals/minerals within the soil.

Orifice : A control structure ; a small opening, usually in a metal plate or wall, used to restrict the amount of water discharging from a site.

Permeability : The capacity of rock or sediment for transmitting fluid flow under unequal pressure.

Piezometer : A well installed into the ground that penetrates an underground water bearing unit – in which the groundwater elevation can be monitored along with its associated head.

Reduction : The removal of oxygen from soil or water.

Slag : Iron and steel manufacturing by-product. Waste material resulting from the impurities of mineral ore and ash from coke.

Stage-Discharge Rating Curve : A curve illustrating discharge rates for water leaving a site at given stages or elevations.

Seep : A location where groundwater discharges to the surface.

Stop Logs : Removable planks used to block water from leaving a site. The top stop log will set the normal pool level for a basin.

Stormwater Control Structure : A device, usually an orifice or a weir, used to regulate water discharge from a site.

Stratigraphy : The arrangement of rock and or soil types in chronologic order of sequence.

Submerged : Located entirely underwater.

Tailwater : The depth of water at the downstream end of a control structure or pipe.

Watershed : The area the drains to a similar point location or water body.

Weir : A control structure that prevents discharge from a site until the headwater exceeds the overflow elevation.

*All words are not necessarily referred to in text.

APPENDIX A

) Listing of Communities table on the FIRM Index for NFIP Initial Post–FIRM dates for all jurisdictions shown on this map.

lood insurance is available in this community, contact your r call the National Flood Insurance Program at (800) 638–6620.

APPROXIMATE SCALE

500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

COOK COUNTY,
ILLINOIS
AND INCORPORATED AREAS

PANEL 661 OF 832

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

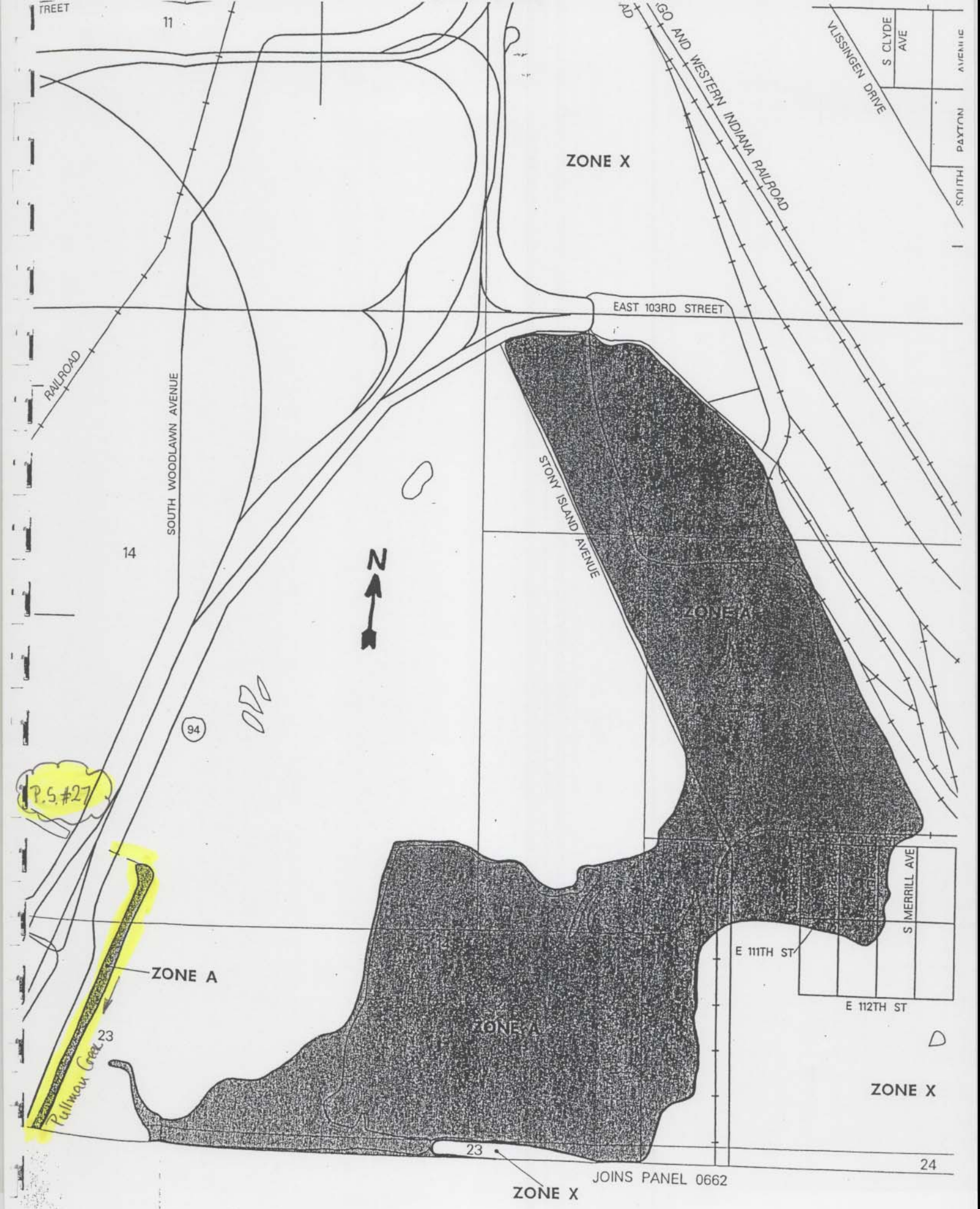
COMMUNITY	NUMBER	PANEL	SUFFIX
CHICAGO, CITYOF	170074	0661	F
COOK COUNTY	170054	0661	F
RIVERDALE, VILLAGE OF	170150	0661	F

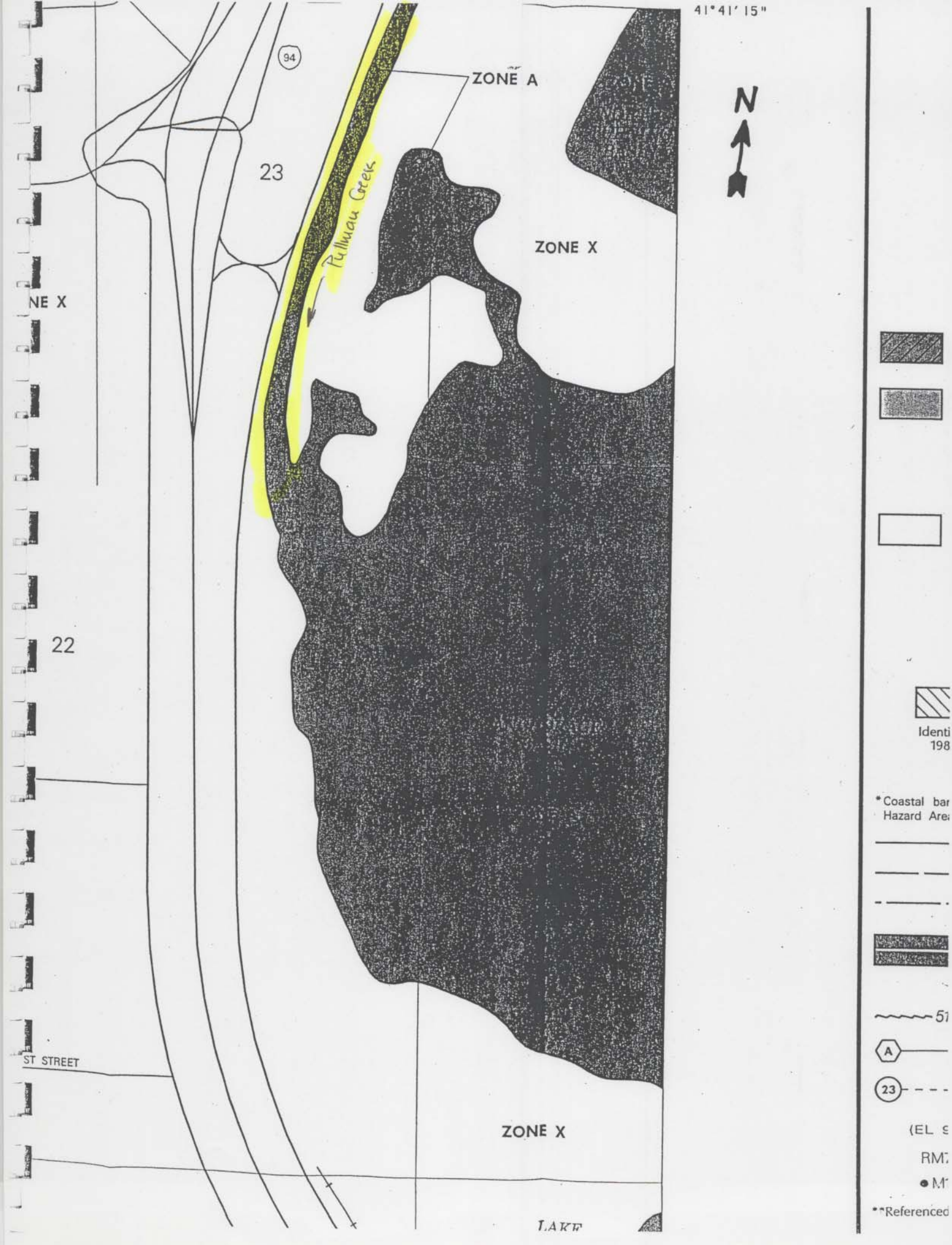
Notice to User: The MAP NUMBER shown below should be used when placing map orders; the COMMUNITY NUMBER shown above should be used on insurance applications for the subject community.

MAP NUMBER
17031C0661 F

EFFECTIVE DATE:
NOVEMBER 6, 2000

Federal Emergency Management Agency


TREET
11
ZONE X
VLISSINGEN DRIVE
S CLYDE AVE
SOUTH PAXTON AVENUE
GO AND WESTERN INDIANA RAILROAD
EAST 103RD STREET
RAILROAD
SOUTH WOODLAWN AVENUE
14
STONY ISLAND AVENUE
N
ZONE A
94
P.S. #27
ZONE A
Pullman Creek
23
ZONE A
S MERRILL AVE
E 111TH ST
E 112TH ST
ZONE X
23
24
JOINS PANEL 0662
ZONE X


41°41' 15"
94
ZONE A
N
23
Pullman Creek
ZONE X
NE X
22
ST STREET
ZONE X
LAKE
Identi
198
*Coastal bar
Hazard Area
51
A
23
(EL
RM
M
**Referenced

PUMP STATION #27

IDOT – PUMP STATION #27

I.D.O.T. P.S. NO. 27
EXISTING SITE PLAN

N

PROPERTY LINE

8' CHAIN LINK FENCE w/ 6 BARBWIRE

SIDEWALK

TRANSFORMER ROOM

PUMPING STATION P.S. 27

TRASH CHAMBER

OUTFALL CHAMBER

2-8'x5' OUTFALL CONDUITS

EXISTING SHEETING

BITUMINOUS PAVEMENT

EXISTING 9'x10' ELLIPTICAL SEWER

56'

EAST EDGE PAVEMENT OF S. DOTY AVENUE

20' CHAIN LINK GATE

PROPERTY LINE

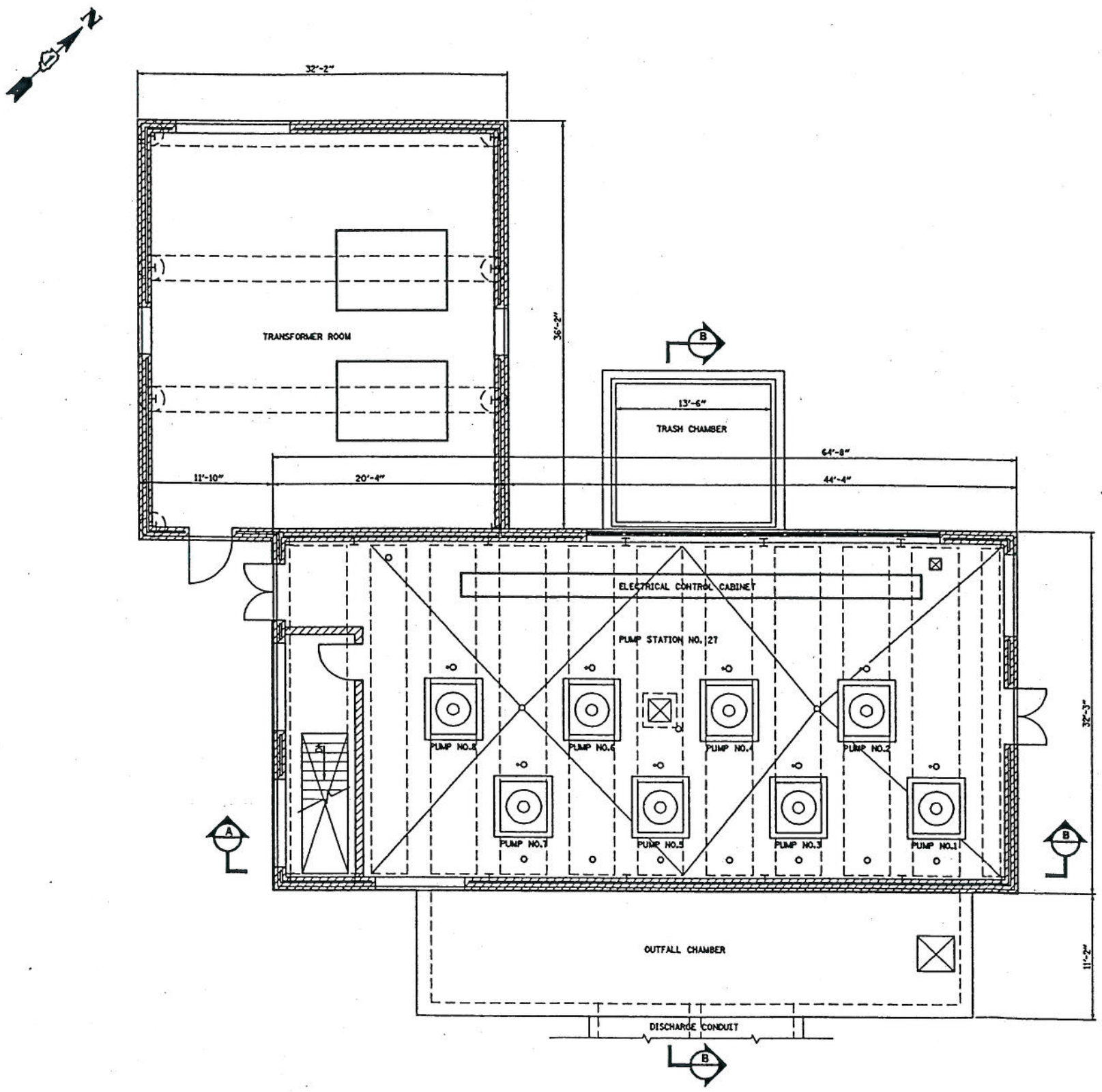
8' CHAIN LINK FENCE w/ 6 BARBWIRE

SCALE: 0 10 20 FT.

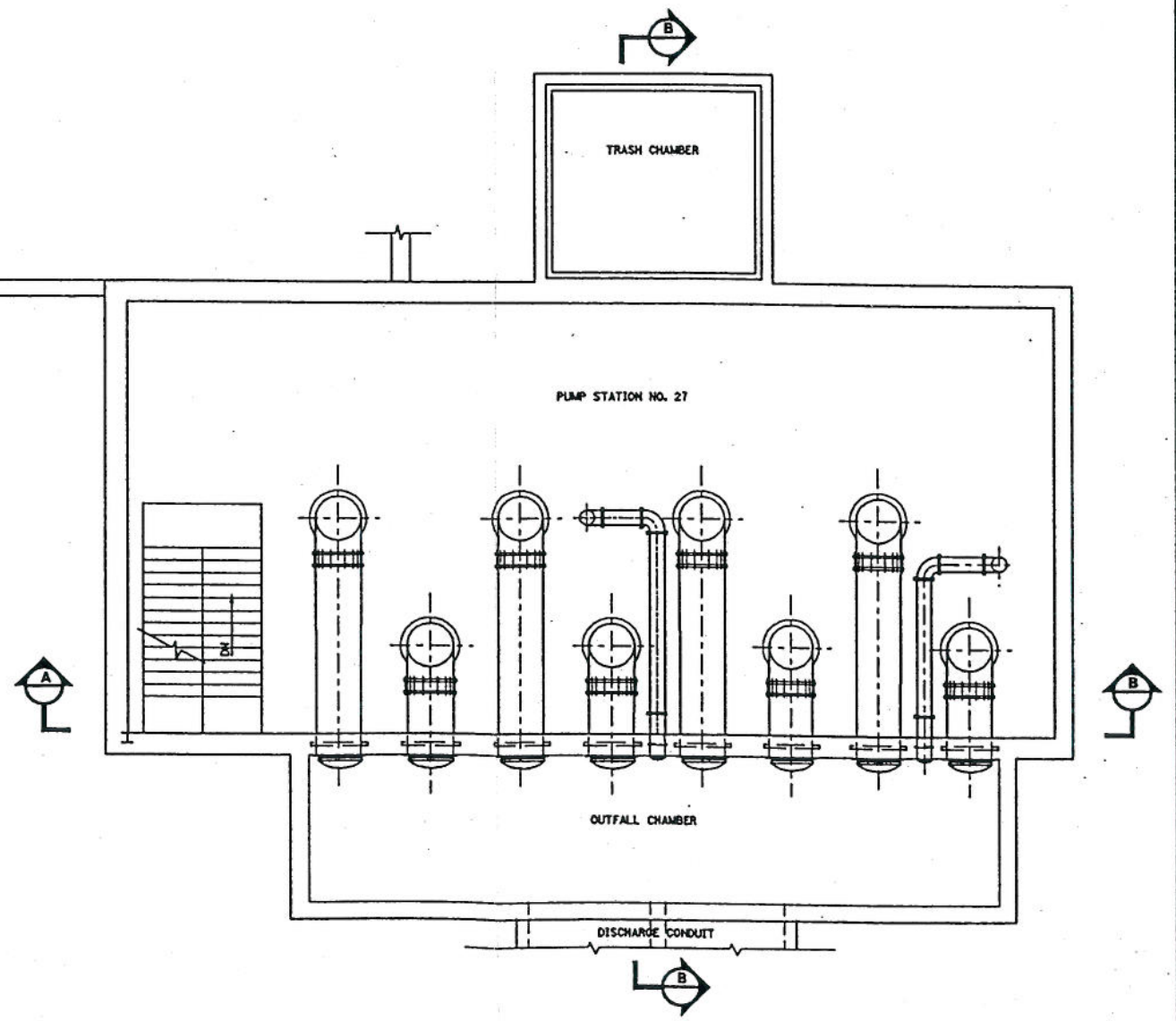
SITE PLAN

ALVORD, BURDICK & HOWSON, L.L.C.
ENGINEERS 2000 CHICAGO

I.D.O.T. P.S. NO. 27
EXISTING STATION PLANS



FLOOR PLAN @
EL. +9.5'

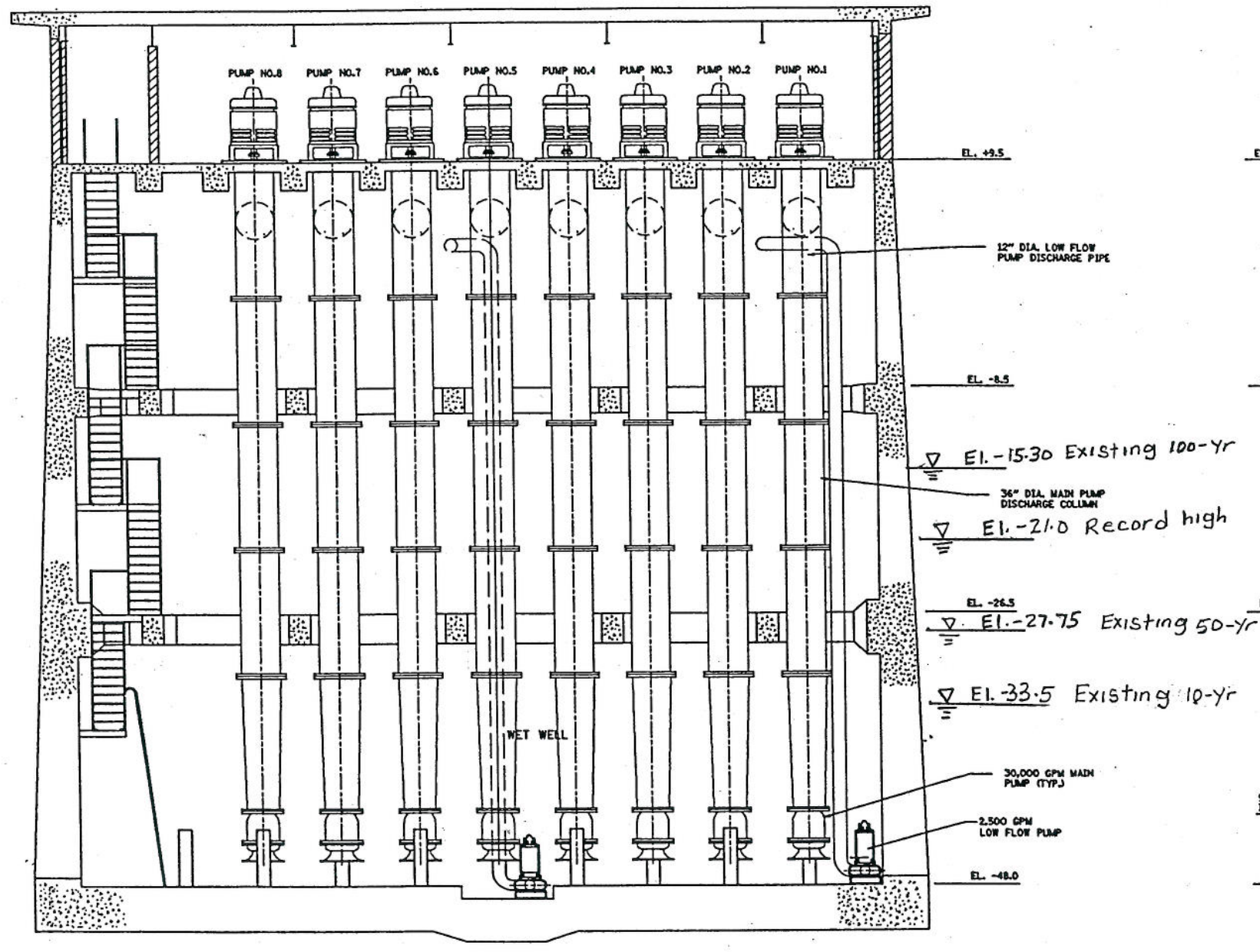


FLOOR PLAN @
EL. +5.0'

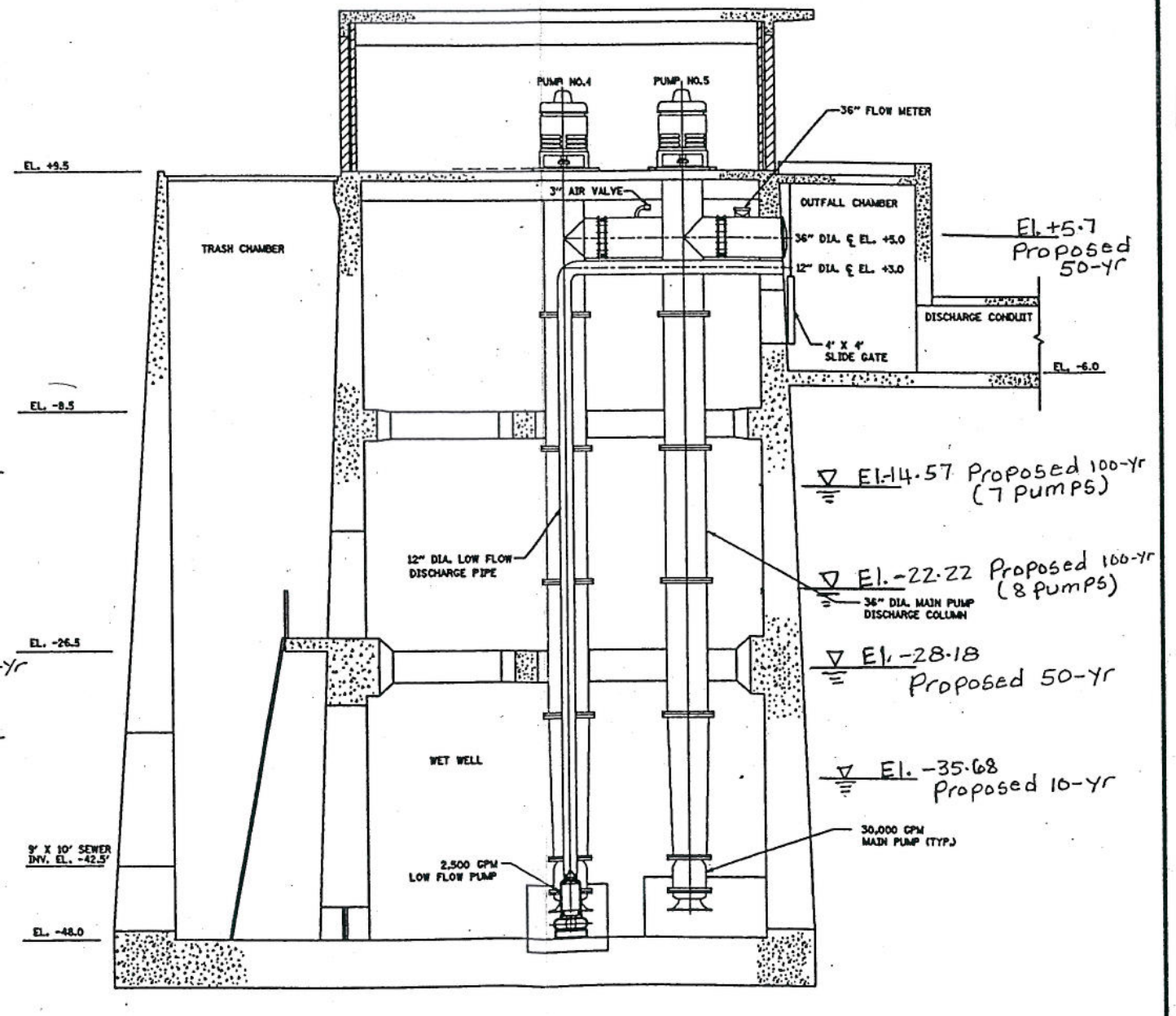
SCALE: 0 4 8 12

ALVORD, BURDICK & HOWSON, L.L.C.
ENGINEERS 2000 CHICAGO

I.D.O.T. P.S. NO. 27
EXISTING SECTIONS



SECT A-A



SECT B-B

SCALE: 0 4 8 12

ALVORD, BURDICK & HOWSON, L.L.C.
ENGINEERS 2000 CHICAGO

(feet from floor)

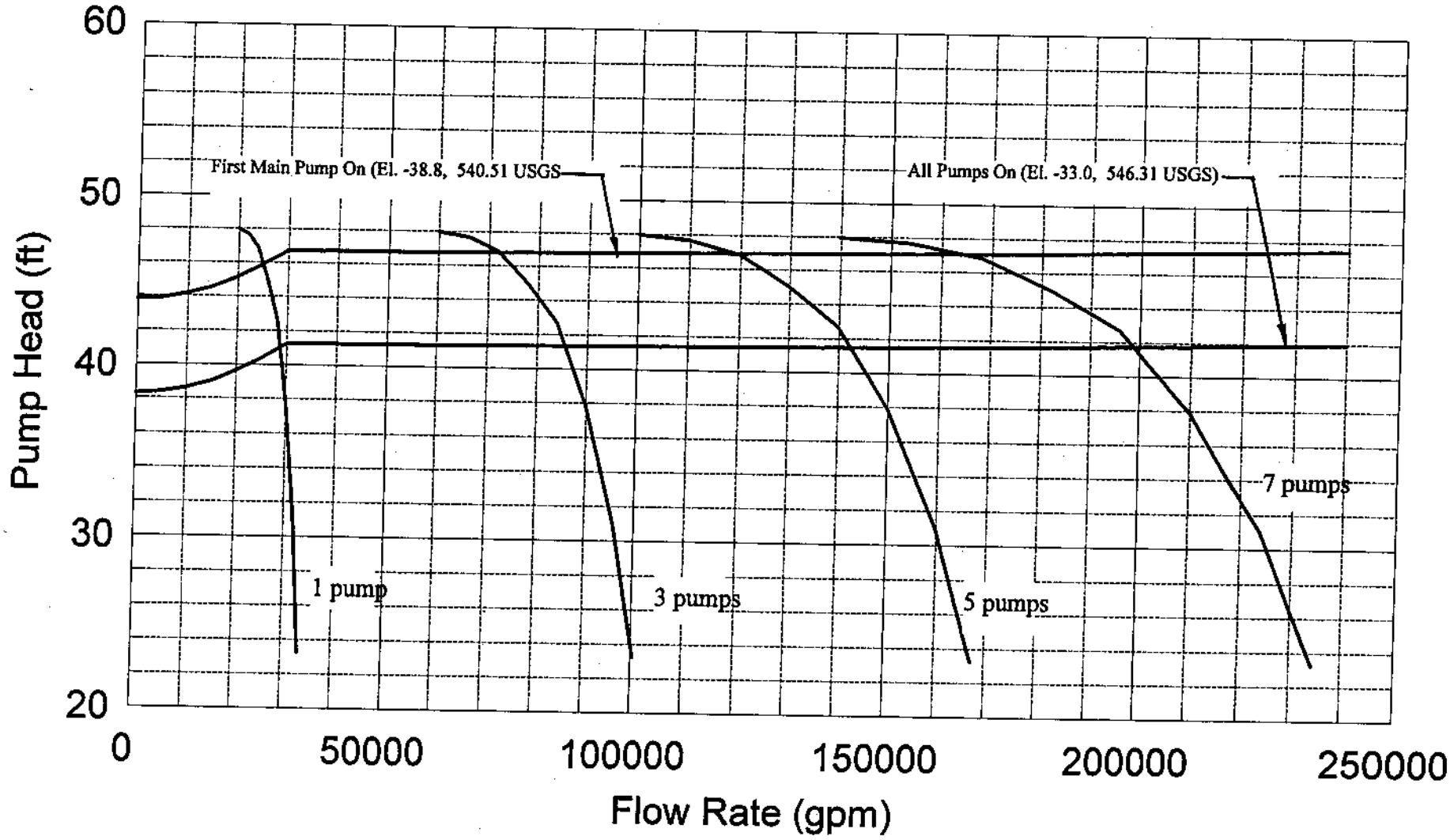
	Bubbler	Electrode	Bubbler	Electrode	SCADA
Pavement Flooding	NONE	NONE	NONE	NONE	20.0
High Level Alarm	18.4	17.5	18.4	18.5	18.5
All Pumps On	NONE	NONE	NONE	NONE	16.0
Start Lag 7 Pump	7.7	16.5	18.0	18.2	15.0
Start Lag 6 Pump	16.5	16.5	16.5	18.2	15.0
Start Lag 5 Pump	14.8	13.5	18.1	18.5	14.5
Start Lag 4 Pump	14.0	13.5	17.4	18.5	14.0
Start Lag 3 Pump	13.0	11.5	17.0	17.2	13.0
Start Lag 2 Pump	12.5	11.5	16.5	17.2	12.0
Start Lag 1 Pump	11.5	8.2	16.0	16.2	11.0
Start Lead Pump	8.0	8.2	15.5	16.2	9.2
Start Dynamic Pump Calls	NONE	NONE	NONE	NONE	9.0
Start Dynamic Pump Stops	NONE	NONE	NONE	NONE	12.0
Stop Lag 7 Pump	15.7	NONE	15.7	NONE	NONE
Stop Lag 6 Pump	14.5	NONE	14.5	NONE	NONE
Stop Lag 5 Pump	14.0	NONE	14.0	NONE	NONE
Stop Lag 4 Pump	12.5	NONE	12.5	NONE	NONE
Stop Lag 3 Pump	11.5	NONE	11.5	NONE	NONE
Stop Lag 2 Pump	10.5	NONE	10.5	NONE	NONE
Stop Lag 1 Pump	9.0	NONE	9.0	NONE	NONE
All Main Pumps Stop	6.0	6.0	6.0	8.0	7.0
Low Water Level	3.0	NONE	3.0	NONE	3.5

	Float		Float		SCADA
Start Lag Low Flow	6.0		7.0		6.0
Start Lead Low Flow	5.0		6.5		5.5
Start Dynamic Low Flow Calls	NONE		NONE		5.0
Stop Lag Low Flow	4.5		4.5		4.0
All Low Flows Stop	3.0		4.5		4.0

Existing Pumps Operating Schedule

SYSTEM CURVES AND PUMP CURVES

Pump Station #27



ALVORD, BURDICK & HOWSON, L.L.C.
ENGINEERS 2001 CHICAGO

OUTLET CHANNEL (PULLMAN CREEK)

OUTLET STRUCTURE FROM P.S. #27
DISCHARGING INTO PULLMAN CREEK

GOLF COURSE OUTLET
INTO PULLMAN CREEK

SMALL TRIBUTARY INTO PULLMAN CREEK

PULLMAN CREEK LOOKING NORTH (BRIDGE #2)

PULLMAN CREEK LOOKING SOUTH (BRIDGE #2)

PULLMAN CREEK LOOKING NORTH (BRIDGE #2)

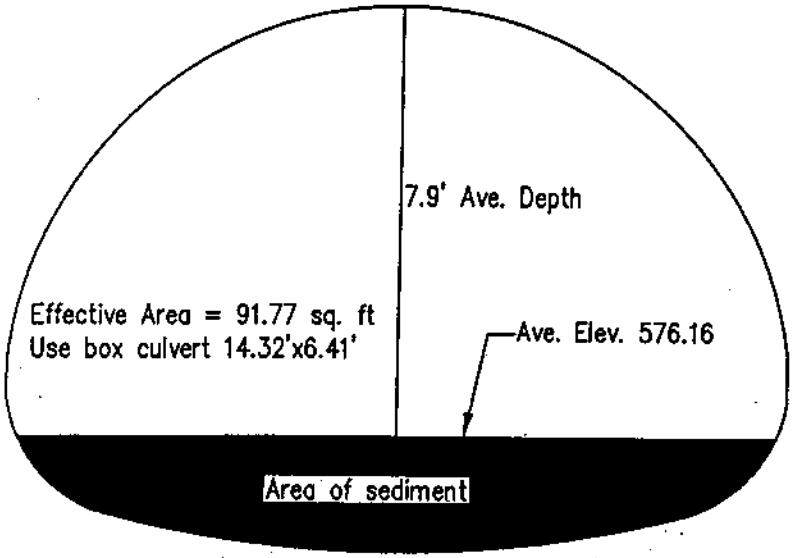
P5150015.JPG

PULLMAN CREEK LOOKING SOUTH (BRIDGE #2)

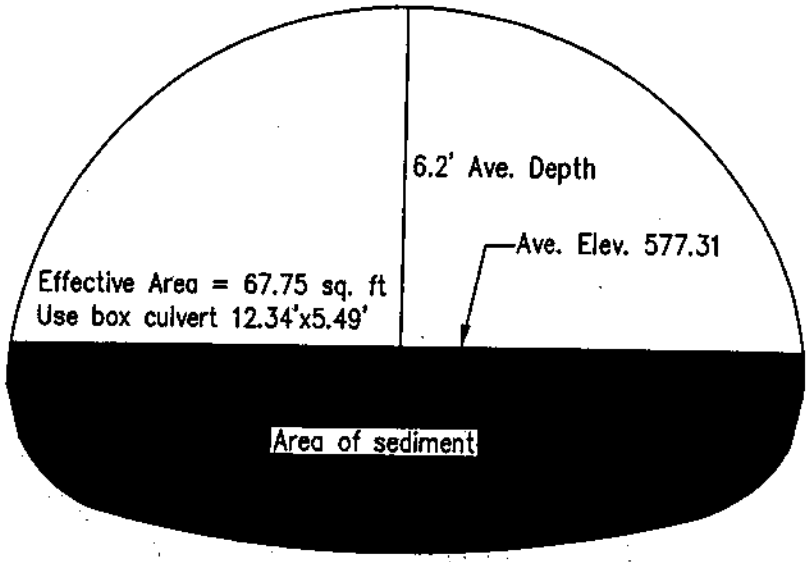
P5150014.JPG

PULLMAN CREEK CULVERTS

Cross Sections of Pipe Arch Culverts at Stations 18+30 and 40+46



South Culverts (14'–5" span, 10'–0" rise)
Station 18+30



North Culverts (14'–5" span, 10'–0" rise)
Station 40+46

Station 18+30

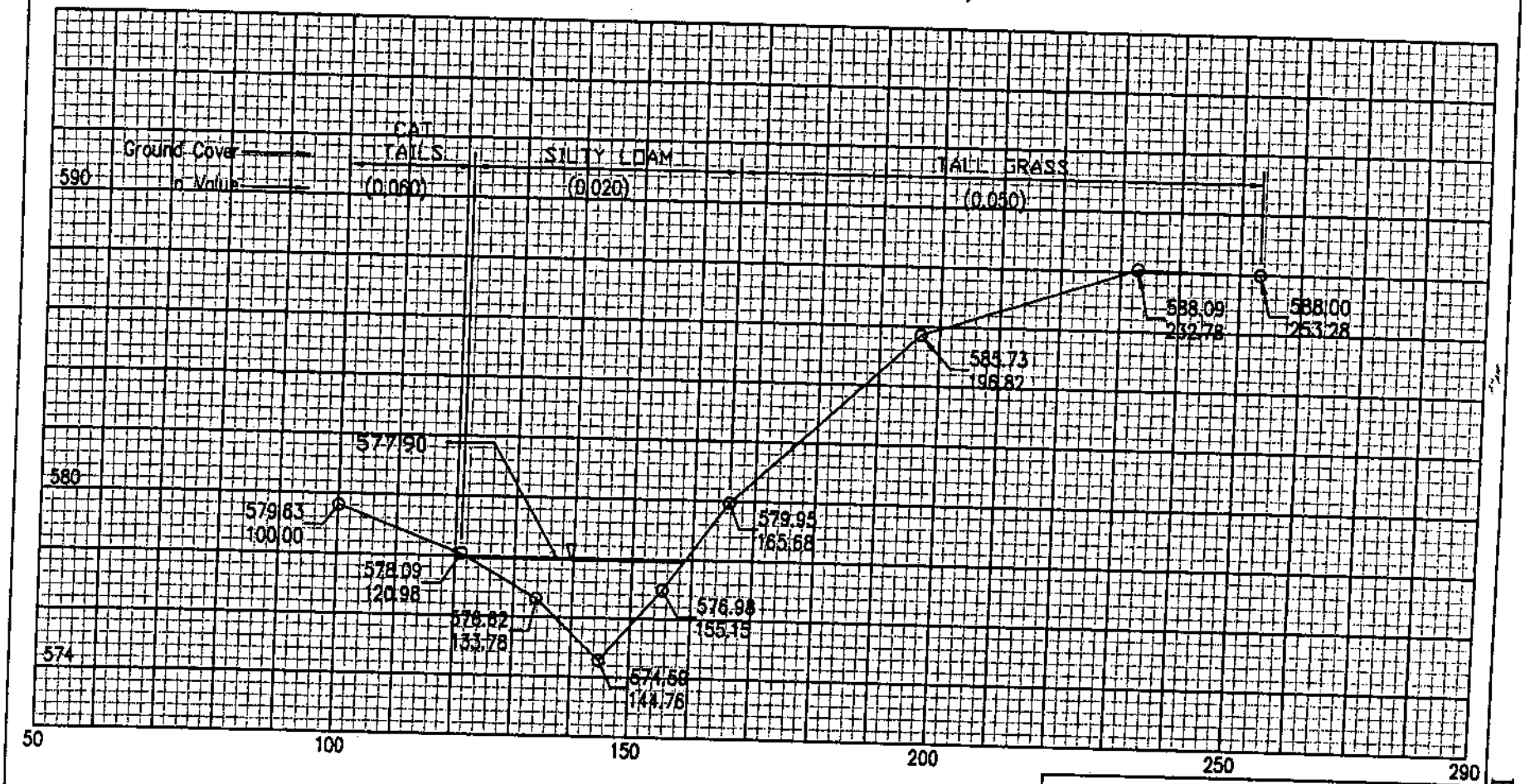
Scale:

Note: Invert of equivalent box culvert selected so that crown elevation is same as average crown elevation of the existing culverts

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
DRAWN BY: WGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 0+00
(Looking Downstream)



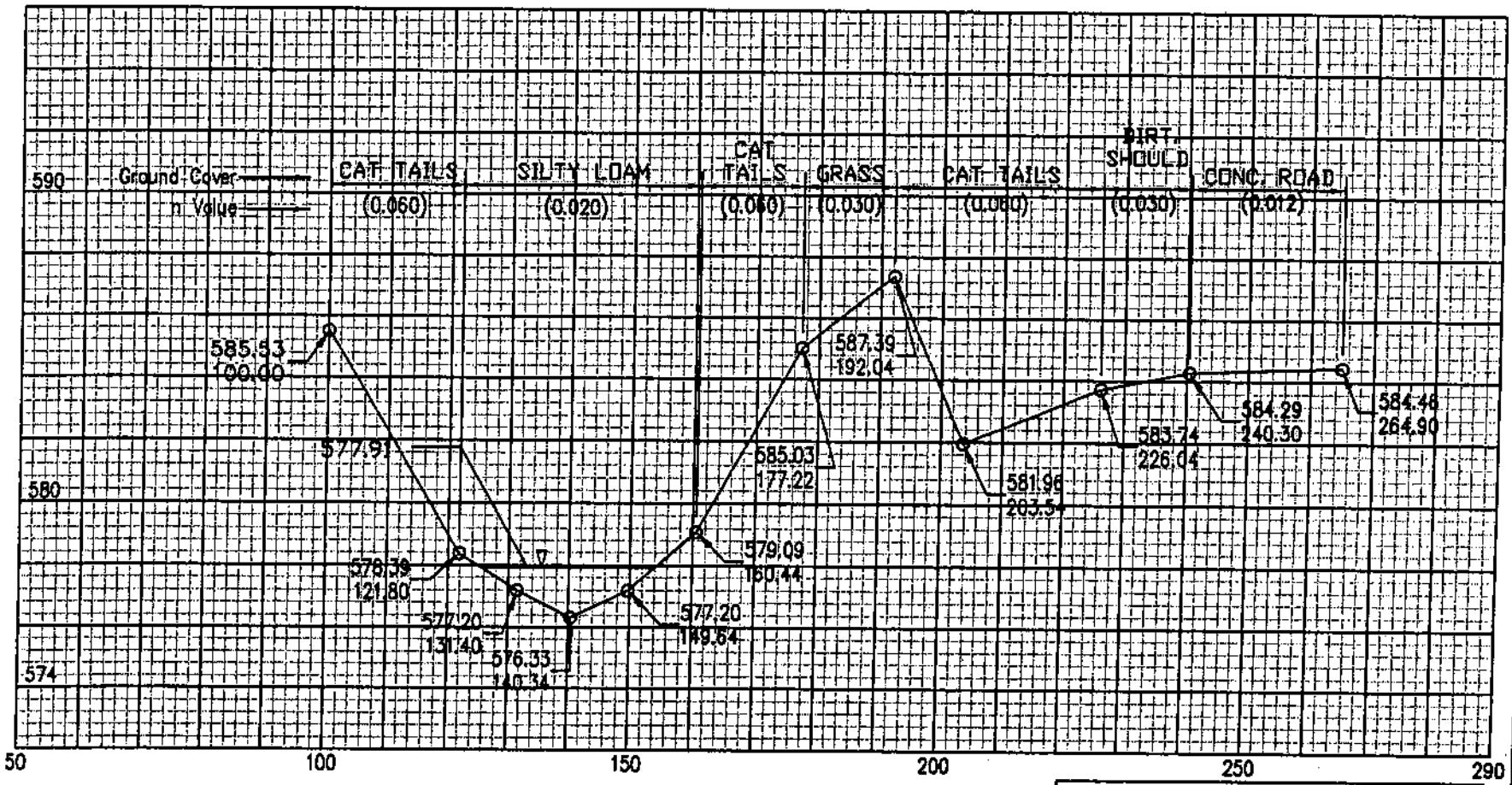
Cross-Section at Sta. 0+00 (5,242' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 87 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: WGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 1+46
(Looking Downstream)



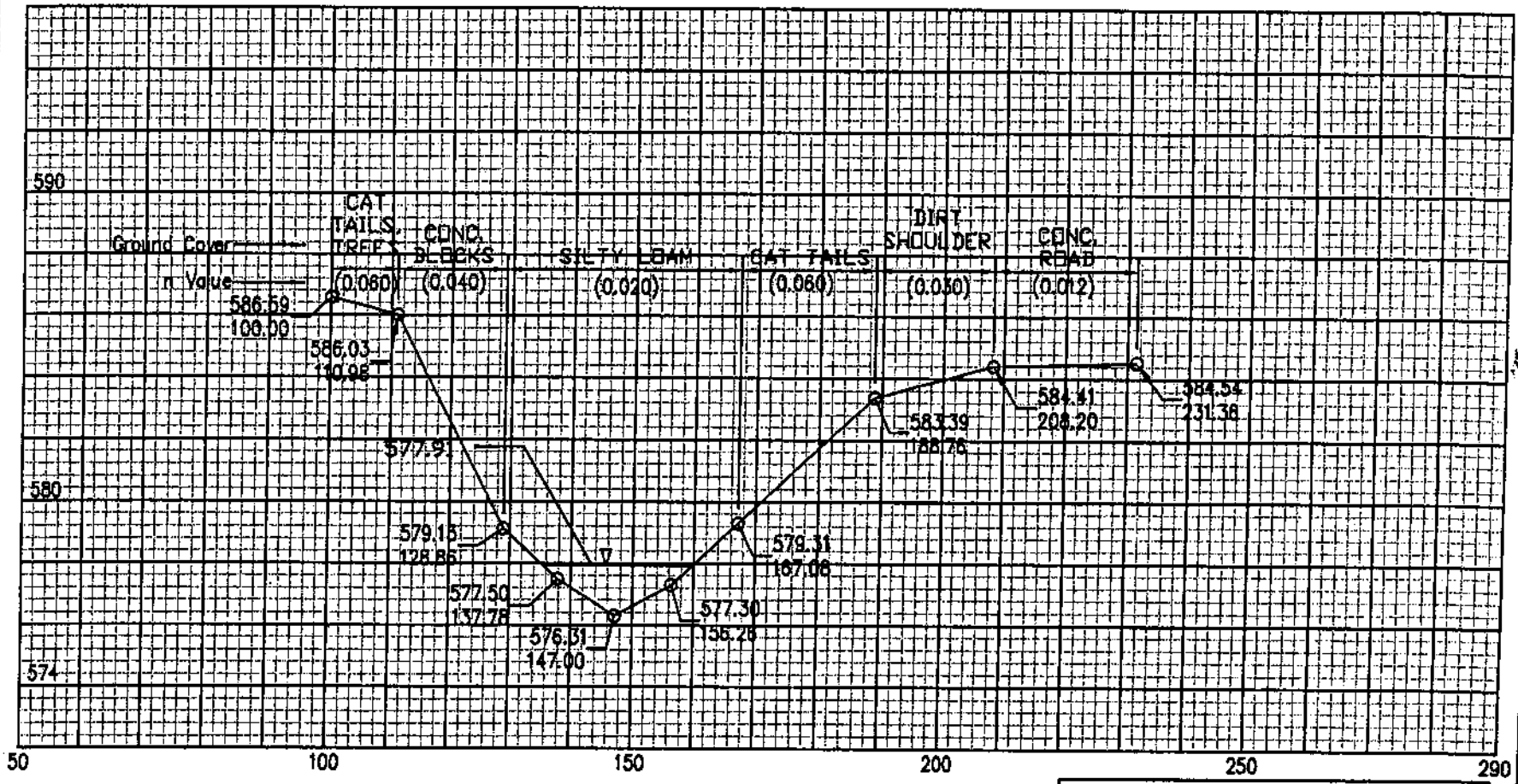
Cross-Section at Sta. 1+46 (5,096' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 87 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGH DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 4+11
(Looking Downstream)



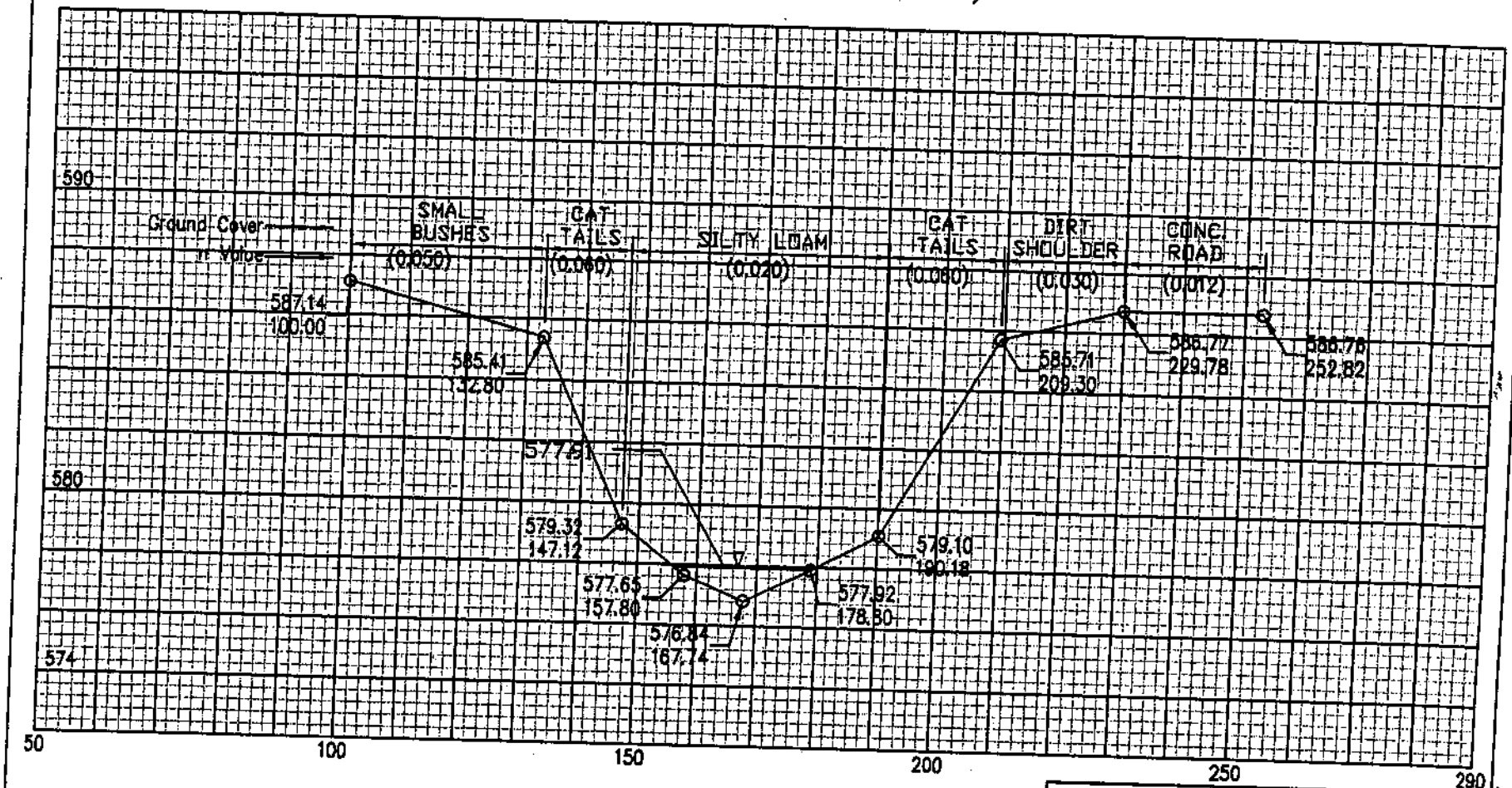
Cross-Section at Sta. 4+11 (4,831' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 11+93
(Looking Downstream)



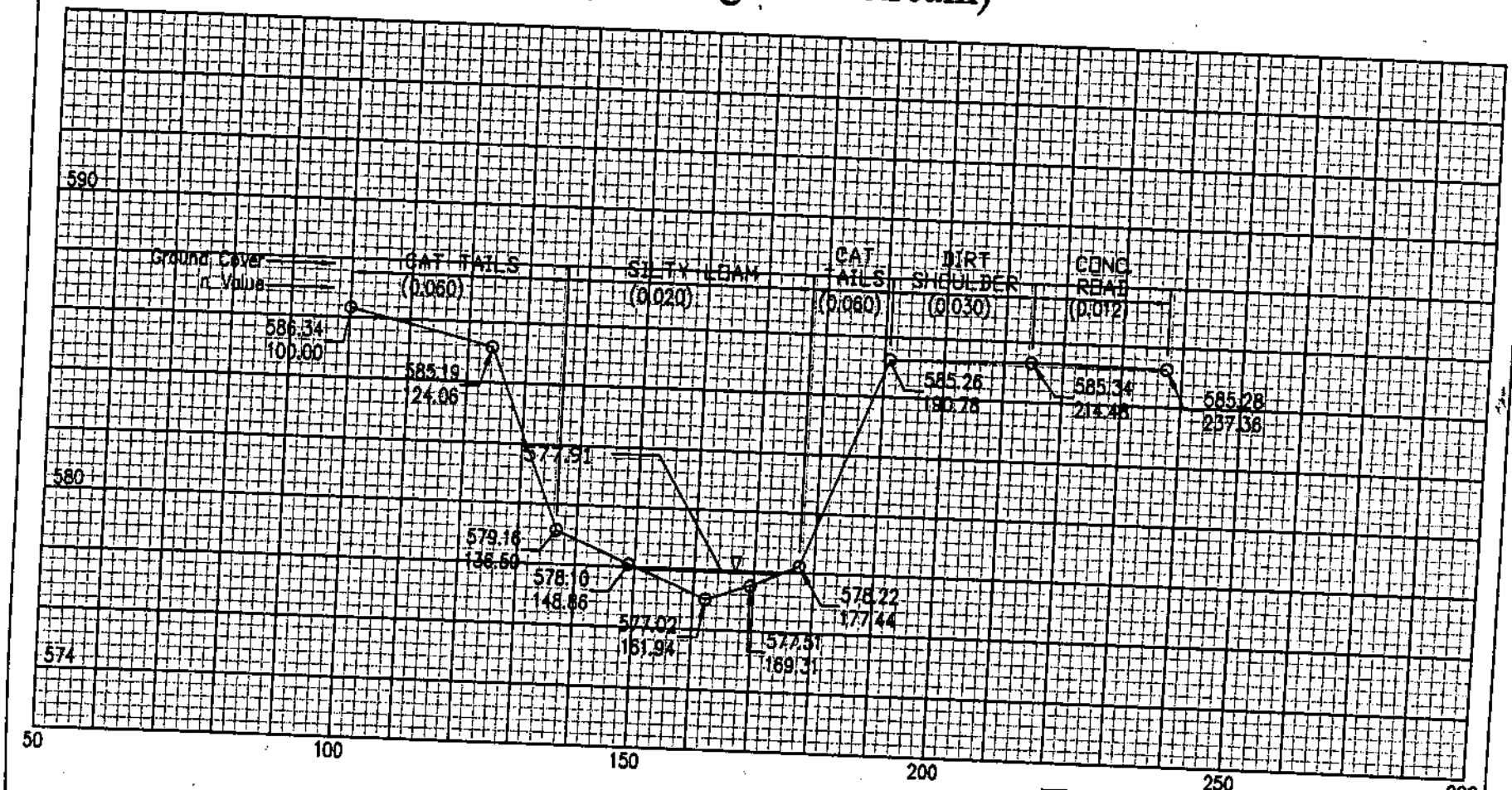
Cross-Section at Sta. 11+93 (4,049' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: WGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 16+93
(Looking Downstream)



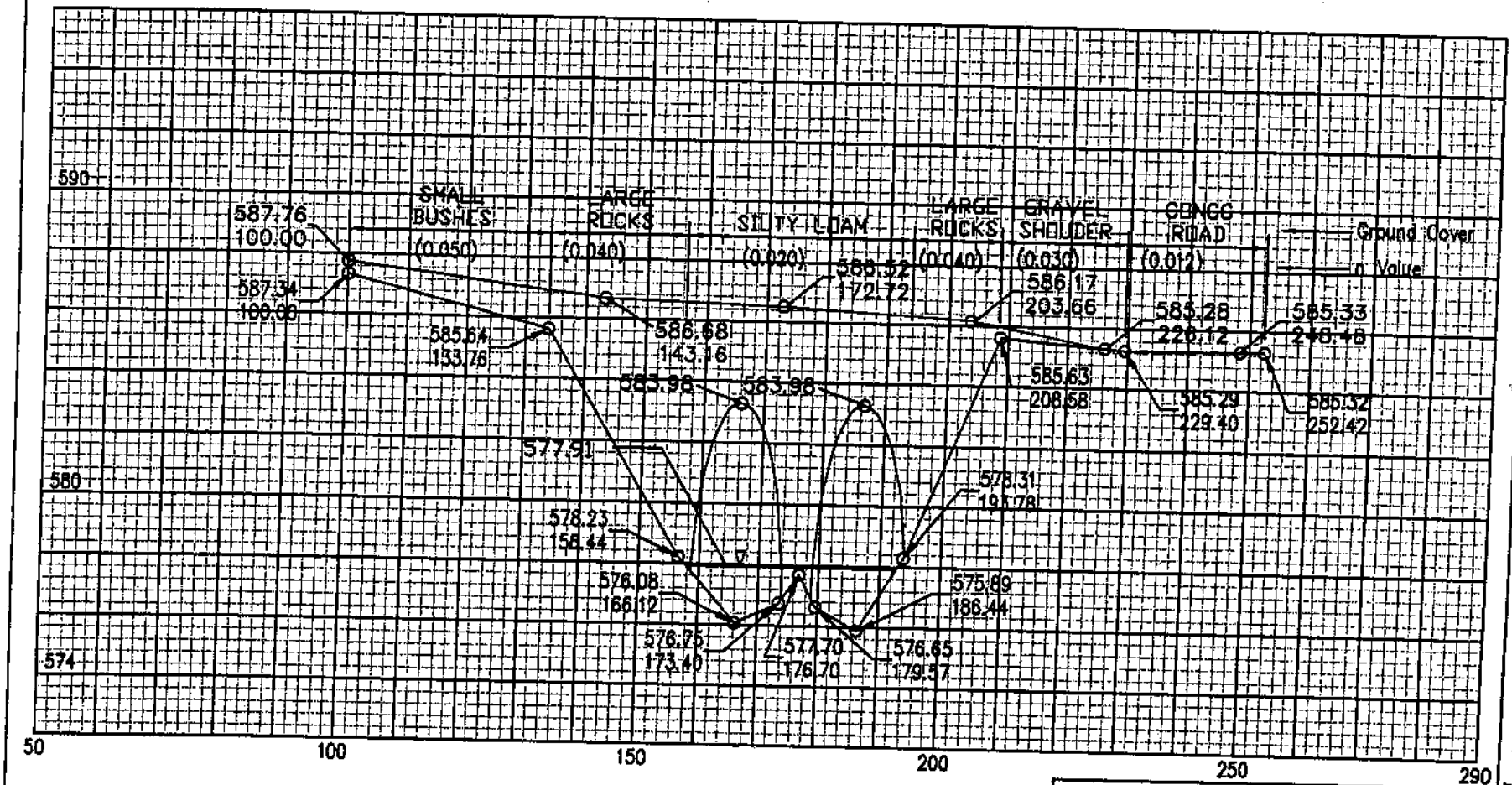
Cross-Section at Sta. 16+93 (3,549' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 6

Channel and Flood Plain Cross-Section at Sta. 17+62
(Looking Downstream)



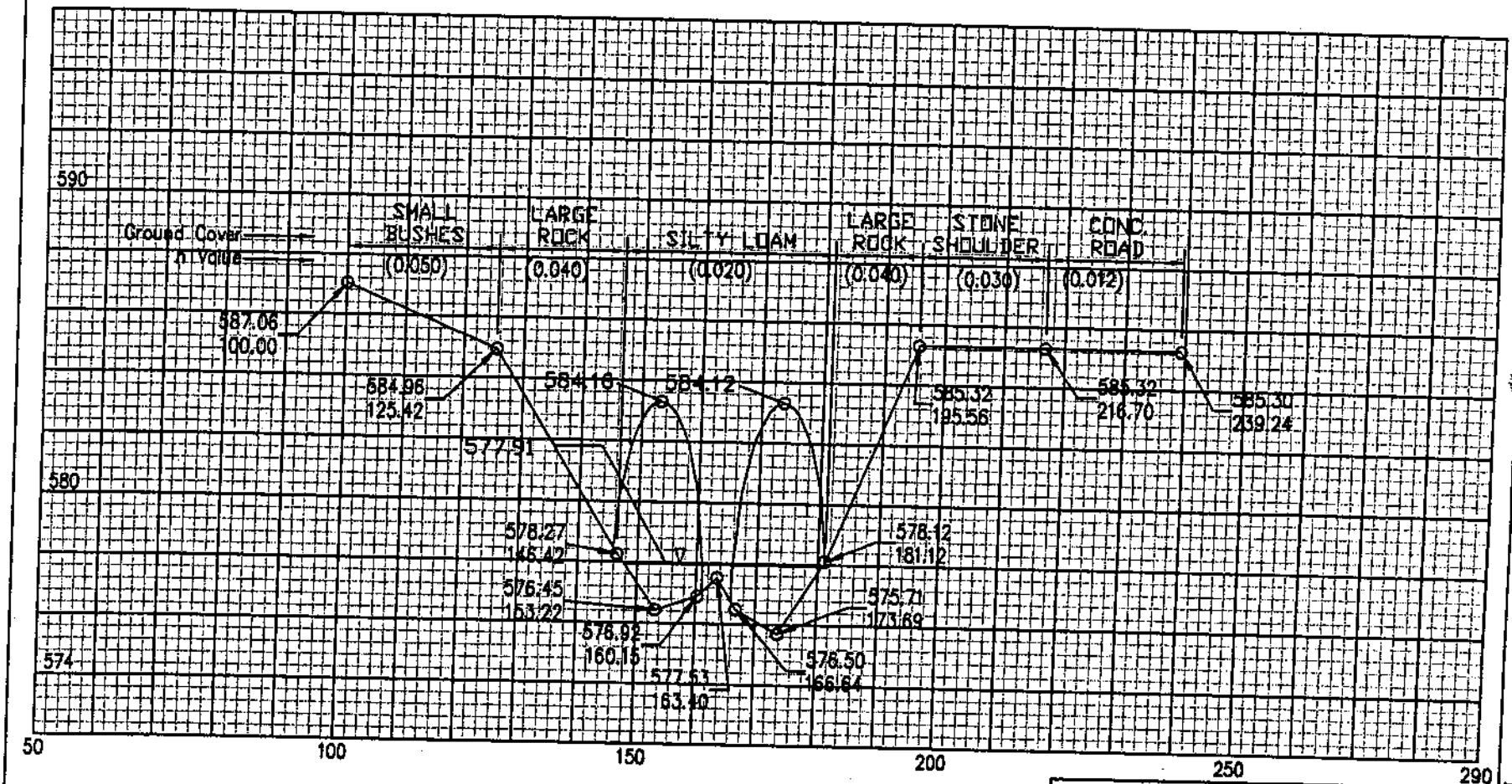
Cross-Section at Sta. 17+62 (3,480' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 18+30
(Looking Downstream)



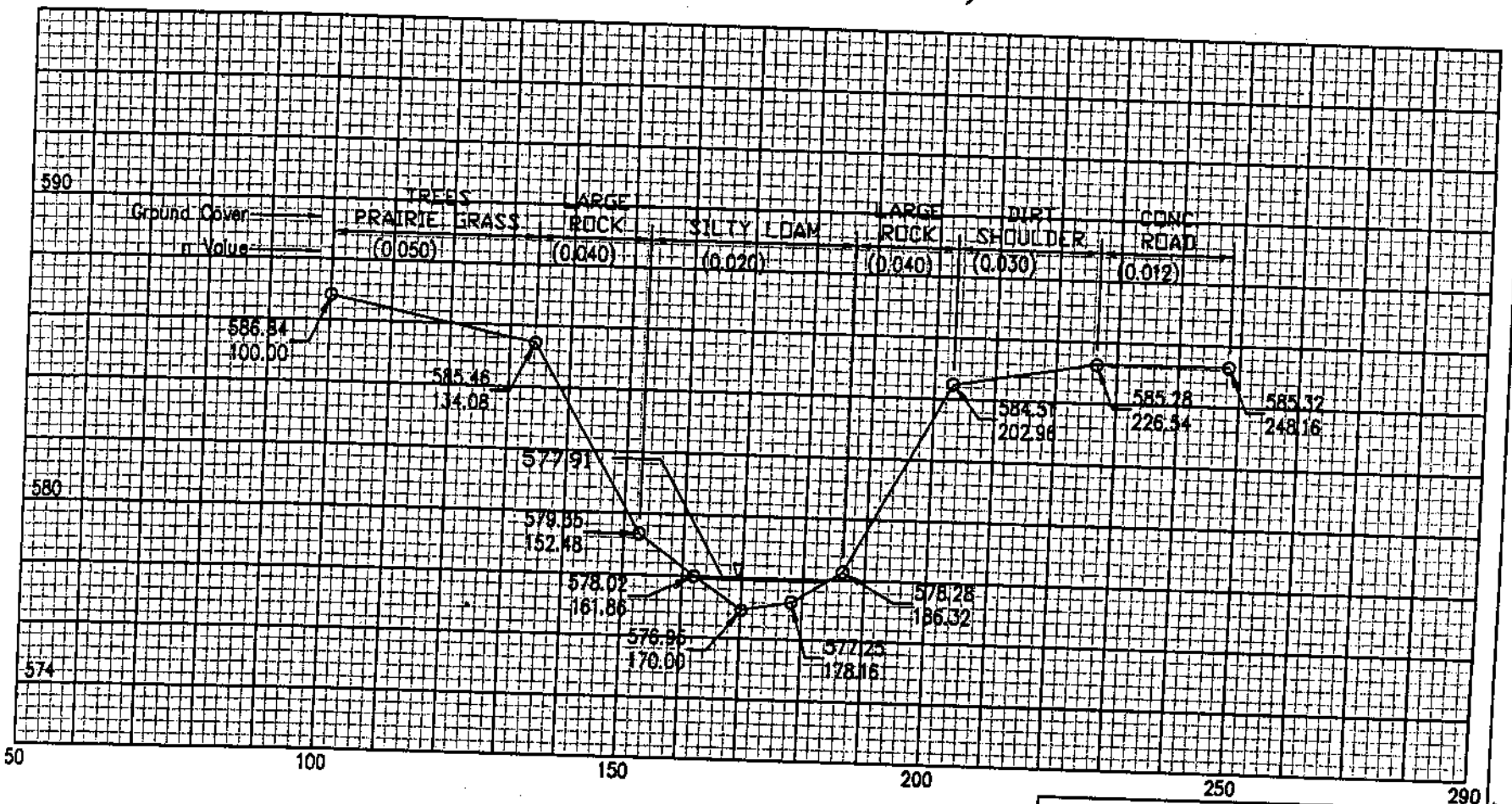
Cross-Section at Sta. 18+30 (3,412' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 18+98
(Looking Downstream)



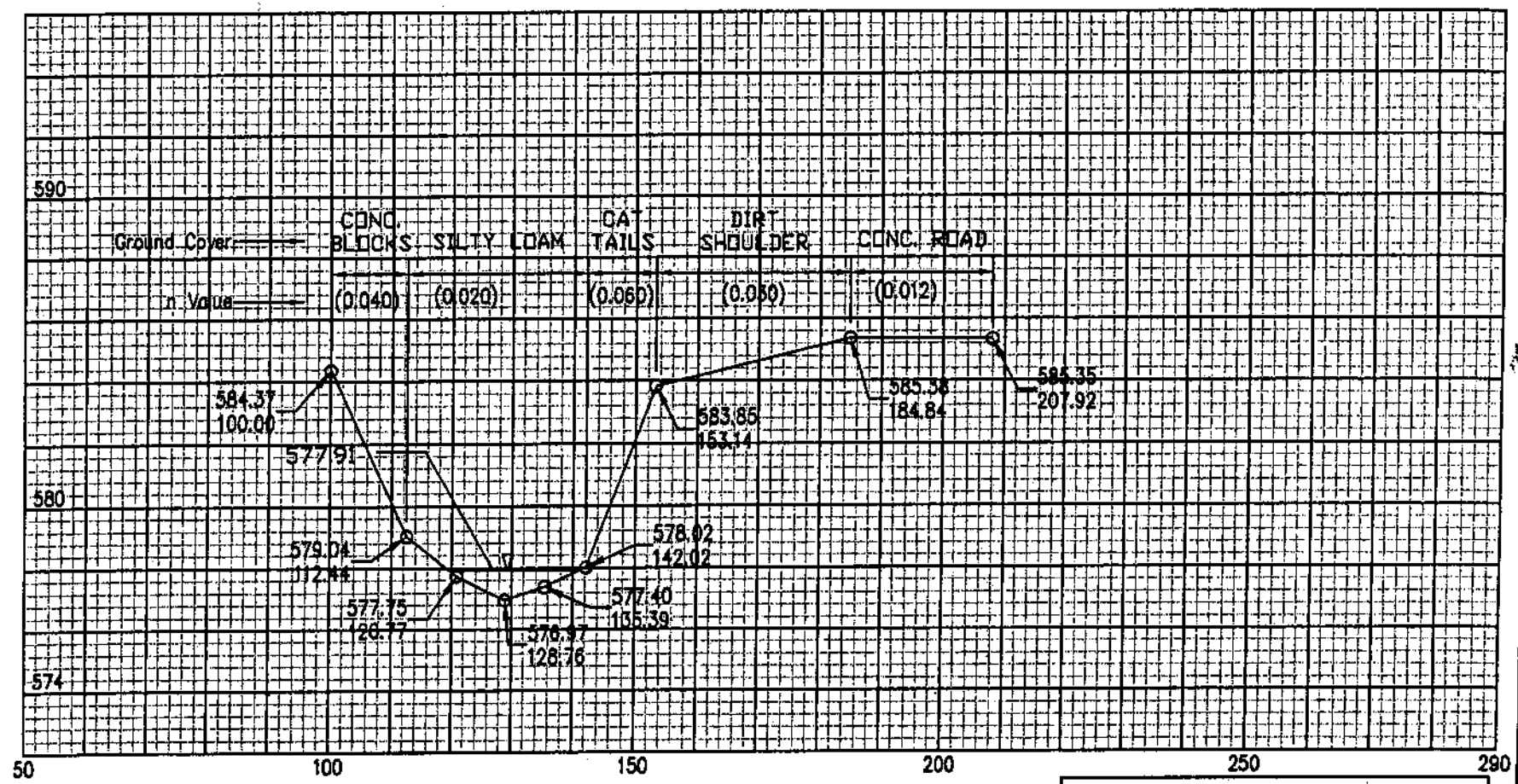
Cross-Section at Sta. 18+98 (3,344' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 87 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: NGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 23+98
(Looking Downstream)



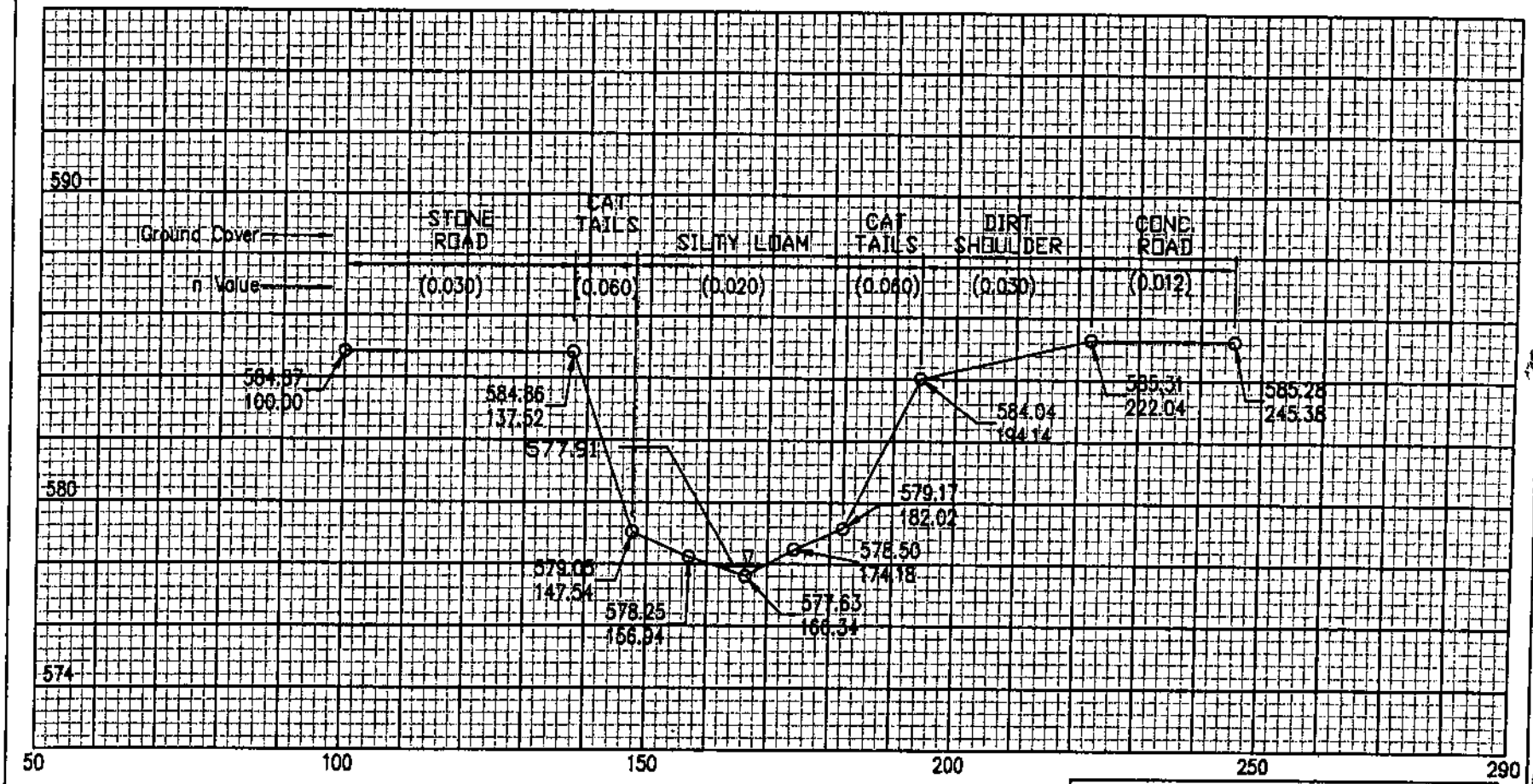
Cross-Section at Sta. 23+98 (2,844' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 28+98
(Looking Downstream)



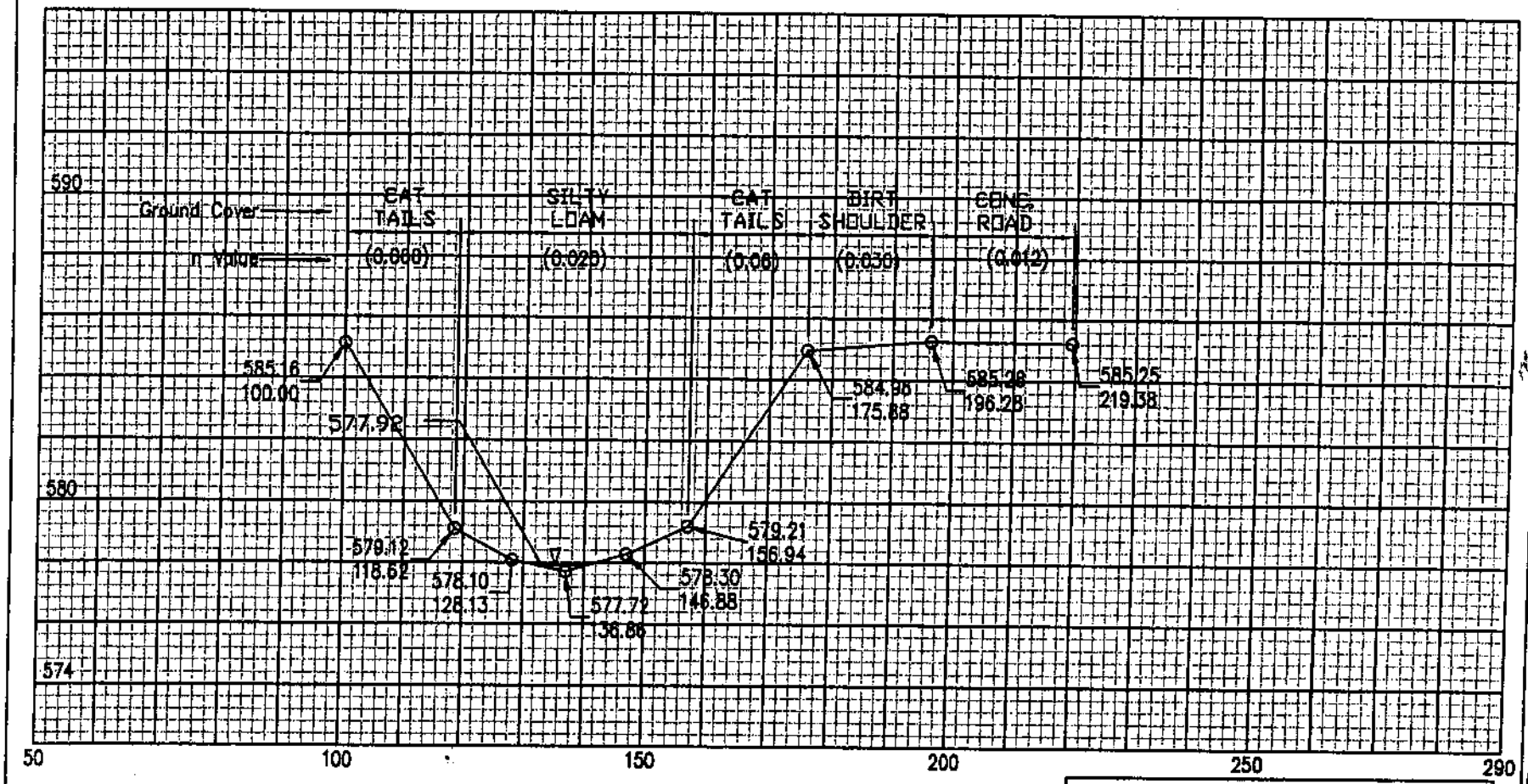
Cross-Section at Sta. 28+98 (2,344' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR 1" = 25' SCALE: VERT 1" = 5'
PLOTTED BY: WCN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 33+98
(Looking Downstream)



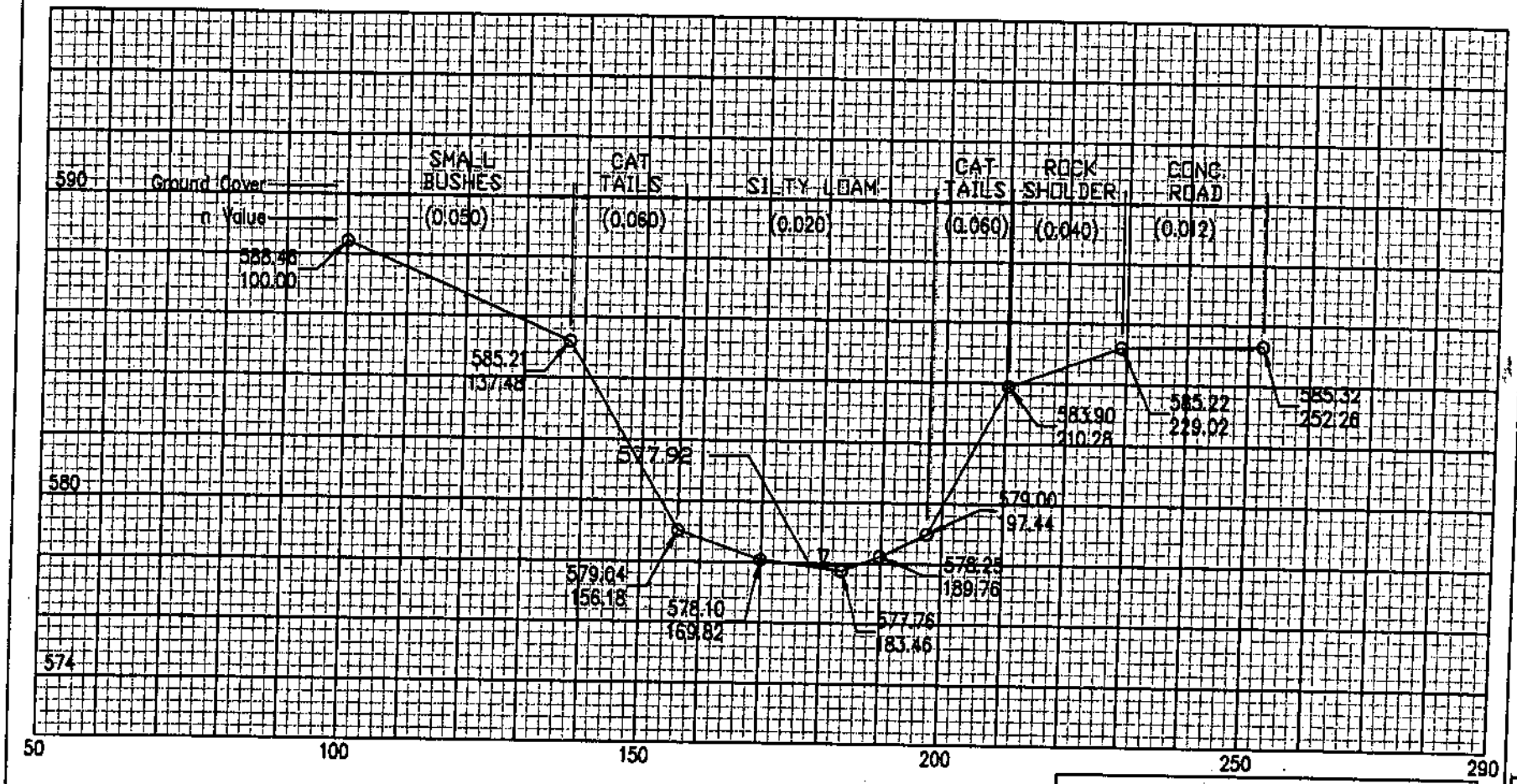
Cross-Section at Sta. 33+98 (1,844' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 38+98
(Looking Downstream)



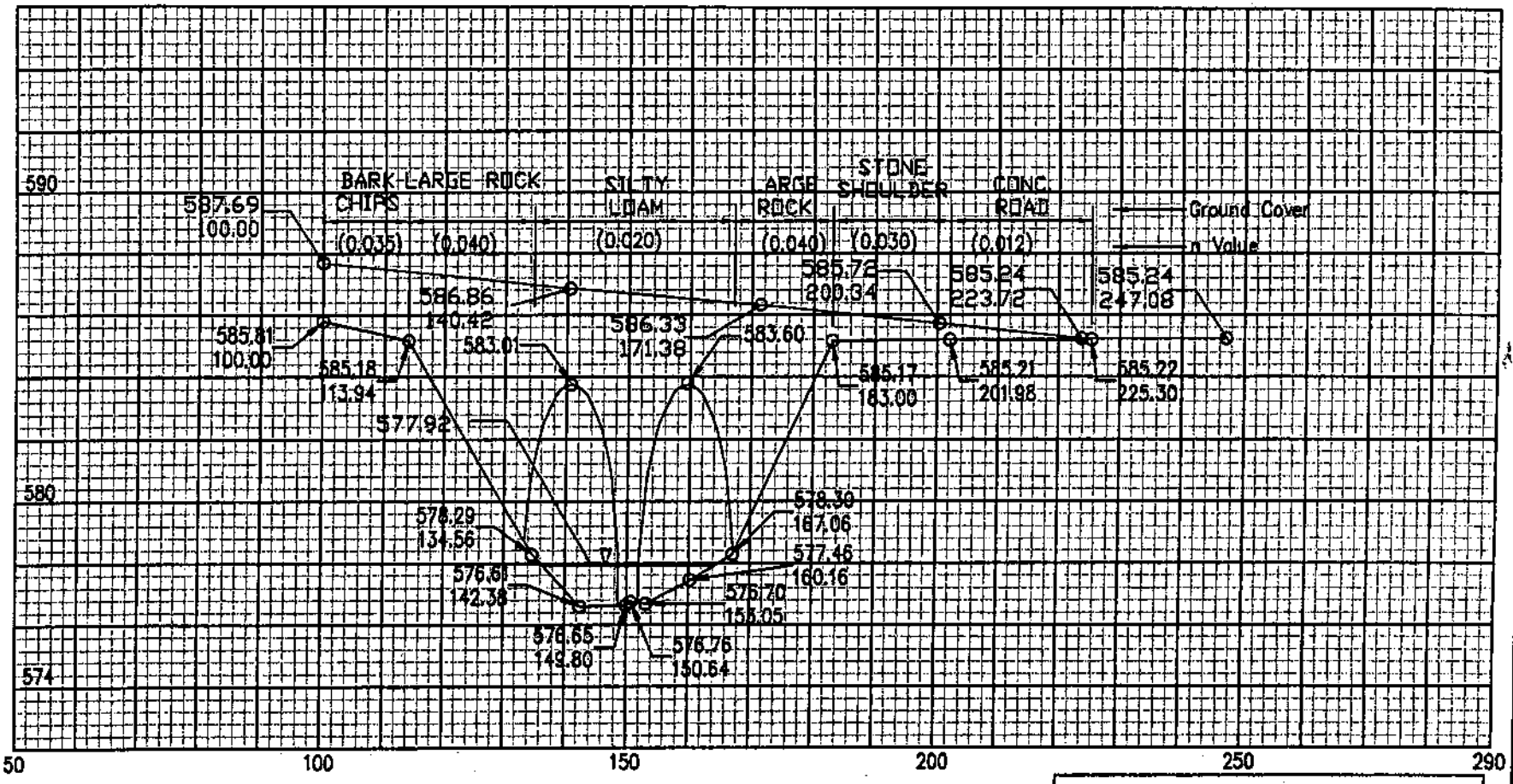
Cross-Section at Sta. 38+98 (1,344' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 39+41
(Looking Downstream)



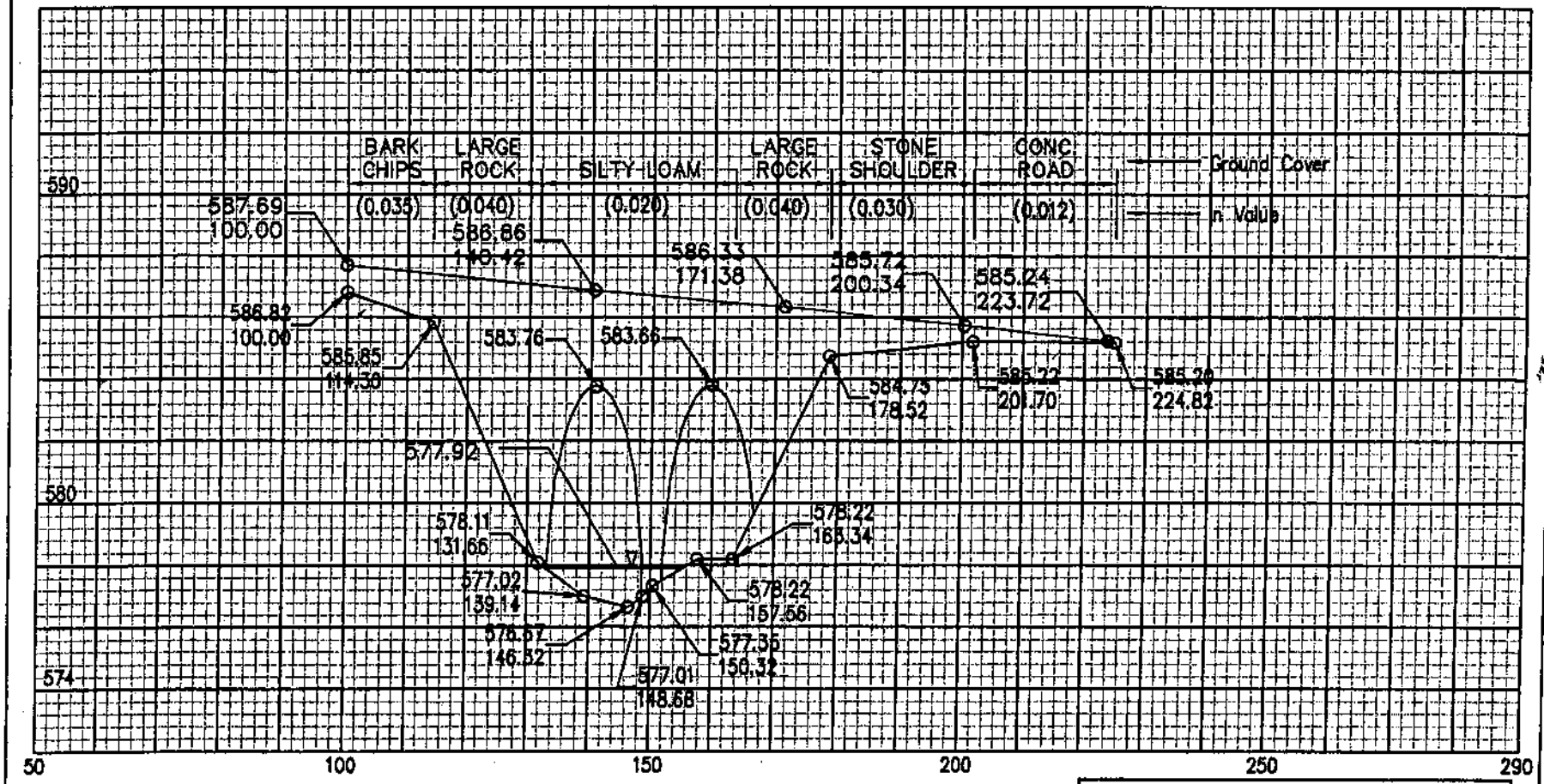
Cross-Section at Sta. 39+41 (1,301' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 40+46
(Looking Downstream)



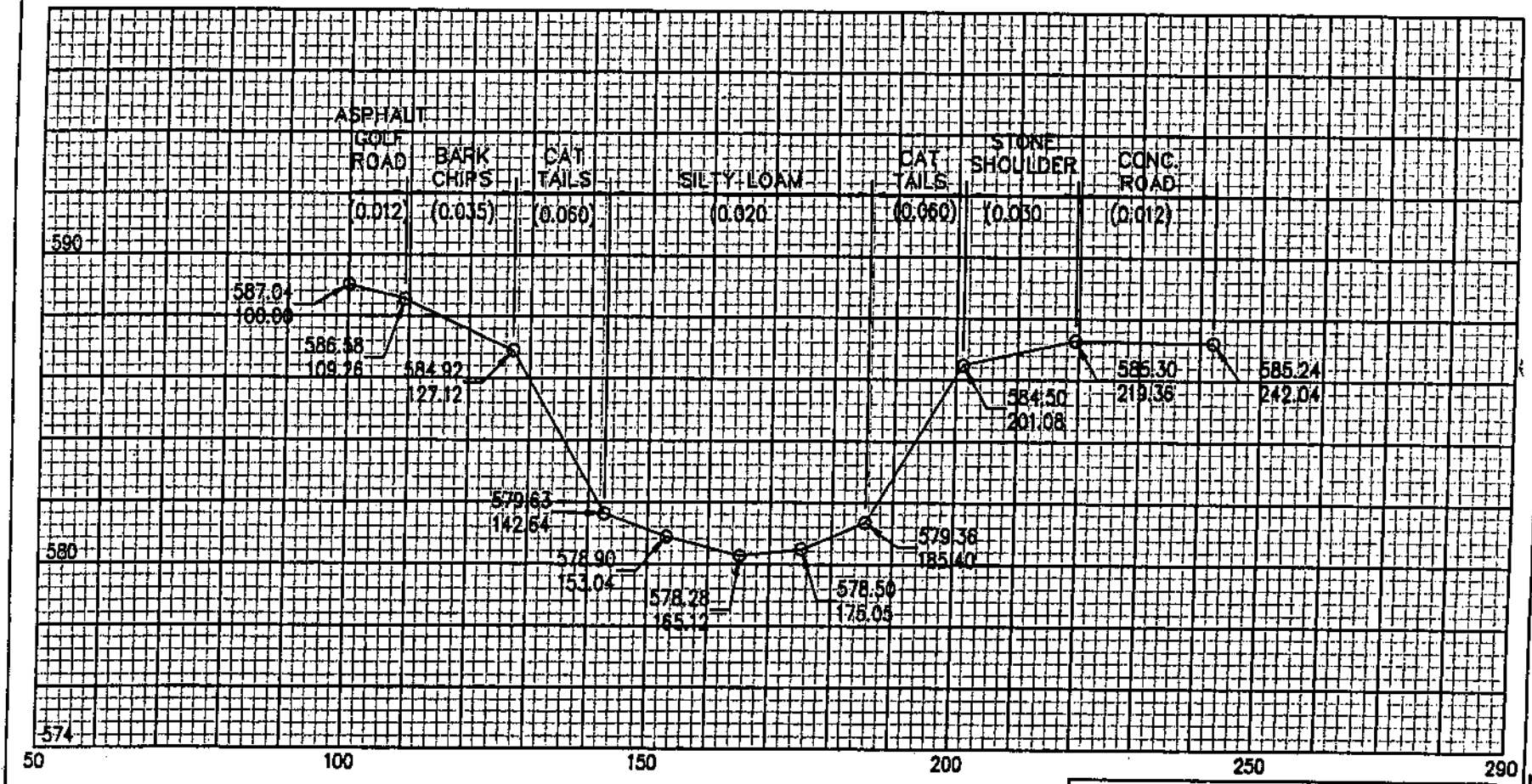
Cross-Section at Sta. 40+46 ((1,196' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: WGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 40+85
(Looking Downstream)

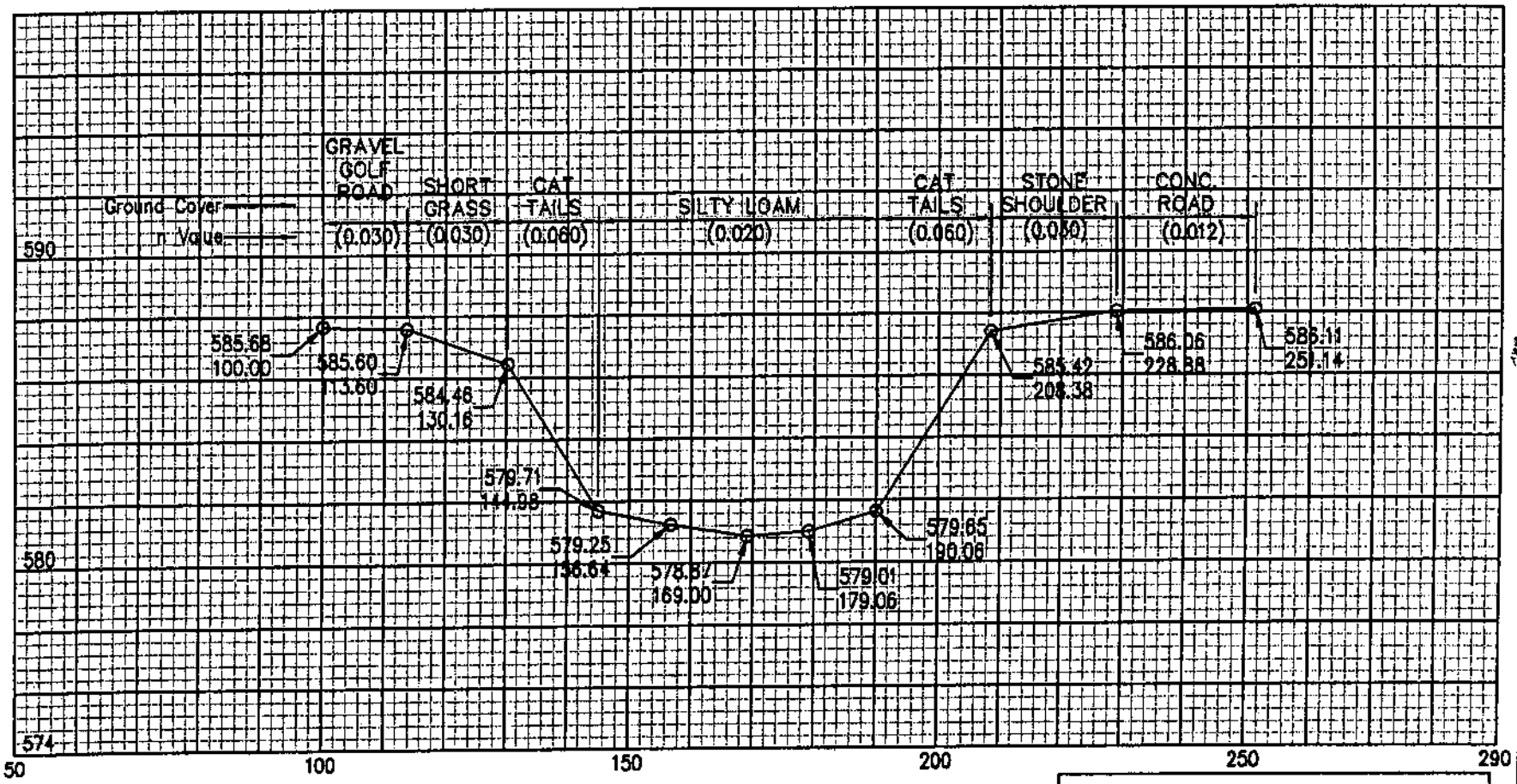


Cross-Section at Sta. 40+85 (1,157' from Pump Station)

ROUTE: I-87, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 45+67
(Looking Downstream)



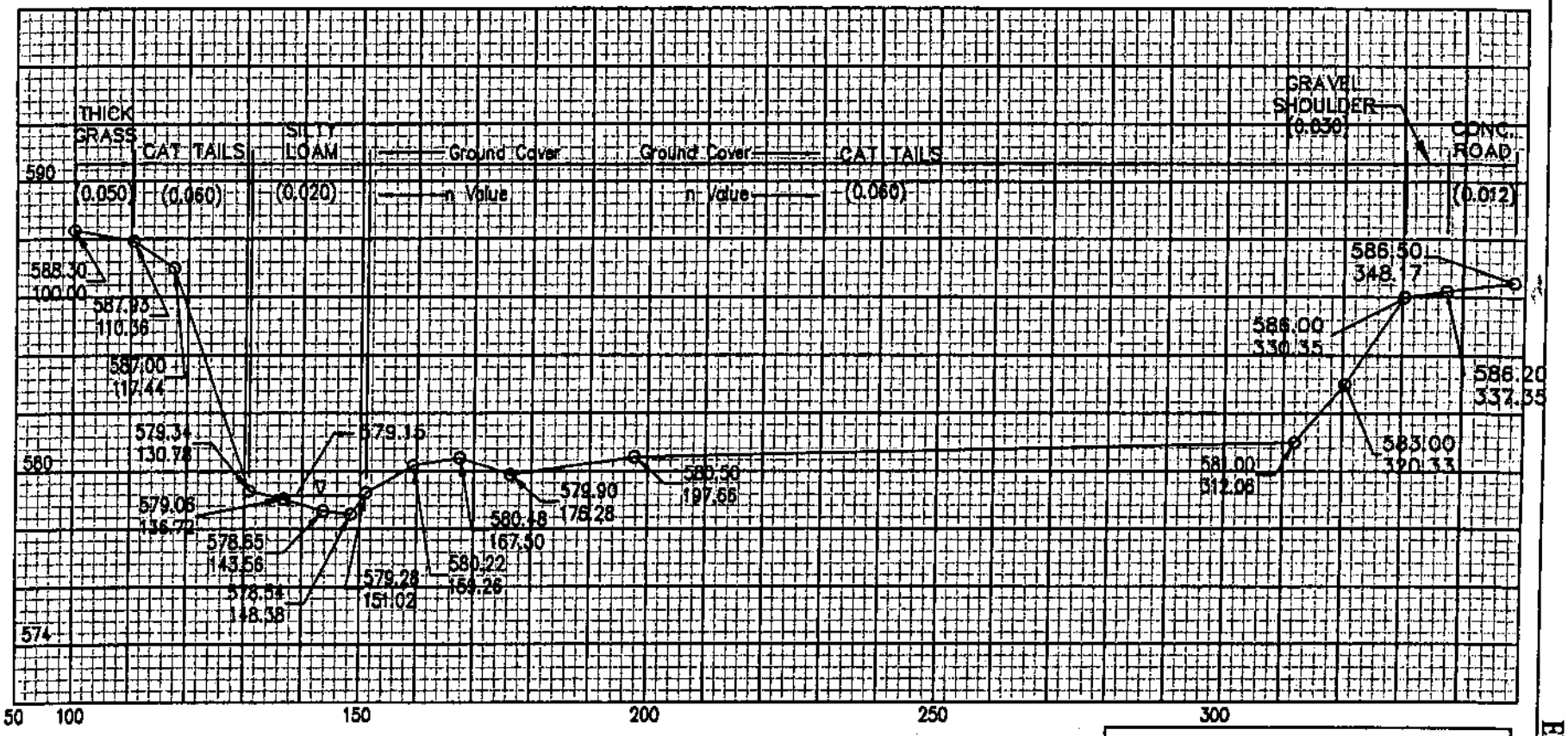
Cross-Section at Sta. 45+67 (675' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MON DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 50+67
(Looking Downstream)



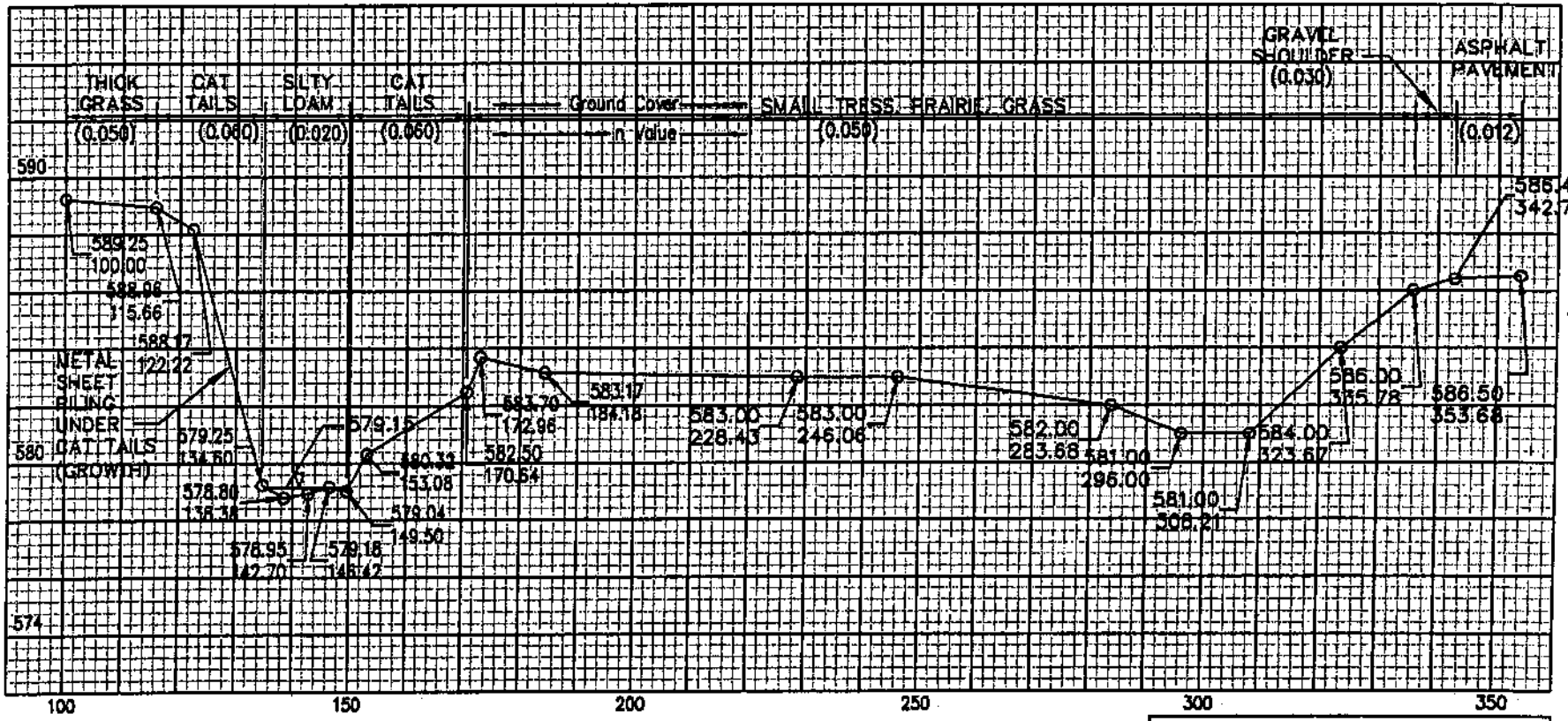
Cross-Section at Sta. 50+67 (175' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND	
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL	
SCALE: HOR: 1" = 25'	SCALE: VERT: 1" = 5'
PLOTTED BY: MGN	DATE: 01/25/01
CHECKED BY: STC	DATE: 01/25/01
SURVEY DATE: 05/02/00	

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 51+58
(Looking Downstream)



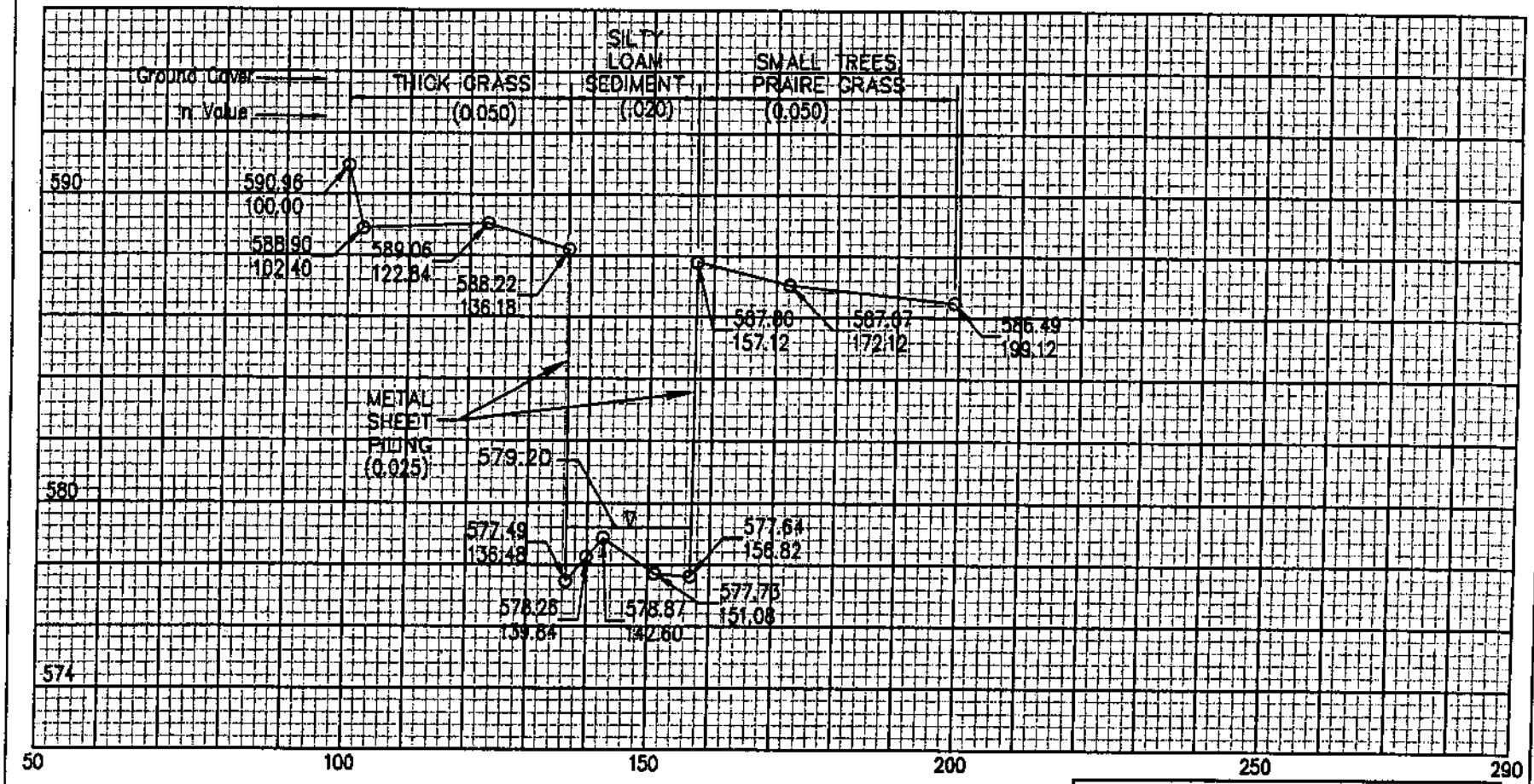
Cross-Section at Sta. 51+58 (84' from Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: MGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

Channel and Flood Plain Cross-Section at Sta. 52+42
(Looking Downstream)



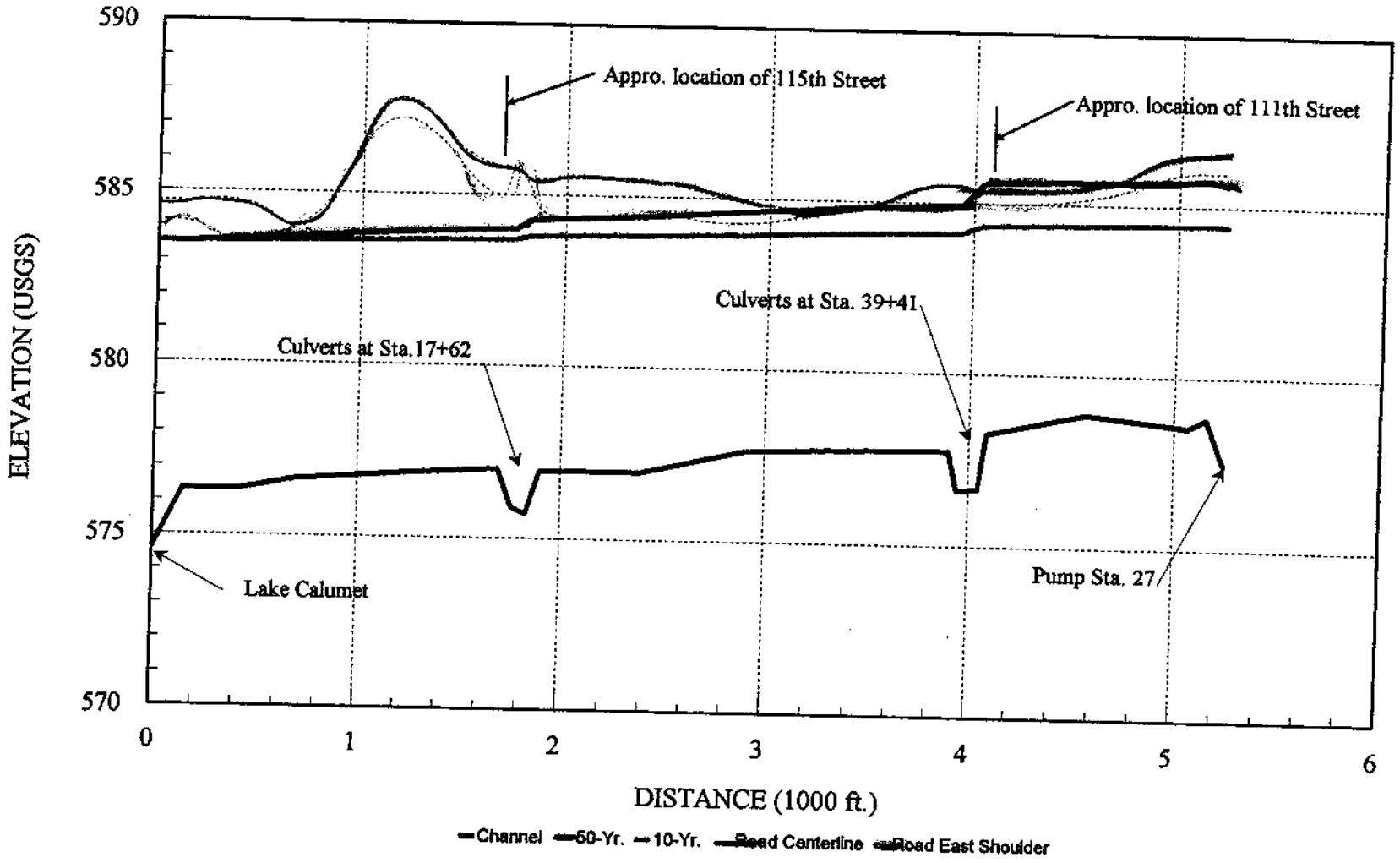
Cross-Section at Sta. 52+42 (Pump Station)

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE: I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 25' SCALE: VERT: 1" = 5'
PLOTTED BY: WGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

EXHIBIT 9

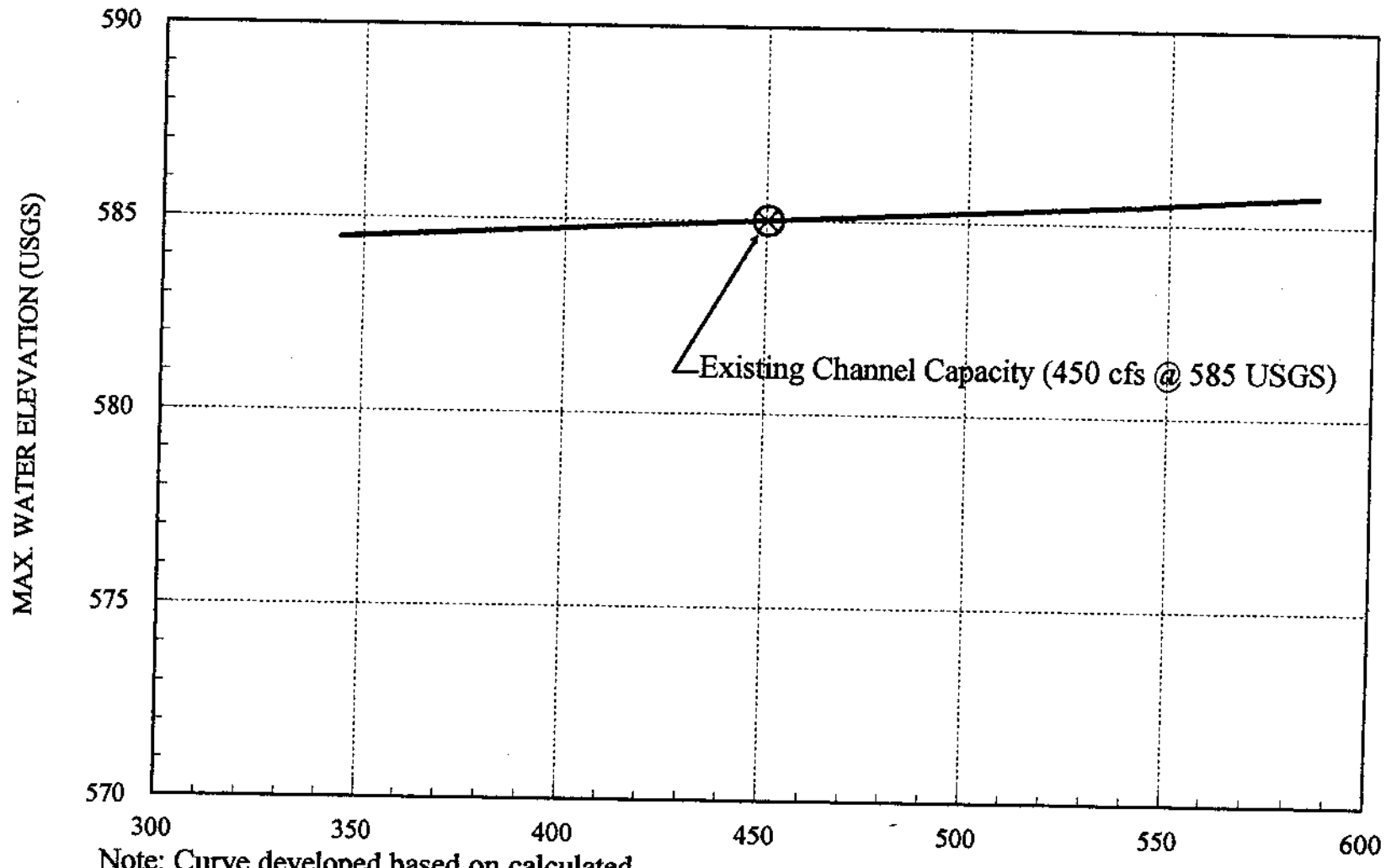
PULLMAN DITCH PROFILE WITH 10-YR. AND 50-YR. FLOODS ELEVATIONS
EXISTING CONDITIONS
ILLINOIS DEPARTMENT OF TRANSPORTATION



ALVORD, BURDICK & HOWSON, L.L.C.
ENGINEERS 2001 CHICAGO

EXHIBIT 15

DISCHARGE VS. STAGE - EXISTING CHANNEL
ILLINOIS DEPARTMENT OF TRANSPORTATION



Note: Curve developed based on calculated existing and proposed 10-yr. and 50-yr. channel flows

ALVORD, BURDICK & HOWSON, L.L.C.
ENGINEERS 2001 CHICAGO

EXHIBIT 15

HEC-RAS September 1998 Version 2.2
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

```
*******************************************************************************

PROJECT DATA
Project Title: PULLMAN DITCH BACKWATER
Project File : PDITCH.prj
Run Date and Time: 5/23/01 2:19:48 PM

Project in English units

Project Description:
IDOT PS-27 (PULLMAN DITCH) BACKWATER ANALYSIS W/LAKE EL. OF 583.52 USGS


*******************************************************************************

PLAN DATA

Plan Title: Natural Channel/Bridge Model
Plan File : C:\IDOT\PS27\PDITCH.p23

          Geometry Title: NATURAL CHANNEL/BRIDGE MODEL
          Geometry File : C:\IDOT\PS27\PDITCH.g16

          Flow Title    : All Flows
          Flow File     : C:\IDOT\PS27\PDITCH.f05

Plan Summary Information:
Number of:  Cross Sections =   20    Mulitple Openings =    0
            Culverts       =    0    Inline Weirs      =    0
            Bridges        =    0

Computational Information
    Water surface calculation tolerance =  0.01
    Critical depth calculaton tolerance =  0.01
    Maximum number of interations       =  20
    Maximum difference tolerance        =  0.3
    Flow tolerance factor               =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow


*******************************************************************************

FLOW DATA

Flow Title: All Flows
Flow File : C:\IDOT\PS27\PDITCH.f05

Flow Data (cfs)
*******************************************************************************************************************
* River           Reach          RS      *   Ext. Pk-10Yr    Ext. Pk-50Yr    Prop. Pk-10Yr    Prop. Pk-50Yr  *
* OUTLET CHANNEL  1              52.42   *         334.34          549.88           412.28           500.09  *
* OUTLET CHANNEL  1              51.58   *         334.46          550.17           412.34           500.43  *
* OUTLET CHANNEL  1              50.67   *         335.91          555.35           413.18           506.46  *
* OUTLET CHANNEL  1              45.67   *         336.49          557.76           413.51           509.26  *
* OUTLET CHANNEL  1              40.85   *         338.44          565.03           414.64           517.73  *
* OUTLET CHANNEL  1              40.46   *         338.51          565.28           414.68           518.02  *
* OUTLET CHANNEL  1              39.41   *         338.91          566.73           414.92           519.71  *
```

* OUTLET CHANNEL	1	38.98	*	339.34	568.21	415.16	521.43 *
* OUTLET CHANNEL	1	33.98	*	340.11	570.91	415.61	524.58 *
* OUTLET CHANNEL	1	28.98	*	340.82	573.45	416.02	527.54 *
* OUTLET CHANNEL	1	23.98	*	341.46	575.74	416.39	530.2 *
* OUTLET CHANNEL	1	18.98	*	341.72	576.66	416.54	531.27 *
* OUTLET CHANNEL	1	18.30	*	342.49	579.4	416.98	534.46 *
* OUTLET CHANNEL	1	17.62	*	342.55	579.61	417.02	534.7 *
* OUTLET CHANNEL	1	16.93	*	342.84	580.67	417.18	535.94 *
* OUTLET CHANNEL	1	11.93	*	343.64	583.68	417.64	539.45 *
* OUTLET CHANNEL	1	6.86	*	344.07	585.29	417.89	541.32 *
* OUTLET CHANNEL	1	4.11	*	344.26	585.95	418	542.08 *
* OUTLET CHANNEL	1	1.46	*	344.36	586.27	418.06	542.46 *
* OUTLET CHANNEL	1	0	*	344.38	586.35	418.07	542.55 *

Boundary Conditions

* River	Reach	Profile	*	Upstream	Downstream *
* OUTLET CHANNEL	1	Ext. Pk-10Yr	*		
* OUTLET CHANNEL	1	Ext. Pk-50Yr	*	Known WS = 583.52	Known WS = 583.52 *

GEOMETRY DATA

Geometry Title: NATURAL CHANNEL/BRIDGE MODEL
Geometry File : C:\IDOT\PS27\PDITCH.g16

CROSS SECTION RIVER: OUTLET CHANNEL
REACH: 1 RS: 52.42

INPUT
Description: CROSS SECTION No. 1
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
100	590.96	102.4	588.9	122.84	589.06	136.18	588.22	136.48	577.49
139.84	578.26	142.6	578.87	151.08	577.73	156.82	577.64	157.12	587.8
172.12	587.07	199.12	586.49						

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
100	.05	136.18	.025	136.48	.02	156.82	.025	157.12	.05

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
136.18	157.12	84	84	.1	.3
Right Levee	Station= 157.12	Elevation=			

CROSS SECTION OUTPUT Profile #Ext. Pk-10Yr

* E.G. Elev (ft)	584.25	* Element	Left OB	Channel	Right OB
* Vel Head (ft)	0.11	* Wt. n-Val.		0.022	
* W.S. Elev (ft)	584.14	* Reach Len. (ft)	84.00	84.00	84.00
* Crit W.S. (ft)	580.11	* Flow Area (sq ft)		124.28	
* E.G. Slope (ft/ft)	0.000279	* Area (sq ft)		124.28	
* Q Total (cfs)	334.34	* Flow (cfs)		334.34	
* Top Width (ft)	20.72	* Top Width (ft)		20.72	
* Vel Total (ft/s)	2.69	* Avg. Vel. (ft/s)		2.69	
* Max Chl Dpth (ft)	6.65	* Hydr. Depth (ft)		6.00	
* Conv. Total (cfs)	20008.5	* Conv. (cfs)		20008.5	
* Length Wtd. (ft)	84.00	* Wetted Per. (ft)		33.73	
* Min Ch El (ft)	577.49	* Shear (lb/sq ft)		0.06	
* Alpha	1.00	* Stream Power (lb/ft s)		0.17	
* Frctn Loss (ft)	0.02	* Cum Volume (acre-ft)		36.92	0.48
* C & E Loss (ft)	0.03	* Cum SA (acres)		8.65	0.34

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION OUTPUT Profile #Ext. Pk-50Yr

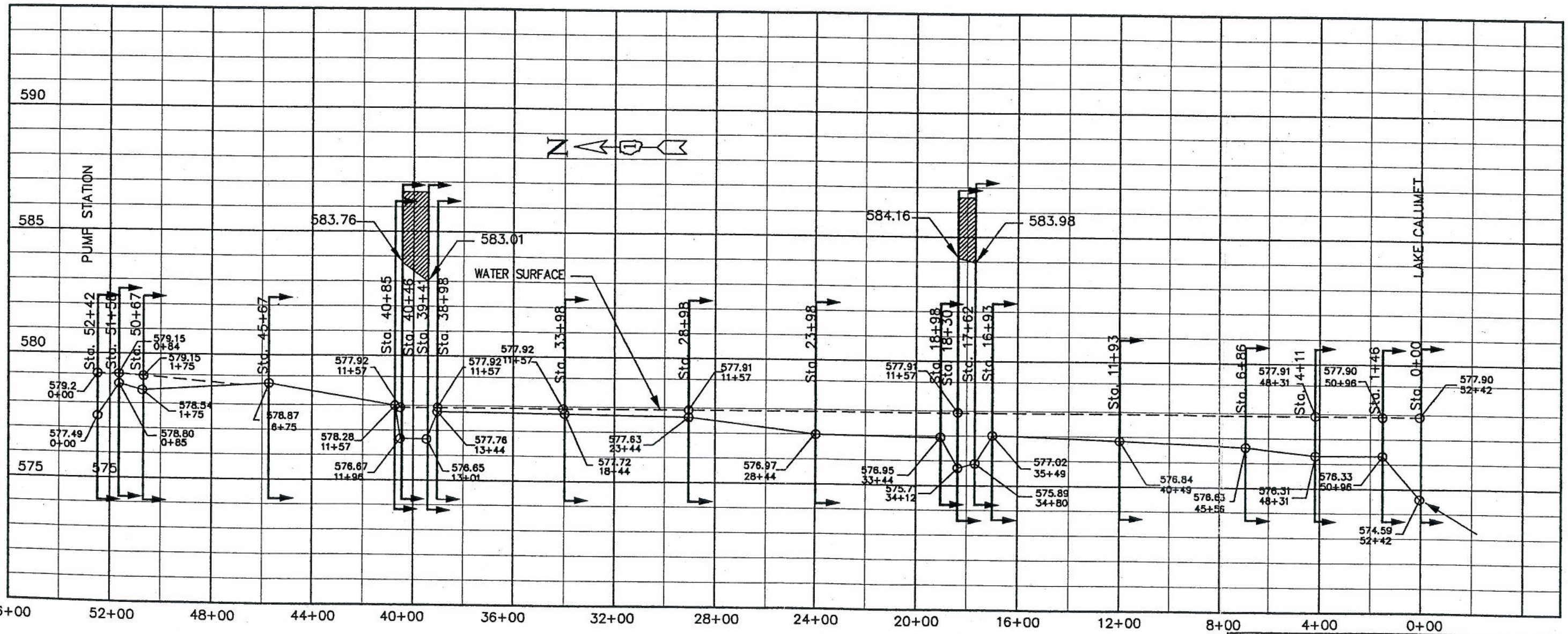
* E.G. Elev (ft)	585.13	* Element	Left OB	Channel	Right OB
* Vel Head (ft)	0.24	* Wt. n-Val.		0.022	
* W.S. Elev (ft)	584.89	* Reach Len. (ft)	84.00	84.00	84.00
* Crit W.S. (ft)	580.90	* Flow Area (sq ft)		139.86	
* E.G. Slope (ft/ft)	0.000546	* Area (sq ft)		139.86	
* Q Total (cfs)	549.88	* Flow (cfs)		549.88	

Reach	River Sta		Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)
1	52.42	Ex	334.34	577.49	584.14	2.69	124.28	20.72
1	52.42	Ex	549.88	577.49	584.89	3.93	139.86	20.76
1	52.42	Pr	412.28	577.49	584.37	3.20	129.02	20.73
1	52.42	Pr	500.09	577.49	584.74	3.66	136.77	20.75
1	51.58		334.46	578.80	584.19	1.16	401.57	197.27
1	51.58		550.17	578.80	585.02	1.30	568.49	204.38
1	51.58		412.34	578.80	584.44	1.26	452.23	199.46
1	51.58		500.43	578.80	584.85	1.27	534.00	202.93
1	50.67		335.91	578.54	584.19	0.46	729.56	201.96
1	50.67		555.35	578.54	585.02	0.62	898.77	206.17
1	50.67		413.18	578.54	584.44	0.53	781.14	203.25
1	50.67		506.46	578.54	584.85	0.59	863.99	205.31
1	45.67		336.49	578.87	584.12	1.19	283.67	73.05
1	45.67		557.76	578.87	584.91	1.63	344.45	83.17
1	45.67		413.51	578.87	584.36	1.37	301.12	74.54
1	45.67		509.26	578.87	584.75	1.54	331.29	80.31
1	40.85		338.44	578.28	584.05	1.18	287.06	70.03
1	40.85		565.03	578.28	584.78	1.66	340.84	80.02
1	40.85		414.64	578.28	584.26	1.37	302.12	71.30
1	40.85		517.73	578.28	584.63	1.57	329.03	76.12
1	40.46		338.51	576.67	584.04	1.18	286.36	58.53
1	40.46		565.28	576.67	584.77	1.71	330.15	62.90
1	40.46		414.68	576.67	584.26	1.39	298.82	59.50
1	40.46		518.02	576.67	584.62	1.61	320.92	61.17
1	39.41		338.91	576.61	584.04	1.09	309.93	63.02
1	39.41		566.73	576.61	584.76	1.59	356.82	66.86
1	39.41		414.92	576.61	584.25	1.28	323.24	64.13
1	39.41		519.71	576.61	584.61	1.50	346.93	66.07
1	38.98		339.34	577.76	584.04	1.10	308.50	71.16
1	38.98		568.21	577.76	584.75	1.58	364.13	83.55
1	38.98		415.16	577.76	584.24	1.29	323.69	74.75
1	38.98		521.43	577.76	584.61	1.49	351.93	80.99
1	33.98		340.11	577.72	583.96	1.18	289.19	68.91
1	33.98		570.91	577.72	584.62	1.70	335.66	73.08
1	33.98		415.61	577.72	584.15	1.38	302.03	70.09
1	33.98		524.58	577.72	584.48	1.61	325.76	72.21
1	28.98		340.82	577.63	583.86	1.44	236.90	54.46
1	28.98		573.45	577.63	584.40	2.14	268.15	63.77
1	28.98		416.02	577.63	584.01	1.70	244.98	55.08
1	28.98		527.54	577.63	584.29	2.02	261.05	61.08
1	23.98		341.46	576.97	583.77	1.44	237.53	51.59
1	23.98		575.74	576.97	584.18	2.21	260.00	59.54
1	23.98		416.39	576.97	583.88	1.71	243.27	52.66
1	23.98		530.20	576.97	584.09	2.08	254.97	57.55
1	18.98		341.72	576.95	583.71	1.27	268.50	61.50
1	18.98		576.66	576.95	584.04	2.00	288.86	63.35
1	18.98		416.54	576.95	583.80	1.52	273.85	61.99
1	18.98		531.27	576.95	583.97	1.87	284.54	62.96
1	18.30		342.49	575.71	583.71	1.08	316.75	63.01
1	18.30		579.40	575.71	584.04	1.72	337.53	64.68
1	18.30		416.98	575.71	583.80	1.29	322.23	63.45
1	18.30		534.46	575.71	583.97	1.60	333.12	64.33
1	17.62		342.55	575.89	583.71	1.03	331.84	65.04
1	17.62		579.61	575.89	584.03	1.64	352.99	66.67
1	17.62		417.02	575.89	583.80	1.24	337.41	65.47
1	17.62		534.70	575.89	583.96	1.53	348.50	66.32
1	16.93		342.84	577.02	583.70	1.19	287.54	60.69
1	16.93		580.67	577.02	584.00	1.90	306.20	61.89
1	16.93		417.18	577.02	583.78	1.43	292.45	61.01
1	16.93		535.94	577.02	583.94	1.77	302.24	61.64
1	11.93		343.64	576.84	583.64	1.15	298.20	66.37

1	11.93	583.68	576.84	583.86	1.87	312.72	67.50	
1	11.93	417.64	576.84	583.70	1.38	301.94	66.66	
1	11.93	539.45	576.84	583.81	1.74	309.60	67.26	
1	6.86	344.07	576.63	583.59	1.10	313.83	69.23	
1	6.86	585.29	576.63	583.71	1.82	322.30	69.94	
1	6.86	417.89	576.63	583.62	1.32	315.97	69.41	
1	6.86	541.32	576.63	583.68	1.69	320.46	69.78	
1	4.11	344.26	576.31	583.55	1.15	300.55	74.44	
1	4.11	585.95	576.31	583.61	1.92	304.99	75.72	
1	4.11	418.00	576.31	583.57	1.39	301.65	74.76	
1	4.11	542.08	576.31	583.60	1.79	304.00	75.44	
1	1.46	344.36	576.33	583.52	1.13	303.99	66.81	
1	1.46	586.27	576.33	583.51	1.93	303.75	66.79	
1	1.46	418.06	576.33	583.52	1.38	303.93	66.80	
1	1.46	542.46	576.33	583.52	1.79	303.81	66.79	
1	0	344.38	574.59	583.52	0.80	431.51	84.91	
1	0	586.35	574.59	583.52	1.36	431.51	84.91	
1	0	418.07	574.59	583.52	0.97	431.51	84.91	
1	0	542.55	574.59	583.52	1.26	431.51	84.91	

EXHIBIT 10

Streambed Profile



Streambed Profile

NOTE: ELEVATIONS SHOWN ARE IDOT ELEVATIONS

ROUTE I-57, I-94 AND STONY ISLAND
WATERCOURSE: PUMP STATION No. 27 OUTLET CHANNEL
SCALE: HOR: 1" = 400' SCALE: VERT: 1" = 5'
PLOTTED BY: WGN DATE: 01/25/01
CHECKED BY: STC DATE: 01/25/01
SURVEY DATE: 05/02/00

PROPOSED IMPROVEMENTS

SHEET:

COMPUTED: WGN DATE: 05/24/2001

CHECKED: STC DATE: 05/24/2001

ROUTE: I-57, I-94 AND STONY ISLAND
SECTION: N/A
COUNTY: COOK
STREAM NAME: PULLMAN DITCH (PS-27 DISCHARGE DITCH)
STRUCTURE NO: N/A
STRUCTURE TYPE: PIPE ARCH CORRUGATED CULVERTS
APPROXIMATE SIZE: 14'-5" SPAN X 10' RISE
EXISTING LOW CHORD ELEV: 583.71
PROPOSED LOW CHORD ELEV: 585.6

WATERWAY INFORMATION TABLE - NORTH CULVERTS AT STATION 40+46

Drainage Area = 1.22 Sqare Miles | Low Grade Elev. = 584.70 (Doty Road) | Max. Recorded H.W.E. = N/A

Flood	Frequency (Yr)	Discharge (cfs)	Waterway Opening (sq. ft.) Existing	Waterway Opening (sq. ft.) Proposed	Natural H.W.E.	Created Head (ft) Existing	Created Head (ft) Proposed	Headwater Elevation Existing	Headwater Elevation Proposed
	10	344.38*	135.50		584.04	0.31		584.35	
	10	418.07**		202.50	584.26		0.10		584.36
DESIGN	50	586.35***	135.50		584.77	0.66		585.43	
DESIGN	50	542.55****		214.80	584.62		0.15		584.77
BASE	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OVERTOPPING		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MAX CALC	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Comments:

All Elevations are Based on IDOT Datum

* Used 5 of the existing 8 pumps

** Used - of the proposed --- pumps (alternative 1) with proposed operating schedule

*** Used all 8 existing pumps

**** Used 7 of the 8 proposed pumps (alternative 1) with proposed operating schedule

ROUTE: I-57, I-94 AND STONY ISLAND
SECTION:
COUNTY: COOK
STREAM NAME: PULLMAN DITCH (PS-27 DISCHARGE DITCH)
STRUCTURE NO:
STRUCTURE TYPE: PIPE ARCH CORRUGATED CULVERTS
APPROXIMATE SIZE: 14'-5" SPAN X 10' RISE
EXISTING LOW CHORD ELEV: 583.71
PROPOSED LOW CHORD ELEV:

SHEET:
COMPUTED: WGN DATE: 05/24/2001
CHECKED: STC DATE: 05/24/2001

WATERWAY INFORMATION TABLE - SOUTH CULVERTS AT STATION 18+30

Drainage Area = 1.22 Sqare Miles | Low Grade Elev. = 584.50 (Doty Road) | Max. Recorded H.W.E. = N/A

Flood	Frequency (Yr)	Discharge (cfs)	Waterway Opening (sq. ft.)		Natural H.W.E.	Created Head (ft)		Headwater Elevation	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
	10	344.38*	173.84		583.71	0.10		583.81	
	10	418.07**		184.8	583.80		0.06		583.86
DESIGN	50	586.35***	183.54		584.04	0.25		584.29	
	50	542.55****		190.8	583.97		0.10		584.07
BASE	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OVERTOPPING		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MAX CALC	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Comments:
All Elevations are Based on IDOT Datum
* Used 5 of the existing 8 pumps
** Used - of the proposed ---- pumps (alternative 1) with proposed operating schedule
*** Used all 8 existing pumps
**** Used 7 of the 8 proposed pumps (alternative 1) with proposed operating schedule

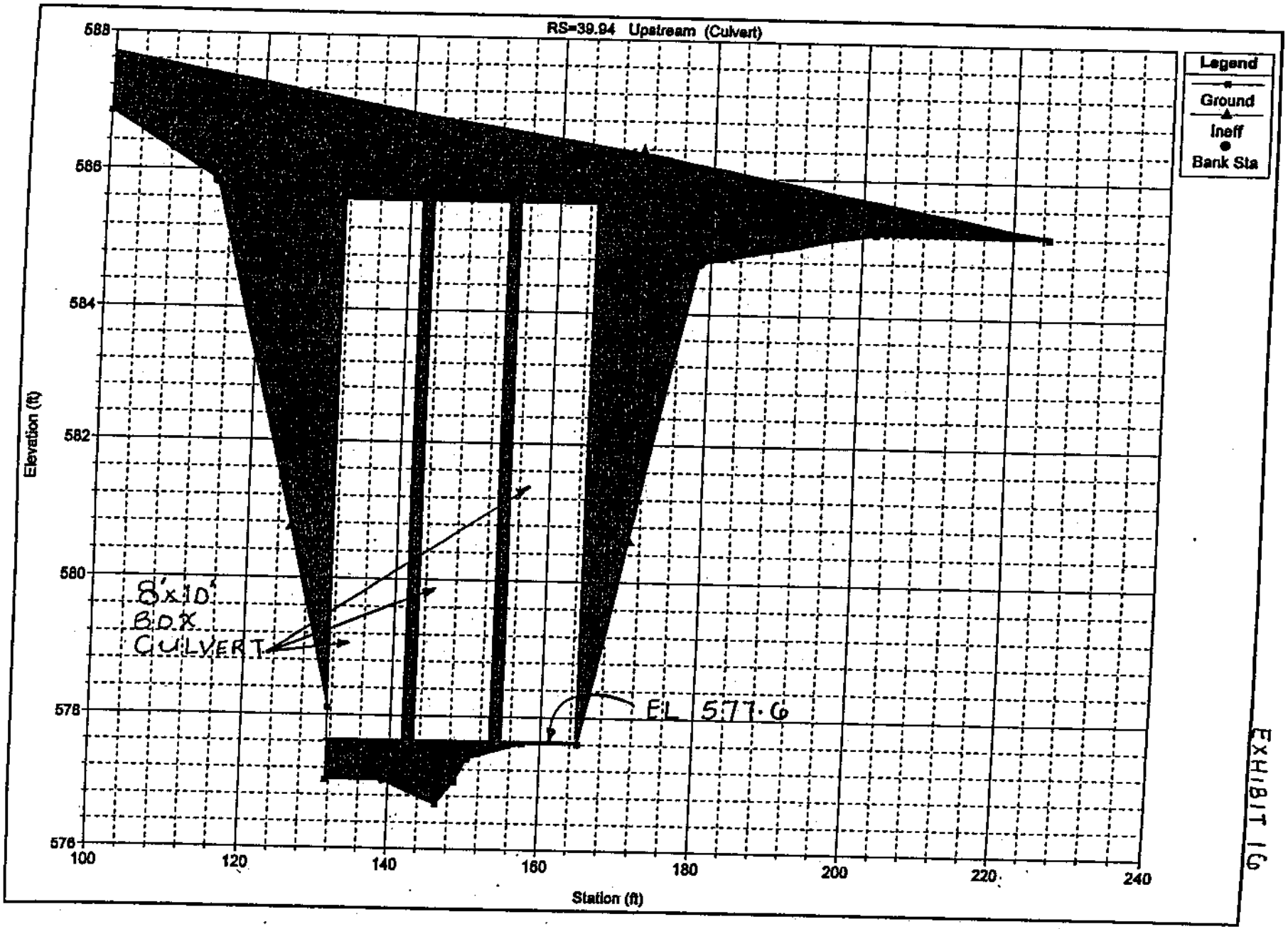
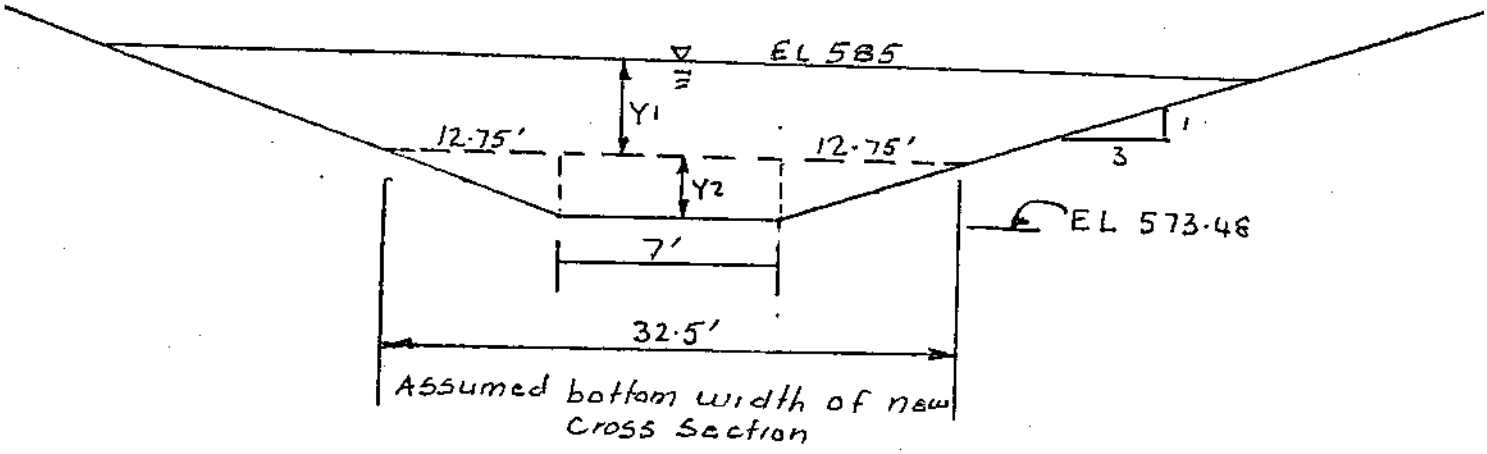

RS=39.94 Upstream (Culvert)
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
588
586
584
582
580
578
576
100
120
140
160
180
200
220
240
Station (ft)
8'x10'
BOX
CULVERT
EL 577.6

EXHIBIT 16

Original Design Channel Cross Section



$Y_2 = 12.75/3 = 4.25'$

$Y_1 = (585 - 573.48) - 4.25 = 7.27'$

Area of original Cross Section = A_1

$A_1 = [((Y_1 + Y_2) * 3 * 2 + 7) + 7] / 2 * Y_1 + Y_2$

$= (11.52 * 6 + 14) / 2 * 11.52$

$= 478.77 ft^2$

For Combination Trapezoidal/Rectangular channel:

Combined area = $478.77 ft^2$

* Trapezoid section: $Y = Y_1 = 7.27'$

$B = 32.5'$

$A = (7.27 * 6 + 32.5 * 2) / 2 * 7.27$

$= 394.83 ft^2$

* Rectangular Section: $A = 478.77 - 394.83$

$= 83.94 ft^2$

$Y = 83.94 / 32.5 = 2.58'$

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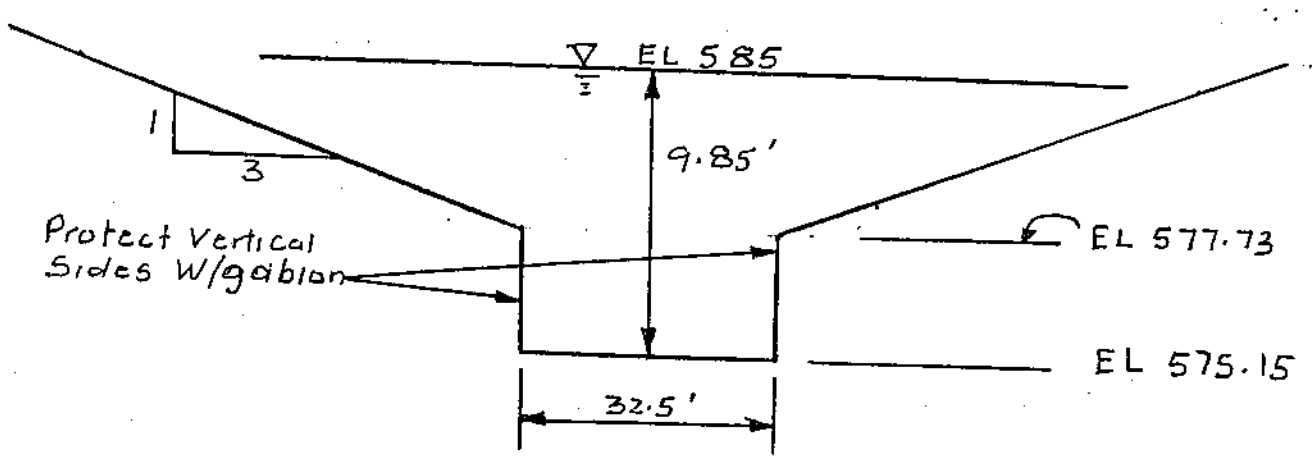
BY WGN SUBJECT PS 27 DATE 2/9/01

Trapezoidal/Rectangular Channel



PULLMAN DITCH PROFILE WITH 10-YR. AND 50-YR. FLOODS ELEVATIONS
COMBINATION TRAPEZOIDAL/RECTANGULAR CHANNEL
ILLINOIS DEPARTMENT OF TRANSPORTATION

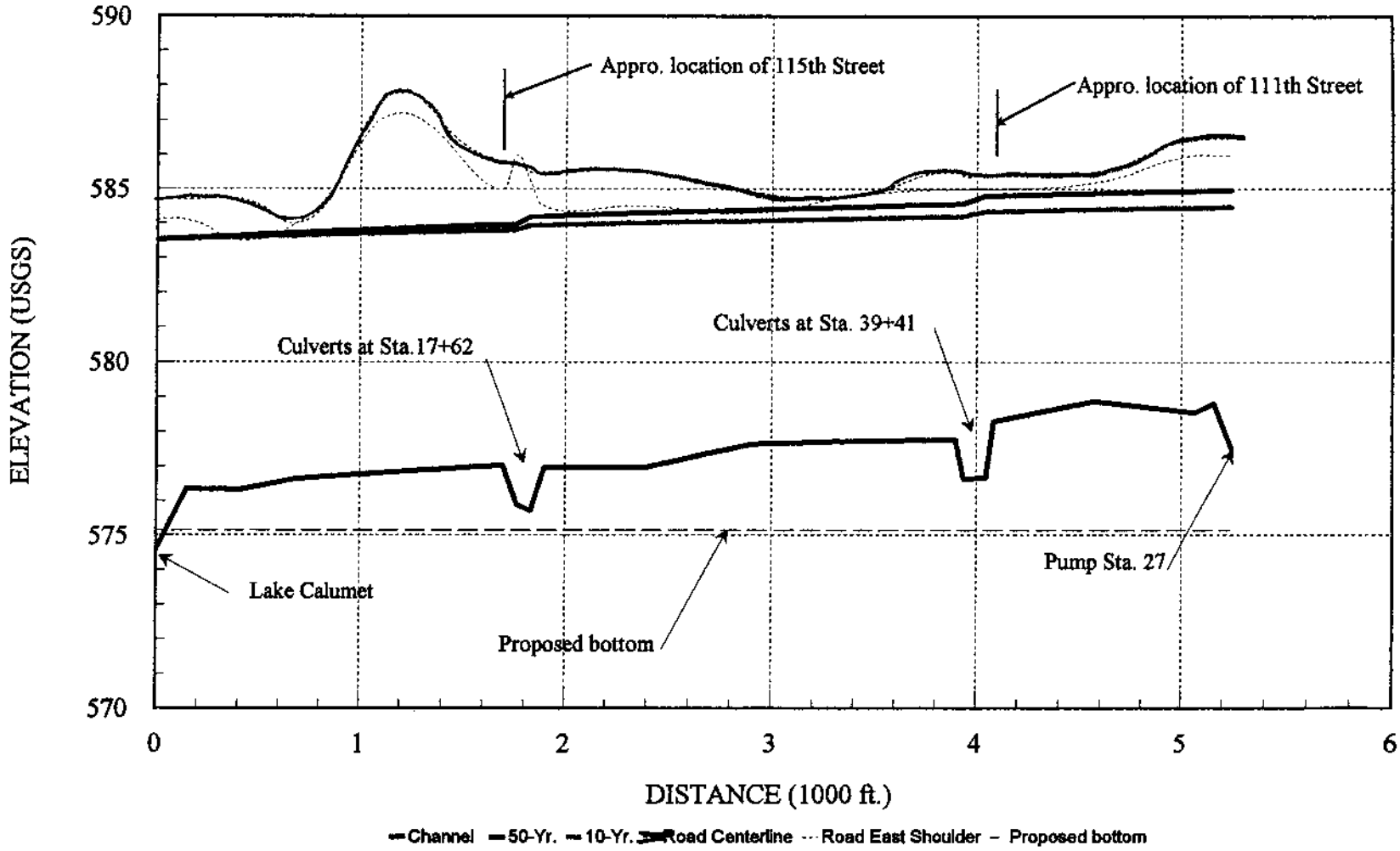


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EXHIBIT 15

PHOTOS ALONG PULLMAN CREEK (OUTLET CHANNEL)

Cross-Section No.1

Cross-Section No.2

Cross-section No.3

Cross-section No.4

Cross-section No.5

Cross-section No.6


FEB 4 2004