Attachment 02.04.03-08Q
TVA letter dated February 2, 2010
RAI Response

ASSOCIATED ATTACHMENTS/ENCLOSURES:

Attachment 02.04.03-8Q: Dam Rating Curves, Nottely

(106 Pages including Cover Sheet)

NPG CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
L58 081211 801	Calculations (nuclear)	L58 091230 028

Calc Title: Dam Rating Curve, Nottely

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURRENT	CN	NUC	GEN	CEB	CDQ000020080016	1	2	Entire calc ☒ Selected pages ☐
NEW								

ACTION	NEW ☐ REVISION ☒	DELETE ☐ RENAME ☐	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
N/A	N/A	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
*See below	N/A	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS and/or ISFSI SAR/CoC AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
J. B. Mauter	205-298-6074	CEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Janie B. Mauter *[signature]*	12/14/09	Andrew C. Murr *[signature]*	12/14/09
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Andrew C. Murr *[signature]*	12/14/09	K. R. Spates *[signature]*	12/23/09

STATEMENT OF PROBLEM/ABSTRACT

Headwater rating curves for 20 dams are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations for the Tennessee River and tributaries. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents the headwater rating curve for Nottely Dam.

This calculation contains electronic attachments and must be stored in EDMS as an ADOBE .pdf file to maintain the ability to retrieve the electronic attachments.

*EDCN 22404A (SQN), EDCN 54018A (WBN), EDCN Later (BFN)

MICROFICHE/EFICHE Yes ☐ No ☒ FICHE NUMBER(S)

☐ LOAD INTO EDMS AND DESTROY
☒ LOAD INTO EDMS AND RETURN CALCULATION TO CALCULATION LIBRARY. ADDRESS: LP4D-C
☐ LOAD INTO EDMS AND RETURN CALCULATION TO:

L58 081211 801

TVAN CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
L58081211801	Calculations (nuclear)	N/A

Calc Title: Dam Rating Curves, Nottely

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURRENT	CN	NUC						Entire calc ☐ Selected pages ☐
NEW	CN	NUC	GEN	CEB	CDQ000020080016	N/A	0	

ACTION: NEW ☒ REVISION ☐ | DELETE ☐ RENAME ☐ | SUPERSEDE ☐ DUPLICATE ☐ | CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required) | No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
000	N/A	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
N/A	N/A	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS and/or ISFSI SAR/CoC AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
A. T. Tinsley	865-220-4418	CEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Andrew T. Tinsley	12/9/08	Janie B. Mauter	12/9/08
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Andrew C. Murr	12/9/08	[signature]	12/10/08

STATEMENT OF PROBLEM/ABSTRACT

Headwater rating curves for 20 dams are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations for the Tennessee River and tributaries. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents the headwater rating curve for Nottely Dam.

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MICROFICHE/EFICHE Yes ☐ No ☐ FICHE NUMBER(S)

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TVAN CALCULATION COVERSHEET/CCRIS UPDATE

REV 0 EDMS/RIMS NO.	EDMS TYPE:	EDMS ACCESSION NO (N/A for REV. 0)
L58 081211 801	Calculations (nuclear)	L58 090216 003

Calc Title: Dam Rating Curves, Nottely

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	CUR REV	NEW REV	REVISION APPLICABILITY
CURRENT	CN	NUC	GEN	CEB	CDQ000020080016	0	1	Entire calc ☒ Selected pages ☐
NEW								

ACTION	NEW ☐ REVISION ☒	DELETE ☐ RENAME ☐	SUPERSEDE ☐ DUPLICATE ☐	CCRIS UPDATE ONLY ☐ (Verifier Approval Signatures Not Required)	No CCRIS Changes ☐ (For calc revision, CCRIS been reviewed and no CCRIS changes required)

UNITS	SYSTEMS	UNIDS
000	N/A	N/A

DCN,EDC,N/A	APPLICABLE DESIGN DOCUMENT(S)	CLASSIFICATION
N/A	N/A	E

QUALITY RELATED?	SAFETY RELATED? (If yes, QR = yes)	UNVERIFIED ASSUMPTION	SPECIAL REQUIREMENTS AND/OR LIMITING CONDITIONS?	DESIGN OUTPUT ATTACHMENT?	SAR/TS and/or ISFSI SAR/CoC AFFECTED
Yes ☒ No ☐	Yes ☒ No ☐	Yes ☒ No ☐	Yes ☐ No ☒	Yes ☐ No ☒	Yes ☐ No ☒

PREPARER ID	PREPARER PHONE NO	PREPARING ORG (BRANCH)	VERIFICATION METHOD	NEW METHOD OF ANALYSIS
A. T. Tinsley	865-220-4418	CEB	Design Review	☐ Yes ☒ No

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
Andrew Tinsley	1/23/09	Sara Martinez	1-23-09
VERIFIER SIGNATURE	**DATE**	**APPROVAL SIGNATURE**	**DATE**
Joe V. Peyton	1/23/09	K. R. Spates	2/13/09

STATEMENT OF PROBLEM/ABSTRACT

Headwater rating curves for 20 dams are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations for the Tennessee River and tributaries. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents the headwater rating curve for Nottely Dam.

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NPG CALCULATION COVERSHEET/CCRIS UPDATE

CALC ID	TYPE	ORG	PLANT	BRANCH	NUMBER	REV
	CN	NUC	GEN	CEB	CDQ000020080016	2

ALTERNATE CALCULATION IDENTIFICATION

BLDG	ROOM	ELEV	COORD/AZIM	FIRM	Print Report Yes ☐
				BWSC	

CATEGORIES NA

KEY NOUNS (A-add, D-delete)

ACTION (A/D)	KEY NOUN	A/D	KEY NOUN

CROSS-REFERENCES (A-add, C-change, D-delete)

ACTION (A/C/D)	XREF CODE	XREF TYPE	XREF PLANT	XREF BRANCH	XREF NUMBER	XREF REV
A	P	EN	WBN	CEB	54018	
A	P	EN	SQN	CEB	22404	
A	S	CN	GEN	CEB	CDQ000020080053	

CCRIS ONLY UPDATES:
Following are required only when making keyword/cross reference CCRIS updates and page 1 of form NEDP-2-1 is not included:

PREPARER SIGNATURE	DATE	CHECKER SIGNATURE	DATE
PREPARER PHONE NO.	EDMS ACCESSION NO.		

NPG CALCULATION RECORD OF REVISION	
CALCULATION IDENTIFIER	CDQ000020080016
Title	Dam Rating Curve, Nottely
Revision No.	**DESCRIPTION OF REVISION**
0	Initial issue
1	Revised Calculation to include Turbine Flow. Revised pages 1-11, 15, and 17-22. Revised Attachment 1. Added Attachments 7, 13, 16, and 22 (renumbered accordingly as necessary). 38 total pages after revision including R0 cover sheet as page 1a.
2	This calculation was revised to address the following: • PER 203951. The verification of the original calculation was completed by personnel who had not completed the required NEDP-7 Job Performance Record (JPR). A verification JPR is now in place for all personnel engaged in verification tasks. Checking includes only changes made in this revision as the checking of the calculation was not impacted by PER 203951. The verification is inclusive of work completed prior to this revision. • PER 203872. Replace NEDP-2 forms on pages 1 through 6 with the forms from the NEDP-2 revision in effect at the time of calculation issuance. • UVA 3.2.1. Removed and replaced with Assumption 3.1.4 based on Reference 2.8. • UVA 3.2.2. Removed and replaced with Assumption 3.1.5 based on Reference 2.9. • Add Assumption 3.1.6 based on Technical Justification. • Updated Figure 8 and Table 5. • Add Case 2 for gate failure without turbine flow. • Add Figure 5 and Table 4. Significant changes to text in Revision 2 are marked with a right-hand margin revision bar. Administrative changes and typos are excluded. Pages Deleted: None Pages Revised: 1 – 7, 9-19, 22-25 New Pages added: 1b, 5 Total hardcopy pages Revision 2: 42 Additional Comments: • Rev. 1 coversheet is page 1b • Added Verification Form as page 5 • Updated page numbers • Include number of pages per attachment in Table of Contents

NPG CALCULATION TABLE OF CONTENTS

Calculation Identifier: CDQ000020080016	Revision: 2	

TABLE OF CONTENTS

NPG CALCULATION VERIFICATION FORM

Calculation Identifier CDQ000020080016 Revision 2

Method of verification used:		
1. Design Review	☒	Verifier Andrew C. Murr Date 12/14/2009
2. Alternate Calculation	☐	
3. Qualification Test	☐	

Comments:

This calculation entitled, "Dam Rating Curve, Nottely" was verified by independent design review. The process involved a critical review of the calculation to ensure that it is correct and complete, uses appropriate methodologies, and achieves its intended purpose. The inputs were reviewed and determined to be appropriate inputs for this calculation. The results of the calculation were reviewed and were found to be reasonable and consistent with the inputs provided. Backup files and documents were consulted as necessary to verify data and analysis details found in the calculation.

Detailed comments and editorial suggestions for the changes made in this revision were transmitted to the author and reviewer by email along with a marked up copy of the calculation.

(Note: The design verification of this calculation revision is for the total calculation, not just the changes made in the revision. This complete re-verification is performed to disposition PER 203951 as described in the Calculation Revision Log on Page 3.)

NPG COMPUTER INPUT FILE
STORAGE INFORMATION SHEET

Document CDQ000020080016	Rev. 2	Plant: GEN	

Subject:
Dam Rating Curve, Nottely

☐ Electronic storage of the input files for this calculation is not required. Comments:

There are no electronic input/output files associated with this calculation.

☒ Input files for this calculation have been stored electronically and sufficient identifying information is provided below for each input file. (Any retrieved file requires re-verification of its contents before use.)

These files are electronically attached to the parent ADOBE. PDF calculation file. All files are therefore stored in an unalterable medium and are retrievable through the EDMS number for this calculation.

Attachment 14: Nottely DRC Calcs_Rev2.xls Spreadsheet for headwater rating curve calculations
Attachment 15: Electronic Copy of Reference 2.2
Attachment 16: Electronic Copy of Reference 2.8
Attachments 17-22: High Resolution Electronic Copies of References 2.1.1 through 2.1.6

☐ Microfiche/eFiche

1. Purpose

Headwater rating curves for twenty dams geographically located on the Tennessee River and its tributaries above the existing Bellefonte Nuclear facility are required as inputs to TVA's SOCH and TRBROUTE models, which perform flood-routing calculations. The headwater rating curves for each dam provide total dam discharge as a function of headwater elevation. This calculation presents the headwater rating curve for Nottely Dam.

TVA developed methods of analysis, procedures, and computer programs for determining design basis flood levels for nuclear plant sites in the 1970's. Determination of maximum flood levels included consideration of the most severe flood conditions that may be reasonably predicted to occur at a site as a result of both severe hydrometerological conditions and seismic activity. This process was followed to meet Nuclear Regulatory Guide 1.59. At that time, there were no computer programs available that would handle unsteady flow and dam failure analysis. As a result of this early work and method development TVA developed a runoff and stream course modeling process for the TVA reservoir system. This process provided a basis for currently licensed plants (Sequoyah Nuclear Plant, Watts Bar Nuclear Plant, and Browns Ferry Nuclear Plant). The Bellefonte Nuclear Plant (BLN) Units 1 & 2 Final Safety Analysis Report (FSAR) was also based on this process.

BLN Unit 3 & 4 Combined Operating License Application (COLA) was submitted using data and analysis that was determined for the original BLN FSAR (Unit 1 and Unit 2) and was documented in a 1998 reassessment. In 1998, the analysis process and documentation was brought under the nuclear quality assurance process for the first time. A quality assurance audit conducted by NRC staff in early 2007 raised several questions related to the documentation of past work regarding design basis flood level determinations. This calculation supports a portion of the effort to improve the design basis documentation.

Preparation of all calculations supporting nuclear development and licensing are subject to TVA Standard Department Procedure NEDP-2. This standard dictates the process in which calculations are prepared, checked, verified, stored, and cross referenced in a goal to provide the highest quality nuclear design input and output possible.

Figure 1 is a plan and elevation view of Nottely dam (Reference 2.1.1). For headwaters in the normal operating range, discharge is passed through the Unit 1 turbine or over the spillway. The spillway consists of fifty (50) vertical lift spillway gates, each with a rectangular gate to control discharge. During a PMF event, headwater rises above the normal operating range and discharge passes over the spillway crest assuming all fifty gates are in the up and stored configuration. As the headwater level increases, flow is un-restricted until the free flowing nappe first contacts the bottoms of the raised gates. The discharge under the gates is predicted by orifice flow equations. As the headwater elevation continues to rise, it will eventually flow over the raised gates. At this point discharge is occurring both above and below the raised gates. The dam embankment elevation was raised in 1988 to accommodate the PMF to ensure no overflow of the dam.

This headwater rating curve is based on the configuration of the Nottely Dam as defined on the current design drawings. The purpose of this calculation does not evaluate the design loading conditions for the dam.

Headwater rating curves are computed for three separate scenarios as follows:

- Case 1 – Headwater Rating Curve with Turbine Flow
- Case 1a – Headwater Rating Curve without Turbine Flow
- Case 2 – Headwater Rating Curve with Gate Failure and without Turbine Flow

Previous revisions included curves with and without turbine flow in which the gates remained in the stored position. In Revision 2, a third scenario is added in which the gates fail in the open stored position, without turbine flow, due to a PMF event.

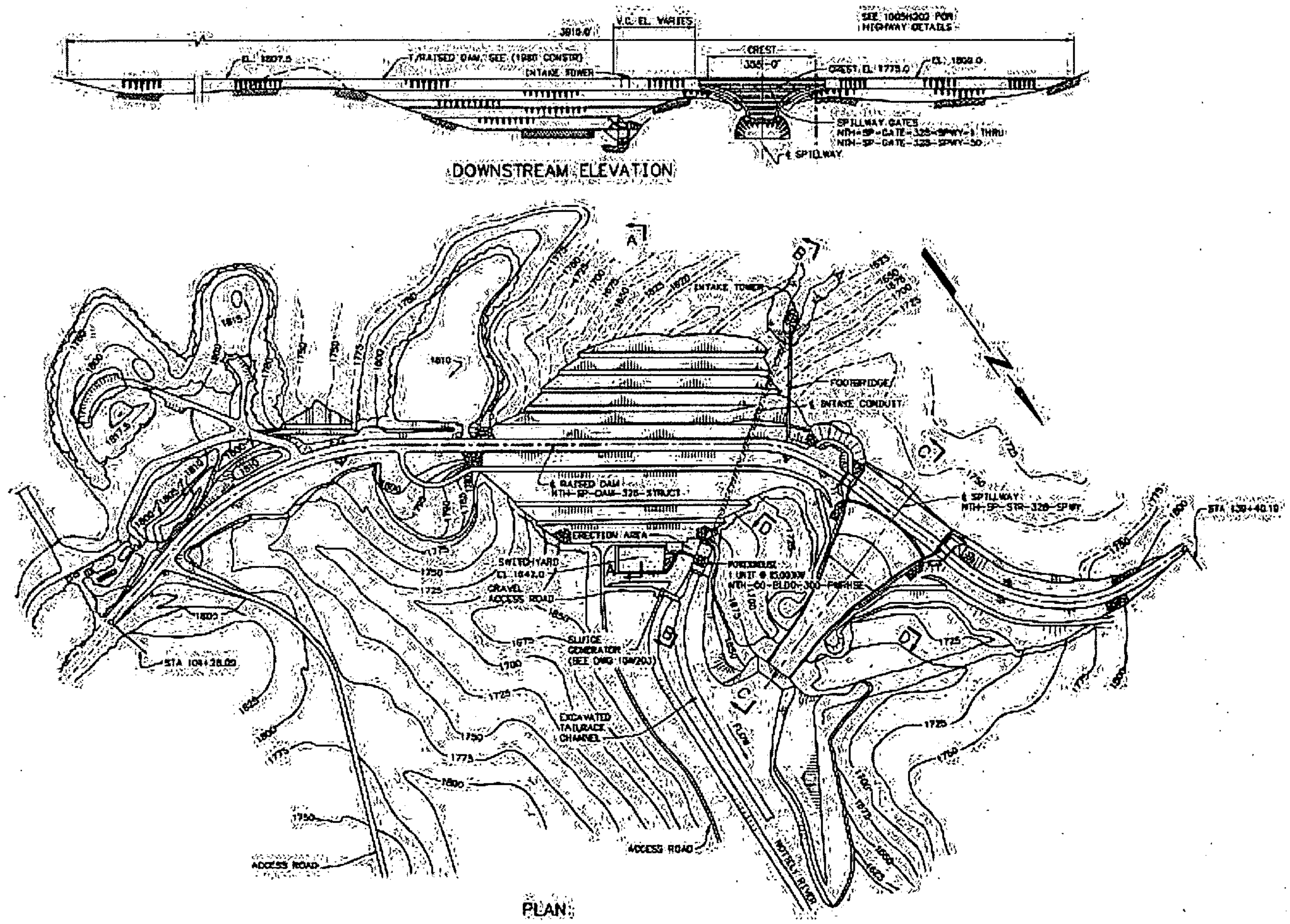


Figure 1 – Nottely Dam, General Plan and Elevation (Reference 2.1.1)

2. References

2.1. TVA Drawings

2.1.1. 10W200, R18 (Attachments 8 and 17)

2.1.2. 54W320, R3 (Attachments 9 and 18)

2.1.3. 21E205-1, R4 (Attachments 10 and 19)

2.1.4. 54N310, R1 (Attachments 11 and 20)

2.1.5. 58N202, R1 (Attachments 12 and 21)

2.1.6. 41W600, R7 (Attachments 13 and 22)

2.2. "Nottely Dam Spillway Discharge Tables", River Operations, Tennessee Valley Authority, 2004 (Attachments 3 and 15)

2.3. "Hydraulic Design Criteria", USACE (U.S. Army Corp of Engineers), U. S. Army Engineer Waterways Experiment Station, Eighteenth Issue, Vicksburg, MS, 1998.

2.4. Tennessee Valley Authority. "Spillway Discharge Studies: Nottely Project Rating Curve." Engineering Lab Project Files. Box 53760 (K04K070). ASF 590. (Attachment 2)

2.5. Hydraulic Design Chart 711 (HDC 711) from Reference 2.3 (Attachment 5).

2.6. U.S. Department of the Interior. "Design of Small Dams." U.S. Government Printing Office. 1977.

2.7. TVA Files, Binder "River Scheduling: Tailwater Rating Curves by Project." (Attachment 1)

2.8. TVA Water Control Project Blue Book. Nottely Dam. July 2001. Page 41. (Attachments 6, 7 and 16)

2.9. "Basis for Dam Spillway Gate/Outlet Open Configuration for Flood Analyses," Tennessee Valley Authority, May 29, 2009 (EDMS No. L58 090529 800).

3. Assumptions & Methodology

The headwater rating curves developed in these calculations will be used in simulations of probable maximum flood events. Consequently, the rating curves have been calculated well above the normal operating range.

3.1. Assumptions

3.1.1. Assumption: The Unit 1 turbine will be operating during the PMF event for tailwater elevations of less than 1643 feet.
Technical Justification: The unit 1 turbine will be in operation until there is a technical reason to shut off the turbine. The elevation of the powerhouse and switchyard (Reference 2.1.1 and Reference 2.1.6) is lower than the anticipated tailwater levels shown in Attachment 1 (Reference 2.7). Therefore, the switchyard and powerhouse will be submerged whenever the tailwater levels exceed approximately 1643 feet. If the tailwater elevation is less than 1643 feet, the turbine will be assumed to be operating at a maximum sustainable discharge of 1800 cfs as indicated in Attachment 7.

3.1.2 Assumption: Tailwater does not affect spill discharge at Nottely.
Technical Justification: See Attachment 1 for tailwater curve plot of discharge versus elevation which indicates that the maximum tailwater elevation would be much less than the spillways crest elevation of 1775.0 thereby not affecting the discharge.

3.1.3 Assumption: The tailwater rating curve provided as Attachment 1 is used in the evaluation of headwater rating curve calculations.
Technical Justification: This curve was produced by TVA's River Operations Flood Risk Group. The maximum estimated overflow presented in this calculation is 166,000 cfs which places the tailwater elevation at approximately 1666 feet. Since the crest elevation is located at approximately 1775 feet, there is a possibility for over 100 feet of error in the tailwater rating curve before it affects the overflow of the dam. Since a flood of this magnitude would be highly unlikely as well as incredibly destructive, it is assumed that the tailwater will have no effect on the overflow of the dam. Reference 2.1.1 also shows that the dam was designed for a maximum tailwater elevation of 1638.7 at a flow of 57,000 cfs, a minimum tailwater elevation of 1605.6 at no flow and a normal tailwater elevation of 1613.5 at a flow of 1730 cfs. These values correlate well with the curve and show that the model used to predict the tailwater curve is accurate enough to make this assumption.

3.1.4 Assumption: The embankments will not be overtopped during a PMF event.
Technical Justification: The dam safety modifications completed in the late 1980s were designed to ensure that the embankments will not be overtopped during a PMF event (Reference 2.8, relevant pages included in Attachment 6).

3.1.5 Assumption: All spillway gates will remain operable and will be set to the maximum openings specified in the spillway discharge tables.
Technical Justification: For technical justification, see Reference 2.9, "Basis for Dam Spillway Gate/Outlet Open Configuration for Flood Analyses."

3.1.6 Assumption: The position of the Nottely spillway gates will not be significantly changed at headwater levels up to 1789.8 feet (transition point from free flow to orifice flow). The spillway gates will remain in place when the headwater level is at or below 1789.8 feet. The spillway gates' stability is indeterminate for water levels above elevation 1789.8 feet and the gates will be considered to fail (total washout).
Technical Justification: There are no structural evaluations that confirm the structural integrity of the spillway gates in their stored position. Headwater levels above this value results in water forces directly impacting the lower portion of the raised gate. In the fully raised stored position, only the lower rollers are in contact with the gate guides. At headwater levels at or above 1789.8 feet, the gate is in the flow path. The gate has been judged to be wedged at the lower roller within the guide, and any structural failure of the gate was judged to be bending; not a total washout of the gate. However, even if a total washout of the gate occurred, the remaining orifices that would allow flow through would represent only a minor increase in flow capacity from the calculated values, and would have discernable impact on downstream PMF levels. Once the water reaches the midpoint of the gate, the

gate stresses increase significantly and it is uncertain the gates will remain in place. For conservatism, the gates will be considered to fail (total washout) when water elevations rise above 1789.08 feet on the gate (midpoint of fully raised stored gate), which corresponds to a headwater elevation of 1789.8 feet.

3.2 Unverified Assumptions (UVA)

None.

3.3 Methodology -- Discharge Equations

3.3.1 Case 1 – Free Flow through Spillways (1775'<H_W<H_T)

As water level rises and gates are opened, water will crest the spillway and flow as a weir flow as shown in Figure 2 above H_w=1775'. This type of flow will continue until the water level reaches H_T. H_T is the height at which the nappe touches the bottoms of the raised gates and will be discussed further in Section 3.3.2.

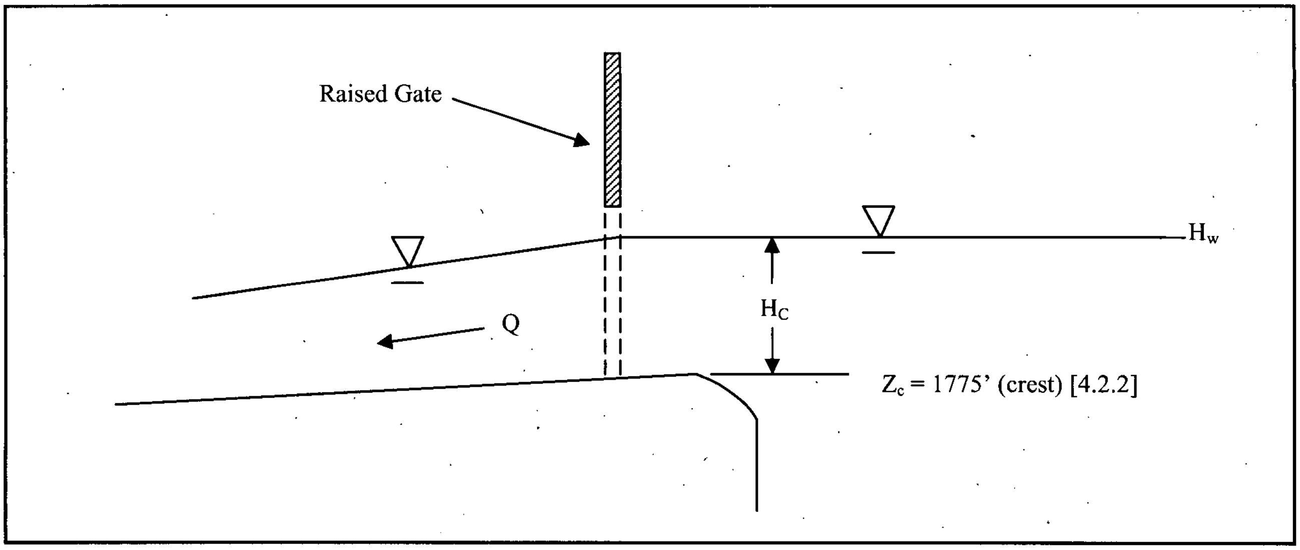


Figure 2 – Case 1 Illustration

Standard flow computations are not utilized for this scenario as a rating curve giving Q_f vs. Headwater Elevation is available from the TVA Spillway Discharge Study dated November 4, 1942 for the Nottely Project (Reference 2.4, Attachment 2). This free discharge curve can be modeled using the following polynomial:

$$Q_f = 0.4163H_C^4 - 16.551H_C^3 + 413.75H_C^2 + 602.98H_C \quad (1)$$

Where H_c is the head over crest (ft)

Figure 3 shows the scaled points and the fit derived from the data. Also note that the rating curve in Attachment 2 is still in use in the most updated spillway discharge tables by TVA (Reference 2.2, Attachment 3) and correlates very well with the current data.

Note that this curve was derived from model data. The preliminary measured flows were less than 2000 cfs (see note on attachment) and the rest of the curve was fit by scale model simulations.

Submergence factors and related calculations are unnecessary as there are no tailwater effects (Assumption 3.1.2).

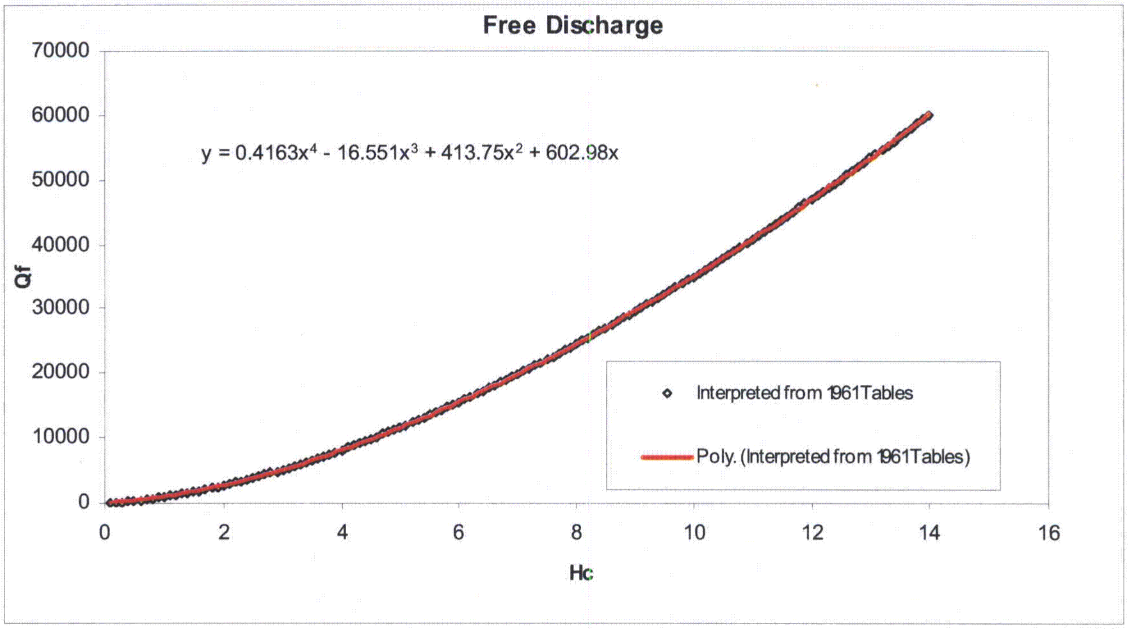


Figure 3– Nottely Spillway Discharge Curve

3.3.2 Case 2 - Transition Region ($H_{bottom}<H_W<H_T$)

The flow does not transform into orifice flow as soon as the water height reaches the elevation of the bottoms of the gates (See Figure 4). There is a transition zone in which unknown behavior of the flow is anticipated. Attachment 11 (Dwg. 54N310, View-Typical Section Thru Centerline of Gate) shows a water elevation of 1788.5 (H_C=13.5') and a height of nappe at the crest equal to 1785.4' (H_n=10.4'). The ratio of these values is taken to develop a relationship between the water elevation and nappe height for a given crest geometry.

$$\frac{H_c}{H_n} = \frac{13.5'}{10.4'} = 1.30 \quad (2)$$

Where H_n is the height of the nappe directly beneath the spillway gates.

This ratio can be assumed as constant for the same crest. Therefore, H_T = 1.3(d) = 1.3*11.4' = 14.8' over the crest or a headwater elevation of 1789.8'. Note that d=11.4' comes from Attachment 9, Elevation A-A/B-B.

The headwater elevation will remain relatively constant as the nappe gradually rises to equal the previously determined H_T value. At this point, the flow is no longer in the transition region and the headwater will continue to rise (see Figure 5).

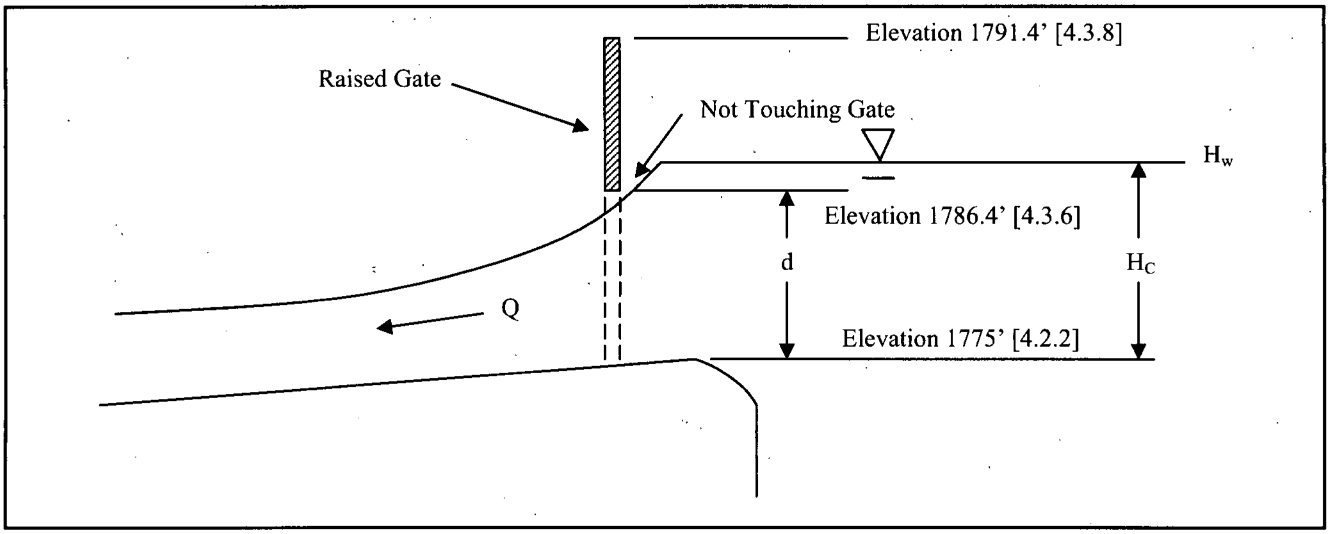


Figure 4 – Transition Region – Not Touching Gate

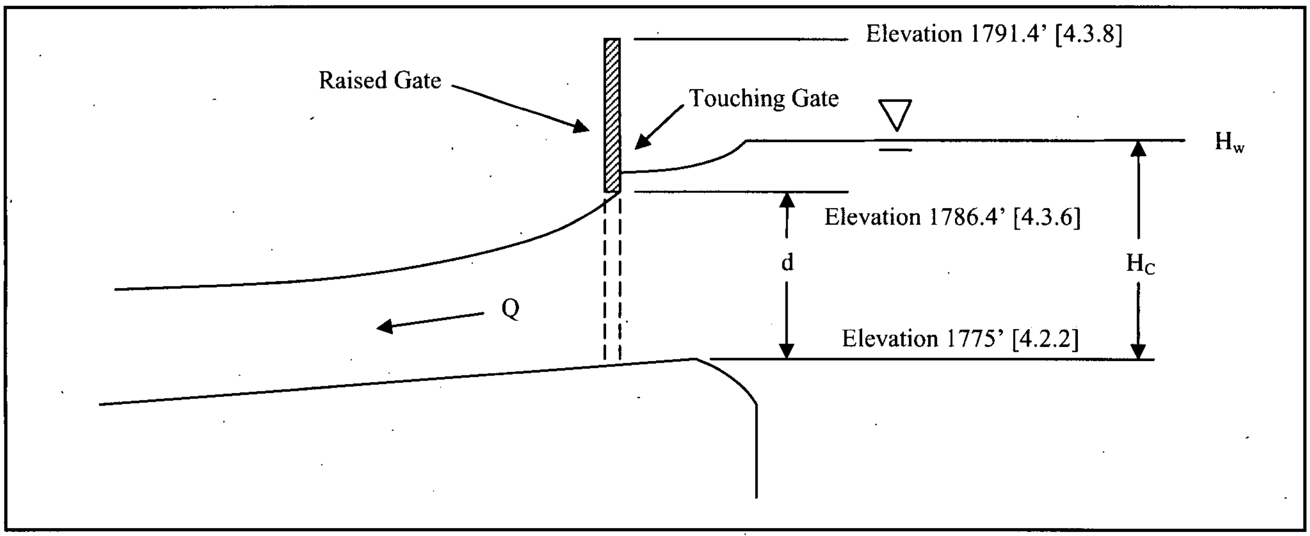


Figure 5 – Transition Region – Touching Gate

3.3.3 Case 3 – Orifice flow through gates ($H_T < H_W < H_{MAX}$)

As headwater rises, it eventually reaches a level beyond the transition zone (See Figure 6). For headwaters above that level, discharge is predicted using an orifice type equation. Model data for the gated flow at Nottely are not available, but Reference 2.6 provides a relationship between C_O (the orifice discharge coefficient) and d/H that may be used as an approximation in the following equation for orifice discharge, Q_O:

$$Q_O = \frac{2}{3}\sqrt{2g}C_O L\left[H_c^{1.5} - (H_C - d)^{1.5}\right] \quad (3)$$

with C_O taken from Fig 257 (Attachment 4) out of Reference 2.6, L= Overflow Length (ft), d = height of orifice, and g=the acceleration due to gravity. See Figure 4 for graphical representation of equation terms. All other terms are defined in Figure 5.

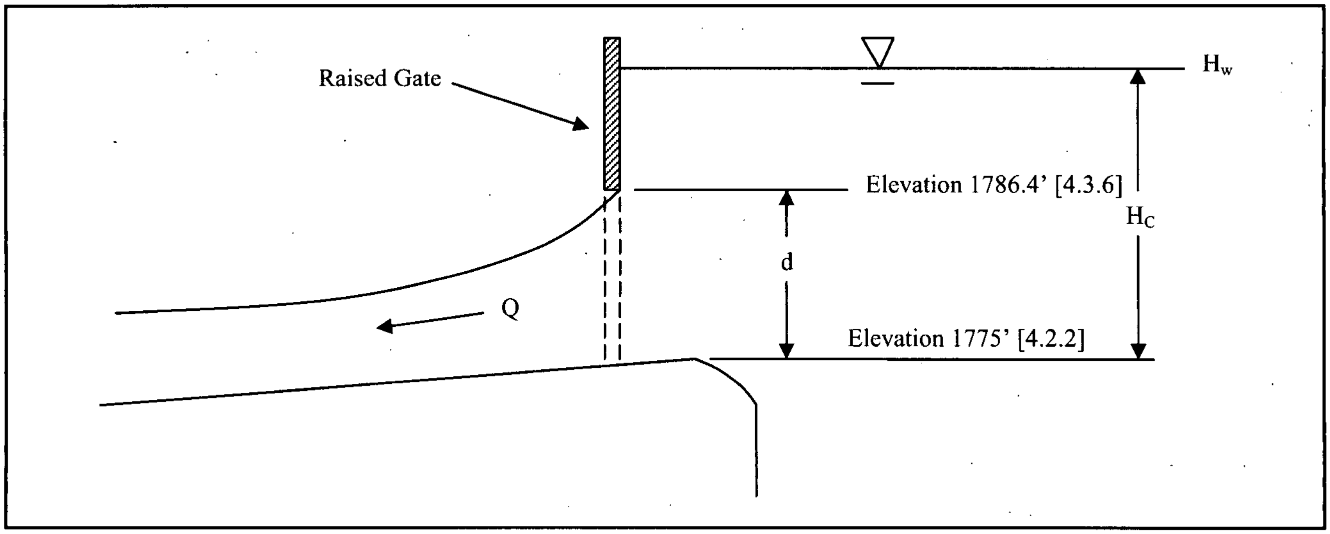


Figure 6 – Case 3 Illustration

Interpolation of C_O values from the chart in Attachment 4, yields values shown in Table 1. A linear regression fit shown in Figure 7 indicates a satisfactory estimate of C_O can be yielded for a range of H_c values from 16.29' to 32.57' for Cases 1 and 1a (in the actual figure, H_1 is equivalent to H_c in this calculation), and 15.4' to 34.29' for Case 2. The equation developed from the linear regression is shown in Equation 4 and will be used to estimate the values of C_O for a range of $16.29' < H_c < 32.57'$ for Cases 1 and 1a, and a range of $15.4' < Hc < 34.29'$ for Case 2.

Table 1: Interpolation of C_O from Figure 257 of Reference 2.6

		Cases 1&1a		Case 2	
d/H_c	C	H_c	H_w	H_c	H_w
0.78	0.638	14.63	1789.63	15.40	1790.40
0.75	0.641	15.20	1790.20	16.00	1791.00
0.70	0.646	16.29	1791.29	17.14	1792.14
0.65	0.651	17.54	1792.54	18.46	1793.46
0.60	0.656	19.00	1794.00	20.00	1795.00
0.55	0.662	20.73	1795.73	21.82	1796.82
0.50	0.667	22.80	1797.80	24.00	1799.00
0.45	0.672	25.33	1800.33	26.67	1801.67
0.40	0.6775	28.50	1803.50	30.00	1805.00
0.35	0.6825	32.57	1807.57	34.29	1809.29

Note that the maximum d/H_c on Attachment 4 is 0.70 which translates into a minimum H_c of 16.29' (i.e. d=11.4', therefore at d/Hc=0.7, Hc=11.4'/0.7=16.29') for Cases 1 and 1a. However, a value of 0.78 was needed for Case 2, giving a minimum Hc of 15.4'. Therefore, the value was extrapolated. The minimum d/H_c of 0.35 was all that was necessary to provide the data for the range of headwater elevations required by this calculation.

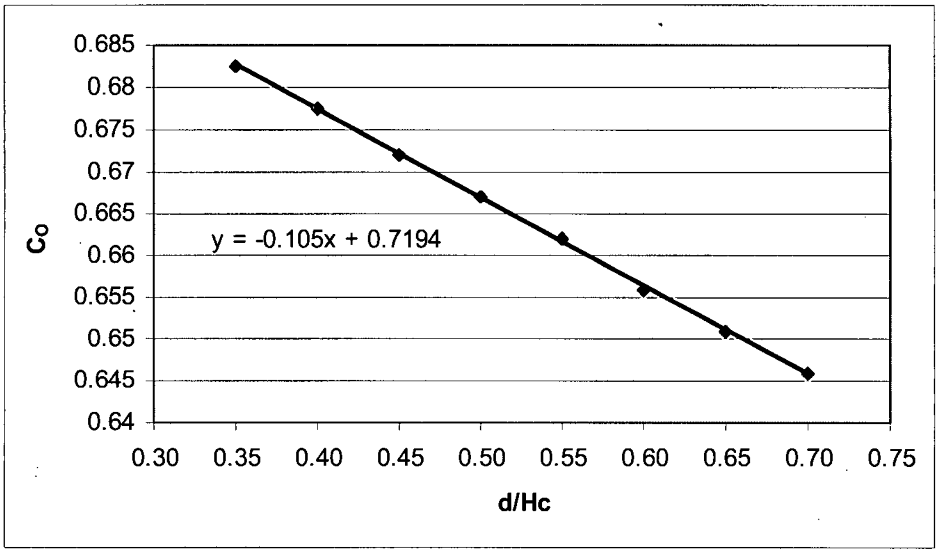


Figure 7 – Linear Regression fit for Data in Table 1

$$C_O = -.105\frac{d}{H_C} + .7194 \tag{4}$$

3.3.4 Case 4 – Combined Orifice Flow through Gates and Weir Flow Over Gates ($H_W > H_{Top}$)

As the headwater continues to rise, it will eventually overtop the raised gates at elevation 1791.4. This flow can be computed as a weir flow over the top of the gates. The C_W coefficient can be computed using USACE Hydraulic Design Criteria, specifically Hydraulic Design Chart 711 (Attachment 5, Reference 2.5). The governing weir equation is a slightly modified form of the basic weir equation and is taken as (Reference 2.5):

$$Q_W = C_W L_W (H_W - 1791.4)^{1.5} \qquad (5)$$

where L_w is the length of the weir, H_w is the elevation of the headwater, and C_w is the discharge coefficient of the weir.

The upper plot of HDC 711 (Attachment 5, Reference 2.5) shows that C_W is about 2.65 for very broad crests ($H_l/B < 0.4$ where $H_l = H_c$ and B = streamwise length of the crest) and gradually increases to 3.3, the maximum value for a "sharp crested" weir. The flood gates are approximately 4.25"** wide (Attachment 11, Reference 2.1.4). The water level can range from 0-16.1' over the top of these gates given the analysis elevations of this calculation. This yields an H_l/B ranging from 0 to 45.5, indicating that the weir will likely behave as a sharp crested weir. Since the estimation of discharge over the top of various sections of the dam is an approximation, small variations of C_W with H_c are not modeled. Consequently, for all overflows C_W will be assigned a single value taken as the maximum of 3.3 since this is the value indicated for a sharp crested weir. Neglecting minor variations in C_W values has negligible impact on the dam rating curve.

**Gate is made of a 4" wide C-Channel and covered with a ¼" skin plate for a total width of approximately 4.25".

In Case 2, the gates fail as water reaches the midpoint of the gate at 1789.08 feet, when the headwater is at an elevation of 1789.8 feet. When the gates fail, the water overtops the gate machinery at elevation 1790.4 feet. This flow can be computed as a weir flow. The C_W coefficient can be computed using USACE Hydraulic Design Chart 711. The governing weir equation is a slightly modified form of Equation 5:

$$Q_W = C_W L_W (H_W - 1790.4)^{1.5} \qquad (6)$$

where L_w is the length of the weir, H_w is the elevation of the headwater, and C_w is the discharge coefficient of the weir.

The gate machinery is approximately 11" wide (Attachment 9, Reference 2.1.2). The weir will likely behave as a sharp crested weir. Consequently, for all overflows C_W will be assigned a single value taken as the maximum of 3.3. Neglecting minor variations in C_W values has negligible impact on the dam rating curve.

4. Design Input

Sect.	Input Parameter	Source	Symbol	Value
4.1	Acceleration of gravity	Common knowledge	g	32.2 ft/sec^2
4.2	**Spillway crest parameters**			
4.2.1	Crest length	50, 6' wide gates, Reference 2.1.4, Key Plan View	L	300 feet
4.2.2	Crest elevation	Reference 2.1.1, Downstream Elevation View	Z_c	1775 feet
4.2.3	Free discharge curve	Polynomial fit to model data demonstrated in Figure 3 (Reference 2.7)	Q_f	Equation 1
4.3	**Spillway gate parameters – Gates remain in place**			
4.3.1	Vertical opening	Reference 2.1.2, Elevation A-A and B-B, also Fig. 4	d	11.4 feet
4.3.4	Headwater elevation at which nappe touches gates	Justification in Section 3.3.2	H_T	1789.8 feet
4.3.5	Orifice discharge coefficient	Estimated by Equation 4 in Section 3.3.3	$C_O(H_c)$	Equation 4
4.3.6	Bottom Elevation of Raised Gates	Reference 2.1.2, Elevation A-A and B-B	H_{bottom}	1786.4 feet
4.3.7	Height of Gates	Reference 2.1.4, Section B-B	V	5.0 feet
4.3.8	Top Elevation of Raised Gates	Bottom Elevation of Raised Gates plus the gate height	H_{top}	1791.4 feet
4.3A	**Spillway gate parameters – Gates fail**			
4.3A.1	Vertical opening	Reference 2.1.2, Elevation A-A and B-B, also Fig. 4	d	12 feet
4.3A.4	Headwater elevation at which gates fail	Justification in Section 3.3.2	H_T	1789.8 feet
4.3A.5	Orifice discharge coefficient	Estimated by Equation 4 in Section 3.3.3	$C_O(H_c)$	Equation 4
4.4	**Spillway gate overflow**			
4.4.1	Overflow discharge coeff.	Justification in Section 3.3.4	C_W	3.3
4.4.2	Overflow elevation – Gates Remain	Bottom Elevation of Raised Gates plus the gate height	Z_w	1791.4 feet
	Overflow elevation – Gates fail	Reference 2.1.2, Elevation D-D	Zw	1790.4 feet
4.4.3	Overflow length	Reference 2.1.5, Plan View	L_W	325 feet
4.4A	**Overflow weir Discharge – Gates remain**	Justification in Section 3.3.4	Qw	Equation 5
4.4B	**Overflow weir Discharge – Gates fail**	Justification in Section 3.3.4	Qw	Equation 6
4.5	**Tailwater Rating Curve**			
4.5.1	TW vs. total discharge, Q	Reference 2.7	TW(Q)	Equation 7
4.6	Upper Limit on Headwater Elevation for Rating	Top of Dam Elevation	H_{max}	1807.5
4.7	**Turbine Flow**			
4.7.1	Turbine Flow when $TW \leq 1643$ feet	Assumption 3.1.1 and Attachment 7	Q_T	1800 cfs
4.7.2	Turbine Flow when $TW > 1643$ feet	Assumption 3.1.1	Q_T	0 cfs

4.8 Tailwater rating curve

The tailwater rating curve used in this calculation is shown in Attachment 1-1. Attachment 1-2 lists points scaled from this plot and shows a polynomial fit to the result. The polynomial indicated in Attachment 1-2 and repeated below is used for the dam rating curve calculations.

$$TW = 1611.1148 + 0.8083Q - 6.807 \times 10^{-3}Q^2 + 3.305 \times 10^{-5}Q^3 - 5.759 \times 10^{-8}Q^4 \quad (7)$$

in which Q = total discharge past the dam in cfs divided by 1000 ("1000 cfs").

5. Special Requirements/Limiting Conditions

N/A

6. Calculations

The calculations consist of computing spillway and overflow discharges (from Equations 1 through 4) for a list of headwater elevations ranging from the minimum for which discharge exceeds zero up to 1807.5. The headwater rating curve is a plot of headwater elevation versus total dam discharge.

Table 2 shows the spreadsheet calculations for the headwater rating curve (spreadsheet included as Attachment 14). The final result, the rating curve, is defined by the first two columns, HW vs. Total Discharge and is shown in Figure 7.

The calculations presented in Table 2 are a reflection of the methodologies outlined in Section 3. The Free Flow column is computed using the spillway discharge curve shown in Figure 3 and represented by Equation 1. C_f is obtained by utilizing Equation 2 and the flow is calculated using Equation 1.

There are no particular calculations shown for the transition region. The geometry of this dam's crest and height of the spillway gates gives a transition area of less than 6". Therefore, it was judged that calculations would not be required in this region.

The orifice flow columns calculate the flow once the water level exceeds H_T and the flow transforms into orifice flow versus a free discharge as before. C_O is calculated utilizing Equation 4 and the flow is calculated by Equation 3.

The Overtopping Flow in Cases 1 and 1a is the flow over the tops of the raised gates. It is combined with the orifice flow in the final discharge rating curve as both flows will be occurring simultaneously. Flow is calculated using Equation 5. C_W for this case was selected as a constant value of 3.3 and is justified in Section 3.3.4.

The Overtopping Flow in Case 2 is the flow over the top of the gate machinery at a headwater elevation of 1790.4 feet when the gates fail. It is combined with the orifice flow in the final discharge rating curve as both flows will be occurring simultaneously. Flow is calculated using Equation 6. C_W for this case was selected as a constant value of 3.3 and is justified in Section 3.3.4.

The turbine flow is calculated as outlined in Assumption 3.1.1 and section 4.7

The Total Discharge column provides the final discharge curve values in 1000 cfs and is simply a summation of flows in the appropriate flow regimes as outlined above.

Table 3 shows the calculations for case 1a which are performed identical to case 1 with the omission of the turbine flow.

Table 4 shows the calculations for Case 2 which are performed similar to Case 1a but with gate failure.

Nottely Dam Headwater Rating Curve - With Turbine Flow

Spill Way Parameters
L= 300 feet
Z_c= 1775 feet
d= 11.4 feet
L_w= 325 feet

					Free Flow	Orifice Flow		Overtopping Flow		Turbine Flow
HW Elev (feet)	Total Discharge (1000 cfs)	TW Elev (feet)	Hc (feet)	d/Hc	Q_F (cfs)	C_O	Q_O (cfs)	C_w	Q_W (cfs)	Q_T (cfs)
1775	1.80	1612.5	0	0.00	0	-	0	-	0	1800
1777	4.54	1614.6	2	5.70	2735	-	0	-	0	1800
1779	9.88	1618.5	4	2.85	8079	-	0	-	0	1800
1781	17.28	1623.2	6	1.90	15477	-	0	-	0	1800
1783	26.33	1628.3	8	1.43	24535	-	0	-	0	1800
1785	36.82	1633.2	10	1.14	35017	-	0	-	0	1800
1786.4	44.96	1636.5	11.4	1.00	43155	-	0	-	0	1800
1787	48.65	1637.8	12	0.95	46848	-	0	-	0	1800
1789	61.91	1642.1	14	0.81	60113	-	0	-	0	1800
1789.8	65.87	1643.2	14.8	0.77	65870	-	0	-	0	0
1791.29	56.95	1640.6	16.29	0.70	0	0.6459	56950	-	0	0
1791.4	57.31	1640.7	16.4	0.70	0	0.6464	57305	-	0	0
1793	64.43	1642.8	18	0.63	0	0.6529	62258	3.3	2171	0
1795	75.31	1645.6	20	0.57	0	0.6596	67984	3.3	7326	0
1797	87.51	1648.5	22	0.52	0	0.6650	73300	3.3	14213	0
1799	100.75	1651.3	24	0.48	0	0.6695	78283	3.3	22471	0
1801	114.89	1654.2	26	0.44	0	0.6734	82988	3.3	31901	0
1803	129.83	1657.3	28	0.41	0	0.6767	87455	3.3	42373	0
1805	145.51	1660.6	30	0.38	0	0.6795	91718	3.3	53791	0
1807	161.88	1664.2	32	0.36	0	0.6820	95801	3.3	66082	0
1807.5	166.08	1665.2	32.5	0.3508	0	0.6826	96796	3.3	69285	0

Table 2 – Case 1 Calculation

Nottely Dam Headwater Rating Curve - No Turbine Flow

Spill Way Parameters

L= 300 feet

Z_c= 1775 feet

d= 11.4 feet

L_w= 325 feet

					Free Flow	Orifice Flow		Overtopping Flow	
HW Elev (feet)	Total Discharge (1000 cfs)	TW Elev (feet)	Hc (feet)	d/Hc	Q_F (cfs)	C_O	Q_O (cfs)	C_w	Q_W (cfs)
1775	0.00	1611.1	0	0.00	0	-	0	-	0
1777	2.74	1613.3	2	5.70	2735	-	0	-	0
1779	8.08	1617.2	4	2.85	8079	-	0	-	0
1781	15.48	1622.1	6	1.90	15477	-	0	-	0
1783	24.53	1627.3	8	1.43	24535	-	0	-	0
1785	35.02	1632.4	10	1.14	35017	-	0	-	0
1786.4	43.16	1635.8	11.4	1.00	43155	-	0	-	0
1787	46.85	1637.2	12	0.95	46848	-	0	-	0
1789	60.11	1641.5	14	0.81	60113	-	0	-	0
1789.8	65.87	1643.2	14.8	0.77	65870	-	0	-	0
1791.29	56.95	1640.6	16.29	0.70	0	0.6459	56950	-	0
1791.4	57.31	1640.7	16.4	0.70	0	0.6464	57305	-	0
1793	64.43	1642.8	18	0.63	0	0.6529	62258	3.3	2171
1795	75.31	1645.6	20	0.57	0	0.6596	67984	3.3	7326
1797	87.51	1648.5	22	0.52	0	0.6650	73300	3.3	14213
1799	100.75	1651.3	24	0.48	0	0.6695	78283	3.3	22471
1801	114.89	1654.2	26	0.44	0	0.6734	82988	3.3	31901
1803	129.83	1657.3	28	0.41	0	0.6767	87455	3.3	42373
1805	145.51	1660.6	30	0.38	0	0.6795	91718	3.3	53791
1807	161.88	1664.2	32	0.36	0	0.6820	95801	3.3	66082
1807.5	166.08	1665.2	32.5	0.3508	0	0.6826	96796	3.3	69285

Table 3 – Case 1a Calculation

Nottely Dam Headwater Rating Curve - Gate Failure Without Turbine Flow

Spill Way Parameters

L= 300 feet
Z_c= 1775 feet
d= 11.4 feet
d= 12 feet (bottom of walkway at 1781.0') after gates fail at HW = 1789.8'
L_w= 325 feet

HW Elev (feet)	Total Discharge (1000 cfs)	TW Elev (feet)	Hc (feet)	d/Hc	Free Flow Q_F (cfs)	Orifice Flow C_O	Orifice Flow Q_O (cfs)	Overtopping Flow C_w	Overtopping Flow Q_W (cfs)
1775	0.00	1611.1	0	0.00	0	-	0	-	0
1777	2.74	1613.3	2	5.70	2735	-	0	-	0
1779	8.08	1617.2	4	2.85	8079	-	0	-	0
1781	15.48	1622.1	6	1.90	15477	-	0	-	0
1783	24.53	1627.3	8	1.43	24535	-	0	-	0
1785	35.02	1632.4	10	1.14	35017	-	0	-	0
1786.4	43.16	1635.8	11.4	1.00	43155	-	0	-	0
1787	46.85	1637.2	12	0.95	46848	-	0	-	0
1789	60.11	1641.5	14	0.81	60113	-	0	-	0
1789.8	65.87	1643.2	14.8	0.77	65870	-	0	-	0
1790	52.28	1639.1	15	0.80	0	0.6354	52280	-	0
1790.4	53.66	1639.5	15.4	0.78	0	0.6376	53656	-	0
1791	56.16	1640.3	16	0.75	0	0.6407	55663	3.3	498
1792	61.04	1641.8	17	0.71	0	0.6453	58868	3.3	2171
1793	66.42	1643.3	18	0.67	0	0.6494	61924	3.3	4496
1795	78.24	1646.4	20	0.60	0	0.6564	67660	3.3	10581
1797	91.17	1649.3	22	0.55	0	0.6621	72985	3.3	18185
1799	105.02	1652.2	24	0.50	0	0.6669	77976	3.3	27049
1801	119.70	1655.2	26	0.46	0	0.6709	82689	3.3	37013
1803	135.13	1658.4	28	0.43	0	0.6744	87165	3.3	47968
1805	151.27	1661.9	30	0.40	0	0.6774	91434	3.3	59831
1807	168.06	1665.6	32	0.38	0	0.6800	95524	3.3	72537
1807.5	172.36	1666.6	32.5	0.37	0	0.6806	96521	3.3	75839

Table 4 – Case 2 Calculation

7. Results/Conclusions

For convenience, the headwater rating results, separate from the calculation details provided above, are tabulated as total discharge in cfs vs. headwater elevation in feet in Table 5. The headwater rating curve is plotted in Figure 8.

Note the discontinuity that appears in Figure 8 at a headwater elevation of just under 1790.4'. This is the result of the flow transitioning from free flow over the dam crest to orifice flow through the flood gates. The discontinuity was anticipated and is typical for this type of flow transition.

The headwater rating curves developed in this calculation provide Nottely total dam discharge vs. headwater elevation for use in TVA's SOCH and TRBROUTE models for simulation conditions satisfying the assumptions in [3.1]. In particular, the spillway gates must all be fully raised.

Case 1		Case 1a		Case 2	
HW (ft)	Discharge (1000 cfs)	HW	Discharge (1000 cfs)	HW	Discharge (1000 cfs)
1775	1.80	1775	0.00	1775	0.00
1777	4.54	1777	2.74	1777	2.74
1779	9.88	1779	8.08	1779	8.08
1781	17.28	1781	15.48	1781	15.48
1783	26.33	1783	24.53	1783	24.53
1785	36.82	1785	35.02	1785	35.02
1786.4	44.96	1786.4	43.16	1786.4	43.16
1787	48.65	1787	46.85	1787	46.85
1789	61.91	1789	60.11	1789	60.11
1789.8	65.87	1789.8	65.87	1789.8	65.87
1791.29	56.95	1791.29	56.95	1790	52.28
1791.4	57.31	1791.4	57.31	1790.4	53.66
1793	64.43	1793	64.43	1791	56.16
1795	75.31	1795	75.31	1792	61.04
1797	87.51	1797	87.51	1793	66.42
1799	100.75	1799	100.75	1795	78.24
1801	114.89	1801	114.89	1797	91.17
1803	129.83	1803	129.83	1799	105.02
1805	145.51	1805	145.51	1801	119.70
1807	161.88	1807	161.88	1803	135.13
1807.5	166.08	1807.5	166.08	1805	151.27
				1807	168.06
				1807.5	172.36

Table 5 – Headwater Rating Results

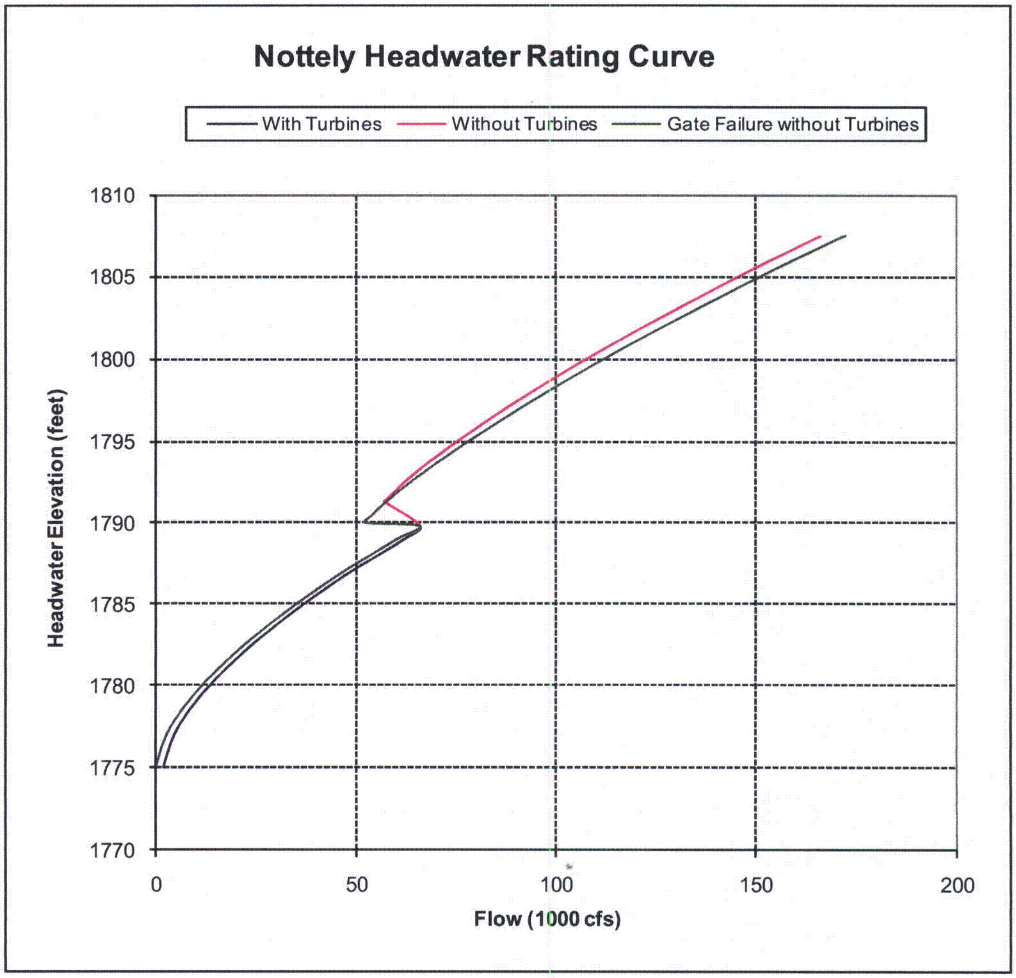
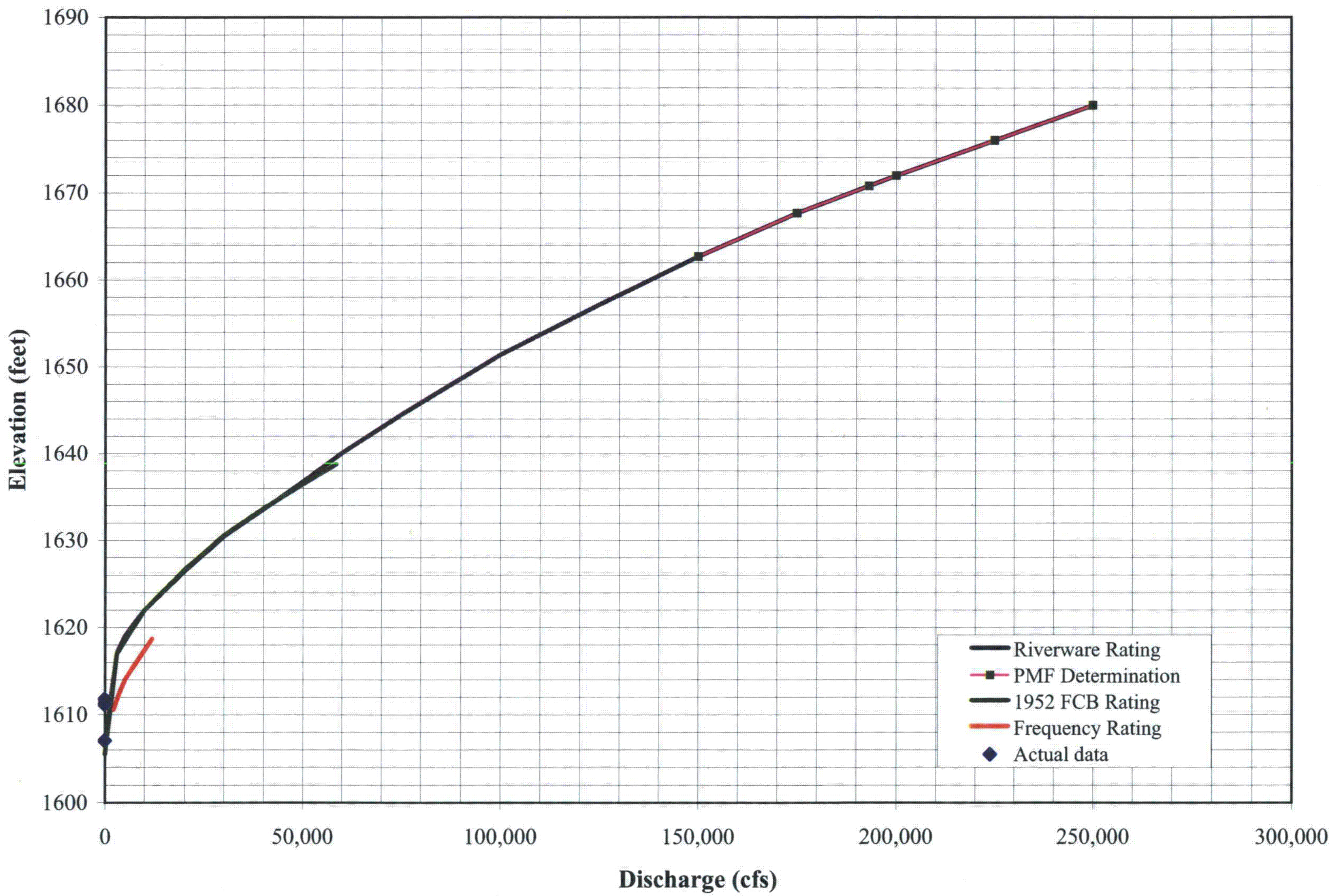


Figure 8 – Headwater Rating Curves

Nottely Tailwater Rating



Nottely Tailwater Rating

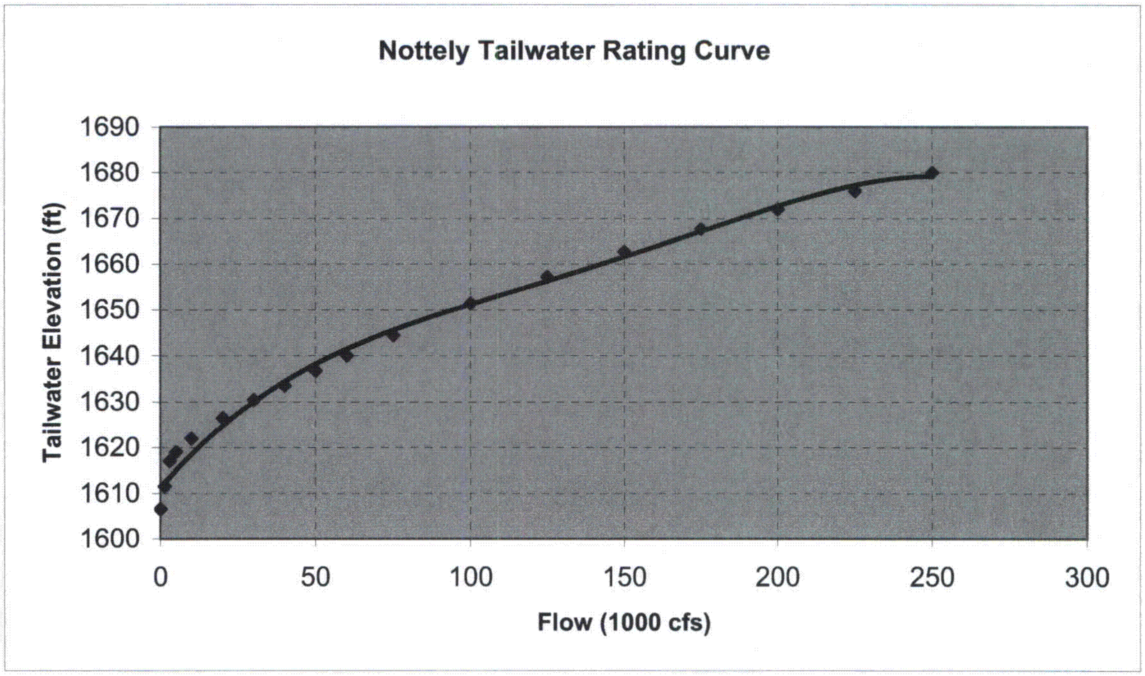
Points from Riverware Rating from Attachment 1-1

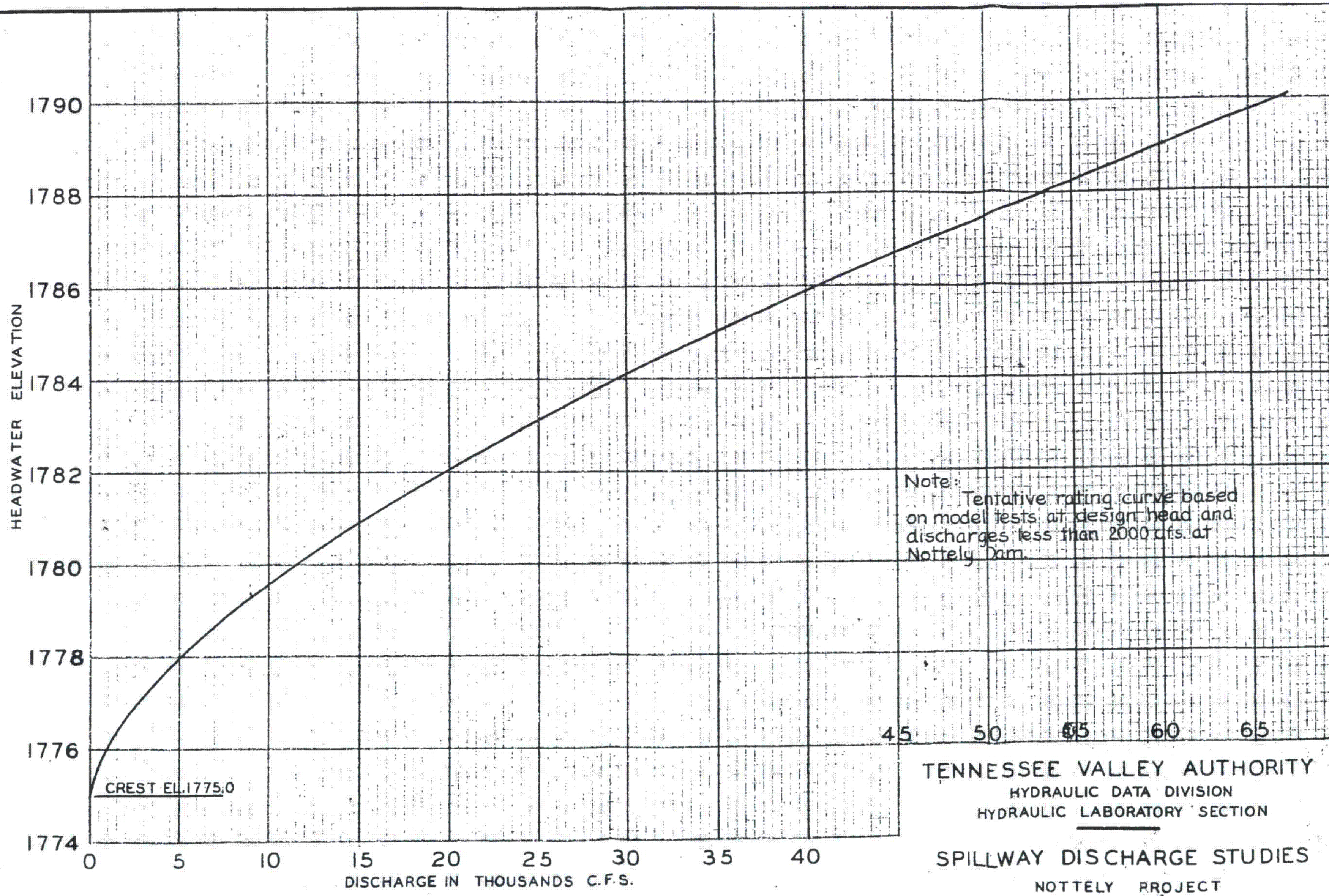
Riverware Rating			TW
Q*1000	Q	Elevation	Fit
0	0	1606.55	1611.115
0.05	50	1606.66	1611.155
1.4	1,400	1611.5	1612.233
3	3,000	1617	1613.479
5	5,000	1619	1614.99
10	10,000	1622	1618.55
20	20,000	1626.5	1624.813
30	30,000	1630.5	1630.083
40	40,000	1633.6	1634.523
50	50,000	1636.8	1638.284
60	60,000	1640.1	1641.5
75	75,000	1644.5	1645.568
100	100,000	1651.4	1651.165
125	125,000	1657.2	1656.281
150	150,000	1662.7	1661.586
175	175,000	1667.7	1667.208
200	200,000	1672	1672.735
225	225,000	1676	1677.216
250	250,000	1680	1679.159

$TW = -5.759 \times 10^{-8} Q^4 + 3.305 \times 10^{-5} Q^3 - 6.807 \times 10^{-3} Q^2 + 0.8083Q + 1611.1148$

Where TW = Tailwater Elevation in Feet

Q = Discharge through Dam in 1000 cfs





TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA DIVISION
HYDRAULIC LABORATORY SECTION

SPILLWAY DISCHARGE STUDIES
NOTTELY PROJECT
RATING CURVE
NOVEMBER 4, 1942

ASF-590

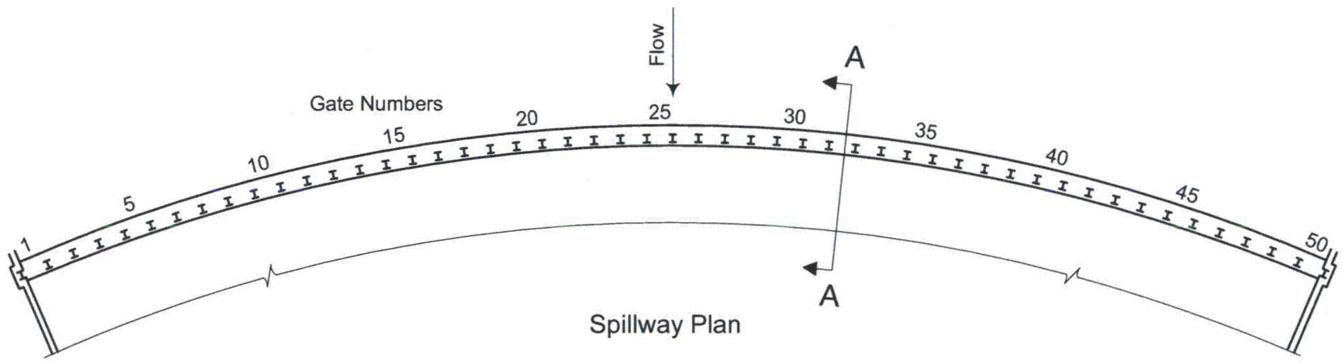
SUBMITTED A.J. Peterka
APPROVED C.W. Hickox
APPROVED A.S. Fry

DRAWN R.A.E.
CHECKED A.J.P.

MA-B-5921

NOTTELY DAM

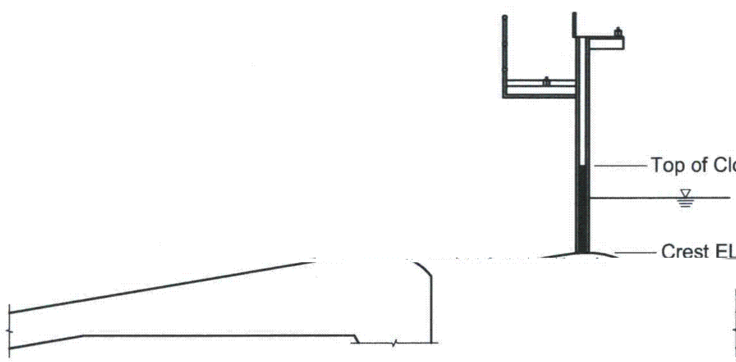
LOCATION OF SPILLWAY GATES



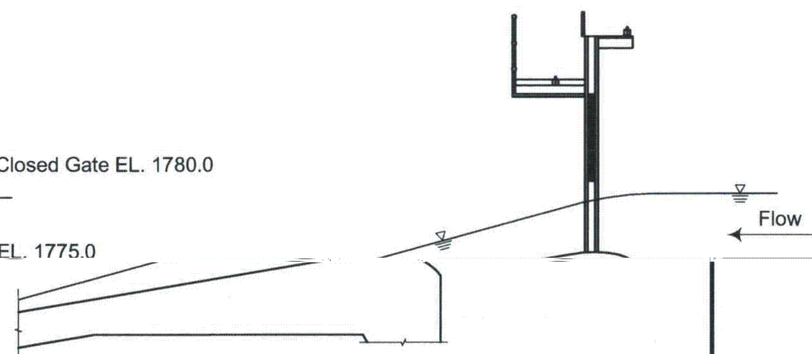
Spillway Plan

Key to Gate Arrangement Table

Designations under the gate operating conditions shown below refer to gate opening positions used in Gate Arrangement Table, Page 5



Section A-A, Gate Closed
Designated by -



Section A-A, Gate Raised Above Water Surface
Designated by R

NOTTELY DAM

SPILLWAY GATE ARRANGEMENTS

Arrange-ment Number	Gate Number																																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-
11	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-
12	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-
13	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**
14	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R
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16	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R
17	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R
18	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
19	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
20	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
21	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
22	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
23	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
24	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
25	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

GATE OPENINGS

Figures in columns under each gate number refer to gate opening indicator reading
dash (-) indicates closed gate
"R" indicates gate raised above water surface and dogged
"**R**" indicates first use of each gate

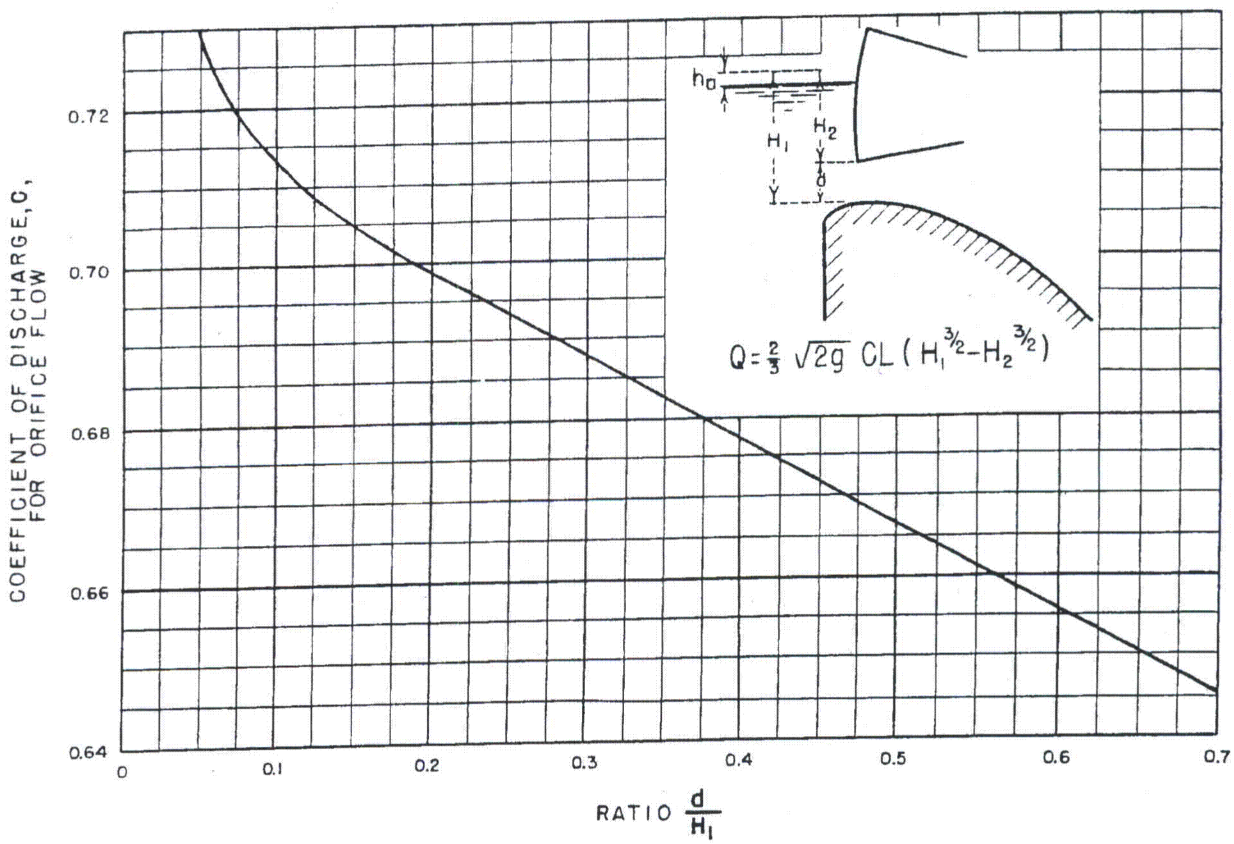


Figure 257. Coefficient of discharge for flow under gates. 288–D–2417.

is the inflow per foot of length of weir crest. The momenta [3] at the two sections therefore will be:

$$\text{Upstream, } M_u=\frac{Qv}{g} \tag{8}$$

$$\text{Downstream, } M_d=\frac{[Q+q(\Delta x)]}{g}[v+\Delta v] \tag{9}$$

Subtracting equation (8) from equation (9):

$$\Delta M=\frac{Q(\Delta v)}{g}+\frac{q(\Delta x)}{g}[v+\Delta v] \tag{10}$$

Dividing by Δx:

$$\frac{\Delta M}{\Delta x}=\frac{Q(\Delta v)}{g(\Delta x)}+\frac{q}{g}[v+\Delta v] \tag{11}$$

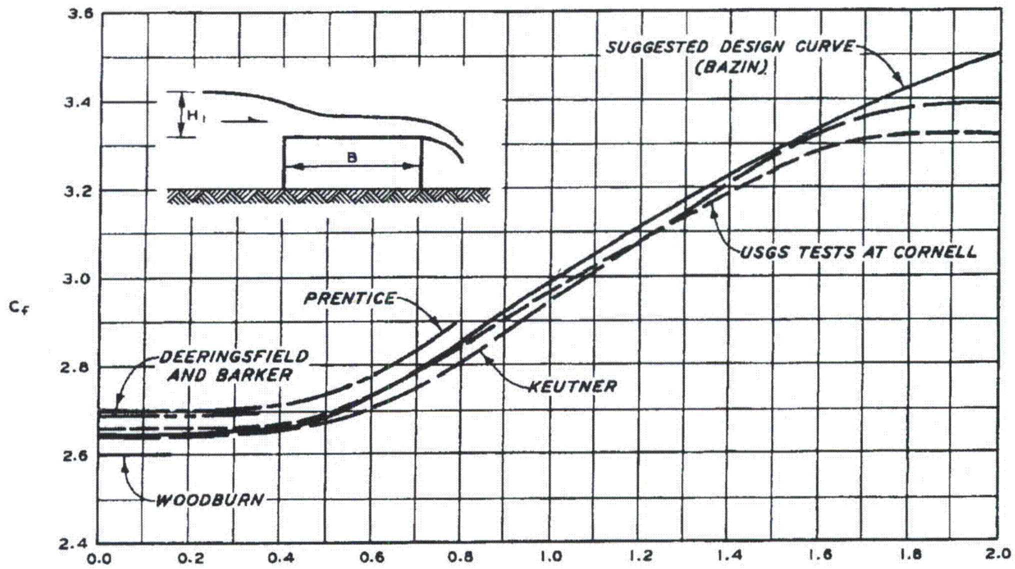
[3] The weight of 1 cubic foot of water is taken as a unit force to eliminate the necessity of multiplying all forces and momenta by 62.5 to convert them into pounds.

The rate of change of momentum with respect to time being v times the rate of change with respect to x, and considering the average velocity to be $\left[v+\frac{1}{2}(\Delta v)\right]$, equation (11) can be written:

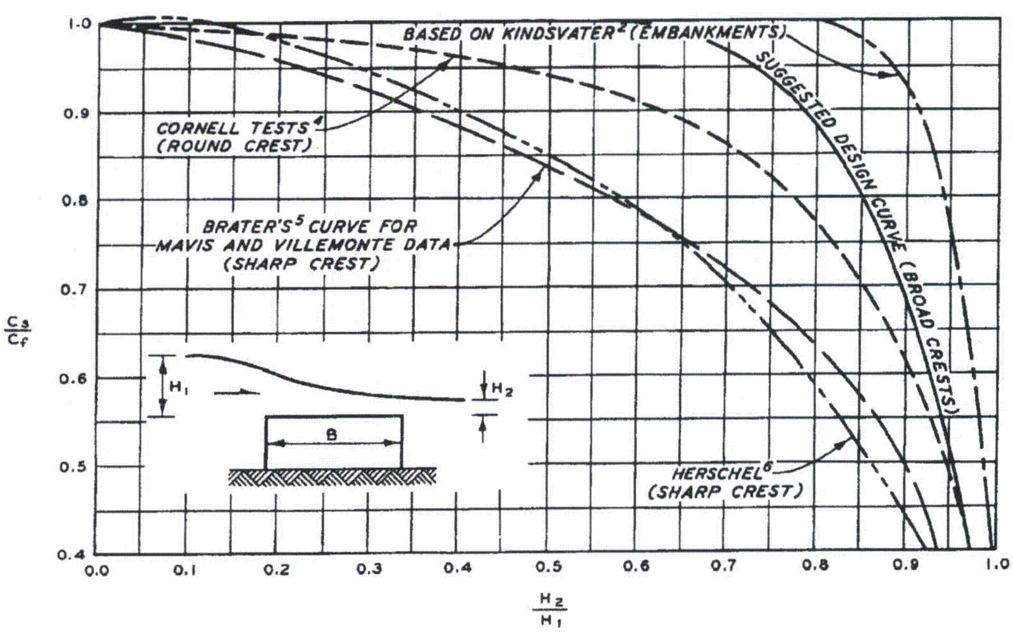
$$\frac{\Delta M}{\Delta t}=\frac{Q(\Delta v)}{g(\Delta x)}\left[v+\frac{1}{2}(\Delta v)\right]+\frac{q}{g}[v+\Delta v]\left[v+\frac{1}{2}(\Delta v)\right] \tag{12}$$

As $\frac{\Delta M}{\Delta t}$ is the accelerating force, which is equal to the slope of the water surface $\frac{\Delta y}{\Delta x}$ times the average discharge, equation (12) becomes:

$$\frac{\Delta y}{\Delta x}\left[Q+\frac{1}{2}(\Delta Q)\right]=\frac{Q(\Delta v)}{g(\Delta x)}\left[v+\frac{1}{2}(\Delta v)\right]+\frac{q}{g}[v+\Delta v]\left[v+\frac{1}{2}(\Delta v)\right] \tag{13}$$



a. FREE FLOW



b. SUBMERGED FLOW

NOTE: C_f = FREE-FLOW COEFFICIENT
C_s = SUBMERGED-FLOW COEFFICIENT
NEGLIGIBLE VELOCITY OF APPROACH
RAISED NUMBERS ON SUBMERGED FLOW CHART ARE REFERENCE NUMBERS FROM TEXT.

LOW-MONOLITH DIVERSION
DISCHARGE COEFFICIENTS
HYDRAULIC DESIGN CHART 711

WES 1-66

PREPARED BY U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISSISSIPPI

RESERVOIR RELEASES IMPROVEMENTS

The aeration and minimum flow equipment at Nottely Dam is part of the implementation of TVA's Lake Improvement Plan (LIP) approved by the Board of Directors in 1991. One of the goals of the Lake Improvement Plan is to improve the dissolved oxygen (DO) levels and minimum flows of the releases of 16 dams. Minimum flow releases of 55 cfs at Nottely were obtained by the installation of a small hydroturbine unit which is operated whenever the main unit is off. At Nottely testing showed the target minimum DO content of the release (4 mg/L) to be best achieved by the installation of air injection equipment. Blower and compressor systems inject air at the large and small hydroturbines respectively. The blower system consists of two blowers (250 hp each), controls, piping, and valves designed to inject air into the water flow through the large unit. The air compressor system consists of two air compressors, controls, piping, and valves designed to inject air into the flow through the small unit. The air compressors are rated at 25 hp each.

SAFETY MODIFICATIONS FOR PROBABLE MAXIMUM FLOOD

Chronology

Safety analysis studies for Chatuge Dam for the probable maximum flood (PMF) were started on July 29, 1976, and completed in May 1984. Final design was completed in January 1988. Onsite construction began in July 1986, and was completed on June 20, 1988.

Cost of Modifications

Design costs for the capital safety modifications to Chatuge Dam were $1,520,000. Construction costs were $13,680,000. The total project cost was $15,200,000. This total does not include costs for dam safety evaluation studies which resulted in the modifications.

Controlling Features

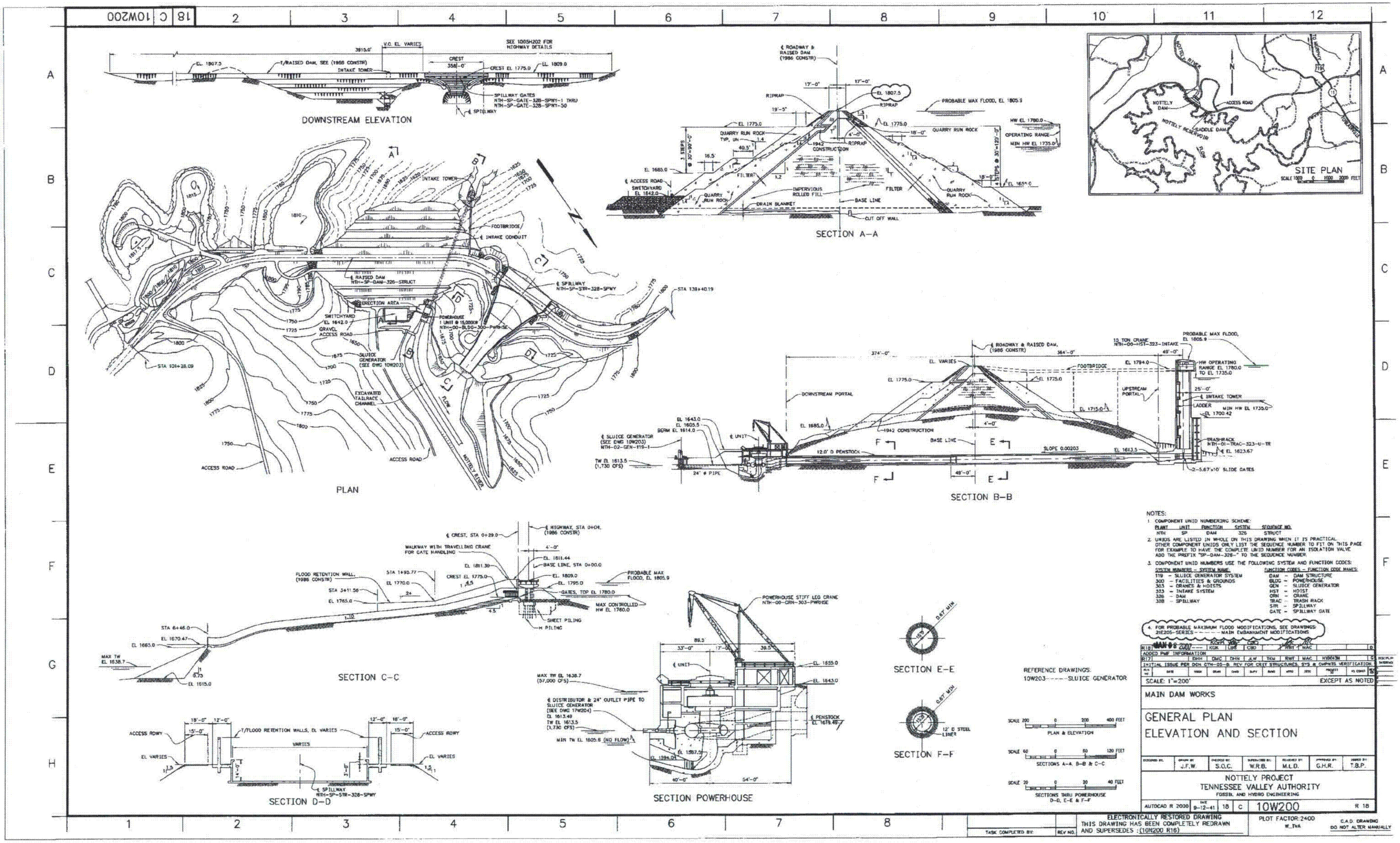
The embankments at Nottely were modified in order to safety pass the probable maximum flood. The embankments were raised to elevation 1807 by the addition of rockfill. A new bridge was built with a 30 ft. width of asphalt roadway. These PMF modifications will prevent overtopping and erosion of the embankments and thus prevent breach and failure of the dam.

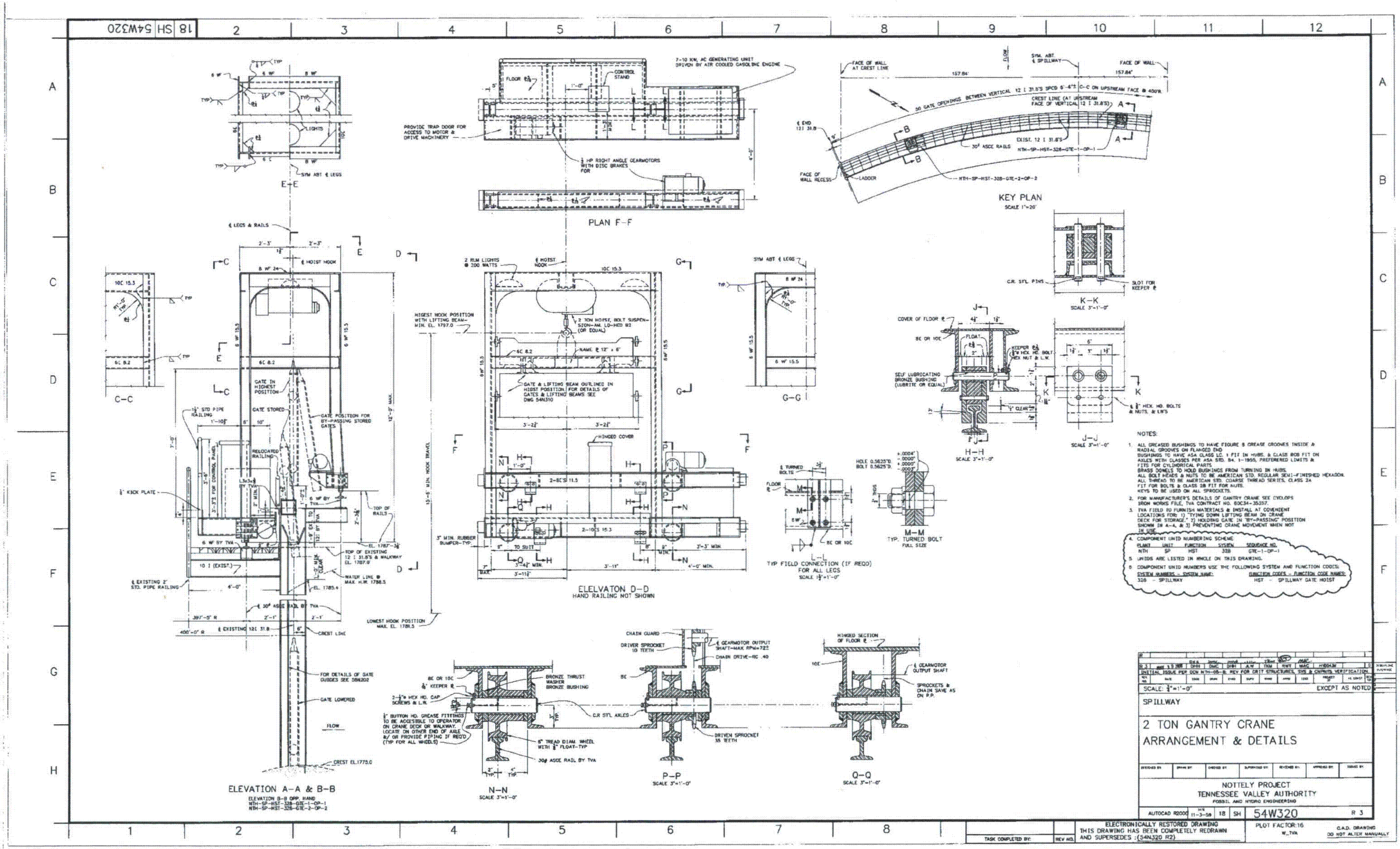
RESERVOIR AND POWER DATA

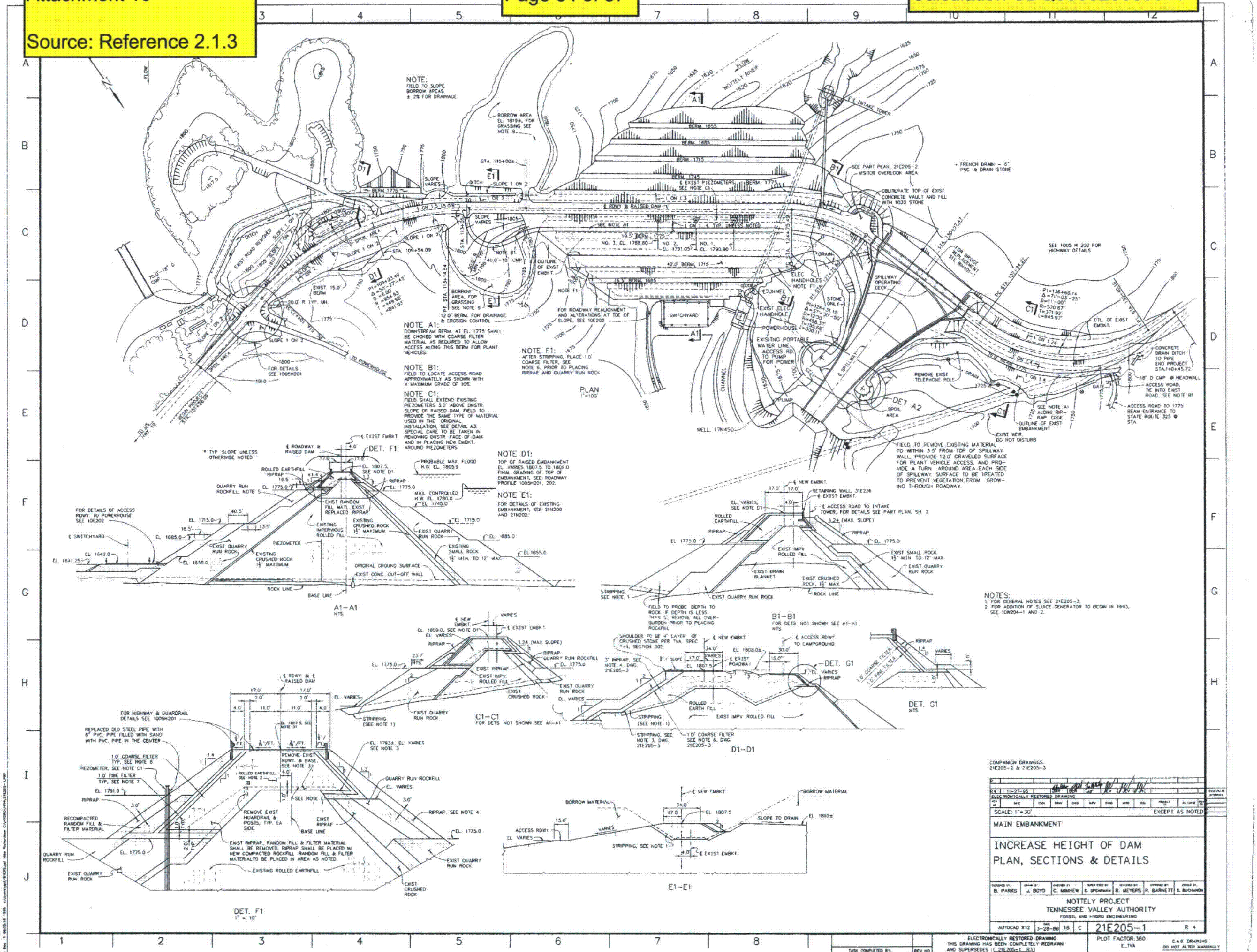
Nottely

Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Gross Head (feet)	Best Efficiency: Plant Output (mW)	Best Efficiency: Turbine Discharge (cfs)	Best Efficiency: kW/CFS	Maximum Sustainable: Plant Output (mW)	Maximum Sustainable: Turbine Discharge (cfs)	Maximum Sustainable: kW/CFS
1780	4.32	174.3	167.4	17.2	1,390	12.44	20.0	1,630	12.25
1779	4.18	170.1	166.4	17.1	1,390	12.35	20.0	1,650	12.16
1778	4.05	165.9	165.4	17.0	1,390	12.26	20.0	1,660	12.06
1777	3.93	162.0	164.3	16.9	1,390	12.17	20.0	1,670	11.96
1776	3.83	158.1	163.3	16.8	1,390	12.08	20.0	1,690	11.86
1775	3.73	154.3	162.3	16.7	1,400	11.99	20.0	1,700	11.76
1774	3.65	150.6	161.2	16.6	1,400	11.90	20.0	1,710	11.66
1773	3.56	147.0	160.2	16.5	1,400	11.81	20.0	1,730	11.56
1772	3.48	143.5	159.2	16.4	1,400	11.72	19.9	1,740	11.46
1771	3.39	140.0	158.2	16.3	1,400	11.62	19.8	1,740	11.36
1770	3.31	136.7	157.1	16.2	1,410	11.53	19.7	1,750	11.26
1769	3.23	133.4	156.1	16.1	1,410	11.44	19.6	1,760	11.15
1768	3.15	130.2	155.1	16.0	1,410	11.34	19.5	1,760	11.05
1767	3.07	127.1	154.1	15.9	1,410	11.25	19.4	1,770	10.95
1766	2.99	124.1	153.1	15.8	1,420	11.16	19.3	1,780	10.85
1765	2.92	121.1	152.1	15.7	1,420	11.06	19.2	1,790	10.75
1764	2.85	118.3	151.0	15.6	1,420	10.97	19.1	1,790	10.65
1763	2.78	115.4	150.0	15.5	1,420	10.88	19.0	1,800	10.54
1762	2.71	112.7	149.0	15.4	1,430	10.81	18.9	1,800	10.49
1761	2.65	110.0	148.0	15.3	1,430	10.73	18.8	1,800	10.43
1760	2.59	107.4	147.0	15.2	1,430	10.66	18.7	1,800	10.38
1759	2.53	104.8	146.0	15.1	1,430	10.59	18.6	1,800	10.33
1758	2.47	102.3	145.0	15.0	1,430	10.52	18.5	1,800	10.27
1757	2.42	99.9	144.0	14.9	1,430	10.45	18.4	1,800	10.22
1756	2.36	97.5	143.0	14.8	1,430	10.38	18.3	1,800	10.16
1755	2.31	95.2	142.0	14.7	1,430	10.31	18.2	1,800	10.11
1754	2.26	92.9	141.0	14.6	1,430	10.24	18.1	1,800	10.06
1753	2.21	90.6	140.0	14.5	1,430	10.17	18.0	1,800	10.00
1752	2.17	88.4	139.0	14.4	1,420	10.11	17.8	1,790	9.94

NOTE: Energy in storage data not included


DOWNSTREAM ELEVATION
SECTION A–A
SITE PLAN
PLAN
SECTION B–B
SECTION C–C
SECTION E–E
SECTION F–F
SECTION D–D
SECTION POWERHOUSE
MAIN DAM WORKS
GENERAL PLAN
ELEVATION AND SECTION
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
10W200
SCALE: 1"=200'
EXCEPT AS NOTED
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES : (10W200 R16)
PLOT FACTOR: 2400
C.A.D. DRAWING
DO NOT ALTER MANUALLY


18 SH 54W320
PLAN F-F
KEY PLAN
SCALE 1"=20'
K-K
J-J
H-H
C-C
G-G
ELELVATON D-D
HAND RAILING NOT SHOWN
ELEVATION A-A & B-B
M-M
TYP. TURNED BOLT
FULL SIZE
L-L
TYP FIELD CONNECTION (IF REQD)
FOR ALL LEGS
N-N
P-P
Q-Q
NOTES:
SCALE: 3/8"=1'-0"
EXCEPT AS NOTED
SPILLWAY
2 TON GANTRY CRANE
ARRANGEMENT & DETAILS
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
AUTOCAD R2000
18 SH 54W320
R 3
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN
AND SUPERSEDES : (54N320 R2)
PLOT FACTOR:16
W_TVA
C.A.D. DRAWING
DO NOT ALTER MANUALLY
TASK COMPLETED BY:
REV NO.



R4	11-27-95										
ELECTRONICALLY RESTORED DRAWING											

SCALE: 1"= 30' EXCEPT AS NOTED

MAIN EMBANKMENT

INCREASE HEIGHT OF DAM
PLAN, SECTIONS & DETAILS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
B. PARKS	J. BOYD	C. MAYHEW	E. SPEARMAN	R. MEYERS	R. BARNETT	S. BUCHANAN

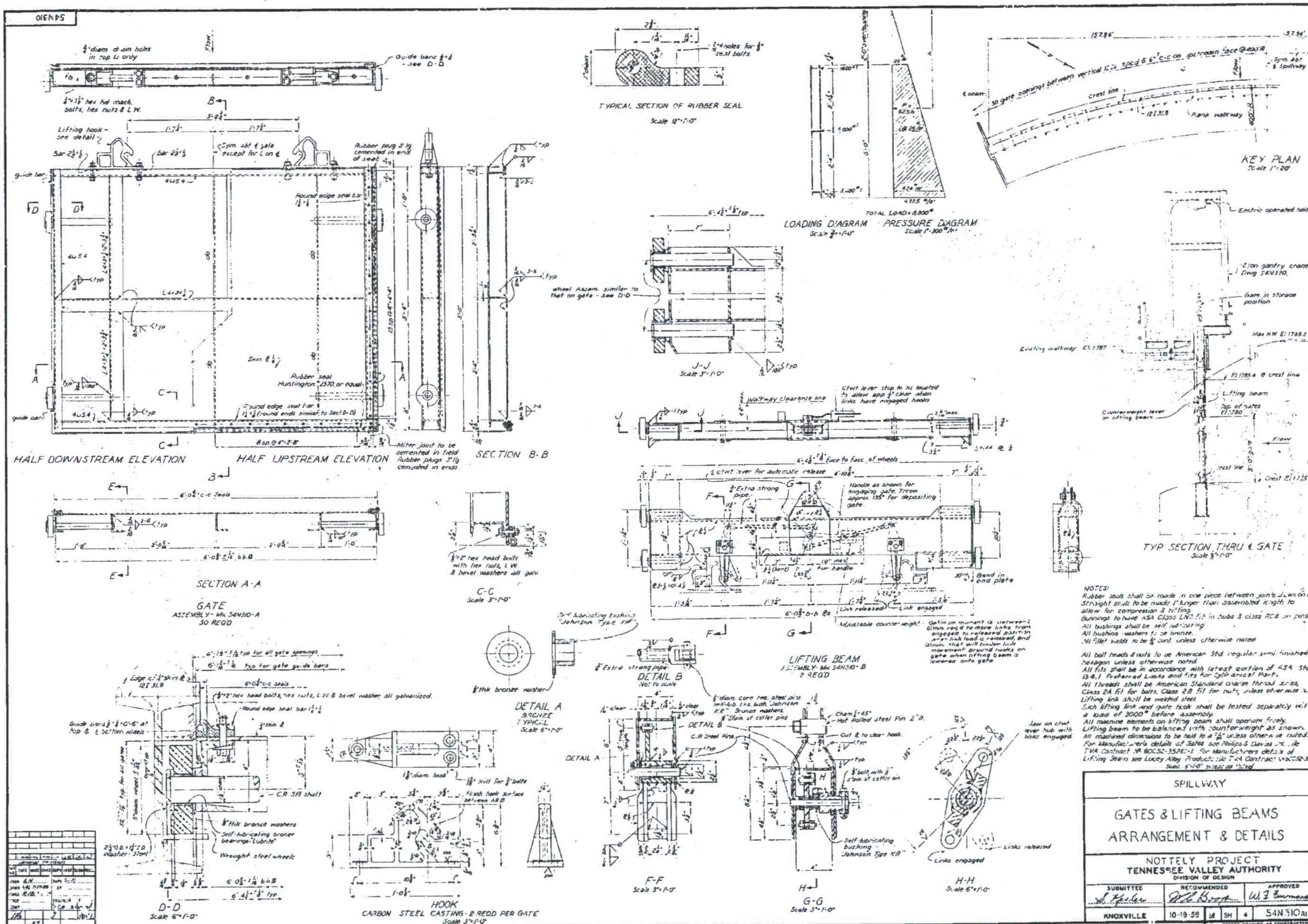
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

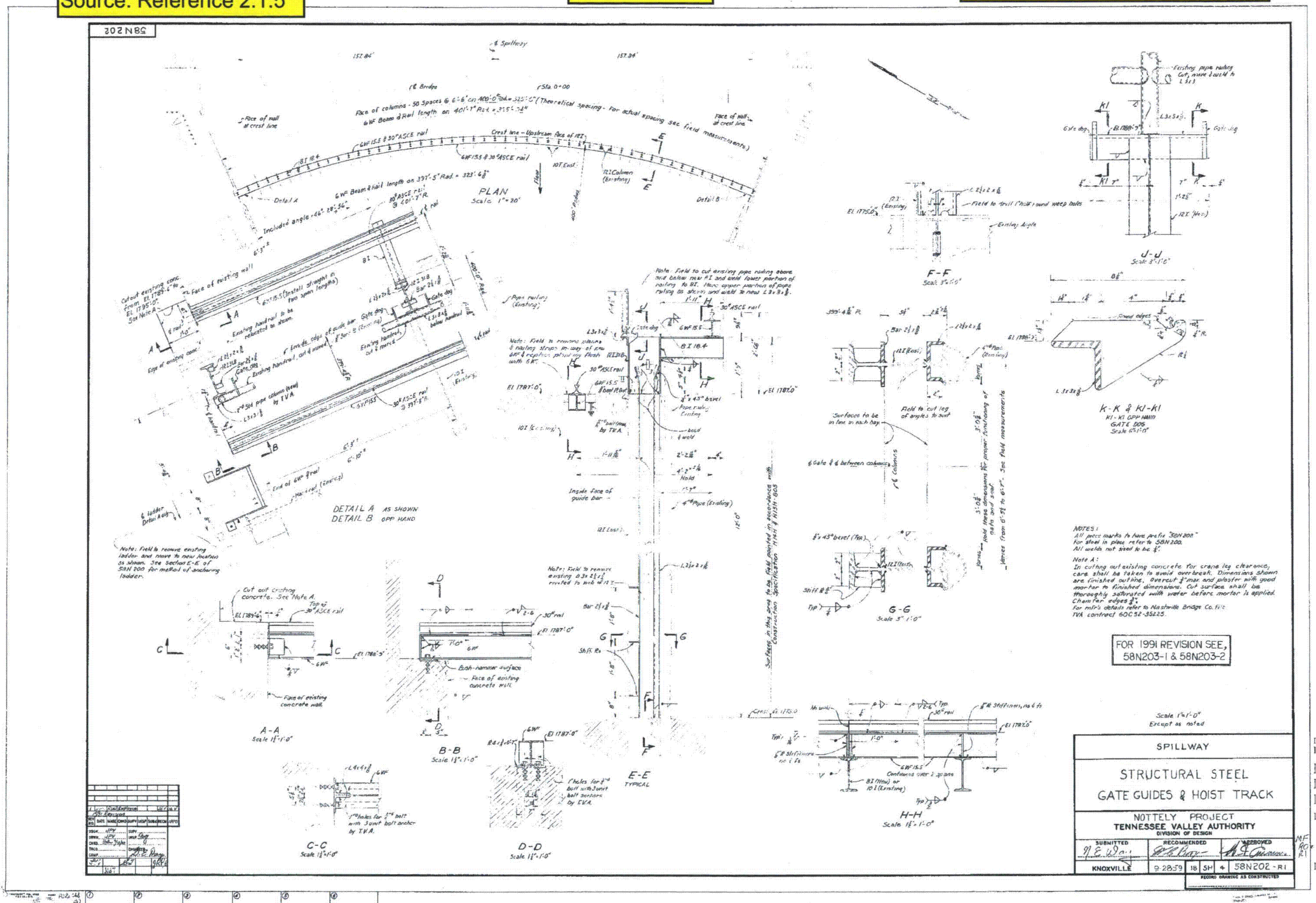
AUTOCAD R12 | 3-28-86 | 18 | C | 21E205-1 | R 4

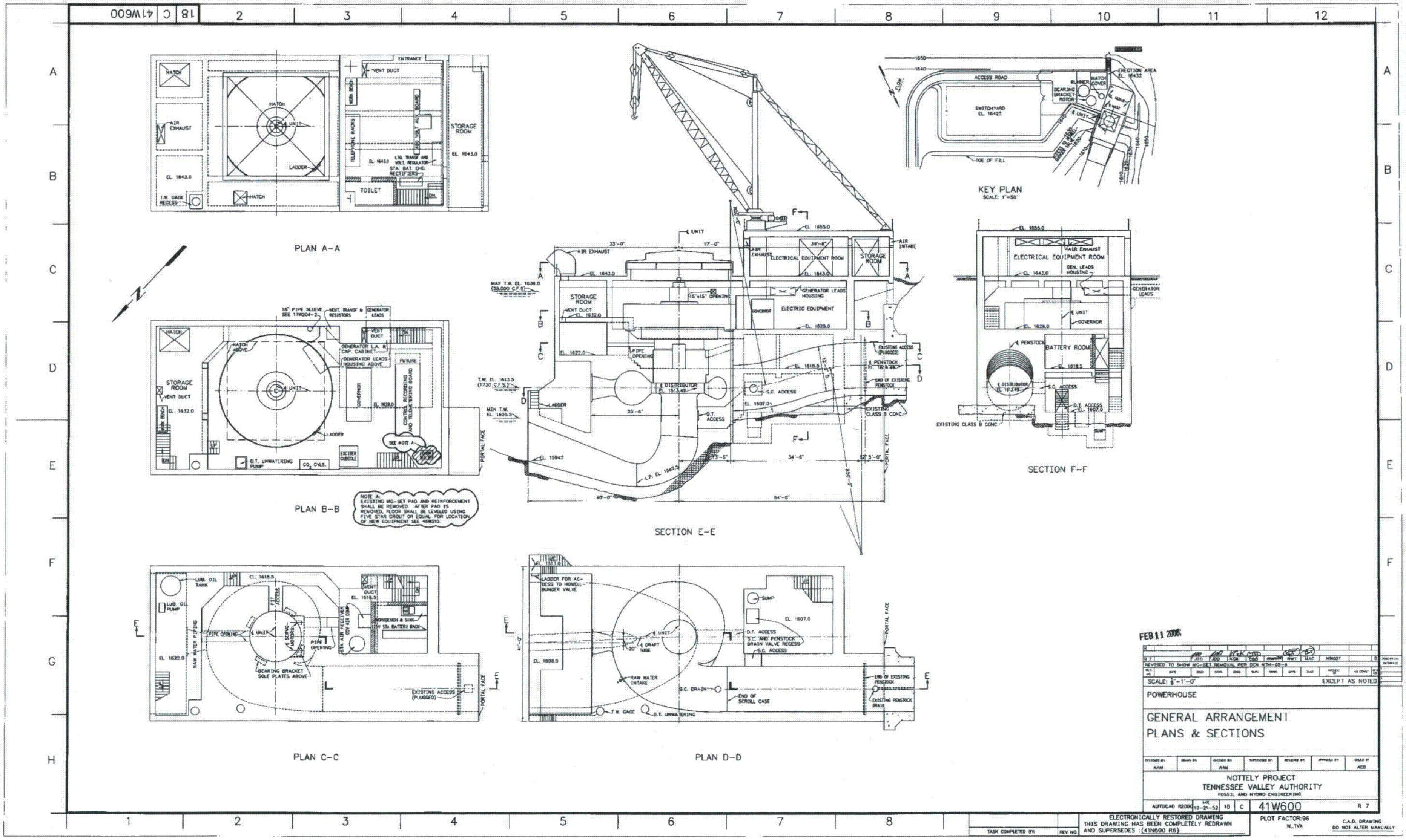
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES : (21E205-1 R3)

PLOT FACTOR:360
E_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY


HALF DOWNSTREAM ELEVATION
HALF UPSTREAM ELEVATION
SECTION B-B
SECTION A-A
GATE
TYPICAL SECTION OF RUBBER SEAL
LOADING DIAGRAM
PRESSURE DIAGRAM
KEY PLAN
TYP SECTION THRU ℄ GATE
LIFTING BEAM
DETAIL A
DETAIL B
D-D
HOOK
F-F
G-G
H-H
SPILLWAY
GATES & LIFTING BEAMS
ARRANGEMENT & DETAILS
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
KNOXVILLE
10-19-59
54N310


58N202
PLAN
Scale 1" = 20'
DETAIL A AS SHOWN
DETAIL B OPP HAND
A-A
B-B
C-C
D-D
E-E
TYPICAL
F-F
G-G
H-H
J-J
K-K & K1-K1
NOTES:
All piece marks to have prefix "58N202"
For steel in place refer to 58N200.
All welds not sized to be 1/4".
FOR 1991 REVISION SEE, 58N203-1 & 58N203-2
Scale 1" = 1'-0"
Except as noted
SPILLWAY
STRUCTURAL STEEL
GATE GUIDES & HOIST TRACK
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE
9-28-59
58N202-R1
RECORD DRAWING AS CONSTRUCTED


PLAN A-A
PLAN B-B
PLAN C-C
PLAN D-D
SECTION E-E
SECTION F-F
KEY PLAN
STORAGE ROOM
ELECTRICAL EQUIPMENT ROOM
BATTERY ROOM
TOILET
FEB 11 2008
POWERHOUSE
GENERAL ARRANGEMENT
PLANS & SECTIONS
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
41W600
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN
AND SUPERSEDES (41N600 R6)
PLOT FACTOR:96
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TENNESSEE VALLEY AUTHORITY
RIVER SYSTEM OPERATIONS & ENVIRONMENT
RIVER OPERATIONS

NOTTELY DAM

SPILLWAY DISCHARGE TABLES

APRIL 2004

CONTENTS

INSTRUCTIONS FOR USE OF TABLES

1. Tables Update

These tables supersede the tables issued in January 1961. The revised discharges, which are only slightly different from those in the 1961 tables, were generated using the computer code SPILLQ. SPILLQ is a computer code used in TVA software for monitoring spill discharges and determining gate arrangements.

2. Purpose of Tables

These tables provide a means for setting required spillway discharges and for determining the discharge when a specific arrangement of gates is in use. The tabulated discharges are based on test results from a 1:45 scale model of Nottely spillway supplemented by prototype measurements, which were used to establish the lower end of the rating.

The specific gate arrangements in the tables were determined from model tests in which consideration was given to obtaining satisfactory flow conditions throughout the length of the spillway chute. Any deviation from the specified arrangements may cause overtopping of the chute walls.

3. Range of Tables

The tables cover a discharge range from 0 to 60,040 cubic feet per second. Headwater elevations range from 1775 feet to 1789 feet. The tailwater does not affect the discharges from this spillway.

4. Arrangement of Tables

The tables show spillway discharges in cubic feet per second. Headwater elevations in 0.1-foot increments are shown at the top of each column. The headwater range is shown at the bottom of each page.

The discharge is tabulated under the headwater elevations for specific arrangements of gate openings, which are indicated by number in the left and right columns of each page. The numbered arrangements are defined in the table of Spillway Gate Arrangements on page 5. Reference to this table and to the drawing showing the location of the gates on page 4 will determine the gates to be raised for any particular discharge given in the tables.

5. Discharge Intervals

The tables have been prepared so that the incremental discharge between the tabulated values for consecutive gate arrangements is adequate for all situations. Therefore it will not be necessary to interpolate between values given in these tables.

When the exact headwater elevation does not appear in the tables, the discharge for the headwater elevation closest to it is used. For example, the column headed 1776.2 is used for actual headwater elevations between 1776.15 feet and 1776.24 feet inclusive. When the actual headwater elevation is exactly halfway between tabular values, the larger value is used.

6. Spillway Gate Operation

The spillway gates are used to control discharges up to headwater elevation 1780 feet, which is the top elevation of the closed gates. To prevent gate overflow, all spillway gates should be raised before the headwater elevation exceeds 1780 feet. However, to provide for accidental operation in which some gates have not been raised, the tabulated discharges include the total discharge, under the raised gates and over the closed gates, for headwater elevations from 1780 feet to 1783 feet.

Either one or two cranes may be used to open and close the spillway gates. It has been estimated that all gates can be raised in approximately 3 hours using one crane and in 1½ hours using two cranes.

7. Use of Tables

The tables can be used in two ways: (1) to determine the arrangement of gates needed to pass a required discharge at a given headwater elevation, and (2) to determine the discharge for a given arrangement of gates and headwater elevation.

Example 1 -- What gate arrangement is necessary to pass a discharge of 1,000 cubic feet per second with the headwater at elevation 1777.84 feet?

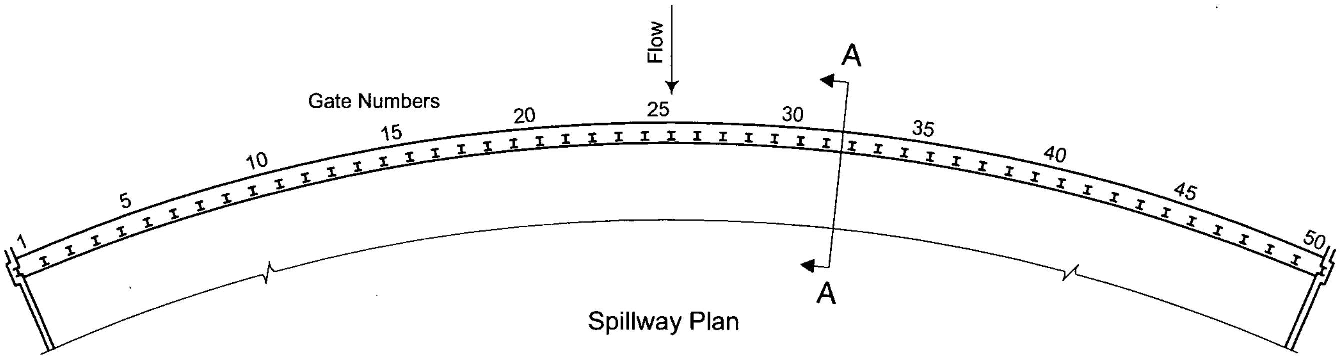
The first step is to find the table in which the headwater elevation appears. Referring to the contents page, we find that headwater elevations between 1777 feet and 1779 feet are found on page 7. The headwater elevation closest to 1777.84 feet is 1777.8 feet. In the column headed 1777.8 the discharge nearest to the required 1,000 cubic feet per second is 920 cubic feet per second. By tracing the horizontal line in which 920 cubic feet per second appears, to either side of the page, we find that gate arrangement 5 is the one for producing the discharge closest to 1,000 cubic feet per second at headwater elevation 1777.8 feet. Referring to page 5 it is found that for gate arrangement 5, gates 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19 are raised.

After the gates are raised, suppose it is necessary to increase the discharge from 1,000 cubic feet per second to 2,000 cubic feet per second. Assume the headwater elevation remains at 1777.8 feet. In the column headed 1777.8 feet on page 7, the discharge closest to the required 2,000 cubic feet per second is 2,030 cubic feet per second for gate arrangement 11. To change from gate arrangement 5 to gate arrangement 11, gates 21, 23, 25, 26, 28, 30, 32, 34, 36, 38, 40, and 42 are raised in addition to those gates already opened.

Example 2 -- Suppose the operating records show that the headwater is at elevation 1779.5 feet, and gate arrangement 21 is in use. The headwater is found on page 8 which is marked "Headwater 1779 to 1781." In the column headed 1779.5 opposite gate arrangement 21, the discharge is found to be 8,240 cubic feet per second.

NOTTELY DAM

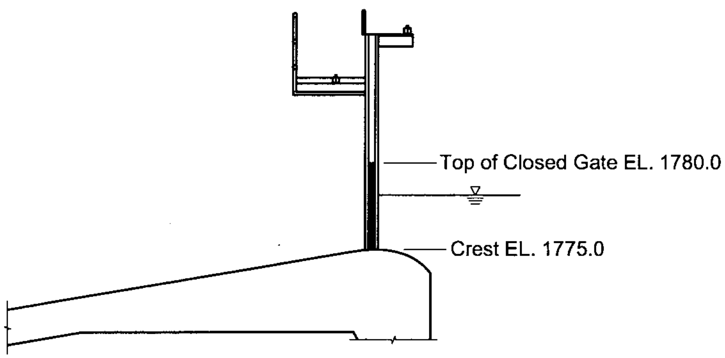
LOCATION OF SPILLWAY GATES



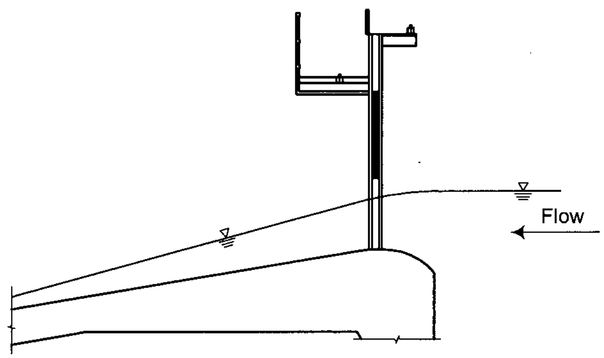
Spillway Plan

Key to Gate Arrangement Table

Designations under the gate operating conditions shown below refer to gate opening positions used in Gate Arrangement Table, Page 5



Section A-A, Gate Closed
Designated by -



Section A-A, Gate Raised Above Water Surface
Designated by R

NOTTELY DAM

SPILLWAY GATE ARRANGEMENTS

Arrangement Number	Gate Number																																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-	-	-	-	-
11	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-	-	-	-	-
12	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**	-	-	-	-
13	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	**R**	-	**R**
14	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R
15	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R
16	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R
17	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R
18	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
19	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
20	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
21	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
22	R	-	R	-	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
23	R	-	R	-	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
24	R	-	R	-	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
25	R	**R**	R	**R**	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R

GATE OPENINGS

Figures in columns under each gate number refer to gate opening indicator reading
dash (-) indicates closed gate
"R" indicates gate raised above water surface and dogged
"**R**" indicates first use of each gate

NOTTELY DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1775.0	1775.1	1775.2	1775.3	1775.4	1775.5	1775.6	1775.7	1775.8	1775.9	1776.0	1776.1	1776.2	1776.3	1776.4	1776.5	1776.6	1776.7	1776.8	1776.9	1777.0	
1	0	0	5	5	10	10	15	20	25	30	35	40	50	55	60	70	75	85	90	100	110	1
2	0	0	5	10	20	25	35	40	50	60	75	85	95	110	120	140	150	170	180	200	220	2
3	0	5	10	15	25	35	50	60	75	90	110	130	140	160	180	210	230	250	270	300	320	3
4	0	5	10	25	35	50	65	85	100	120	150	170	190	220	250	270	300	330	370	400	430	4
5	0	5	15	30	45	60	80	100	130	150	180	210	240	270	310	340	380	420	460	500	540	5
6	0	5	20	35	55	75	100	120	150	180	220	250	290	330	370	410	460	500	550	600	650	6
7	0	10	20	40	60	85	110	150	180	220	250	290	340	380	430	480	530	580	640	700	760	7
8	0	10	25	45	70	100	130	170	200	250	290	340	390	440	490	550	610	670	730	800	860	8
9	0	10	30	50	80	110	150	190	230	280	330	380	430	490	550	620	680	750	820	900	970	9
10	0	10	30	55	90	120	160	210	260	310	360	420	480	550	610	690	760	840	910	1,000	1,080	10
11	0	10	35	60	95	140	180	230	280	340	400	460	530	600	680	750	830	920	1,010	1,100	1,190	11
12	0	15	35	70	110	150	200	250	310	370	440	510	580	660	740	820	910	1,000	1,100	1,190	1,300	12
13	0	15	40	75	110	160	210	270	330	400	470	550	630	710	800	890	990	1,090	1,190	1,290	1,400	13
14	0	15	45	80	120	170	230	290	360	430	510	590	680	770	860	960	1,060	1,170	1,280	1,390	1,510	14
15	0	15	45	85	130	190	250	310	380	460	540	630	720	820	920	1,030	1,140	1,250	1,370	1,490	1,620	15
16	0	15	50	90	140	200	260	330	410	490	580	670	770	880	980	1,100	1,210	1,340	1,460	1,590	1,730	16
17	0	20	50	95	150	210	280	350	440	520	620	720	820	930	1,040	1,160	1,290	1,420	1,550	1,690	1,840	17
18	0	20	55	100	160	220	300	370	460	550	650	760	870	980	1,110	1,230	1,370	1,500	1,650	1,790	1,940	18
19	0	20	60	110	170	240	310	400	490	580	690	800	920	1,040	1,170	1,300	1,440	1,590	1,740	1,890	2,050	19
20	0	20	60	110	180	250	330	420	510	620	730	840	960	1,090	1,230	1,370	1,520	1,670	1,830	1,990	2,160	20
21	0	25	65	120	180	260	340	440	540	650	760	880	1,010	1,150	1,290	1,440	1,590	1,750	1,920	2,090	2,270	21
22	0	25	65	120	190	270	360	460	560	680	800	930	1,060	1,200	1,350	1,510	1,670	1,840	2,010	2,190	2,380	22
23	0	25	70	130	200	280	380	480	590	710	830	970	1,110	1,260	1,410	1,580	1,750	1,920	2,100	2,290	2,480	23
24	0	25	75	140	210	300	390	500	610	740	870	1,010	1,160	1,310	1,480	1,640	1,820	2,000	2,190	2,390	2,590	24
25	0	25	75	140	220	310	410	520	640	770	910	1,050	1,210	1,370	1,540	1,710	1,900	2,090	2,290	2,490	2,700	25

NOTTELY DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1777.0	1777.1	1777.2	1777.3	1777.4	1777.5	1777.6	1777.7	1777.8	1777.9	1778.0	1778.1	1778.2	1778.3	1778.4	1778.5	1778.6	1778.7	1778.8	1778.9	1779.0	
1	110	120	130	130	140	150	160	170	180	190	210	220	230	240	250	260	280	290	300	310	330	1
2	220	230	250	270	290	310	330	350	370	390	410	430	460	480	500	530	550	570	600	620	650	2
3	320	350	380	400	430	460	490	520	550	580	620	650	680	720	750	790	830	860	900	940	980	3
4	430	470	500	540	580	620	660	700	740	780	820	870	910	960	1,000	1,050	1,100	1,150	1,200	1,250	1,300	4
5	540	580	630	670	720	770	820	870	920	970	1,030	1,080	1,140	1,200	1,260	1,310	1,380	1,440	1,500	1,560	1,630	5
6	650	700	750	810	870	920	980	1,040	1,110	1,170	1,230	1,300	1,370	1,440	1,510	1,580	1,650	1,720	1,800	1,870	1,950	6
7	760	820	880	940	1,010	1,080	1,150	1,220	1,290	1,360	1,440	1,520	1,600	1,680	1,760	1,840	1,930	2,010	2,100	2,190	2,280	7
8	860	930	1,010	1,080	1,150	1,230	1,310	1,390	1,470	1,560	1,650	1,730	1,820	1,920	2,010	2,100	2,200	2,300	2,400	2,500	2,600	8
9	970	1,050	1,130	1,210	1,300	1,390	1,470	1,570	1,660	1,750	1,850	1,950	2,050	2,160	2,260	2,370	2,480	2,590	2,700	2,810	2,930	9
10	1,080	1,170	1,260	1,350	1,440	1,540	1,640	1,740	1,840	1,950	2,060	2,170	2,280	2,390	2,510	2,630	2,750	2,870	3,000	3,120	3,250	10
11	1,190	1,280	1,380	1,480	1,590	1,690	1,800	1,910	2,030	2,140	2,260	2,380	2,510	2,630	2,760	2,890	3,030	3,160	3,300	3,440	3,580	11
12	1,300	1,400	1,510	1,620	1,730	1,850	1,970	2,090	2,210	2,340	2,470	2,600	2,740	2,870	3,010	3,160	3,300	3,450	3,600	3,750	3,900	12
13	1,400	1,520	1,630	1,750	1,880	2,000	2,130	2,260	2,400	2,530	2,680	2,820	2,960	3,110	3,260	3,420	3,580	3,730	3,900	4,060	4,230	13
14	1,510	1,630	1,760	1,890	2,020	2,160	2,290	2,440	2,580	2,730	2,880	3,040	3,190	3,350	3,520	3,680	3,850	4,020	4,200	4,370	4,550	14
15	1,620	1,750	1,880	2,020	2,160	2,310	2,460	2,610	2,770	2,920	3,090	3,250	3,420	3,590	3,770	3,940	4,130	4,310	4,500	4,690	4,880	15
16	1,730	1,870	2,010	2,160	2,310	2,460	2,620	2,780	2,950	3,120	3,290	3,470	3,650	3,830	4,020	4,210	4,400	4,600	4,800	5,000	5,200	16
17	1,840	1,980	2,140	2,290	2,450	2,620	2,790	2,960	3,130	3,310	3,500	3,690	3,880	4,070	4,270	4,470	4,680	4,880	5,100	5,310	5,530	17
18	1,940	2,100	2,260	2,430	2,600	2,770	2,950	3,130	3,320	3,510	3,700	3,900	4,100	4,310	4,520	4,730	4,950	5,170	5,400	5,620	5,850	18
19	2,050	2,220	2,390	2,560	2,740	2,930	3,110	3,310	3,500	3,700	3,910	4,120	4,330	4,550	4,770	5,000	5,230	5,460	5,700	5,940	6,180	19
20	2,160	2,330	2,510	2,700	2,890	3,080	3,280	3,480	3,690	3,900	4,120	4,340	4,560	4,790	5,020	5,260	5,500	5,750	6,000	6,250	6,500	20
21	2,270	2,450	2,640	2,830	3,030	3,230	3,440	3,650	3,870	4,090	4,320	4,550	4,790	5,030	5,270	5,520	5,780	6,030	6,290	6,560	6,830	21
22	2,380	2,570	2,760	2,970	3,170	3,390	3,610	3,830	4,060	4,290	4,530	4,770	5,020	5,270	5,520	5,790	6,050	6,320	6,590	6,870	7,160	22
23	2,480	2,680	2,890	3,100	3,320	3,540	3,770	4,000	4,240	4,480	4,730	4,990	5,240	5,510	5,780	6,050	6,330	6,610	6,890	7,190	7,480	23
24	2,590	2,800	3,020	3,240	3,460	3,700	3,930	4,180	4,420	4,680	4,940	5,200	5,470	5,750	6,030	6,310	6,600	6,900	7,190	7,500	7,810	24
25	2,700	2,920	3,140	3,370	3,610	3,850	4,100	4,350	4,610	4,870	5,140	5,420	5,700	5,990	6,280	6,570	6,880	7,180	7,490	7,810	8,130	25

NOTTELY DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1779.0	1779.1	1779.2	1779.3	1779.4	1779.5	1779.6	1779.7	1779.8	1779.9	1780.0	1780.1	1780.2	1780.3	1780.4	1780.5	1780.6	1780.7	1780.8	1780.9	1781.0	
0*	0	0	0	0	0	0	0	0	0	0	0	15	55	110	190	280	380	500	620	750	890	0*
1	330	340	350	360	380	390	410	420	430	450	460	490	550	620	710	810	920	1,050	1,180	1,330	1,480	1
2	650	680	700	730	760	780	810	840	870	900	930	970	1,040	1,120	1,220	1,340	1,460	1,600	1,750	1,900	2,060	2
3	980	1,010	1,050	1,090	1,140	1,180	1,220	1,260	1,300	1,350	1,390	1,450	1,530	1,630	1,740	1,870	2,000	2,150	2,310	2,470	2,640	3
4	1,300	1,350	1,410	1,460	1,510	1,570	1,620	1,680	1,740	1,800	1,860	1,930	2,020	2,130	2,260	2,390	2,540	2,700	2,870	3,050	3,230	4
5	1,630	1,690	1,760	1,820	1,890	1,960	2,030	2,100	2,170	2,250	2,320	2,410	2,510	2,630	2,770	2,920	3,080	3,250	3,430	3,620	3,810	5
6	1,950	2,030	2,110	2,190	2,270	2,350	2,440	2,520	2,610	2,690	2,780	2,880	3,000	3,140	3,290	3,450	3,620	3,810	4,000	4,190	4,400	6
7	2,280	2,370	2,460	2,550	2,650	2,750	2,840	2,940	3,040	3,140	3,250	3,360	3,490	3,640	3,810	3,980	4,160	4,360	4,560	4,770	4,980	7
8	2,600	2,710	2,810	2,920	3,030	3,140	3,250	3,360	3,480	3,590	3,710	3,840	3,990	4,150	4,320	4,510	4,700	4,910	5,120	5,340	5,560	8
9	2,930	3,040	3,160	3,280	3,410	3,530	3,660	3,780	3,910	4,040	4,170	4,320	4,480	4,650	4,840	5,040	5,240	5,460	5,680	5,910	6,150	9
10	3,250	3,380	3,510	3,650	3,780	3,920	4,060	4,200	4,350	4,490	4,640	4,800	4,970	5,160	5,350	5,560	5,780	6,010	6,240	6,480	6,730	10
11	3,580	3,720	3,870	4,010	4,160	4,310	4,470	4,620	4,780	4,940	5,100	5,270	5,460	5,660	5,870	6,090	6,320	6,560	6,810	7,060	7,320	11
12	3,900	4,060	4,220	4,380	4,540	4,710	4,870	5,040	5,220	5,390	5,570	5,750	5,950	6,160	6,390	6,620	6,860	7,110	7,370	7,630	7,900	12
13	4,230	4,400	4,570	4,740	4,920	5,100	5,280	5,460	5,650	5,840	6,030	6,230	6,440	6,670	6,900	7,150	7,400	7,660	7,930	8,200	8,480	13
14	4,550	4,740	4,920	5,110	5,300	5,490	5,690	5,880	6,080	6,290	6,490	6,710	6,930	7,170	7,420	7,680	7,940	8,210	8,490	8,780	9,070	14
15	4,880	5,070	5,270	5,470	5,680	5,880	6,090	6,300	6,520	6,740	6,960	7,190	7,430	7,680	7,940	8,210	8,480	8,770	9,060	9,350	9,650	15
16	5,200	5,410	5,620	5,840	6,060	6,280	6,500	6,730	6,950	7,190	7,420	7,660	7,920	8,180	8,450	8,730	9,020	9,320	9,620	9,920	10,240	16
17	5,530	5,750	5,980	6,200	6,430	6,670	6,910	7,150	7,390	7,630	7,880	8,140	8,410	8,690	8,970	9,260	9,560	9,870	10,180	10,500	10,820	17
18	5,850	6,090	6,330	6,570	6,810	7,060	7,310	7,570	7,820	8,080	8,350	8,620	8,900	9,190	9,490	9,790	10,100	10,420	10,740	11,070	11,400	18
19	6,180	6,430	6,680	6,930	7,190	7,450	7,720	7,990	8,260	8,530	8,810	9,100	9,390	9,690	10,000	10,320	10,640	10,970	11,300	11,640	11,990	19
20	6,500	6,770	7,030	7,300	7,570	7,840	8,120	8,410	8,690	8,980	9,280	9,570	9,880	10,200	10,520	10,850	11,180	11,520	11,870	12,220	12,570	20
21	6,830	7,100	7,380	7,660	7,950	8,240	8,530	8,830	9,130	9,430	9,740	10,050	10,370	10,700	11,040	11,380	11,720	12,070	12,430	12,790	13,150	21
22	7,160	7,440	7,730	8,030	8,330	8,630	8,940	9,250	9,560	9,880	10,200	10,530	10,870	11,210	11,550	11,900	12,260	12,620	12,990	13,360	13,740	22
23	7,480	7,780	8,080	8,390	8,710	9,020	9,340	9,670	10,000	10,330	10,670	11,010	11,360	11,710	12,070	12,430	12,800	13,180	13,550	13,940	14,320	23
24	7,810	8,120	8,440	8,760	9,080	9,410	9,750	10,090	10,430	10,780	11,130	11,490	11,850	12,210	12,590	12,960	13,340	13,730	14,120	14,510	14,910	24
25	8,130	8,460	8,790	9,120	9,460	9,810	10,150	10,510	10,870	11,230	11,590	11,960	12,340	12,720	13,100	13,490	13,880	14,280	14,680	15,080	15,490	25

** Arrangement "0" indicates that all spillway gates are closed. Discharge is spillway gate overflow.*

NOTTELY DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	1781.0	1781.1	1781.2	1781.3	1781.4	1781.5	1781.6	1781.7	1781.8	1781.9	1782.0	1782.1	1782.2	1782.3	1782.4	1782.5	1782.6	1782.7	1782.8	1782.9	1783.0	GATE ARRANGE-MENT
	HEADWATER ELEVATION																					
0*	890	1,040	1,190	1,360	1,530	1,710	1,900	2,090	2,290	2,500	2,700	2,890	3,070	3,220	3,340	3,420	3,430	3,360	3,200	2,920	2,500	0*
1	1,480	1,630	1,800	1,970	2,150	2,340	2,540	2,750	2,960	3,170	3,380	3,580	3,770	3,940	4,070	4,160	4,190	4,150	4,010	3,760	3,380	1
2	2,060	2,230	2,400	2,590	2,780	2,980	3,190	3,400	3,620	3,840	4,060	4,280	4,480	4,660	4,800	4,910	4,960	4,940	4,830	4,610	4,260	2
3	2,640	2,820	3,010	3,200	3,410	3,620	3,830	4,060	4,290	4,520	4,750	4,970	5,180	5,370	5,540	5,660	5,730	5,730	5,640	5,450	5,140	3
4	3,230	3,420	3,610	3,820	4,030	4,250	4,480	4,710	4,950	5,190	5,430	5,670	5,890	6,090	6,270	6,400	6,490	6,510	6,450	6,290	6,020	4
5	3,810	4,010	4,220	4,430	4,660	4,890	5,120	5,370	5,620	5,870	6,120	6,360	6,590	6,810	7,000	7,150	7,260	7,300	7,270	7,140	6,900	5
6	4,400	4,610	4,820	5,050	5,280	5,520	5,770	6,020	6,280	6,540	6,800	7,050	7,300	7,530	7,730	7,900	8,020	8,090	8,080	7,980	7,780	6
7	4,980	5,200	5,430	5,660	5,910	6,160	6,410	6,680	6,940	7,210	7,480	7,750	8,010	8,250	8,460	8,650	8,790	8,870	8,890	8,820	8,660	7
8	5,560	5,800	6,030	6,280	6,530	6,790	7,060	7,330	7,610	7,890	8,170	8,440	8,710	8,960	9,190	9,390	9,550	9,660	9,700	9,670	9,540	8
9	6,150	6,390	6,640	6,900	7,160	7,430	7,700	7,990	8,270	8,560	8,850	9,140	9,420	9,680	9,920	10,140	10,320	10,450	10,520	10,510	10,420	9
10	6,730	6,980	7,240	7,510	7,780	8,060	8,350	8,640	8,940	9,240	9,540	9,830	10,120	10,400	10,660	10,890	11,080	11,240	11,330	11,350	11,300	10
11	7,320	7,580	7,850	8,130	8,410	8,700	8,990	9,300	9,600	9,910	10,220	10,530	10,830	11,120	11,390	11,640	11,850	12,020	12,140	12,200	12,180	11
12	7,900	8,170	8,450	8,740	9,030	9,330	9,640	9,950	10,270	10,580	10,900	11,220	11,530	11,830	12,120	12,380	12,620	12,810	12,960	13,040	13,060	12
13	8,480	8,770	9,060	9,360	9,660	9,970	10,280	10,600	10,930	11,260	11,590	11,920	12,240	12,550	12,850	13,130	13,380	13,600	13,770	13,880	13,930	13
14	9,070	9,360	9,660	9,970	10,280	10,600	10,930	11,260	11,590	11,930	12,270	12,610	12,940	13,270	13,580	13,880	14,150	14,380	14,580	14,730	14,810	14
15	9,650	9,960	10,270	10,590	10,910	11,240	11,570	11,910	12,260	12,610	12,960	13,300	13,650	13,990	14,310	14,620	14,910	15,170	15,390	15,570	15,690	15
16	10,240	10,550	10,870	11,200	11,540	11,870	12,220	12,570	12,920	13,280	13,640	14,000	14,350	14,700	15,040	15,370	15,680	15,960	16,210	16,410	16,570	16
17	10,820	11,150	11,480	11,820	12,160	12,510	12,860	13,220	13,590	13,950	14,320	14,690	15,060	15,420	15,780	16,120	16,440	16,750	17,020	17,260	17,450	17
18	11,400	11,740	12,080	12,430	12,790	13,150	13,510	13,880	14,250	14,630	15,010	15,390	15,770	16,140	16,510	16,870	17,210	17,530	17,830	18,100	18,330	18
19	11,990	12,340	12,690	13,050	13,410	13,780	14,150	14,530	14,920	15,300	15,690	16,080	16,470	16,860	17,240	17,610	17,970	18,320	18,650	18,950	19,210	19
20	12,570	12,930	13,290	13,660	14,040	14,420	14,800	15,190	15,580	15,980	16,380	16,780	17,180	17,580	17,970	18,360	18,740	19,110	19,460	19,790	20,090	20
21	13,150	13,520	13,900	14,280	14,660	15,050	15,440	15,840	16,240	16,650	17,060	17,470	17,880	18,290	18,700	19,110	19,510	19,890	20,270	20,630	20,970	21
22	13,740	14,120	14,500	14,890	15,290	15,690	16,090	16,500	16,910	17,320	17,740	18,160	18,590	19,010	19,430	19,850	20,270	20,680	21,080	21,480	21,850	22
23	14,320	14,710	15,110	15,510	15,910	16,320	16,740	17,150	17,570	18,000	18,430	18,860	19,290	19,730	20,160	20,600	21,040	21,470	21,900	22,320	22,730	23
24	14,910	15,310	15,710	16,120	16,540	16,960	17,380	17,810	18,240	18,670	19,110	19,550	20,000	20,450	20,900	21,350	21,800	22,260	22,710	23,160	23,610	24
25	15,490	15,900	16,320	16,740	17,160	17,590	18,030	18,460	18,900	19,350	19,800	20,250	20,700	21,160	21,630	22,100	22,570	23,040	23,520	24,010	24,490	25

** Arrangement "0" indicates that all spillway gates are closed. Discharge is spillway gate overflow.*

NOTTELY DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1783.0	1783.1	1783.2	1783.3	1783.4	1783.5	1783.6	1783.7	1783.8	1783.9	1784.0	1784.1	1784.2	1784.3	1784.4	1784.5	1784.6	1784.7	1784.8	1784.9	1785.0	
25	24, 490	24, 980	25, 480	25, 980	26, 480	26, 980	27, 490	28, 010	28, 520	29, 040	29, 570	30, 100	30, 630	31, 160	31, 700	32, 240	32, 790	33, 340	33, 890	34, 450	35, 010	25

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1785.0	1785.1	1785.2	1785.3	1785.4	1785.5	1785.6	1785.7	1785.8	1785.9	1786.0	1786.1	1786.2	1786.3	1786.4	1786.5	1786.6	1786.7	1786.8	1786.9	1787.0	
25	35, 010	35, 570	36, 140	36, 710	37, 280	37, 850	38, 430	39, 020	39, 600	40, 190	40, 790	41, 380	41, 980	42, 590	43, 190	43, 800	44, 410	45, 030	45, 650	46, 270	46, 890	25

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1787.0	1787.1	1787.2	1787.3	1787.4	1787.5	1787.6	1787.7	1787.8	1787.9	1788.0	1788.1	1788.2	1788.3	1788.4	1788.5	1788.6	1788.7	1788.8	1788.9	1789.0	
25	46, 890	47, 520	48, 150	48, 780	49, 420	50, 060	50, 700	51, 350	52, 000	52, 650	53, 310	53, 960	54, 630	55, 290	55, 960	56, 630	57, 310	57, 980	58, 670	59, 350	60, 040	25

NOTTELY DAM

October 1999

RESERVOIR OPERATION OVERVIEW

Nottely is a multipurpose tributary project located on the Nottely River, a tributary to the Hiwassee River. The project was originally constructed without any hydropower facility, primarily to be used for storage augmentation for TVA's downstream Hiwassee and Apalachia projects on the Hiwassee River, as well as for TVA mainstream dams on the Tennessee River. The project was built during World War II, with dam closure in 1942. The single unit powerhouse was completed in 1956. Nottely is operated for many purposes, including flood control, augmentation of flows for navigation, hydropower production, water quality, recreation, and aquatic ecology. Nottely Reservoir has an annual pool variation of about 35 feet during normal years, but could be several feet more during drought or flood periods.

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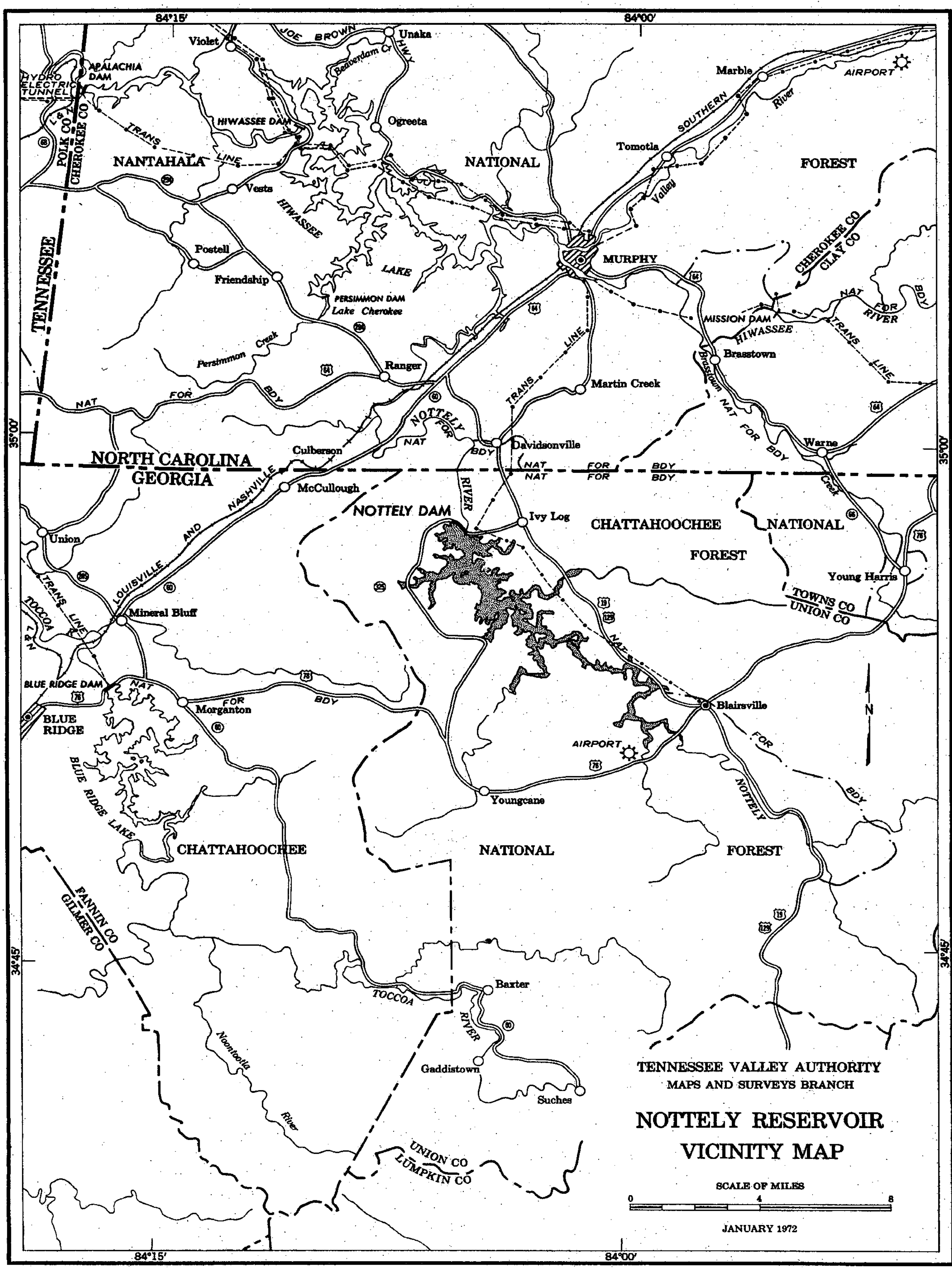

TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH
NOTTELY RESERVOIR
VICINITY MAP
SCALE OF MILES
0 4 8
JANUARY 1972
NOTTELY DAM
NORTH CAROLINA
GEORGIA
TENNESSEE
NANTAHALA
NATIONAL
FOREST
CHATTAHOOCHEE
NATIONAL
FOREST
MURPHY
Blairsville
Young Harris
Ivy Log
Davidsonville
Martin Creek
Brasstown
Warne
Ranger
Culberson
McCullough
Union
Mineral Bluff
Morganton
BLUE RIDGE
Youngcane
Baxter
Gaddistown
Suches
Marble
Tomotla
Unaka
Violet
Ogreeta
Vests
Postell
Friendship
HIWASSEE DAM
APALACHIA DAM
PERSIMMON DAM
Lake Cherokee
MISSION DAM
BLUE RIDGE DAM
HIWASSEE LAKE
BLUE RIDGE LAKE
AIRPORT
TOWNS CO
UNION CO
FANNIN CO
GILMER CO
UNION CO
LUMPKIN CO
CHEROKEE CO
CLAY CO
POLK CO
84°15′
84°00′
35°00′
34°45′

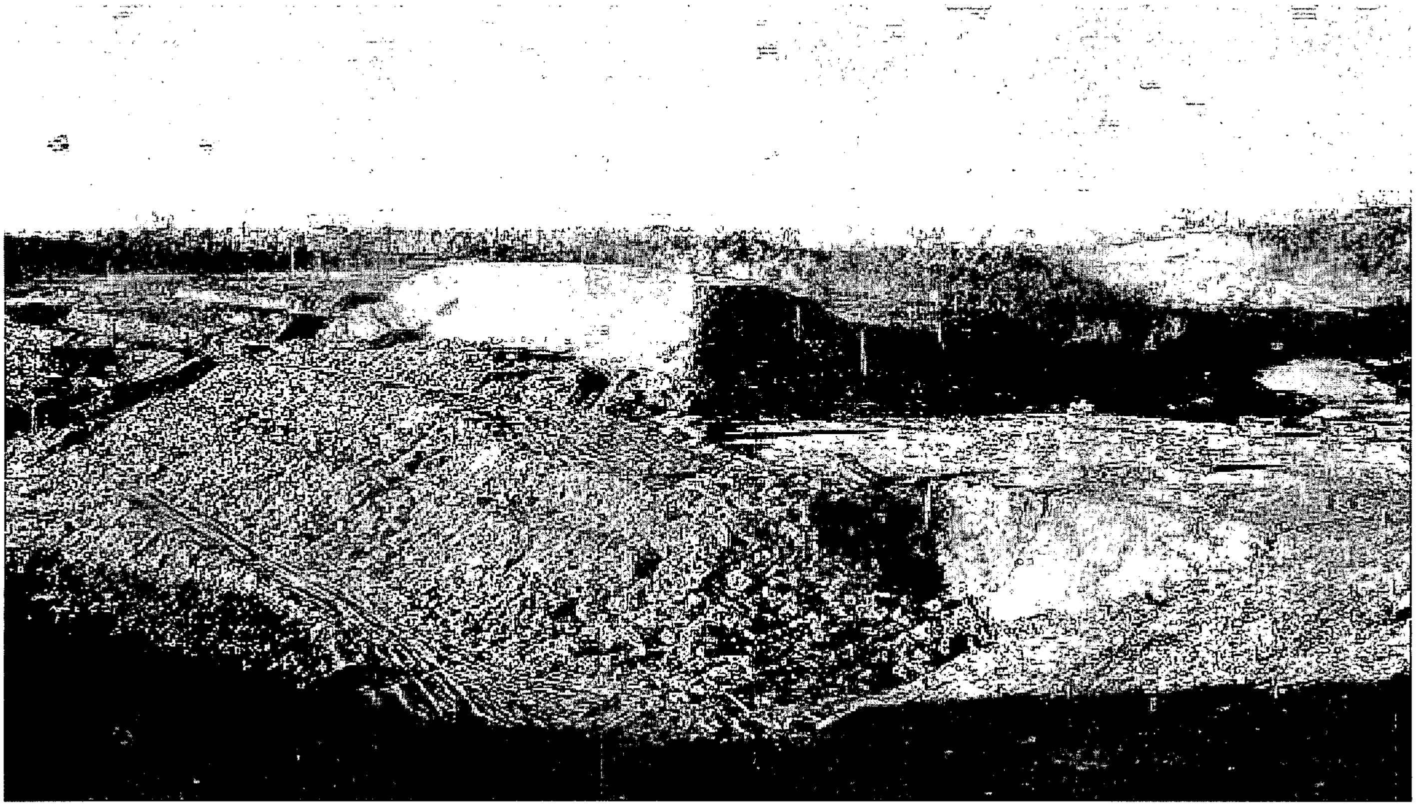


FIGURE 1 - Construction of Dam, 1942

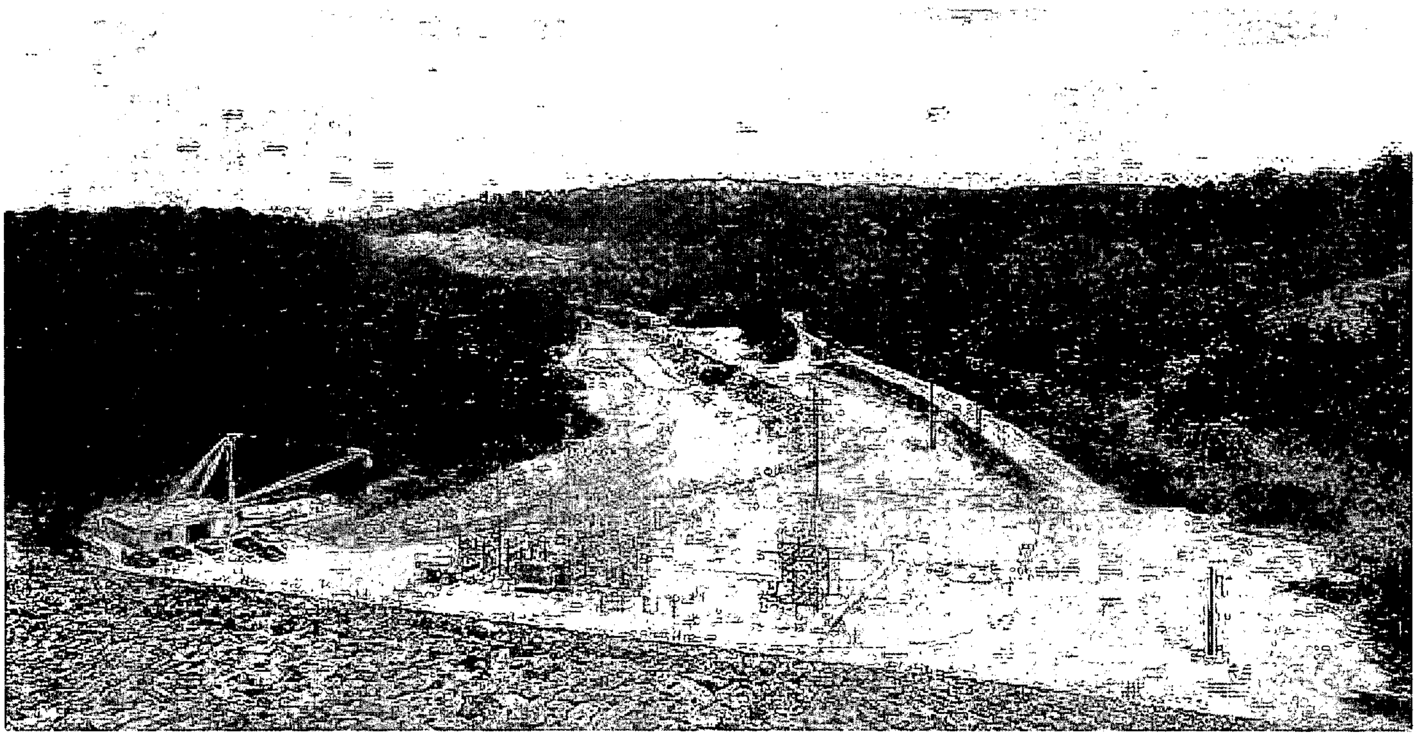


FIGURE 2 - Single Unit Powerhouse, 1956

FIGURE 3

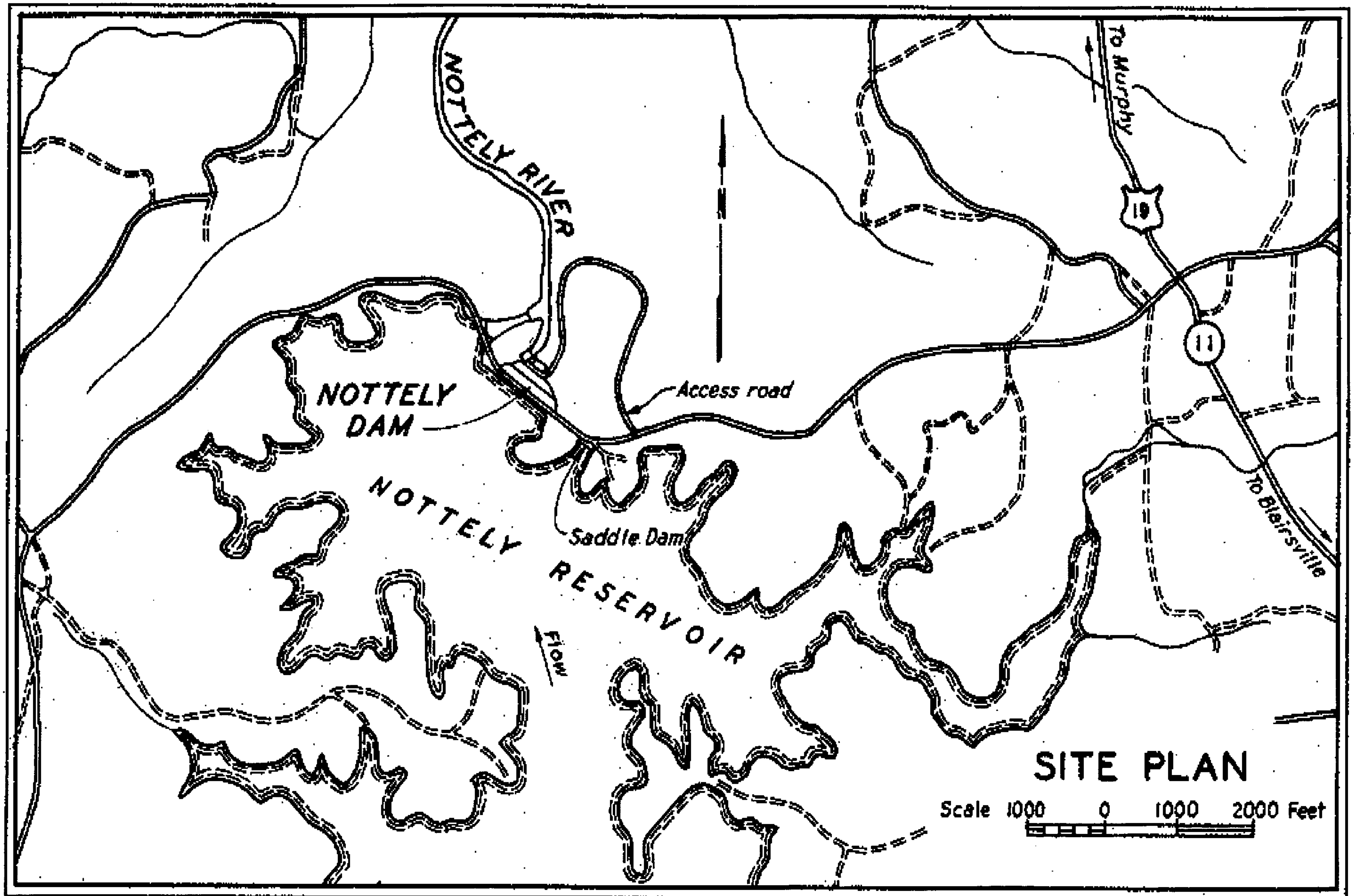
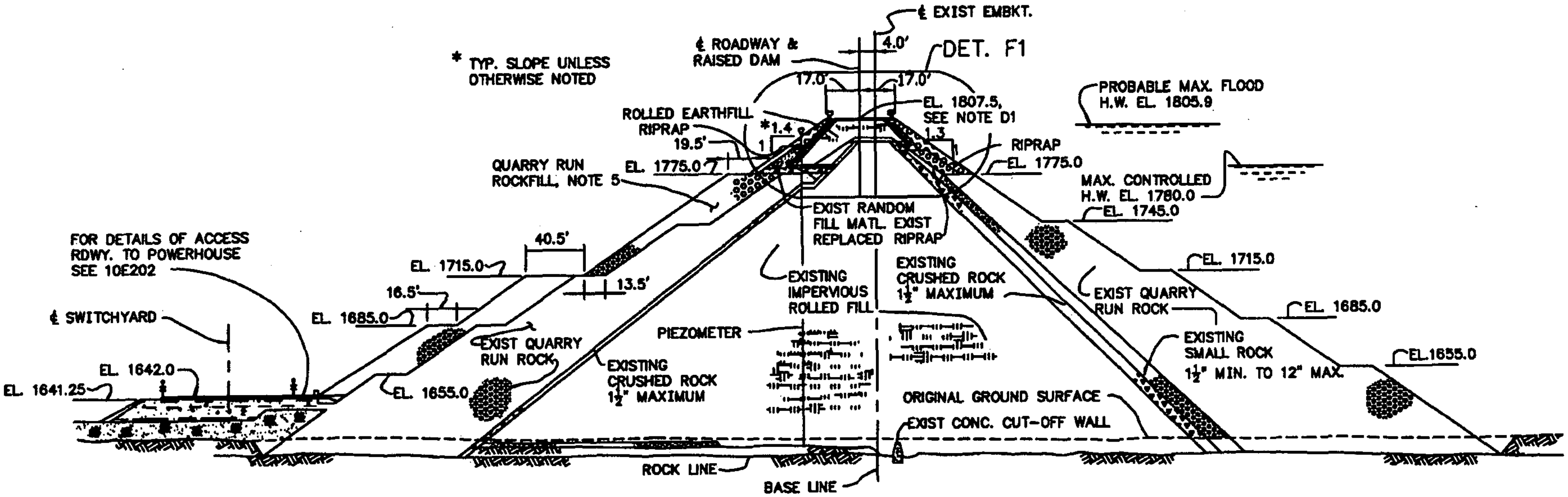
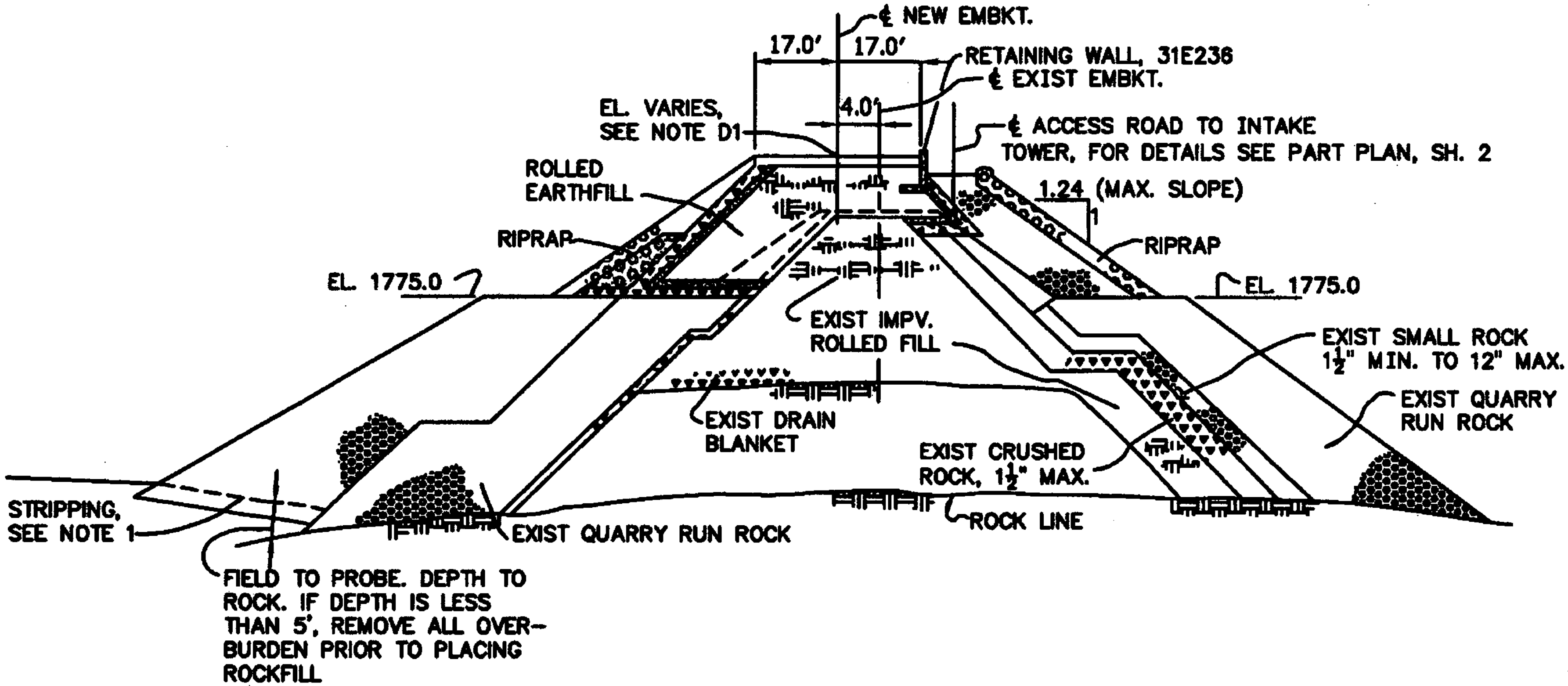

NOTTELY RIVER
To Murphy
19
11
NOTTELY DAM
Access road
NOTTELY RESERVOIR
Saddle Dam
Flow
To Blairsville
SITE PLAN
Scale 1000 0 1000 2000 Feet

FIGURE 4



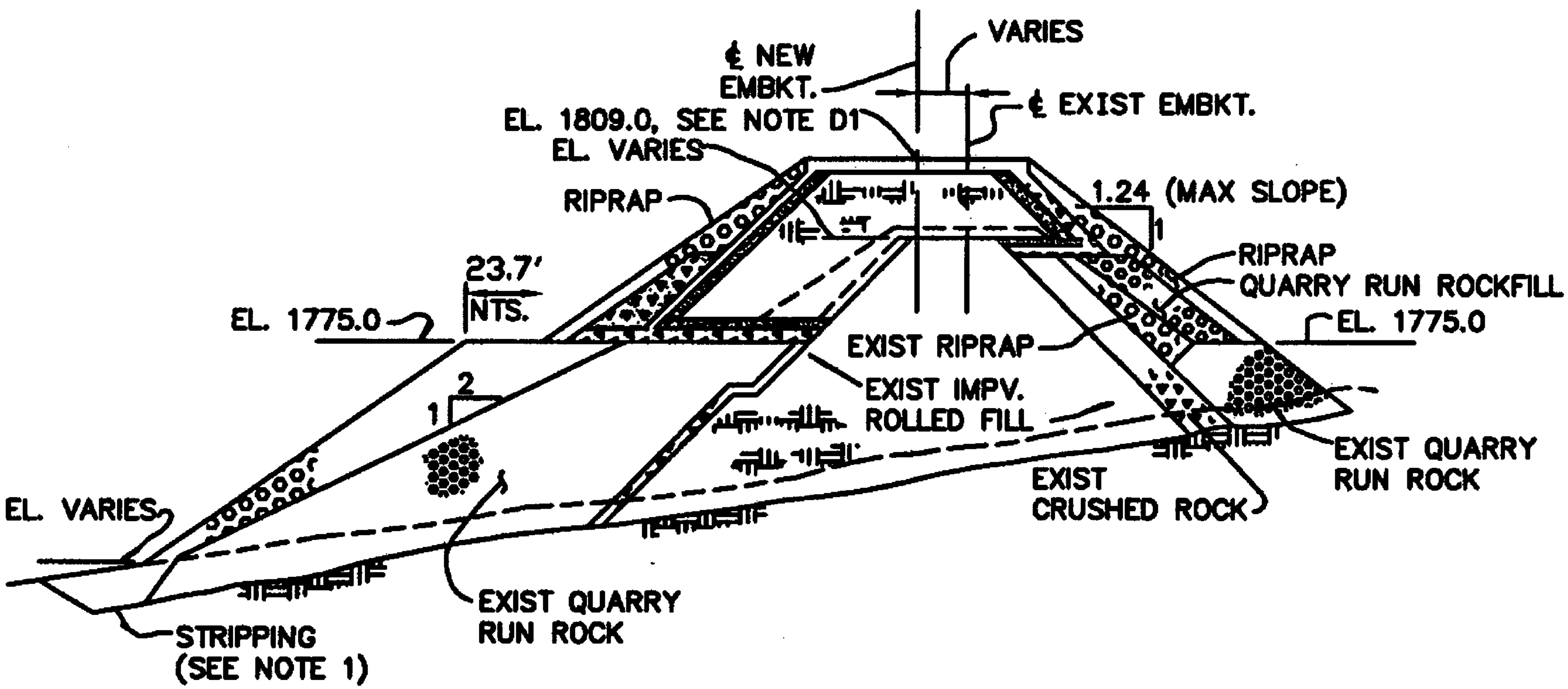
SECTION A1-A1

FIGURE 5



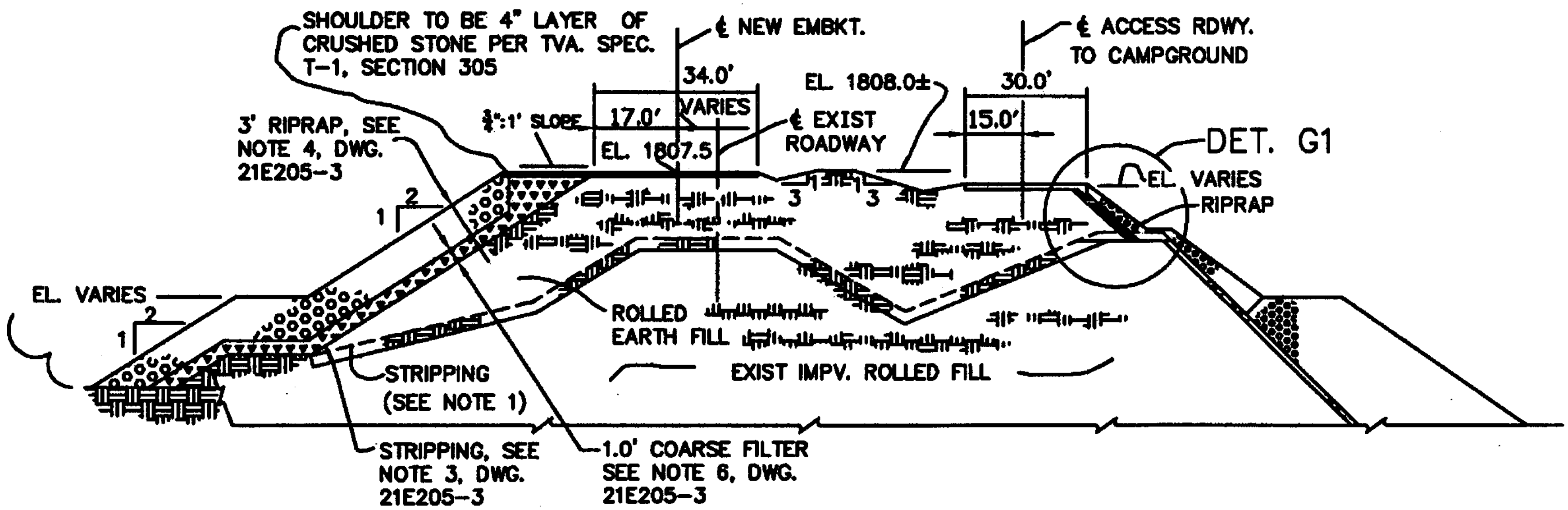
SECTION B1-B1

FIGURE 6



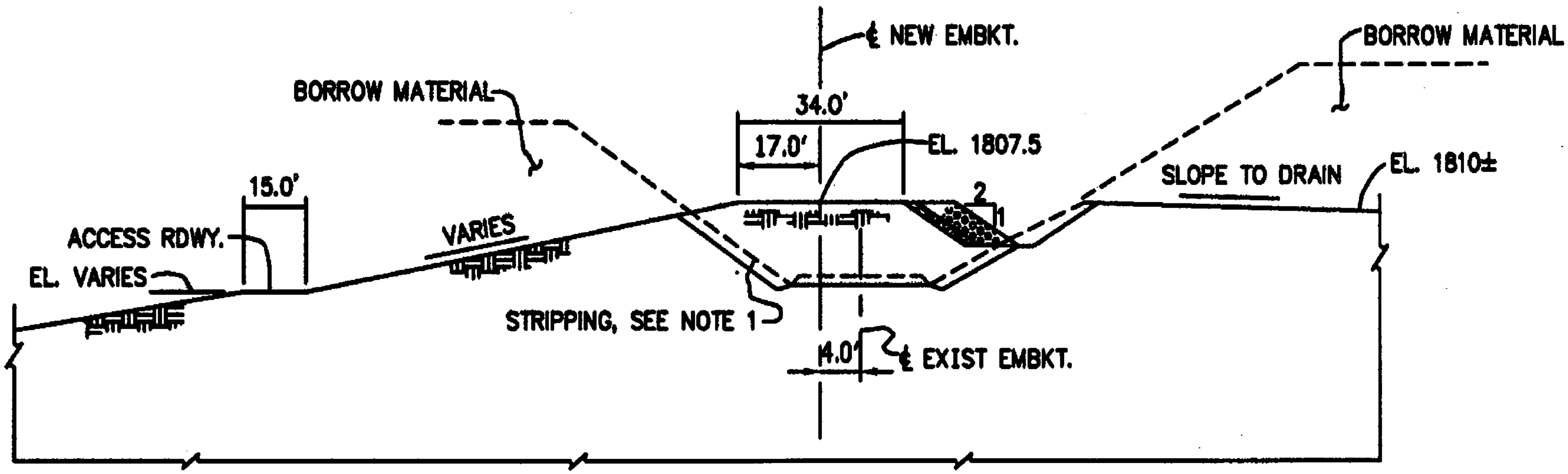
SECTION C1-C1

FIGURE 7



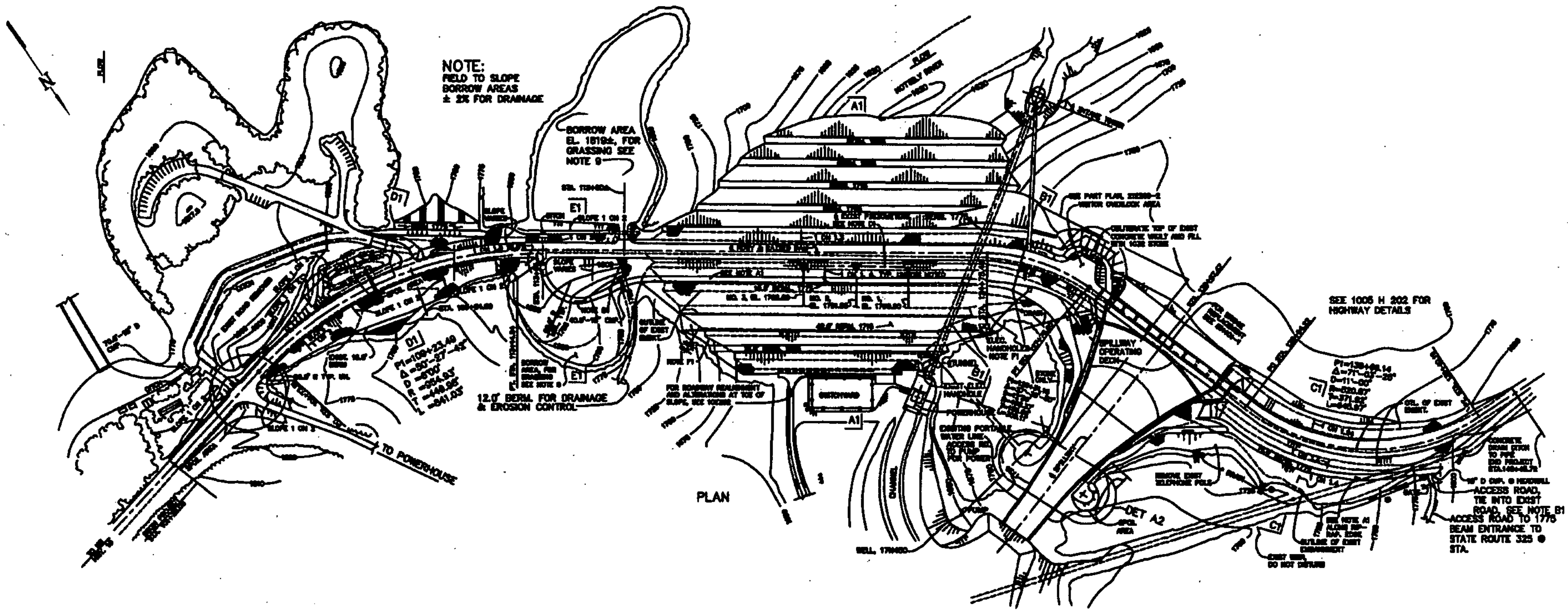
SECTION D1-D1

FIGURE 8



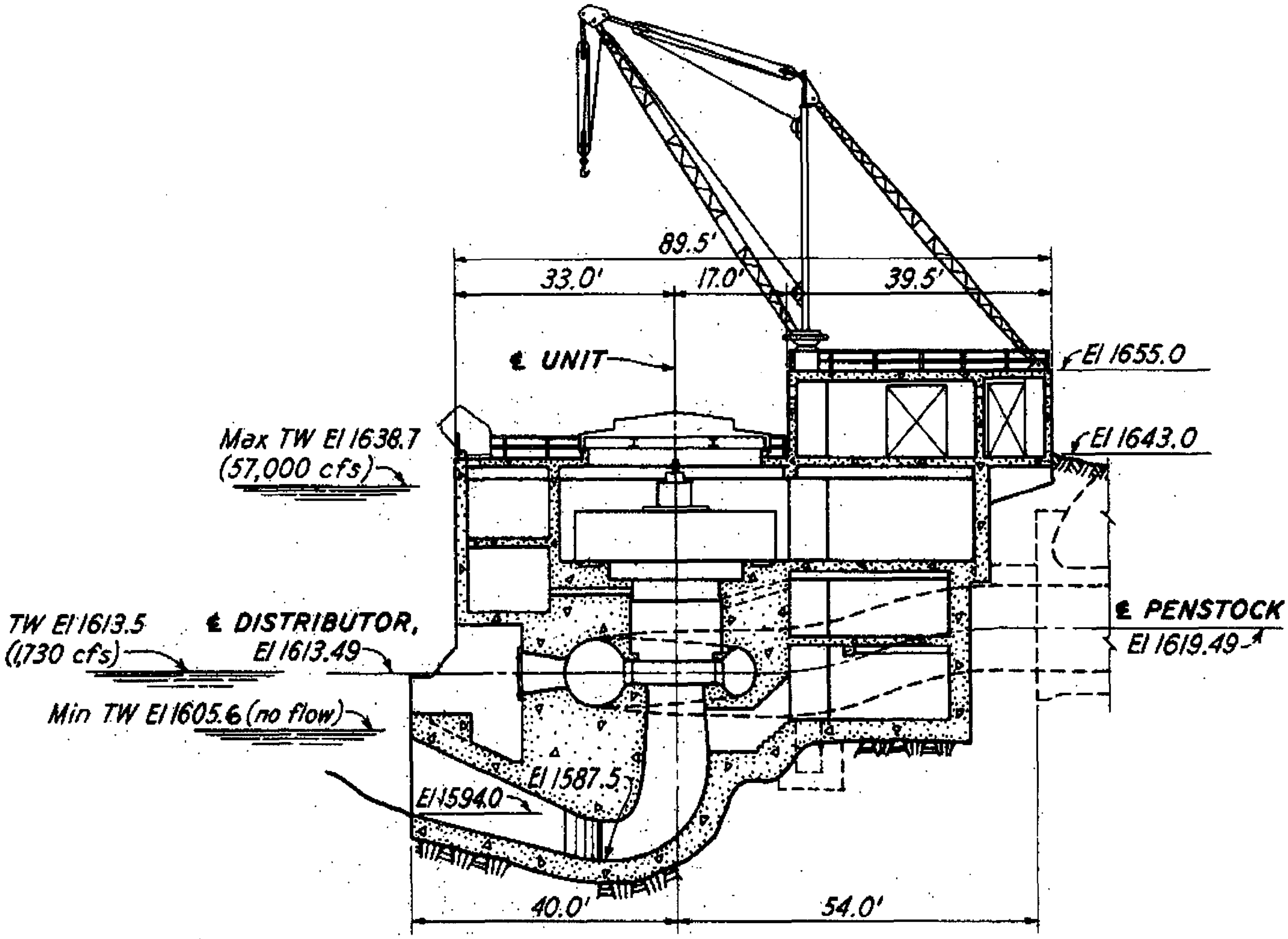
SECTION E1-E1

FIGURE 9



PLAN

FIGURE 10



SECTION - POWERHOUSE

Scale 20 0 20 40 Feet

NOTTELY PROJECT

SUMMARY OF PRINCIPAL FEATURES

NOTE:
Elevations are based on the U.S.C. & G.S. 1936 Supplementary Adjustment.

LOCATION

On Nottely River at river mile 21.0; in Union County, Georgia; 11 air miles southwest of Murphy, North Carolina; 2.3 river miles upstream from Georgia-North Carolina State line.

CHRONOLOGY

Initial appropriation by Congress	July 16, 1941
Authorized by TVA Board of Directors	July 17, 1941
Construction started	July 17, 1941
Dam closure	January 24, 1942
First storage release	October 1, 1942
Power unit authorized by TVA Board of Directors	September 25, 1951
Installation of unit started	December 3, 1952
Unit in commercial operation	January 10, 1956
Safety modifications for probable maximum flood construction completed	June 20, 1988
Reservoir releases improvements - completed	September 30, 1993
Generator and turbine modernization - completed	June 21, 1997

PROJECT COST

Initial project, no units	$5,384,627
Addition of unit 1	2,654,778
Safety modifications for probable maximum flood	15,200,000
Reservoir releases improvements	1,900,000
Generator and turbine modernization	2,195,310
Total, including switchyard	$27,334,715

STREAMFLOW

Drainage area at dam .... 214 sq. miles
Gaging station discharge records:
Near Ivylog, Georgia, October 1936 to
September 1942; drainage area .... 191 sq. miles
At Nottely Dam, September 1941 to date;
drainage area .... 215 sq. miles
Near Ranger, North Carolina, February 1901 to
December 1905, January 1914 to April 1917,
October 1918 to September 1945; drainage area ... 272 sq. miles
Maximum known unregulated flood at dam site (Sept 1898) ... 27,000 cfs
Maximum regulated flood at dam site (May 1973) .... 8,120 cfs
Average unregulated flow at dam site (1903-2000) .... 413 cfs
Minimum daily natural flow at dam site
(1925), approx. .... 35 cfs

RESERVOIR

Counties affected:
State of Georgia .... Union
Reservoir land at May 31, 1996:
Fee simple .... 3,631 ac.
Easements .... 1,840 ac.
Total .... 5,471 ac.
Transferred .... 2,047 ac.
Operating levels at dam:
Probable maximum flood elevation (PMF) .... el. 1805.9
500-year flood elevation .... el. 1785.5
100-year flood elevation .... el. 1782.5
Winter flood guide level .... el. 1735.0
Summer flood guide level .... el. 1779.0
Maximum probable flood .... el. 1796.7
Maximum used for design (57,000 cfs) .... el. 1788.3
Top of gates (area 4310 ac.) .... el. 1780.0
Backwater, length at top of gates level .... 20.2 miles
Shoreline, length at normal maximum pool level:
Main shore .... 98 miles
Islands .... 8 miles
Total .... 106 miles
Original river area (to el. 1780 crossing) .... 170 ac.
Storage (flat pool assumption):
Total volume:
At top of gates (el. 1780) .... 174,300 ac.-ft
At normal maximum pool (el. 1779) .... 170,300 ac.-ft
At normal minimum pool (el. 1735) .... 57,200 ac.-ft

RESERVOIR (continued)

Reservation for flood control on:	
January 1 to January 12(el. 1780-1745)	100,000 ac.-ft
March 15 (el. 1780-1755)	79,150 ac.-ft
Useful controlled storage (el. 1780-1735)	117,100 ac.-ft

TAILWATER

Maximum used for design	el. 1636.0
Maximum known flood (1898)	el. 1624.0
Full plant operation (1 unit)	el. 1613.0
Unit operating at best efficiency	el. 1613.0
Minimum level	el. 1605.6

HEAD (Gross)

Maximum static (el. 1780-1605.6)	174.4 ft
Normal maximum operating (el. 1780-1613)	167.0 ft
Average operating	145.0 ft
Minimum operating (el. 1690-1613)	77.0 ft

RESERVOIR ADJUSTMENTS

Clearing	2,485.3 ac.
Highways:	
Access	4.2 miles
State	2.8 miles
County and tertiary	15.5 miles
Total	22.5 miles
Bridges (highway)	5
Concrete box culverts	19
Families relocated	91
Graves removed	2
Utilities adjusted	8.2 miles

DAMS

MAIN DAM

Material and type .... Rockfill and impervious rolled earthfill embankment
Length (including spillway) .... 2,300 ft
Maximum height .... 184 ft
Maximum width at base .... 720 ft
Top of embankment .... el. 1794.0
Top width .... 32 ft
Highway .... 22 ft wide on dam
Foundation .... Carolina gneiss

SADDLE DAM

Location .... 500 ft beyond right end of main dam
Material and type .... Impervious rolled earthfill embankment with rockfill shoulder on upstream side
Length .... 340 ft
Maximum height .... 40 ft
Top of embankment .... el. 1794.0
Top width .... 20 ft
Foundation .... Earth

OUTLET FACILITIES

SPILLWAY (See Figures 11 and 12)

Location .... At left (north) end of main dam
Material and type .... Concrete chute with curved weir and ski-jump endsill

Weir:

- Crest length, clear .... 300 ft
- Crest level .... el. 1775.0
- Top of gates .... el. 1780.0
- Gates (50) .... 5 ft high by 6 ft wide
- Gate operation .... Two traveling electric cranes on overhead footbridge

Chute:

- Length .... 621 ft
- Width .... Converges from 325 ft at weir to 80 ft at outlet
- Height .... 14 ft
- Level of endsill .... el. 1670.5

OUTLET FACILITIES

SPILLWAY (See Figures 11 and 12)

Discharge capacity:

HW el. 1787.4	49,500 cfs
HW el. 1780.0	11,500 cfs
HW el. 1779.0	8,100 cfs
Highway	20 ft wide, on bridge upstream from weir
Foundation	Earth, except chute outlet on rock

FIGURE 11 - Upper end of concrete spillway chute, October 1999

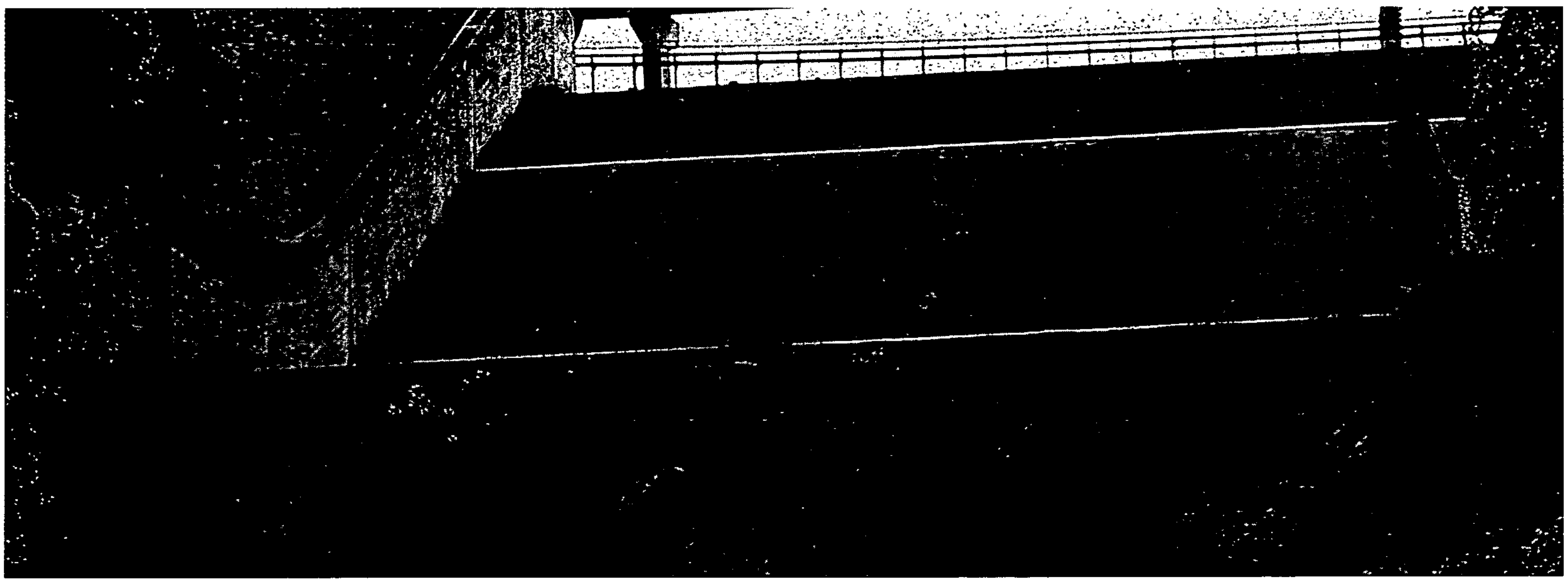


Figure 12 - Lower end of concrete spillway chute, October 1999

POWER FACILITIES

INTAKE (See Figure 13)

Type	Circular reinforced concrete dry tower
Size:	
Inside diameter	25 ft
Height	206 ft
Trashrack	32 sections, 8 ft 0-1/4 in. wide by 10 ft 6 in. high
Gross area at racks	2,700 sq. ft
Gates	Two 5-ft-8-in.-wide by 10-ft high hydraulically operated slide gates
Service crane	15-ton overhead crane

CONDUIT
(Intake to Powerhouse)

Type	Concrete- and steel-lined tunnel
Size:	
Concrete section, inside diameter	15 ft
Steel section, inside diameter	12 ft
Lengths:	
Concrete section	409 ft
Steel section	330 ft

FIGURE 13 - Intake tower and footbridge, October 1999

POWER FACILITIES (CONT.)

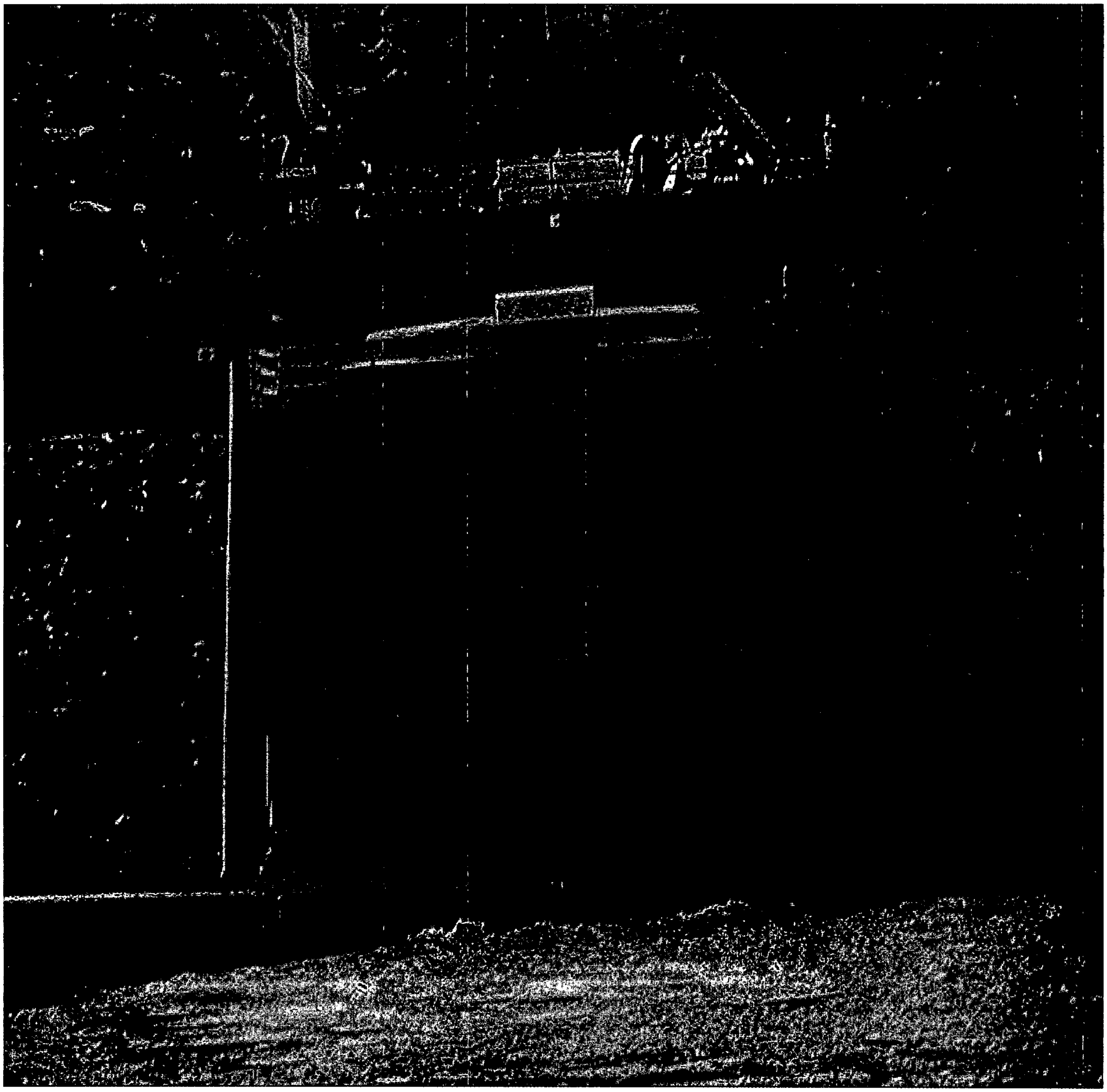
POWERHOUSE (See Figure 14)

Generating capacity, 1 unit .... 15,000 kW
Type of construction .... Semioutdoor; reinforced concrete
Principal outside dimensions .... 96.5 ft long by 41 ft wide by 70 ft high

Draft tube:
- Type .... Elbow, 2 openings
- Horizontal length (centerline of turbine to downstream face) .... 40 ft
- Vertical distance from distributor centerline to draft tube floor .... 26 ft
- Net area at outlet opening .... 304 sq. ft

Derrick .... Stiff leg derrick, installed on powerhouse structure; hook load 70 tons at 25-1/2-ft radius

FIGURE 14 - Powerhouse, October 1999



POWER FACILITIES (CONT.)

EXCAVATED TAILRACE CHANNEL

Length, approx	1000 ft
Width	30 ft
Depth (maximum)	9 ft

HYDRAULIC TURBINE

Number	1
Manufacturer	Voith Hydro, Inc.
Type	Vertical Francis
Rated output	20,600 hp at 128-ft net head
Rated speed	180 rpm
Maximum runaway speed	334 rpm
Specific speed at rating	60.0
Value of sigma at rating	0.27
Diameter of runner at intake	84.489 in.
Diameter of runner at discharge	102.28 in.
Centerline to bottom of runner	42.96 in.
Centerline to top of runner	20.88 in.
Diameter of guide vane circle	128.375 in.
Diameter of lower pit	14.0 ft
Draft tube (see Powerhouse)	Elbow type
Governors	Woodward, cabinet actuator type

GENERATOR

Number	1
Manufacturer	Westinghouse Electric Corp.
Type	Enclosed, water-cooled, vertical-shaft
Rating	16,667 kVA, 15,000 kW, 698 A, 60 degrees C rise, 0.9pf, 13.8kV, 3 ph,60Hz
Capacity	19,167 kVA, 17,250 kW, 803 A, 80 degrees C rise
Efficiency (guaranteed):	
At rated kVA, 1.0 pf	97.15 percent
At 75% kVA, 0.9 pf	96.5 percent
Flywheel effect	8,290,000 $lb\text{-}ft^2$
Thrust bearing	Kingsbury type, dia. 48 in., max. load 180 tons
Neutral equipment	50-kVA transformer, 0.45 ohm, 300 A resistor

POWER FACILITIES (CONT.)

GENERATOR (CONT.)

Exciters:
- Main .... 115 kW, 125 V
- Pilot .... 7 kW, 125 V

Weight of heaviest crane lift, rotor .... 70 tons
Diameter of air housing, less trim .... 360 in.
Top of pilot exciter:
- Above stator soleplates .... 146 in.
- Above generator floor .... 140.5 in.

GENERATOR AND TURBINE MODERNIZATION

This project for Nottely was completed on June 21, 1997. The unit was disassembled. The principal components replaced were the wicket gate seals, the stainless steel wear rings, the runner, and wicket gate bushings (greaseless). Also, the turbine shaft was modified for a new water-lubricated guide bearing. The unit was then reassembled. Unit efficiency and capacity have been improved; refer to the latest "Operating Characteristics Curves" for details.

ELECTRIC CONTROLS

From Hiwassee hydro plant, by frequency-shift powerline carrier. Local controls for initial operation and maintenance.

TRANSMISSION PLANT

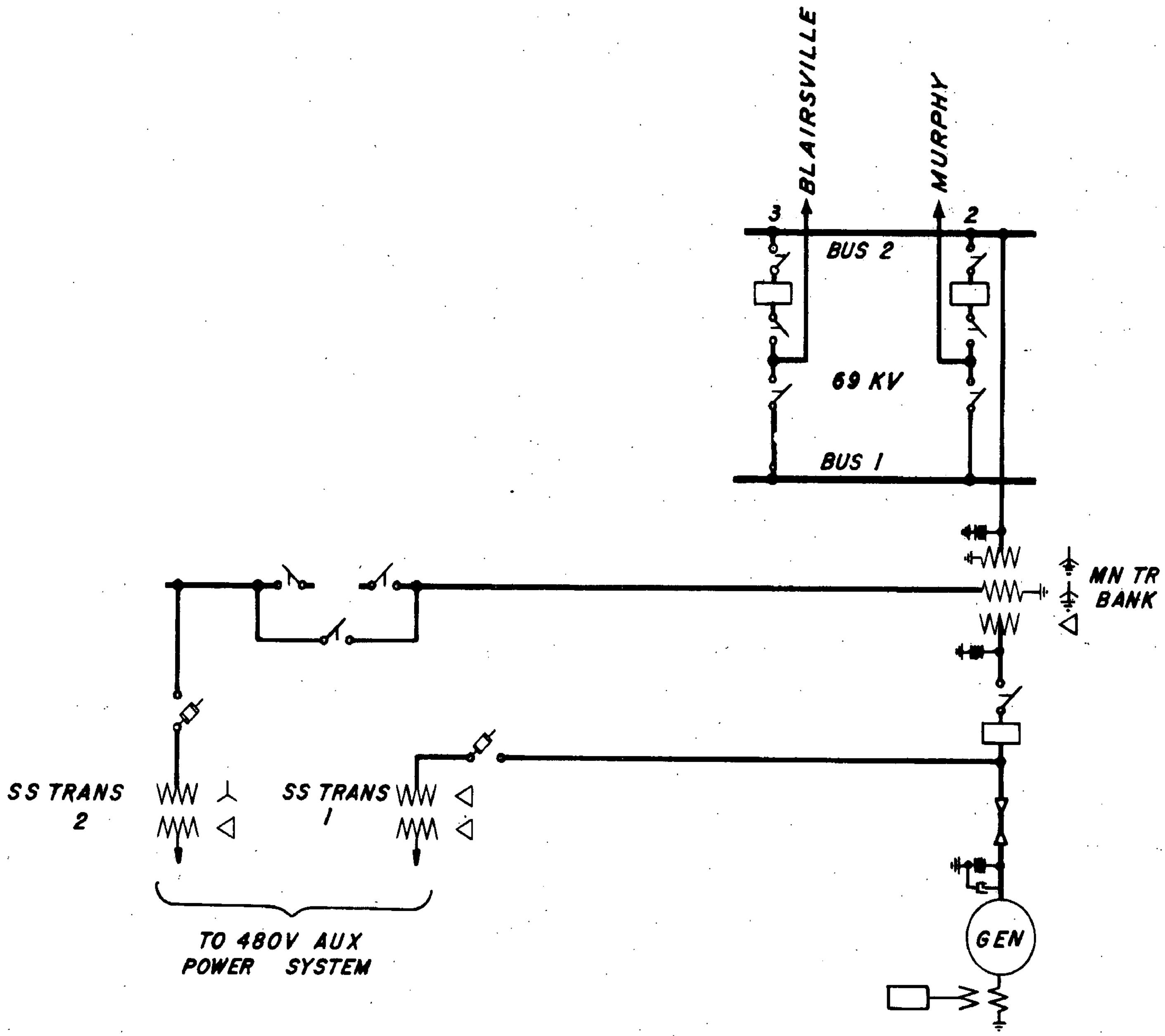
(See Figure 15 for single line diagram of main connections and Figure 16 for view of switchyard)

Step-up and intersystem transformer:
- 1 3-phase, 3-winding transformer, bank 1; rated 12.47 13.2-69 kV, 14,500 kVA self-cooled, 19,333 kVA forced-air-cooled on 13.2- and 69-kV windings; 5000 kVA self-cooled, 6667 kVA forced-air-cooled on 12.47-kV windings; Moloney

69-kV circuit breakers:
- 1 600-A, 1,000,000-kVA, 8/20-Hz, Westinghouse
- 1 600-A, 685,000-kVA, 8/20-Hz, Westinghouse

Structures:
- 2 69-kV switchyard bay, 26 ft wide

FIGURE 15 - Single line diagram of main connections



POWER FACILITIES (CONT.)

EXCAVATED TAILRACE CHANNEL

Length, approx	1000 ft
Width	30 ft
Depth (maximum)	9 ft

HYDRAULIC TURBINE

Number	1
Manufacturer	Voith Hydro, Inc.
Type	Vertical Francis
Rated output	20,600 hp at 128-ft net head
Rated speed	180 rpm
Maximum runaway speed	334 rpm
Specific speed at rating	60.0
Value of sigma at rating	0.27
Diameter of runner at intake	84.489 in.
Diameter of runner at discharge	102.28 in.
Centerline to bottom of runner	42.96 in.
Centerline to top of runner	20.88 in.
Diameter of guide vane circle	128.375 in.
Diameter of lower pit	14.0 ft
Draft tube (see Powerhouse)	Elbow type
Governors	Woodward, cabinet actuator type

GENERATOR

Number	1
Manufacturer	Westinghouse Electric Corp.
Type	Enclosed, water-cooled, vertical-shaft
Rating	16,667 kVA, 15,000 kW, 698 A, 60 degrees C rise, 0.9pf, 13.8kV, 3 ph,60Hz
Capacity	19,167 kVA, 17,250 kW, 803 A, 80 degrees C rise
Efficiency (guaranteed):	
At rated kVA, 1.0 pf	97.15 percent
At 75% kVA, 0.9 pf	96.5 percent
Flywheel effect	8,290,000 $lb\text{-}ft^2$
Thrust bearing	Kingsbury type, dia. 48 in., max. load 180 tons
Neutral equipment	50-kVA transformer, 0.45 ohm, 300 A resistor

POWER FACILITIES (CONT.)

GENERATOR (CONT.)

Exciters:
- Main .... 115 kW, 125 V
- Pilot .... 7 kW, 125 V

Weight of heaviest crane lift, rotor .... 70 tons
Diameter of air housing, less trim .... 360 in.
Top of pilot exciter:
- Above stator soleplates .... 146 in.
- Above generator floor .... 140.5 in.

GENERATOR AND TURBINE MODERNIZATION

This project for Nottely was completed on June 21, 1997. The unit was disassembled. The principal components replaced were the wicket gate seals, the stainless steel wear rings, the runner, and wicket gate bushings (greaseless). Also, the turbine shaft was modified for a new water-lubricated guide bearing. The unit was then reassembled. Unit efficiency and capacity have been improved; refer to the latest "Operating Characteristics Curves" for details.

ELECTRIC CONTROLS

From Hiwassee hydro plant, by frequency-shift powerline carrier. Local controls for initial operation and maintenance.

TRANSMISSION PLANT

(See Figure 13 for single line diagram of main connections and Figure 14 for view of switchyard)

Step-up and intersystem transformer:
- 1 3-phase, 3-winding transformer, bank 1; rated 12.47 13.2-69 kV, 14,500 kVA self-cooled, 19,333 kVA forced-air-cooled on 13.2- and 69-kV windings; 5000 kVA self-cooled, 6667 kVA forced-air-cooled on 12.47-kV windings; Moloney

69-kV circuit breakers:
- 1 600-A, 1,000,000-kVA, 8/20-Hz, Westinghouse
- 1 600-A, 685,000-kVA, 8/20-Hz, Westinghouse

Structures:
- 2 69-kV switchyard bay, 26 ft wide

FIGURE 16 - Switchyard, October 1999

TRANSMISSION PLANT DATA

Plant	Location	Phase	Serial Number	MVA Rating		Voltage kV	Cooling	Tap Changer	Oil Preservation System	Oil Volume Gal.	Configuration	Impedance %			Contract Number	Manuf	Yr of Manuf
				55 deg	65 deg							H-X	H-Y	X-Y			
Nottely	Bank 1	3	910896	14.5/19.33	N/A	69/13.2	OA/FA	DETC	Gas-Blanketed	4130	Wye/Delta	7.90	N/A	N/A	C53-22444	Moloney	1953

Note: H=High voltage winding
Y=Tertiary winding
X=Low voltage winding

RESERVOIR AND POWER DATA

Nottely

Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Gross Head (feet)	Best Efficiency Plant Output (mW)	Best Efficiency Turbine Discharge (cfs)	Best Efficiency kW/CFS	Maximum Sustainable Plant Output (mW)	Maximum Sustainable Turbine Discharge (cfs)	Maximum Sustainable kW/CFS
1780	4.32	174.3	167.4	17.2	1,390	12.44	20.0	1,630	12.25
1779	4.18	170.1	166.4	17.1	1,390	12.35	20.0	1,650	12.16
1778	4.05	165.9	165.4	17.0	1,390	12.26	20.0	1,660	12.06
1777	3.93	162.0	164.3	16.9	1,390	12.17	20.0	1,670	11.96
1776	3.83	158.1	163.3	16.8	1,390	12.08	20.0	1,690	11.86
1775	3.73	154.3	162.3	16.7	1,400	11.99	20.0	1,700	11.76
1774	3.65	150.6	161.2	16.6	1,400	11.90	20.0	1,710	11.66
1773	3.56	147.0	160.2	16.5	1,400	11.81	20.0	1,730	11.56
1772	3.48	143.5	159.2	16.4	1,400	11.72	19.9	1,740	11.46
1771	3.39	140.0	158.2	16.3	1,400	11.62	19.8	1,740	11.36
1770	3.31	136.7	157.1	16.2	1,410	11.53	19.7	1,750	11.26
1769	3.23	133.4	156.1	16.1	1,410	11.44	19.6	1,760	11.15
1768	3.15	130.2	155.1	16.0	1,410	11.34	19.5	1,760	11.05
1767	3.07	127.1	154.1	15.9	1,410	11.25	19.4	1,770	10.95
1766	2.99	124.1	153.1	15.8	1,420	11.16	19.3	1,780	10.85
1765	2.92	121.1	152.1	15.7	1,420	11.06	19.2	1,790	10.75
1764	2.85	118.3	151.0	15.6	1,420	10.97	19.1	1,790	10.65
1763	2.78	115.4	150.0	15.5	1,420	10.88	19.0	1,800	10.54
1762	2.71	112.7	149.0	15.4	1,430	10.81	18.9	1,800	10.49
1761	2.65	110.0	148.0	15.3	1,430	10.73	18.8	1,800	10.43
1760	2.59	107.4	147.0	15.2	1,430	10.66	18.7	1,800	10.38
1759	2.53	104.8	146.0	15.1	1,430	10.59	18.6	1,800	10.33
1758	2.47	102.3	145.0	15.0	1,430	10.52	18.5	1,800	10.27
1757	2.42	99.9	144.0	14.9	1,430	10.45	18.4	1,800	10.22
1756	2.36	97.5	143.0	14.8	1,430	10.38	18.3	1,800	10.16
1755	2.31	95.2	142.0	14.7	1,430	10.31	18.2	1,800	10.11
1754	2.26	92.9	141.0	14.6	1,430	10.24	18.1	1,800	10.06
1753	2.21	90.6	140.0	14.5	1,430	10.17	18.0	1,800	10.00
1752	2.17	88.4	139.0	14.4	1,420	10.11	17.8	1,790	9.94

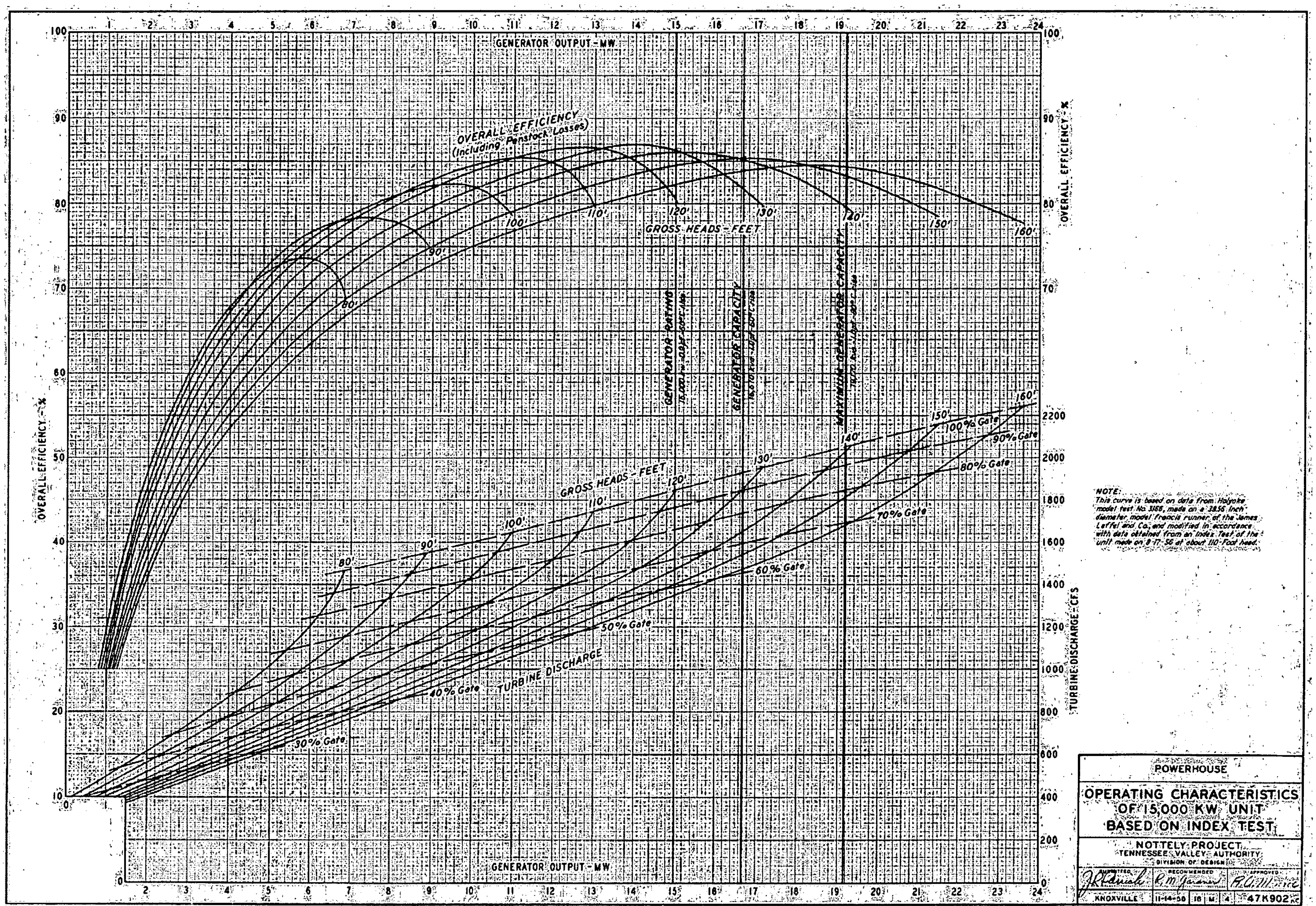
NOTE: Energy in storage data not included

RESERVOIR AND POWER DATA

Nottely

Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Gross Head (feet)	Best Efficiency Plant Output (mW)	Best Efficiency Turbine Discharge (cfs)	Best Efficiency kW/CFS	Maximum Sustainable Plant Output (mW)	Maximum Sustainable Turbine Discharge (cfs)	Maximum Sustainable kW/CFS
1751	2.12	86.3	138.1	14.2	1,410	10.05	17.6	1,780	9.89
1750	2.08	84.2	137.1	14.1	1,410	9.98	17.4	1,770	9.83
1749	2.04	82.1	136.1	13.9	1,400	9.92	17.2	1,760	9.77
1748	2.00	80.1	135.1	13.8	1,390	9.86	17.0	1,750	9.72
1747	1.96	78.1	134.2	13.6	1,390	9.80	16.8	1,740	9.66
1746	1.92	76.2	133.2	13.5	1,380	9.74	16.6	1,730	9.60
1745	1.89	74.3	132.2	13.3	1,370	9.68	16.4	1,720	9.55
1744	1.85	72.4	131.2	13.2	1,370	9.62	16.2	1,710	9.49
1743	1.81	70.6	130.3	13.0	1,360	9.56	16.1	1,700	9.43
1742	1.78	68.8	129.3	12.9	1,360	9.50	15.9	1,690	9.38
1741	1.74	67.0	128.3	12.8	1,350	9.44	15.7	1,680	9.32
1740	1.71	65.3	127.3	12.7	1,350	9.38	15.6	1,670	9.26
1739	1.68	63.6	126.4	12.6	1,350	9.31	15.4	1,660	9.20
1738	1.64	61.9	125.4	12.5	1,350	9.25	15.2	1,650	9.15
1737	1.61	60.3	124.4	12.4	1,340	9.19	15.1	1,640	9.09
1736	1.58	58.7	123.4	12.3	1,340	9.13	14.9	1,630	9.03
1735	1.55	57.2	122.5	12.2	1,340	9.07	14.8	1,620	8.98
1734	1.52	55.6	121.5	12.1	1,330	9.01	14.6	1,610	8.92
1733	1.49	54.1	120.5	12.0	1,330	8.95	14.4	1,610	8.86
1732	1.46	52.7	119.5	11.9	1,330	8.89	14.3	1,600	8.81
1731	1.43	51.2	118.6	11.8	1,320	8.83	14.1	1,590	8.75
1730	1.40	49.8	117.6	11.7	1,320	8.77	14.0	1,580	8.69

NOTE: Energy in storage data not included


GENERATOR OUTPUT - MW
OVERALL EFFICIENCY - %
OVERALL EFFICIENCY (Including Penstock Losses)
GROSS HEADS - FEET
80'
90'
100'
110'
120'
130'
140'
150'
160'
GENERATOR RATING
GENERATOR CAPACITY
MAXIMUM GENERATOR CAPACITY
30% Gate
40% Gate
50% Gate
60% Gate
70% Gate
80% Gate
90% Gate
100% Gate
TURBINE DISCHARGE
TURBINE DISCHARGE - CFS
NOTE:
This curve is based on data from Holyoke model test No. 3166, made on a 38.56 inch diameter model Francis runner of the James Leffel and Co., and modified in accordance with data obtained from an Index Test of the unit made on 8-17-56 at about 110-Foot head.
POWERHOUSE
OPERATING CHARACTERISTICS OF 15,000 KW UNIT BASED ON INDEX TEST
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE
11-14-56
47K902

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet. except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar year and does not always equal the sum of the days in periods because of extension of periods into adjacent years. Water was spilled through the spillway and/or the Howell-Bunger Valve. All unmarked spill was through valve. Howell-Bunger valve was removed and installed at Chatuge in August 1954. Maximum hourly average discharge to date was 8,120 cfs at 2 p.m. on 5/28/73. *Spillway #Spillway and valve
1942	1780	10/2	2	50	*83---9/10---3; #1780---10/2---47
1943	1950	5/23 & 24	9	164	#1760---1/31---20; 1670---2/23---4; *860---3/24---13; *398---4/7---5; #1950---5/23---49; 1700---6/15---14; 1670---7/20---15; 1670---8/8---19; 1500---9/25---10; 1170---12/21---15
1944	1500	7/11	7	193	*742---4/2---5; *742---4/12---14; #1500---7/11---100; 860---8/8---16; 1200---9/15---15; 519---10/15---17; 942---12/6---23
1945	2104	9/30	5	56	1740---5/31---21; 1520---6/27---8; 585---7/28---2; 1180---9/6---10; 2104---9/30---15
1946	2550	1/13	10	218	2550---1/13---14; 954---2/1---6; 2550---2/13---15; 1090---3/10---16; 1520---3/19---5; 1280---4/16---37; 1000---7/3---39; 1320---7/23---73; 538---12/17---2; 998---12/24---9
1947	1690	4/19	5	252	1690---4/19---123; 1000---6/21---18; 656---7/6---5; 527---7/24---6; 1360---7/31---100
1948	2330	6/9	7	146	1490---1/29---15; 2330---6/9---57; 570---6/29---3; 1000---7/10---5; 1140---7/27---4; 1490---8/24---26; 1150---9/21---19
1949	1640	10/25	8	269	1510---1/8---137; 710---5/3---3; 1000---5/20---7; 950---6/4---16; 1050---8/13---30; 1640---10/25---53; 1000---11/11---22; 1250---12/21---38
1950	1500	4/11	9	218	710---2/16-19---41; 500---3/11&12---4; 1500---4/11---54; 1240---6/21&22---27; 1000---8/25-27---25; 500---9/9-11---7; 1100---9/22---25; 1000---12/9---12; 500---5/30---3
1951	2210	1/9	7	163	2210---1/9---23; 100---3/5---2; 1190---3/22---10; 990---6/5---32; 1180---6/21---3; 1000---6/27---8; 1150---7/18---85
1952	1500	4/16&17, 5/13	5	242	1000---2/5---42; 650---2/26---12; 1500---4/16---89; 1000---6/26---96; 1150---12/30---12
1953	1780	8/20	5	197	500---1/20---4; 800---2/3---5; 1500---3/17---29; 1250---6/18---43; 1780---8/20---99
1954	2210	5/6	5	156	1470---1/1---24; 1490---3/9---38; 1980---4/7---9; 2210---5/6---40; 740---6/15---53
1955	2950	5/23	2	201	*2950---5/23---101; *920---9/27---110
1956	1750	8/11	0	10	Turbine began operating January 10.
1957	1563	6/14	0	0	
1958	1395	7/5	0	0	

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet. except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar year and does not always equal the sum of the days in periods because of extension of periods into adjacent years. Water was spilled through the spillway and/or the Howell-Bunger Valve. All unmarked spill was through valve. Howell-Bunger valve was removed and installed at Chatuge in August 1954. Maximum hourly average discharge to date was 8,120 cfs at 2 p.m. on 5/28/73. *Spillway #Spillway and valve
1959	1600	8/4	0	0	
1960	1729	9/14	0	0	
1961	1514	12/27	0	0	
1962	1816	2/26	0	0	
1963	1442	4/25	0	0	
1964	2183	5/3	2	7	*1025---4/29---4; *1864---5/3---3
1965	1552	6/3	0	0	
1966	1210	12/30	9	21	5---8/2---4; 5---8/10---3; 12---8/19---2; 9---8/26---3; 5---8/13---2; 4---9/14---1; 6---9/16---1; 25---9/22---3; 12---9/27---2 (through temporary Howell-Bunger valve for tests)
1967	1877	12/20	5	13	10---7/25---2; 25---8/4---4; 13---8/9---2; 23---8/29---3; 17---10/26---2 (through temporary Howell-Bunger valve for tests)
1968	1845	1/10	0	0	
1969	1212	11/15	0	0	
1970	1679	1/7	0	0	
1971	1382	11/4	0	0	
1972	1810	1/13	0	0	
1973	5363	5/28	1	3	*3740---5/28---3
1974	1599	5/21	0	0	
1975	1507	2/24	0	0	
1976	1868	5/29	0	0	
1977	1794	1/17	0	0	
1978	1664	1/14	0	0	
1979	1292	1/9	0	0	

Nottely Spill Compilation

Tennessee Valley Authority
River System Operations

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet. except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar year and does not always equal the sum of the days in periods because of extension of periods into adjacent years. Water was spilled through the spillway and/or the Howell-Bunger Valve. All unmarked spill was through valve. Howell-Bunger valve was removed and installed at Chatuge in August 1954. Maximum hourly average discharge to date was 8,120 cfs at 2 p.m. on 5/28/73. *Spillway #Spillway and valve
1980	1599	3/2	0	0	
1981	978	12/18	0	0	
1982	1872	2/4	0	0	
1983	1830	5/22	0	0	
1984	1830	5/9	0	0	
1985	1408	1/21	0	0	
1986	1066	1/27	0	0	
1987	934	10/14	0	0	
1988	974	12/1	0	0	
1989	2338	6/21	1	2	*741---6/21---2
1990	1799	3/4	0	0	
1991	1707	5/8	1	12	153---5/30---12
1992	1970	12/24-25	0	0	
1993	1400	1/1	2	9	10---6/8---3; 33---6/15---6
1994	1470	1/20	1	1	13---2/21---1
1995	1553	10/11	1	3	50---10/18-20---3
1996	1450	12/20	0	0	
1997	1402	5/22	1	84	*1402---5/22---84
1998	1300	2/5	0	0	
1999	1356	12/8	0	0	
2000	1332	10/23	1	3	*34---6/14---3

TVA OPERATED RESERVOIR SYSTEM
ANNUAL MAXIMUM AND MINIMUM ELEVATIONS, IN ORDER OF MAGNITUDE
FROM DATE OF RESERVOIR CLOSURE THROUGH 2000

NOTTELY

MAXIMUM					MINIMUM				
ORDER	ELEVATION	YEAR	MONTH	DAY	ORDER	ELEVATION	YEAR	MONTH	DAY
1	1781.47	1973	MAY	28	1	1622.70 *	1942	JAN.	24
2	1780.50	1943	APR.	20	2	1638.60	1947	OCT.	6
3	1779.79	1976	JULY	5	3	1641.60	1954	JULY	30
4	1779.72	1989	JUNE	21	4	1642.40	1953	SEP.	19
5	1779.59	1944	APR.	28	5	1645.75	1952	SEP.	12
6	1779.28	1984	MAY	29	6	1675.50	1951	JAN.	25
7	1779.04	1964	MAY	2	7	1685.42	1948	OCT.	1
8	1778.44	1991	JULY	1	8	1698.20	1944	DEC.	27
9	1778.24	1979	JUNE	11	9	1701.96	1959	SEP.	25
10	1778.21	1980	MAY	25	10	1702.75	1945	JAN.	1
11	1778.09	1992	JULY	4	11	1706.18	1956	DEC.	12
12	1778.09	1998	JUNE	8	12	1709.51	1946	OCT.	3
13	1778.05	1997	JUNE	12	13	1709.75	1958	SEP.	19
14	1777.82	1996	JUNE	11	14	1715.78	1960	SEP.	26
15	1777.76	1990	MAY	8	15	1718.42	1962	DEC.	28
16	1777.22	1955	MAY	23	16	1720.04	1963	JAN.	1
17	1777.13	1946	JUNE	10	17	1721.79	1957	AUG.	17
18	1777.10 %	1994	JUNE	27	18	1724.80	1950	OCT.	13
19	1777.05	1993	JUNE	21	19	1725.25	1966	FEB.	7
20	1777.04	1977	MAY	4	20	1725.36	1965	OCT.	8
21	1776.86	1983	MAY	21	21	1728.38	1955	JAN.	1
22	1776.78	1942	SEP.	27	22	1729.24	1961	FEB.	7
23	1776.18	1967	SEP.	4	23	1729.48	1970	FEB.	4
24	1775.42	1956	JAN.	1	24	1730.05	1943	OCT.	3
25	1774.73	1949	AUG.	8	25	1732.20	1964	JAN.	1
26	1774.14	1975	MAY	5	26	1732.93	1969	NOV.	21
27	1773.86	1974	JUNE	11	27	1734.34	1971	JAN.	1
28	1773.19	1995	JULY	4	28	1734.92	1968	DEC.	17
29	1772.71	1971	AUG.	23	29	1738.07	1974	NOV.	27
30	1772.47	1999	JULY	19	30	1739.79	1977	FEB.	17
31	1772.01	1972	MAY	30	31	1740.46	1999	JAN.	7
32	1771.80	1962	APR.	29	32	1740.84	1998	DEC.	23
33	1770.20	1982	JUNE	7	33	1740.91	2000	JAN.	7
34	1770.02	1966	JULY	8	34	1740.95	1949	OCT.	30
35	1769.43	2000	JULY	5	35	1741.75	1985	JAN.	25
36	1768.97	1963	MAY	6	36	1741.77	1997	DEC.	19
37	1768.46	1987	JULY	8	37	1741.78	1995	JAN.	6
38	1767.69	1957	APR.	12	38	1741.83	1967	FEB.	17
39	1766.80	1945	MAY	30	39	1742.17	1981	FEB.	7
40	1766.61	1965	APR.	27	40	1742.58	1996	JAN.	5
41	1766.51	1960	APR.	28	41	1742.84	1975	DEC.	25
42	1766.28	1968	MAY	20	42	1743.44	1979	JAN.	10
43	1765.75	1958	MAY	25	43	1743.82	1976	DEC.	14
44	1765.60	1988	JUNE	6	44	1744.16	1980	JAN.	10
45	1765.55	1981	JUNE	8	45	1744.26	1978	NOV.	10
46	1765.44	1952	MAR.	28	46	1744.69	1994	DEC.	21
47	1765.03	1978	JUNE	26	47	1746.25	1972	JAN.	1

TVA OPERATED RESERVOIR SYSTEM
ANNUAL MAXIMUM AND MINIMUM ELEVATIONS, IN ORDER OF MAGNITUDE
FROM DATE OF RESERVOIR CLOSURE THROUGH 2000

NOTTELY

MAXIMUM					MINIMUM				
ORDER	ELEVATION	YEAR	MONTH	DAY	ORDER	ELEVATION	YEAR	MONTH	DAY
48	1764.42	1950	APR.	7	48	1746.32	1987	JAN.	15
49	1763.50	1961	JULY	5	49	1746.44	1986	FEB.	14
50	1763.16	1970	JUNE	23	50	1746.61	1973	JAN.	17
51	1762.91	1948	MAY	7	51	1746.66	1989	DEC.	25
52	1761.70	1969	APR.	21	52	1746.76	1983	JAN.	20
53	1761.33	1985	JULY	11	53	1746.83	1988	JAN.	15
54	1760.36	1986	JUNE	1	54	1746.97	1982	JAN.	18
55	1760.11	1953	MAR.	13	55	1747.40	1984	FEB.	10
56	1759.15	1951	MAY	18	56	1748.73	1993	DEC.	31
57	1758.32	1947	APR.	18	57	1749.47	1990	DEC.	21
58	1747.88	1959	JUNE	29	58	1750.37	1992	JAN.	23
59	1740.20	1954	FEB.	22	59	1750.65	1991	JAN.	24

AVERAGE WEEKLY CFS

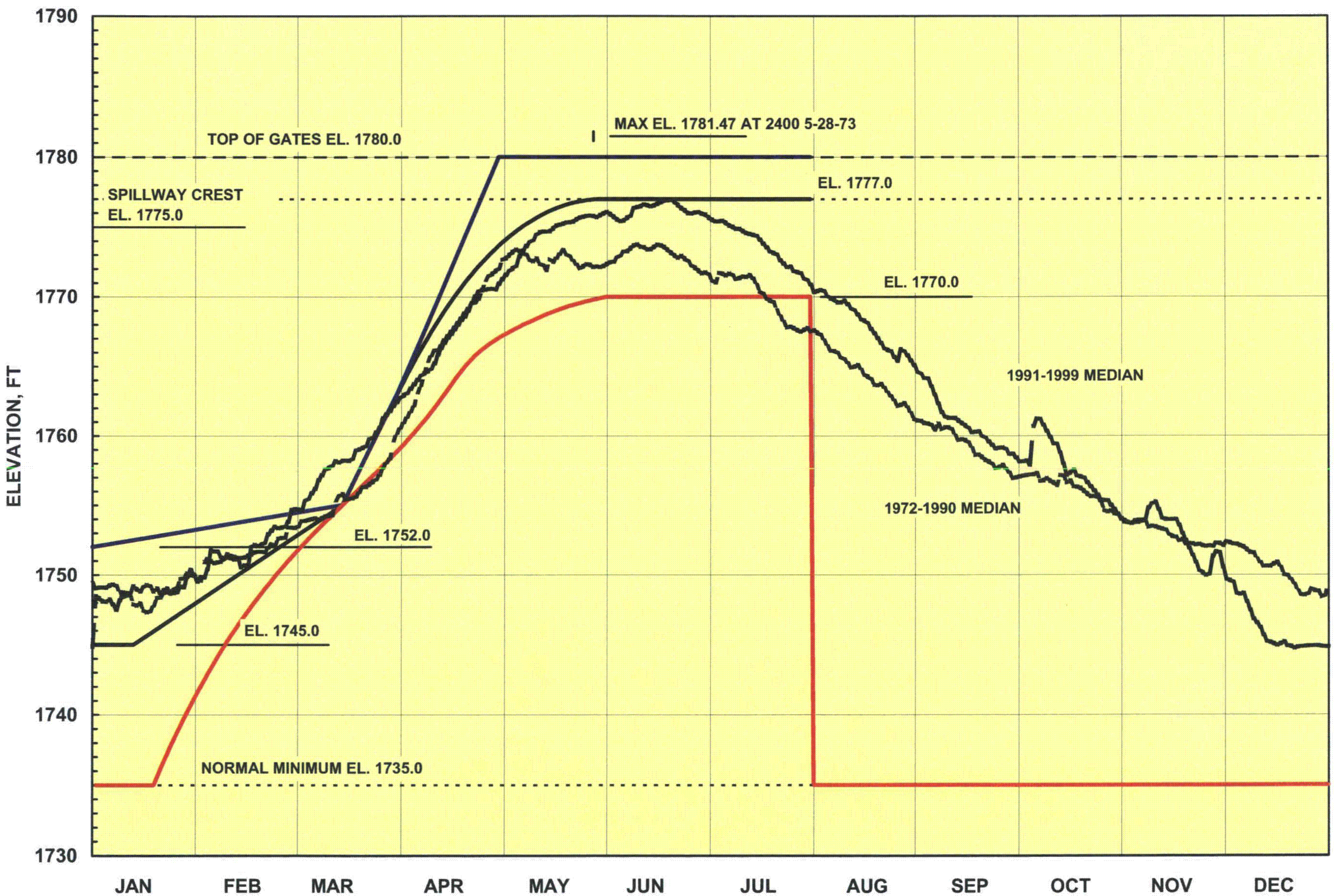
MAXIMUM, MINIMIUM, MEDIAN, AND MEAN
Adjusted Flow by Weeks
Nottely
Years = 1903-2000

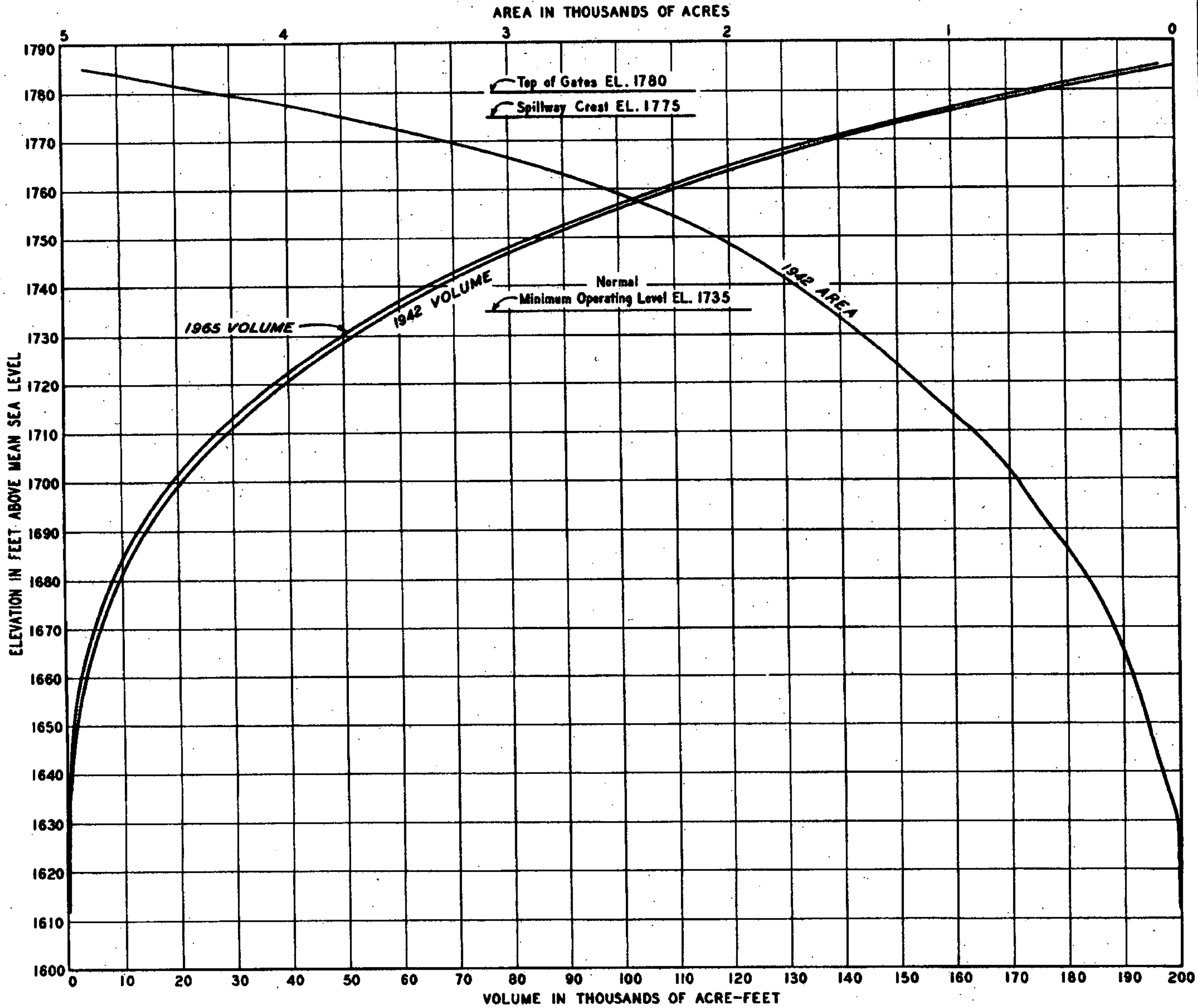
AVERAGE WEEKLY CFS

WEEK ENDING	WEEK NO.	MAXIMUM	YR	MINIMUM	YR	MEDIAN	MEAN
JAN 7	1	1,490	1937	136	1940	425	490
JAN 14	2	1,640	1946	147	1981	420	483
JAN 21	3	1,980	1954	160	1914	421	519
JAN 28	4	1,990	1996	155	1940	508	548
FEB 4	5	1,940	1957	169	1986	474	564
FEB 11	6	2,190	1946	150	1934	484	570
FEB 18	7	2,760	1990	150	1934	495	610
FEB 25	8	2,150	1961	154	1988	520	584
MAR 4	9	1,970	1917	145	1988	527	606
MAR 11	10	1,590	1952	166	1986	546	635
MAR 18	11	2,590	1990	214	1981	506	669
MAR 25	12	1,890	1952	177	1988	564	634
APR 1	13	1,940	1977	168	1988	540	701
APR 8	14	2,920	1936	197	1986	570	679
APR 15	15	1,990	1979	157	1999	552	594
APR 22	16	1,280	1998	151	1986	519	546
APR 29	17	980	1929	130	1986	513	524
MAY	18	1,430	1929	124	1986	468	528
MAY 13	19	1,320	1929	116	1986	463	491
MAY 20	20	2,050	1976	121	1988	404	445
MAY 27	21	1,530	1909	92	1988	390	452
JUN 3	22	1,980	1973	69	1988	360	427
JUN 10	23	1,390	1909	42	1988	342	393
JUN 17	24	780	1909	38	1988	331	367
JUN 24	25	1,370	1989	76	1986	295	330
JUL	26	952	1963	52	1988	290	327
JUL 8	27	1,250	1941	42	2000	281	351
JUL 15	28	2,690	1916	38	2000	292	352
JUL 22	29	1,860	1938	17	2000	271	336
JUL 29	30	1,810	1938	65	1925	277	314
AUG 5	31	1,210	1971	42	1986	264	299
AUG 12	32	1,060	1978	50	1925	259	288
AUG 19	33	1,630	1920	0	1999	241	292
AUG 26	34	3,710	1967	40	1925	211	290
SEP 2	35	1,040	1906	30	1925	210	252
SEP 9	36	1,230	1928	25	1925	200	237
SEP 16	37	570	1906	30	1925	190	212
SEP 23	38	800	1907	25	1925	195	224
SEP 30	39	1,360	1929	47	1986	202	254
OCT 7	40	2,890	1964	43	1986	197	283
OCT 14	41	840	1906	70	1904	192	222
OCT 21	42	943	1975	66	1986	190	236
OCT 28	43	707	1997	70	1904	215	233
NOV 4	44	1,450	1918	46	2000	212	258
NOV 11	45	1,060	1977	75	1931	220	255
NOV 18	46	1,370	1929	100	1904	230	277
NOV 25	47	2,680	1906	80	1904	230	319
DEC 2	48	1,450	1948	95	1933	233	324
DEC 9	49	1,230	1914	109	1987	320	378
DEC 16	50	1,720	1961	105	1958	316	390
DEC 23	51	1,640	1918	116	1987	307	401
DEC 31	52	2,260	1932	120	1935	398	469

AVERAGE FLOW: 1903 - 2000 = 413 CFS

ANNUAL OPERATING CYCLE





ELEV FT	1942 AREA AC	VOLUME 1942 AC-FT	1949 AC-FT	1955 AC-FT	1961 AC-FT	1965 AC-FT
1,785	4,910	199,500	198,800	197,900	197,400	197,300
1,780	4,310	176,500	175,800	174,900	174,400	174,300
1,775	3,750	156,500	155,800	154,900	154,400	154,300
1,770	3,290	138,900	138,200	137,300	136,800	136,700
1,760	2,560	109,700	109,000	108,100	107,600	107,400
1,750	2,060	86,600	86,000	84,900	84,400	84,200
1,740	1,710	67,700	67,200	66,000	65,500	65,300
1,730	1,420	52,100	51,600	50,400	49,900	49,800
1,720	1,160	39,200	38,800	37,500	37,100	37,100
1,710	910	28,800	28,500	27,200	26,800	26,800
1,700	713	20,700	20,400	19,200	19,000	19,000
1,690	563	14,300	14,100	12,900	12,700	12,700
1,680	403	9,520	9,430	8,340	8,190	8,140
1,670	293	6,040	5,950	5,020	4,940	4,860
1,660	213	3,520	3,420	2,650	2,620	2,530
1,650	145	1,750	1,640	1,000	1,040	1,000
1,640	82	613	491	235	315	306
1,630	17	127	34	6	103	101
1,620	5	20	0	0	11	9
1,612	0	0	0	0	0	0

NOTES:

Reservoir areas were measured on TVA land maps, scale 1"=500' at elevations 1785 and 1780. These maps were prepared by the Maps and Surveys Branch. Areas at 1640, 1680, 1720 & 1760 were measured on TVA topographic maps, scale 1"=2,000'. Contours were made to conform to elevations on TVA sediment range cross sections which are located at one to three mile intervals within the reservoir.

The 1949 and subsequent volumes were determined by the constant factor method for computing sediment.

All elevations are referred to the 1936 Supplementary Adjustment of the U.S.C. & G.S.

Area of original river within reservoir to elevation 1780=170 acres.

Drainage area above dam = 214 square miles.

Dam closure January 24, 1942.

THIS DRAWING SUPERSEDES 18-DA-1-321G422R1

NOTTELY RIVER MILE 21.0

RESERVOIR AREAS AND VOLUMES

NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED	RECOMMENDED	APPROVED

KNOXVILLE | 12-28-62 | 18 | DA | 1 | 321N796R2

RESERVOIR RELEASES IMPROVEMENTS

The aeration and minimum flow equipment at Nottely Dam is part of the implementation of TVA's Lake Improvement Plan (LIP) approved by the Board of Directors in 1991. One of the goals of the Lake Improvement Plan is to improve the dissolved oxygen (DO) levels and minimum flows of the releases of 16 dams. Minimum flow releases of 55 cfs at Nottely were obtained by the installation of a small hydroturbine unit which is operated whenever the main unit is off. At Nottely testing showed the target minimum DO content of the release (4 mg/L) to be best achieved by the installation of air injection equipment. Blower and compressor systems inject air at the large and small hydroturbines respectively. The blower system consists of two blowers (250 hp each), controls, piping, and valves designed to inject air into the water flow through the large unit. The air compressor system consists of two air compressors, controls, piping, and valves designed to inject air into the flow through the small unit. The air compressors are rated at 25 hp each.

SAFETY MODIFICATIONS FOR PROBABLE MAXIMUM FLOOD

Chronology

Safety analysis studies for Chatuge Dam for the probable maximum flood (PMF) were started on July 29, 1976, and completed in May 1984. Final design was completed in January 1988. Onsite construction began in July 1986, and was completed on June 20, 1988.

Cost of Modifications

Design costs for the capital safety modifications to Chatuge Dam were $1,520,000. Construction costs were $13,680,000. The total project cost was $15,200,000. This total does not include costs for dam safety evaluation studies which resulted in the modifications.

Controlling Features

The embankments at Nottely were modified in order to safety pass the probable maximum flood. The embankments were raised to elevation 1807 by the addition of rockfill. A new bridge was built with a 30 ft. width of asphalt roadway. These PMF modifications will prevent overtopping and erosion of the embankments and thus prevent breach and failure of the dam.

CONSTRUCTION DATA

PERSONNEL

	Dam and Tunnel	Single-Unit Addition
Peak employed	2,100	121
Total man-hours	1,831,960	305,555
Number of injuries	26	2
Days lost	3,939	539
Fatalities	0	0
Accident frequency	14.2	6.55
Accident severity	2,150	1,764

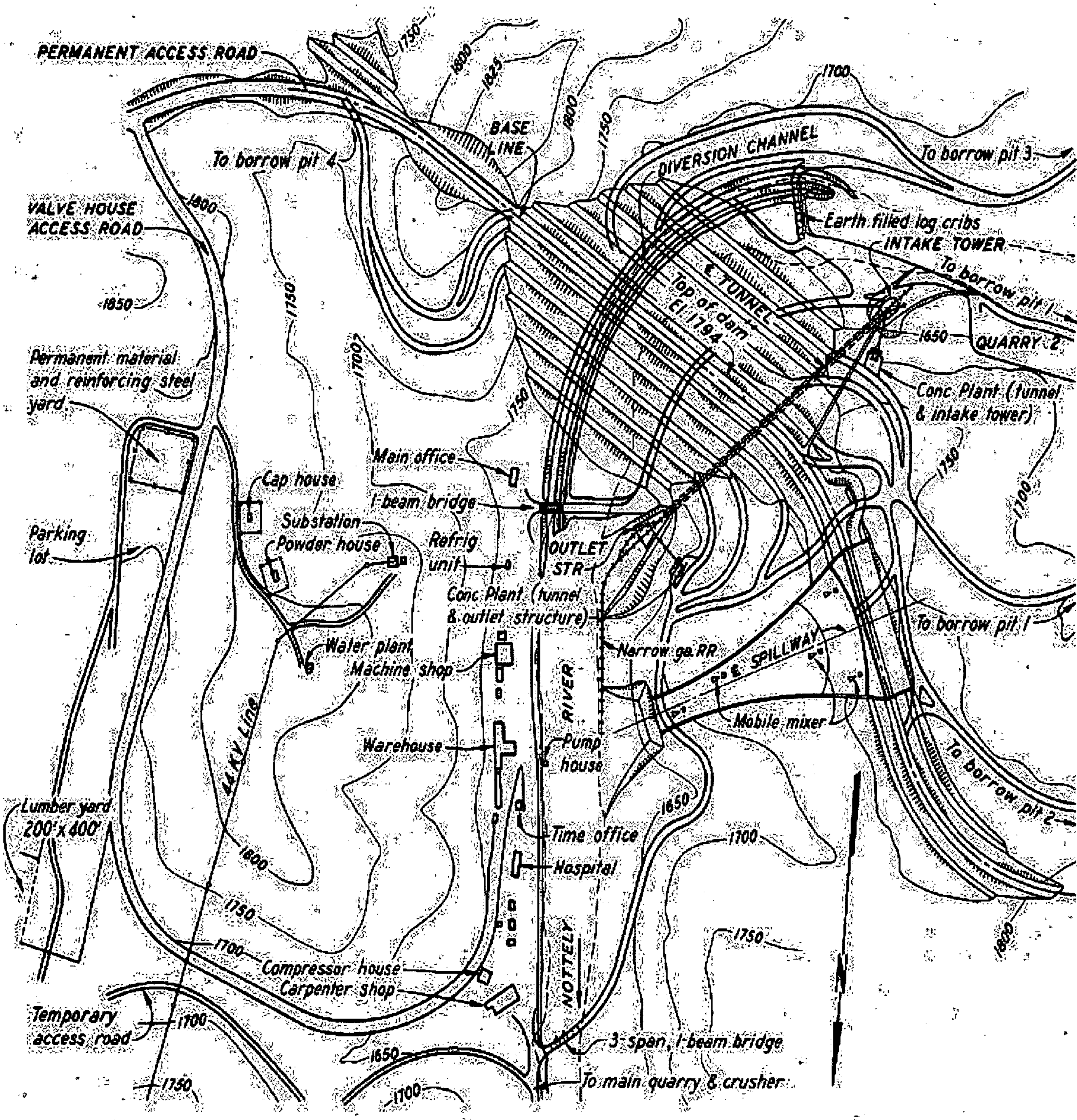
HOUSING FACILITIES
(Initial Project)

Permanent houses built	None
Demountable houses	58
Trailers	50
Tents (160 total capacity)	40
Washhouses	4

Public buildings constructed included a cafeteria and hospital.

QUANTITIES

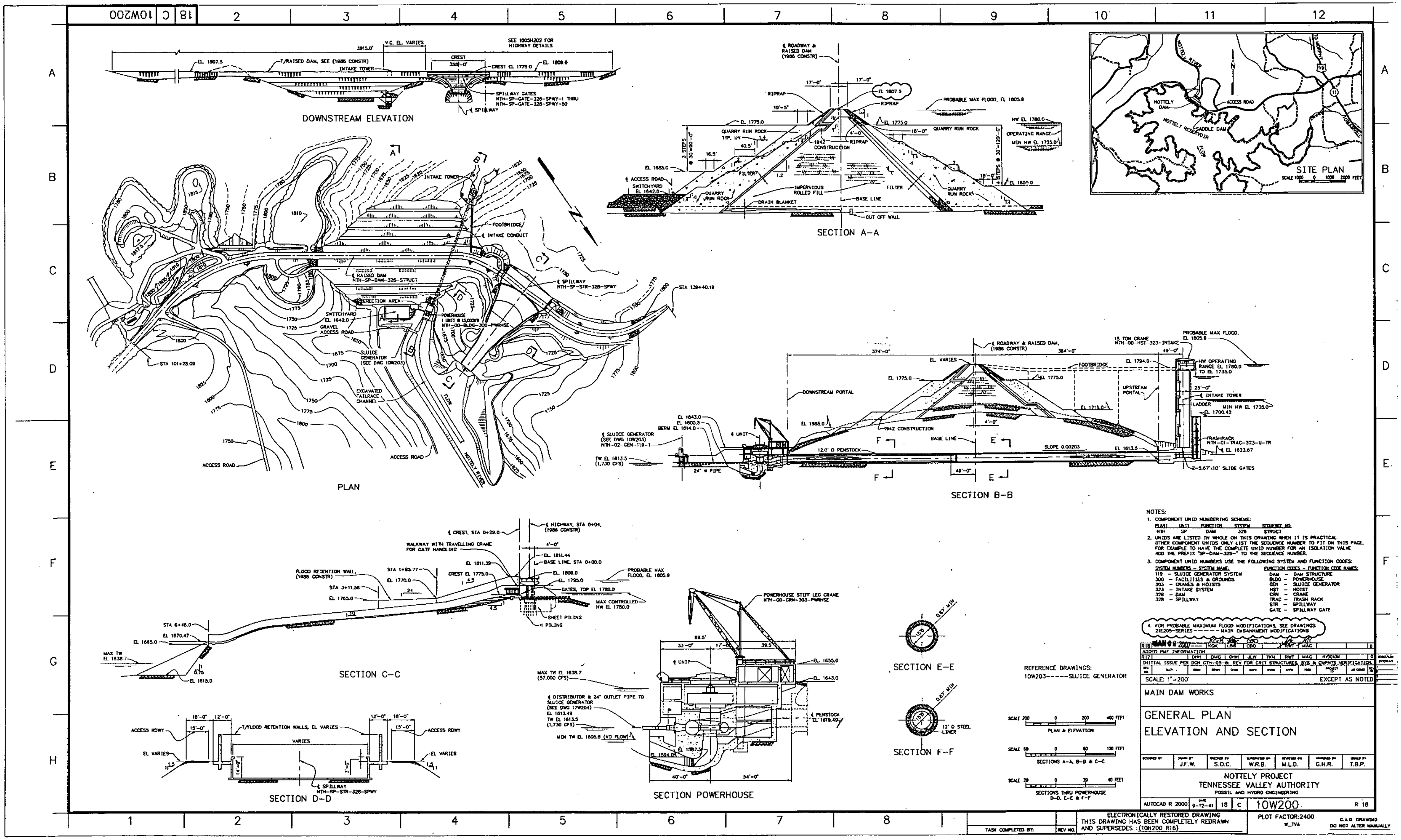
	Initial Project	Single-Unit Addition
Dam and power facilities:		
Unclassified excavation	207,360 cu. yd	15,000 cu. yd
Rock excavation	8,353 cu. yd	-
Rolled earthfill	854,300 cu. yd	-
Dumped rockfill	698,000 cu. yd	-
Concrete	17,700 cu. yd	4,050 cu. yd
Highways:		
Excavation	650,000 cu. yd	-

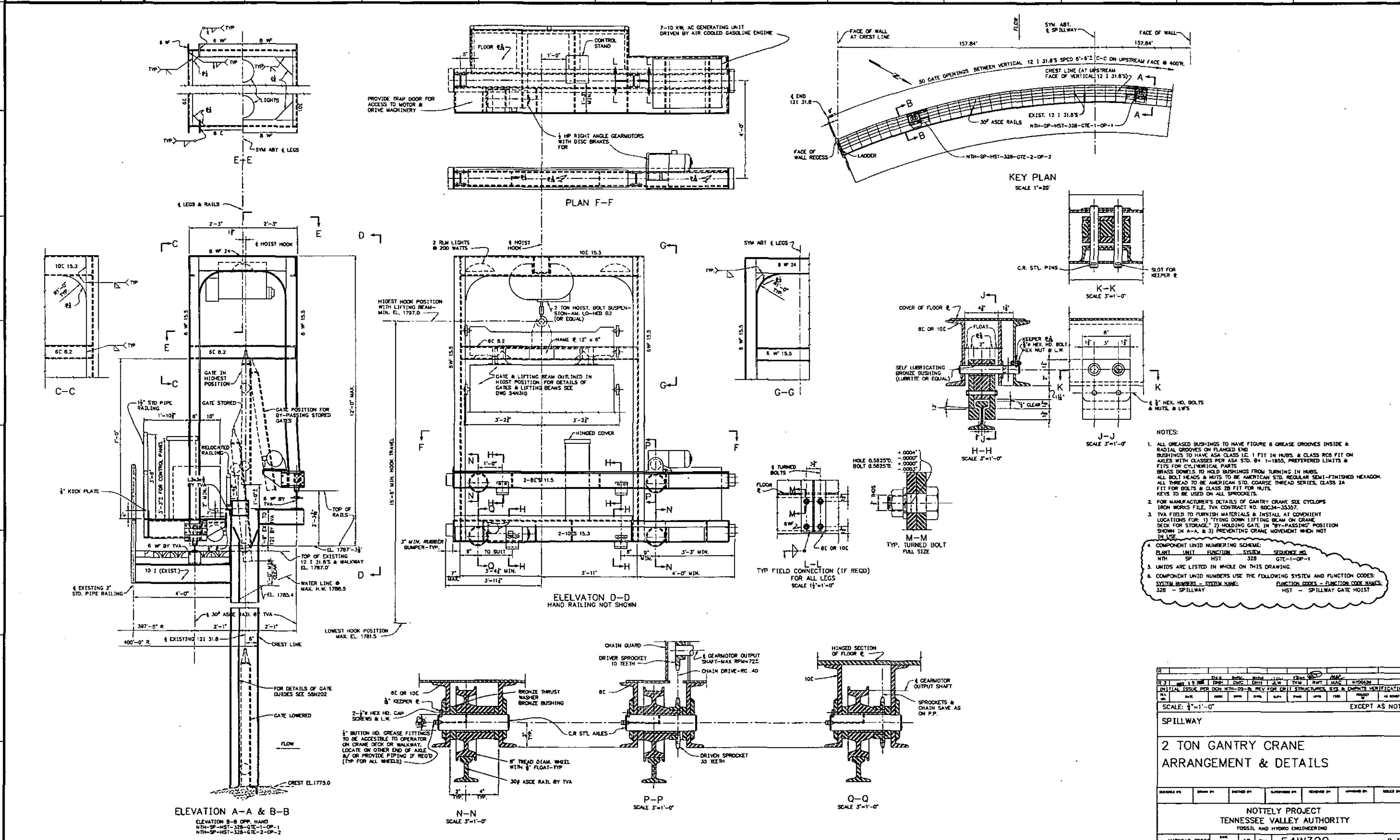


CONSTRUCTION PLANT LAYOUT

STAGES	NO.	ITEM OR EQUIPMENT
CONST SERVICES AND CONST PLANT	A	Access road
	C	Construction utilities-water-air-power
	D	Construction-roads & bridges
	E	Shop & job buildings
	F	Construction plant
	G	Cofferdam & temporary channel excavation
DIVERSION TUNNEL		Excavation-unclassified
		Excavation-rock
		Concrete lining
		Grouting
		Steel liner
INTAKE STRUCTURE		Concrete tower
		Access bridge
		Gates & operating equipment
		Intake crane
		Trashracks
OUTLET STRUCTURE	6	Concrete
	12	Gates & operating equipment
DAM STRUCTURES	26	Foundation excavation
	29	Earth embankment
	30	Rock fill
	32	Operators building
SPILLWAY	3	Excavation-unclassified
	6	Concrete
	12	Crest control equipment
		Highway bridge
		Steel sheet piling
GENERAL	91	Land acquisition
	92	Reservoir clearance
	94	Highway & railroad relocation
	95	Family removal & cemetery relocation
	96	Utilities
	97	Filling reservoir
	98	Tunnel diversion
	99	Clean-up & removal

CONSTRUCTION SCHEDULE


DOWNSTREAM ELEVATION
SEE 10D5H202 FOR HIGHWAY DETAILS
CREST 358'-0"
CREST EL 1775.0
T/RAISED DAM, SEE (1986 CONSTR)
INTAKE TOWER
SPILLWAY GATES NTH-SP-GATE-328-SPWY-1 THRU NTH-SP-GATE-328-SPWY-50
SECTION A-A
PROBABLE MAX FLOOD, EL 1805.9
RIPRAP
QUARRY RUN ROCK
1942 CONSTRUCTION
IMPERVIOUS ROLLED FILL
FILTER
DRAIN BLANKET
BASE LINE
CUT OFF WALL
SWITCHYARD EL 1642.0
SITE PLAN
NOTTELY DAM
SADDLE DAM
ACCESS ROAD
NOTTELY RESERVOIR
PLAN
INTAKE TOWER
FOOTBRIDGE
INTAKE CONDUIT
SPILLWAY NTH-SP-STR-328-SPWY
RAISED DAM NTH-SP-DAM-326-STRUCT
ERECTION AREA
SWITCHYARD EL 1642.0
GRAVEL ACCESS ROAD
POWERHOUSE 1 UNIT @ 15,000KW NTH-00-BLDG-300-PWRHSE
SLUICE GENERATOR (SEE DWG 10W203)
EXCAVATED TAILRACE CHANNEL
STA 101+28.09
STA 139+40.19
ACCESS ROAD
NOTTELY RIVER
SECTION B-B
ROADWAY & RAISED DAM (1986 CONSTR)
DOWNSTREAM PORTAL
UPSTREAM PORTAL
15 TON CRANE NTH-00-HST-323-INTAKE
INTAKE TOWER
TRASHRACK NTH-01-TRAC-323-U-TR
2-5.67'x10' SLIDE GATES
SLUICE GENERATOR (SEE DWG 10W203) NTH-02-GEN-119-1
12.0' D PENSTOCK
SLOPE 0.00203
SECTION C-C
FLOOD RETENTION WALL (1986 CONSTR)
WALKWAY WITH TRAVELLING CRANE FOR GATE HANDLING
CREST EL 1775.0
GATES, TOP EL 1780.0
SHEET PILING
H PILING
SECTION D-D
T/FLOOD RETENTION WALLS, EL VARIES
ACCESS RDWY
SPILLWAY NTH-SP-STR-328-SPWY
SECTION POWERHOUSE
POWERHOUSE STIFF LEG CRANE NTH-00-CRN-303-PWRHSE
SECTION E-E
SECTION F-F
12' D STEEL LINER
REFERENCE DRAWINGS:
10W203------SLUICE GENERATOR
PLAN & ELEVATION
SECTIONS A-A, B-B & C-C
SECTIONS THRU POWERHOUSE D-D, E-E & F-F
NOTES:
1. COMPONENT UNID NUMBERING SCHEME:
PLANT UNIT FUNCTION SYSTEM SEQUENCE NO.
NTH SP DAM 326 STRUCT
2. UNIDS ARE LISTED IN WHOLE ON THIS DRAWING WHEN IT IS PRACTICAL. OTHER COMPONENT UNIDS ONLY LIST THE SEQUENCE NUMBER TO FIT ON THIS PAGE. FOR EXAMPLE TO HAVE THE COMPLETE UNID NUMBER FOR AN ISOLATION VALVE ADD THE PREFIX "SP-DAM-326-" TO THE SEQUENCE NUMBER.
3. COMPONENT UNID NUMBERS USE THE FOLLOWING SYSTEM AND FUNCTION CODES:
SYSTEM NUMBERS - SYSTEM NAME:
119 - SLUICE GENERATOR SYSTEM
300 - FACILITIES & GROUNDS
303 - CRANES & HOISTS
323 - INTAKE SYSTEM
326 - DAM
328 - SPILLWAY
FUNCTION CODES - FUNCTION CODE NAMES:
DAM - DAM STRUCTURE
BLDG - POWERHOUSE
GEN - SLUICE GENERATOR
HST - HOIST
CRN - CRANE
TRAC - TRASH RACK
STR - SPILLWAY
GATE - SPILLWAY GATE
4. FOR PROBABLE MAXIMUM FLOOD MODIFICATIONS, SEE DRAWINGS: 21E205-SERIES------MAIN EMBANKMENT MODIFICATIONS
R18 ADDED PMF INFORMATION
R17 INITIAL ISSUE PER DCN CTH-05-8: REV FOR CRIT STRUCTURES, SYS & CMPNTS VERIFICATION
SCALE: 1"=200' EXCEPT AS NOTED
MAIN DAM WORKS
GENERAL PLAN
ELEVATION AND SECTION
J.F.W. S.O.C. W.R.B. M.L.D. G.H.R. T.B.P.
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
AUTOCAD R 2000 9-12-41 18 C 10W200 R 18
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN
AND SUPERSEDES :(10N200 R16)
PLOT FACTOR:2400
W_TVA
C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTES:

1. ALL GREASED BUSHINGS TO HAVE FIGURE 8 GREASE GROOVES INSIDE & RADIAL GROOVES ON FLANGED END
   BUSHINGS TO HAVE ASA CLASS LC 1 FIT IN HUBS, & CLASS RC6 FIT ON AXLES WITH CLASSES PER ASA STD. B4. 1-1955, PREFERERED LIMITS & FITS FOR CYLINDRICAL PARTS
   BRASS DOWELS TO HOLD BUSHINGS FROM TURNING IN HUBS.
   ALL BOLT HEADS & NUTS TO BE AMERICAN STD. REGULAR SEMI-FINISHED HEXAGON.
   ALL THREAD TO BE AMERICAN STD. COARSE THREAD SERIES, CLASS 2A FIT FOR BOLTS & CLASS 2B FIT FOR NUTS.
   KEYS TO BE USED ON ALL SPROCKETS.
2. FOR MANUFACTURER'S DETAILS OF GANTRY CRANE SEE CYCLOPS IRON WORKS FILE. TVA CONTRACT NO. 60C34-35357.
3. TVA FIELD TO FURNISH MATERIALS & INSTALL AT COVENIENT LOCATIONS FOR: 1) "TYING DOWN LIFTING BEAM ON CRANE DECK FOR STORAGE." 2) HOLDING GATE IN "BY-PASSING" POSITION SHOWN IN A-A, & 3) PREVENTING CRANE MOVEMENT WHEN NOT IN USE.
4. COMPONENT UNID NUMBERING SCHEME:

PLANT	UNIT	FUNCTION	SYSTEM	SEQUENCE NO.
NTH	SP	HST	328	GTE-1-OP-1

5. UNIDS ARE LISTED IN WHOLE ON THIS DRAWING.
6. COMPONENT UNID NUMBERS USE THE FOLLOWING SYSTEM AND FUNCTION CODES:

SYSTEM NUMBERS – SYSTEM NAME:	FUNCTION CODES – FUNCTION CODE NAMES:
328 – SPILLWAY	HST – SPILLWAY GATE HOIST

R 3 | DHH | DMC | DHH | JLW | TKM | RWT | MAC | HYDO43H
INITIAL ISSUE PER DCN NTH-05-8; REV FOR CRIT STRUCTURES, SYS & CMPNTS VERIFICATION.

SCALE: ¼"=1'-0" EXCEPT AS NOTED

SPILLWAY

2 TON GANTRY CRANE ARRANGEMENT & DETAILS

NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

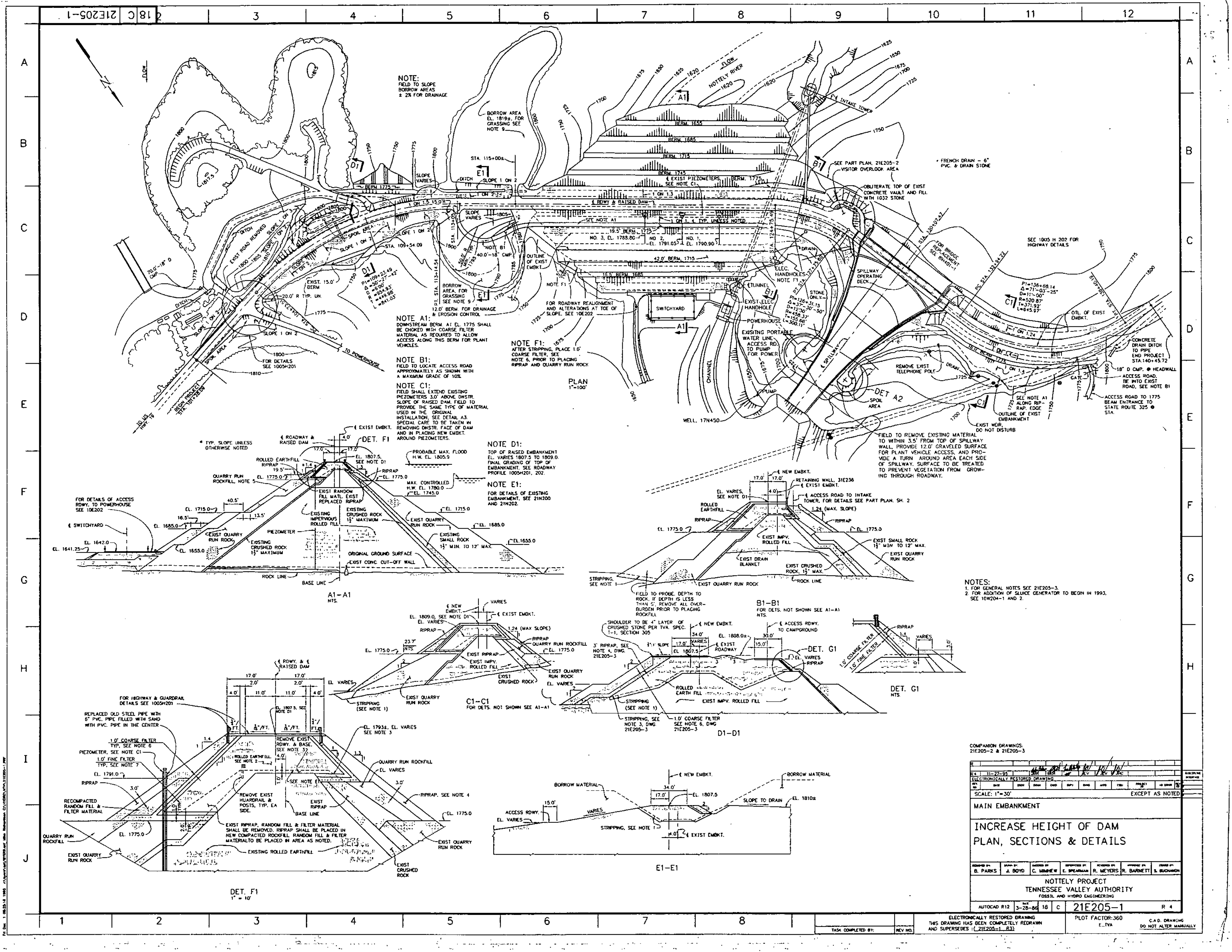
AUTOCAD R2000 | DATE 11-3-59 | 18 | SH | 54W320 | R 3

ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES :(54N320 R2)

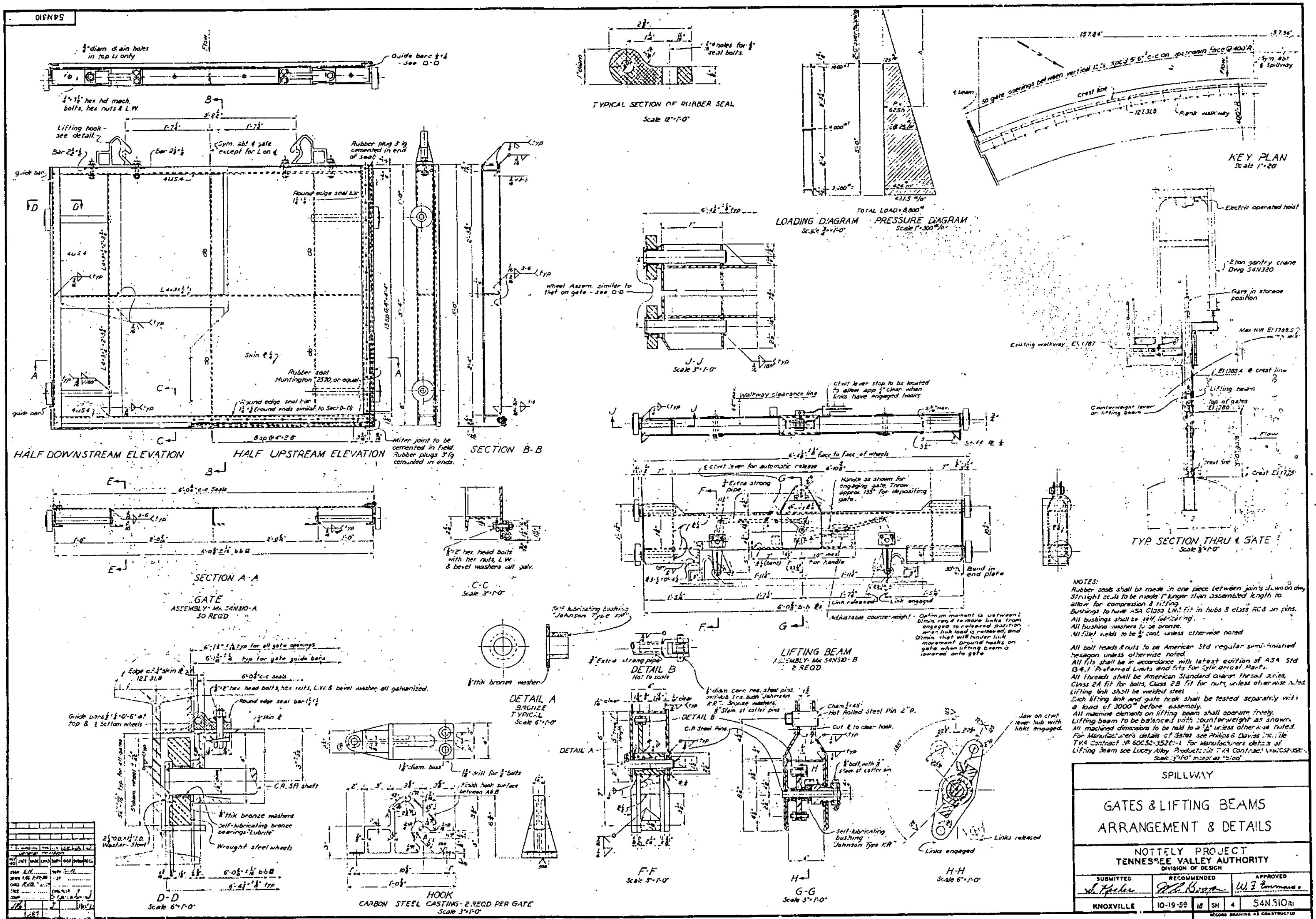
TASK COMPLETED BY: | REV NO.

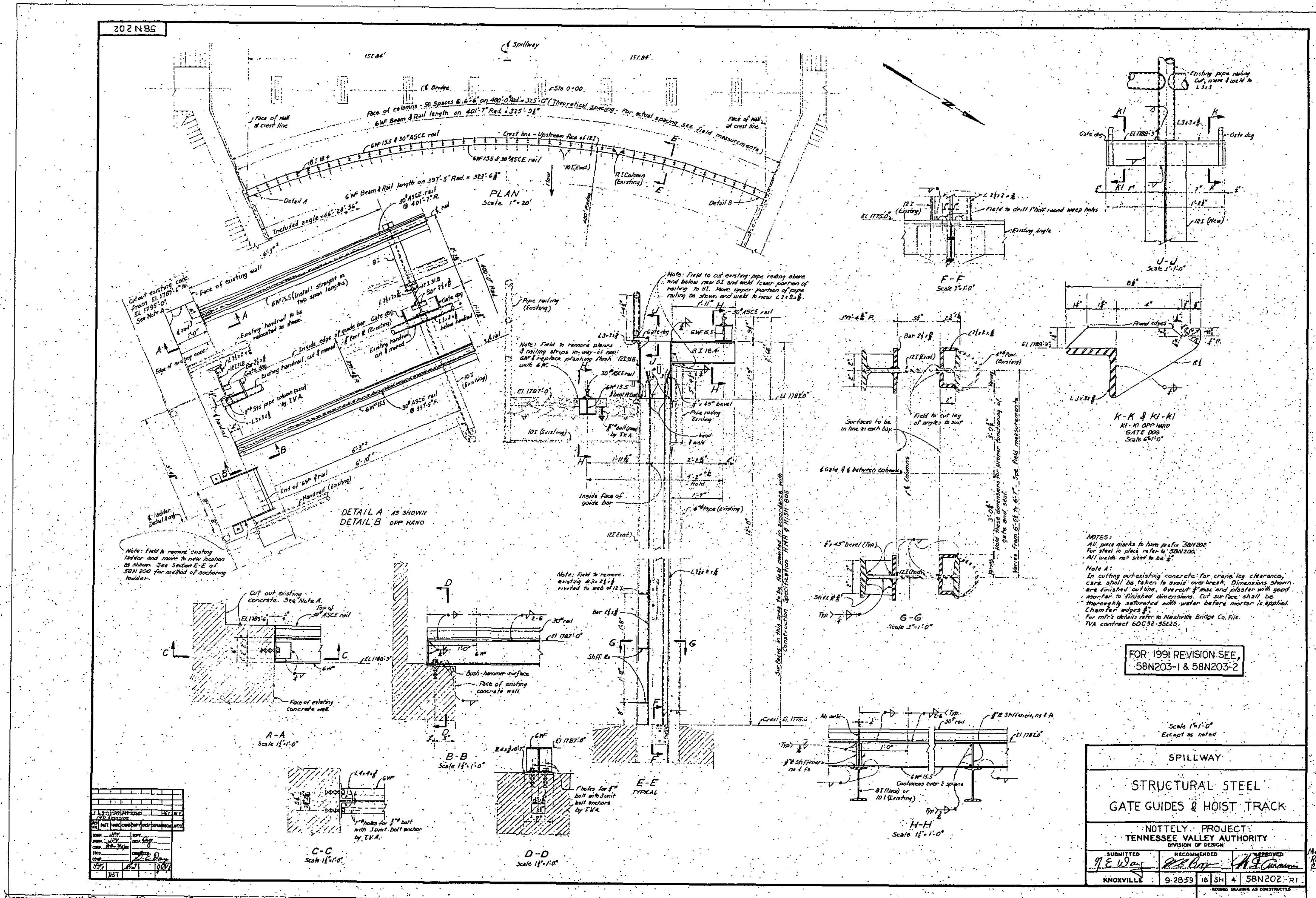
PLOT FACTOR:18
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

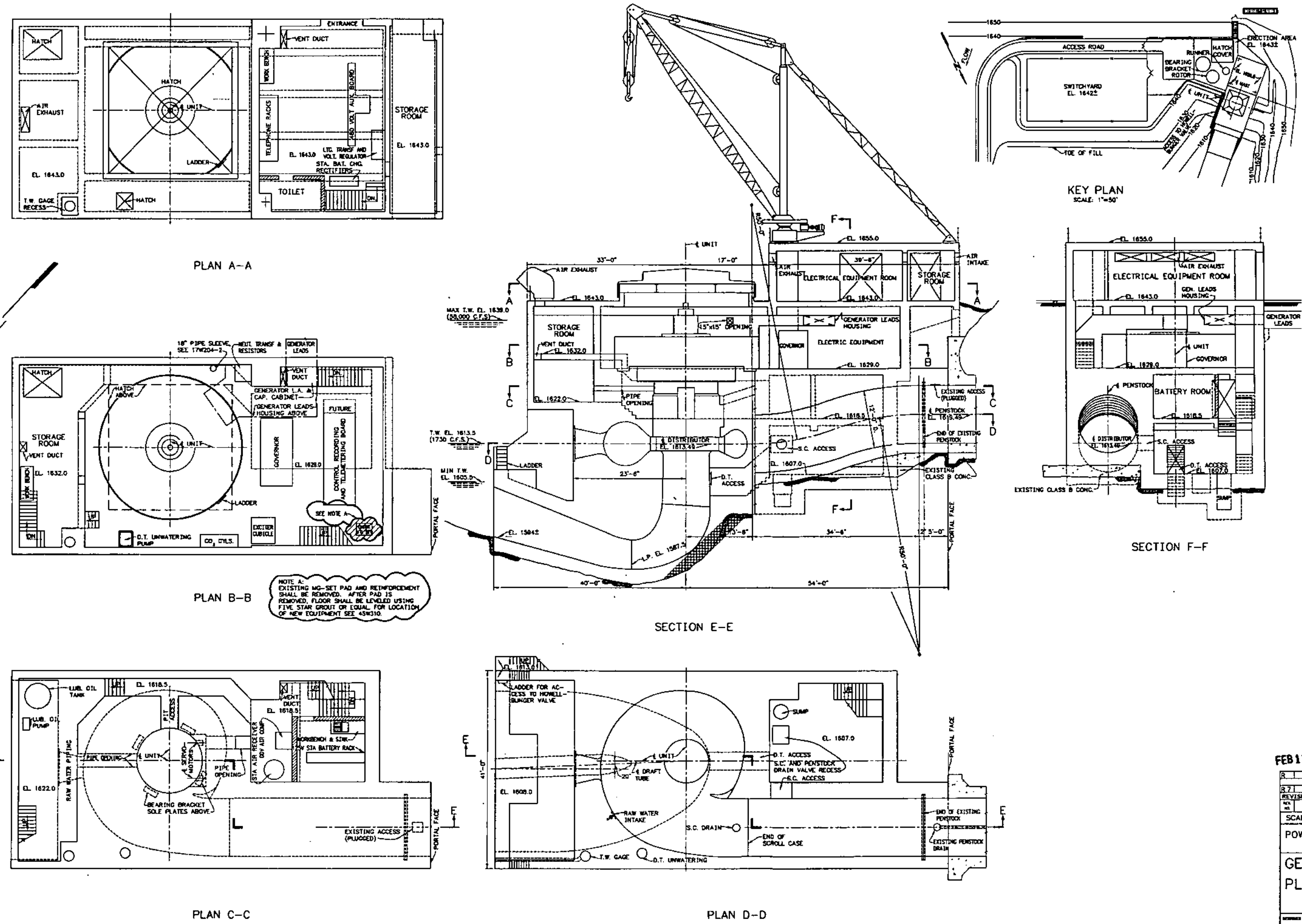


NOTE:
FIELD TO SLOPE BORROW AREAS ± 2% FOR DRAINAGE
NOTE A1:
DOWNSTREAM BERM AT EL. 1775 SHALL BE CHOKED WITH COARSE FILTER MATERIAL AS REQUIRED TO ALLOW ACCESS ALONG THIS BERM FOR PLANT VEHICLES.
NOTE B1:
FIELD TO LOCATE ACCESS ROAD APPROXIMATELY AS SHOWN WITH A MAXIMUM GRADE OF 10%.
NOTE C1:
FIELD SHALL EXTEND EXISTING PIEZOMETERS 3.0' ABOVE DNSTR. SLOPE OF RAISED DAM. FIELD TO PROVIDE THE SAME TYPE OF MATERIAL USED IN THE ORIGINAL INSTALLATION, SEE DETAIL A3. SPECIAL CARE TO BE TAKEN IN REMOVING DNSTR. FACE OF DAM AND IN PLACING NEW EMBKT. AROUND PIEZOMETERS.
NOTE D1:
TOP OF RAISED EMBANKMENT EL. VARIES 1807.5 TO 1809.0. FINAL GRADING OF TOP OF EMBANKMENT, SEE ROADWAY PROFILE 1005H201, 202.
NOTE E1:
FOR DETAILS OF EXISTING EMBANKMENT, SEE 21N200 AND 21N202.
NOTE F1:
AFTER STRIPPING, PLACE 1.0' COARSE FILTER, SEE NOTE 6, PRIOR TO PLACING RIPRAP AND QUARRY RUN ROCK
PLAN
1"=100'
A1-A1
NTS.
B1-B1
FOR DETS. NOT SHOWN SEE A1-A1
NTS.
C1-C1
FOR DETS. NOT SHOWN SEE A1-A1
D1-D1
E1-E1
DET. F1
1" = 10'
DET. G1
NTS
FIELD TO REMOVE EXISTING MATERIAL TO WITHIN 3.5' FROM TOP OF SPILLWAY WALL, PROVIDE 12.0' GRAVELED SURFACE FOR PLANT VEHICLE ACCESS, AND PROVIDE A TURN AROUND AREA EACH SIDE OF SPILLWAY. SURFACE TO BE TREATED TO PREVENT VEGETATION FROM GROWING THROUGH ROADWAY.
NOTES:
1. FOR GENERAL NOTES SEE 21E205-3.
2. FOR ADDITION OF SLUICE GENERATOR TO BEGIN IN 1993, SEE 10W204-1 AND 2.
COMPANION DRAWINGS: 21E205-2 & 21E205-3
ELECTRONICALLY RESTORED DRAWING
SCALE: 1"=30'
EXCEPT AS NOTED
MAIN EMBANKMENT
INCREASE HEIGHT OF DAM
PLAN, SECTIONS & DETAILS
B. PARKS
J. BOYD
C. MINHEW
E. SPEARMAN
R. MEYERS
R. BARNETT
S. BUCHANON
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
AUTOCAD R12
3-28-86
18
C
21E205-1
R 4
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES : (21E205-1 R3)
PLOT FACTOR:360
C.A.D. DRAWING
DO NOT ALTER MANUALLY
TASK COMPLETED BY:
REV NO.


HALF DOWNSTREAM ELEVATION
HALF UPSTREAM ELEVATION
SECTION B-B
SECTION A-A
GATE
C-C
TYPICAL SECTION OF RUBBER SEAL
LOADING DIAGRAM
PRESSURE DIAGRAM
KEY PLAN
J-J
LIFTING BEAM
DETAIL B
DETAIL A
TYP SECTION THRU ℄ GATE
D-D
HOOK
CARBON STEEL CASTING-2 REQD PER GATE
F-F
G-G
H-H
NOTES:
Rubber seals shall be made in one piece between joints shown on dwg. Straight seals to be made 1" longer than assembled length to allow for compression & fitting.
Bushings to have ASA Class LN2 fit in hubs & class RC8 on pins.
All bushings shall be self lubricating.
All bushing washers to be bronze.
All fillet welds to be 3/16" cont. unless otherwise noted.
All bolt heads & nuts to be American Std regular semi-finished hexagon unless otherwise noted.
All fits shall be in accordance with latest edition of ASA Std B4.1 Preferred Limits and fits for Cylindrical Parts.
All threads shall be American Standard coarse thread series, Class 2A fit for bolts, Class 2B fit for nuts, unless otherwise noted.
Lifting link shall be welded steel.
Each lifting link and gate hook shall be tested separately with a load of 3000# before assembly.
All machine elements on lifting beam shall operate freely.
Lifting beam to be balanced with counterweight as shown.
All machined dimensions to be held to ± 1/64" unless otherwise noted.
For Manufacturer's details of Gates see Philips & Davies Inc. file TVA Contract No 60C52-35201-1. For Manufacturer's details of Lifting Beam see Lucey Alloy Products file TVA Contract
SPILLWAY
GATES & LIFTING BEAMS
ARRANGEMENT & DETAILS
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE
10-19-59
54N310 R1



58N202
PLAN
Scale 1" = 20'
DETAIL A AS SHOWN
DETAIL B OPP HAND
A-A
B-B
C-C
D-D
E-E TYPICAL
F-F
G-G
H-H
J-J
K-K & K1-K1
K1-K1 OPP HAND
GATE DOG
NOTES:
All piece marks to have prefix "58N202."
For steel in place refer to 58N200.
All welds not sized to be 1/4".
Note A:
In cutting out existing concrete for crane leg clearance, care shall be taken to avoid overbreak. Dimensions shown are finished outline. Overcut 1/2" max and plaster with good mortar to finished dimensions. Cut surface shall be thoroughly saturated with water before mortar is applied. Chamfer edges 3/4".
For mfr's details refer to Nashville Bridge Co. file.
TVA contract 60C52-55225.
FOR 1991 REVISION SEE, 58N203-1 & 58N203-2
Scale 1" = 1'-0"
Except as noted
SPILLWAY
STRUCTURAL STEEL
GATE GUIDES & HOIST TRACK
NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE
9-28-59
58N202-R1
RECORD DRAWING AS CONSTRUCTED



FEB 11 2008

R 7	JDD	JDD	KGK	CBD	RWT	RWT	MAC	NTH027

REVISED TO SHOW MG-SET REMOVAL PER DCN NTH-05-9

SCALE: $\frac{1}{8}$"=1'-0" EXCEPT AS NOTED

POWERHOUSE

GENERAL ARRANGEMENT
PLANS & SECTIONS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
AAM		AAM				AEB

NOTTELY PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2000 | 10-21-52 | 18 | C | 41W600 | R 7

ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES :(41N600 R6)

PLOT FACTOR:96
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY