GINNA STATION

DEER CREEK OVERFLOW FLOODING STUDY

SEP TOPIC II-3.B

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This report is derived from a recent NUS study, which supplements previous Deer Creek studies[1,2] performed by NUS for Rochester Gas and Electric Corporation. This report determines elevations in Deer Creek and at Ginna structures under conditions of flood flow. The August 1981 study[1] discussed the elevations in Deer Creek for various precipitation events and estimated return periods for the events. It was shown that a storm of 12 inches in 24 hours (estimated return period much greater than 10^4 years) will result in a Deer Creek flow (approximately 13,700 cfs) which remains within the creek channel, thereby not affecting Ginna Station operation. The Probable Maximum Flood (PMF), approximately 32,500 cfs, was found to overflow the channel banks.

An analysis sponsored by the NRC[3] determined that the Standard Project Flood (SPF) for the Ginna site was 15,000 cfs and the PMF was 38,700 cfs. The June 1982 NUS study, using different parameters than the NRC study, found an SPF of approximately 13,100 cfs. This flood, and any flow less than approximately 14,600 cfs, will result in the creek staying totally within its banks.

Study Purpose

The present analysis is an extension of previous NUS analyses, in that it considers water elevations at Ginna Station for floods

which overflow the Deer Creek Channel and breach plant grade elevation. Plant grade elevation is 270 feet to the west of the containment and 269 feet to the east of the containment.

The equipment at the lower elevations of the plant is protected by means of curbs, or equipment elevation, to a height of approximately 255 feet. No specific flood barriers are available at the higher plant grade elevations, other than window sills and door steps. Floor elevation at the higher plant grade is at 271'0".

This analysis presents water levels across the plant, from Deer Creek to the screen house, for flood flows up to 38,700 cfs, corresponding to the largest calculated PMF.

Deer Creek Channel

As in the previous studies, the HEC-2 computer code(5) was used to calculate water surface elevations within Deer Creek Channel at various cross-sections and for various flows. Figure 1 (taken from RG&E drawing SK447-93) shows the locations of cross sections used to model Deer Creek elevations with the 270 foot contour darkened. A number of sections were added between sections 1420 and 2620 since the June 1982 study. These sections were surveyed for this study in order to give better definition to the flood elevations in the area of the Ginna Station. The use of the new surveyed sections lowered the SPF water elevations approximately 0.1 feet.

Parameters used, such as Manning's, transition, and bridge loss coefficients, have been described previously.[1] These Manning's coefficients are more conservative (higher elevation for a given flow) than those of the NRC-sponsored study[3] except in the area between cross-sections 1670 and 2620 (see Figure 1). The overbank coefficient in this area (during the flood conditions considered here almost all of the flow is carried by the overbank) was taken as 0.03. This value corresponds to "Flood Plains-Pasture, no brush-short grass,"[6] the condition actually observed during multiple visits to the site. The difference in predicted elevations for the two sets of Manning's Coefficients[1,3] is one the order of six inches for flows in the range of the SPF.[2]

Ginna Station Channels

When the channel flood flow exceeds 14,600 cfs a portion of the flow will be directed through the plant site to the west of the containment, exiting the site via the discharge canal. When the total flood flow increases to approximately 18,000 cfs, Deer Creek will begin to overflow to the east of the containment as well. The two flow channels will combine in the vicinity of the screen house before exiting the site. Figure 2 (based on RG&E drawing 33013-352 Rev. 5) shows the cross-sections used to model the flood elevations onsite. Sections 1 through 11 define Ginna Station Channel West and Sections 101 through 106 define Ginna Station Channel East. A single Manning's coefficient of 0.030 (short-grass) was chosen.

The HEC-2 computer code was used to calculate water surface elevations within the two Ginna Station Channels at various flows. Deer Creek flows and overflows were taken to synoptically correspond when elevations were equivalent at their flow splits, i.e., at Sections 11 and 2380 for the west channel and Sections 106 and 1475 (average of elevations at 1420 and 1530) for the east channel. Deer Creek Sections 1420, 1530, 2300, and 2380 are indicated on Figure 2 along with the Ginna Station Channels.

Flood Flow Elevations

Between Ginna Station West Section 1 and East Section 101 water elevations will be determined by three hydraulic controls: the spilling of water into the discharge canal, the flow out the discharge canal opening, and the breakwall separating the site from the Lake Ontario beach. For total Ginna Station flows up to 4340 cfs, the spilling of water into the discharge canal will control water elevations in the vicinity of the screen house according to the broad crested weir equation of

$$Q = CLH^{3/2} \qquad (1)$$

where

Q = flow over weir, cfs

L = length of weir crest, feet (296 feet[7])

H = height of water behind weir, feet (measured from elevation 253.5 feet[8])

C = coefficient that depends on H and the breadth of the weir crest.

The value of C was taken as a constant of 2.9,[9] based on the design value of H (1.5 feet) and a weir breadth of 1.5 feet.[8]

For total flows through the station between 4340 cfs (screen house water elevation = 256.4 feet) and the flow that results in the breakwall being overtopped (elevation 261 feet) the discharge canal opening controls water elevations at the screen house. The discharge opening approximates a trapezoid with a base 20 feet wide (at elevation 238 feet) and a top width of 51 feet (at elevation 253.5 feet). From elevation 253.5 feet to the top of the breakwall at elevation 261 feet the opening width remains constant at 51 feet.[7,8] Taking the discharge opening as a flow obstruction, or weir, and applying Bernoulli's equation results in the relationship

$$Q = C \left[LH_t^{3/2} + \frac{3}{5} (B-L) H_1^{3/2} \right] \quad (2)$$

where

L = length of weir at top of opening, feet (51 feet)

H_t = height of water behind weir as measured from lake level, feet (lake level assumed at 247 feet)

B = length of weir at lake level, feet (38 feet)

H_1 = height of top of trapezoid above lake level, feet (6.5 feet)

C = coefficient taken as 3.2.[9]

At elevation 261 feet the flow calculated from equation 2 is 8,160 cfs.

[illegible]

[illegible]

[illegible]

Total Ginna Station flows greater than 8,160 cfs will result in overtoppping of the breakwall, which acts as a broad crested weir. Accordingly, equation 1 is applied to the increment of flow above the 8,160 cfs going through the discharge opening with L = 761 feet,[8] H measured from elevation 261 feet, and C = 2.7[9] (breadth of weir crest = 4 feet[8]). Figure 3 shows the total flow through the Ginna Station Channels as a function of water elevation at the screen house (between Sections 1 and 101), as calculated from the hydraulic control equations described previously. A flow of 1,580 cfs is seen to correspond to the design elevation of 255 feet.

The HEC-2 computer code was run for Ginna Station Channels West and East with the elevations and flows of Figure 3 as boundary conditions. The results indicate that the screen house levels do not affect the levels at sections 11 and 106 because intermediate sections 8 and 105 act as hydraulic controls, i.e., critical flow sections. Figure 4 relates the total Deer Creek overflow into Ginna Staton to the total flood flow, calculated according to the previous descriptions. Also indicated on Figure 4 is the flow through Ginna Station Channel West, the difference between it and the total Ginna Station flow being the amount flowing through Ginna Station Channel East. Figure 4 also shows that the east side overflow does not become significant until total flood flows exceed approximately 21,000 cfs. Even at the maximum calculated PMF of 38,700 cfs, 76 percent of the Ginna Station flow is through the west channel.

Figure 5 shows water elevations at the screen house as a function of total flood flow. Various flows of interest are indicated on Figure 5, including the Deer Creek capacity with no overflow (14,600 cfs - no water at the screen house), the largest calculated SPF[3] (15,000 cfs - screen house water elevation = 253.55 feet), the flow corresponding to the largest calculated SPF plus one foot at Deer Creek Section 2380 (17,300 cfs - screen house water elevation = 254.0 feet), and the largest calculated PMF[3] (38,700 cfs - screen house water elevation = 262.3 feet). It should be noted that the (+1 foot) above SPF is being taken at the cross-section where the Deer Creek overflow occurs. This is the only logical place to add margin, since the SPF itself does not overflow the Deer Creek channel. Taking an additional one foot margin at the buildings or equipment location, when no flooding occurs, would obviously be inappropriate.

Table 1 presents the information of Figures 3, 4, and 5 in tabular form.

Table 2 shows the channel invert and water elevation at the various Deer Creek Channel sections for the SPF and PMF indicated on Figure 5. It can be seen that the SPF elevation barely exceeds plant grade elevation of 270 feet west of the containment (section 2380) and is significantly less than plant grade elevation, 269 feet east of the containment (section 1530). Table 3 shows the corresponding information for the Ginna Station Channels for SPF + 1 foot and PMF (flow is negligible for the SPF). Between sections 1 and 101, the flood water essentially forms a pond, the level of which is determined by the hydraulic controls described

previously. Although no flood water flows down the east channel for the SPF + 1 foot (indicated by dashes in Table 3), the water flowing down the west channel will fill the screen house area to elevation 254 feet. Figure 6 depicts site topography for a general north-south cross section through the plant. This latter figure is included to illustrate the site in an unexaggerated horizontal to vertical scale ratio of 1:1.

Conclusion

RG&E believes that an appropriate Design Basis for Deer Creek flooding would be protection for the Standard Project Flood. The hydraulic analysis presented in this report demonstrates that the safe operation of Ginna Station will not be affected by flood flows less than 17,300 cfs (SPF + 1 foot).

Cost/Benefit Evaluation

As requested in the NRC's SER, RG&E has made an estimate of the cost to provide protection for the PMF. Based on extensive channel widening and improvement (excavating 106,000 yd^3 of material, forming a channel with a bottom width of 116 ft., with 1:1 side slopes), construction of a new bridge, possible relocation of the training center, and installation of approximately 31 waterproof doors, the cost is estimated at more than $2 million. Based on the fact that 1) the Ginna SPF has an expected recurrence interval of greater than 10^4 years, 2) an additional margin of 1 foot is available, 3) the cost in terms of money and manpower expenditures, which would have to be distracted from other ongoing

regulatory review efforts, would be quite severe, and 4) the Ginna Station meets the requirements of General Design Criterion 2, "Design Basis for Protection Against Natural Phenomena," in that the SPF + 1 foot certainly reflects ". . . appropriate consideration of the most severe of the natural phenomena [related to flooding] that have been historically reported for the site and surrounding area . . . with sufficient margin . . ." it is considered that no additional protection for Deer Creek flooding is warranted.

REFERENCES

1. NUS Corporation, Ginna Station Design Basis Flooding Study For Rochester Gas and Electric Corporation, Rockville, MD, August 1981.

2. NUS Corporation, Ginna Station Standard Project Flooding Study For Rochester Gas and Electric Corporation, Gaithersburg, MD, June 1982.

3. J.S. Scherrer et al, Hydrological Considerations Rochester Gas and Electric Corporation, R.E. Ginna Nuclear Power Plant, Technical Evaluation Report, Franklin Research Center, Philadelphia, PA, April 27, 1982.

4. Nuclear Regulatory Commission, Final Safety Evaluation Report For Ginna Station, Topic II-3.B, 1982.

5. Corps of Engineers, HEC-2 Water Surface Profiles Users Manual, Davis, CA, January 1981.

6. Ven Te Chow, Open-Channel Hydraulics, McGraw-Hill Book Co., New York, NY, 1959.

7. Rochester Gas and Electric Corporation, Drawing No. 33013-171F, R. E. Ginna Nuclear Power Station, 1973.

8. Rochester Gas and Electric Corporation, Drawing No. 33013-51E, R. E. Ginna Nuclear Power Station, 1973.

9. E. F. Brater and H. W. King, Handbook of Hydraulics, 6th Edition, McGraw-Hill Book Co., New York, NY, 1976.

Table 1. Deer Creek Overflow Summary Table

Total Flood Flow (cfs)	Flow Through Ginna Station (cfs)	Flow Through Ginna Station West Channel (cfs)	Elevation at Screen House (ft)	Elevation at Deer Creek Section 2380 (ft)	
14,600	0	0	253.5	270.0	Channel Capacity
15,000	0	0	253.55	270.1	SPF
16,000	100	100	253.7	270.6	
17,300	300	300	254.0	271.1	SPF + 1 foot
18,000	500	500	254.2	271.4	
20,000	1,300	1,300	254.8	272.1	
20,600	1,580	1,580	255.0	272.3	
22,000	2,300	2,250	255.4	272.8	
24,000	3,350	3,200	256.0	273.3	
26,000	4,400	4,150	256.6	273.8	
28,000	5,400	4,900	257.8	274.2	
30,000	6,400	5,600	259.0	274.5	
35,000	9,150	7,400	261.6	275.1	
38,700	11,400	8,700	262.3	275.7	PMF

TABLE 2 - DEER CREEK CHANNEL FLOOD ELEVATIONS

Cross Section Number (Distance from mouth, ft)	Channel Invert (ft)	Water Surface Elevation (ft.) For Indicated Discharge: Standard Project Flood (SPF)* 15,000 cfs* *	Water Surface Elevation (ft.) For Indicated Discharge: Probable Maximum Flood (PMF)* 38,700 cfs**
100	246.0	257.4	260.6
200	247.0	260.0	263.7
470	247.4	263.7	267.4
580	247.0	267.2	271.2
680	248.3	267.1	271.0
780	248.7	267.3	271.5
860	246.0	267.4	271.6
880	247.0	267.4	271.5
900 (Lower Bridge)	247.0	267.7	271.9
920	248.0	267.7	271.9
1120	249.6	267.7	271.9
1420	251.7	267.1	271.6
1530	249.7	268.0	272.9
1670	250.0	267.4	272.2
1740	249.1	266.8	273.5
1820	251.0	267.1	272.4
1860	250.0	269.1	274.5
1920	250.5	269.9	274.8
2150	250.2	269.9	274.8
2280	250.0	269.9	274.8
2300 (Culvert Bridge)	250.0	270.1	275.0
2320	249.0	270.1	275.2
2380	249.8	270.1	275.7
2500	248.5	270.1	276.1
2620	251.0	270.2	276.5

* Maximum calculated value

** Downstream from Ginna Station (Section 1420), flows within Deer Creek Channel for SPF, and PMF are 15,000, and 27,300 cfs, respectively.

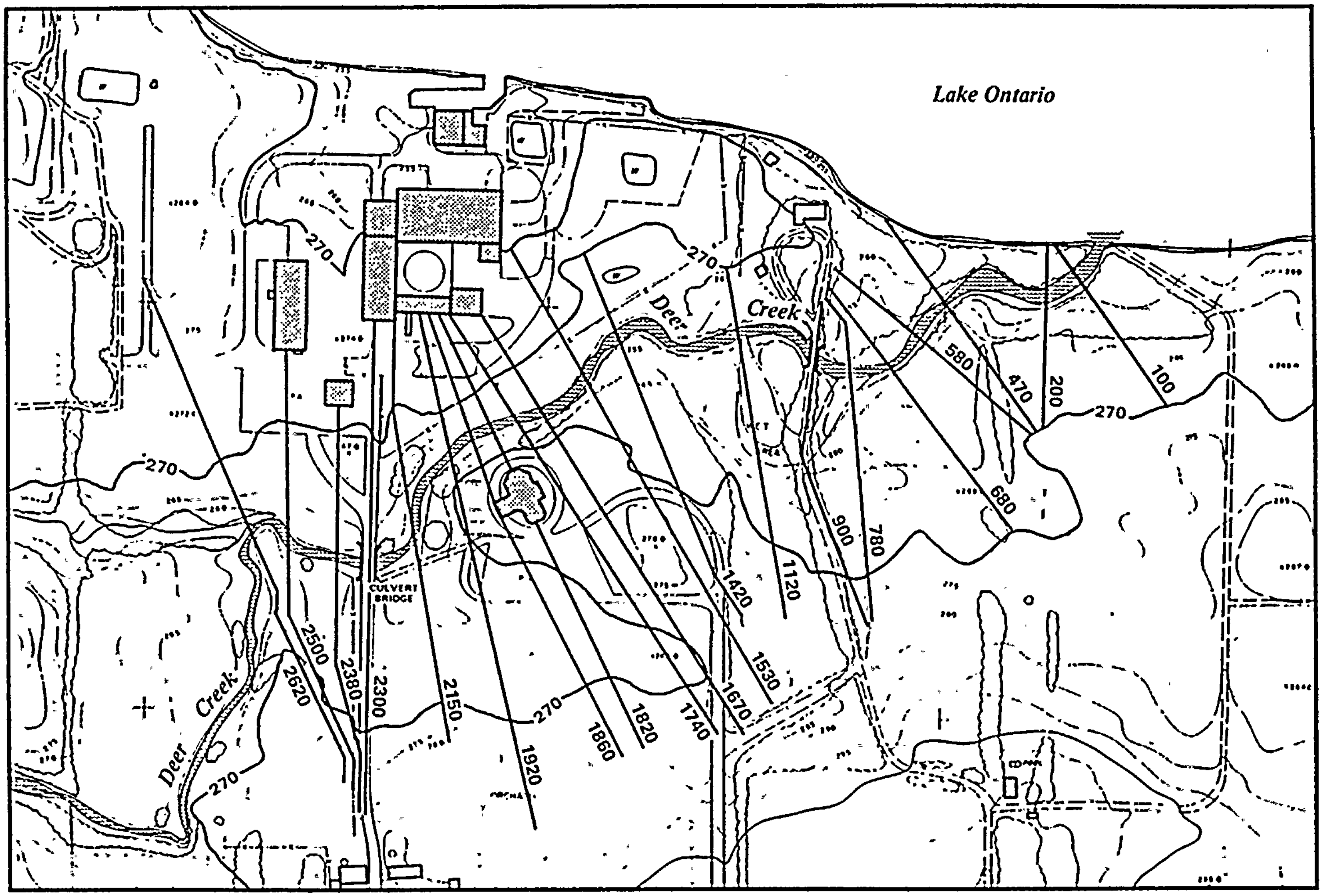
Table 3 - Ginna Station Channel Flood Elevations

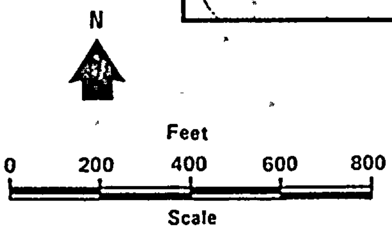
Cross-Section Number	Channel Invert (ft)	Water Surface Elevation (ft.) For Indicated Discharge*: Standard Project Flood Plus One Foot (SPF+1') 17,300 CFS***	Water Surface Elevation (ft.) For Indicated Discharge*: Probable Maximum Flood (PMF)** 38,700 cfs***
West Channel			
1	253.5	254.1	262.4
2	253.8	254.5	262.4
3	254.0	254.9	262.3
4	254.0	255.5	262.2
5	254.0	256.0	261.6
6	256.0	258.0	264.6
7	260.0	261.6	267.1
8	269.0	270.1	273.3
9	270.0	270.7	274.5
10	270.0	270.9	275.0
11	270.0	271.1	275.7
East Channel			
101	252.5	254.0	262.4
102	254.7	---	262.4
103	257.5	---	262.3
104	264.5	---	267.0
105	268.3	---	271.4
106	269.0	---	272.2

* Negligible flow in channels for Standard Project Flood.

** Maximum calculated value.

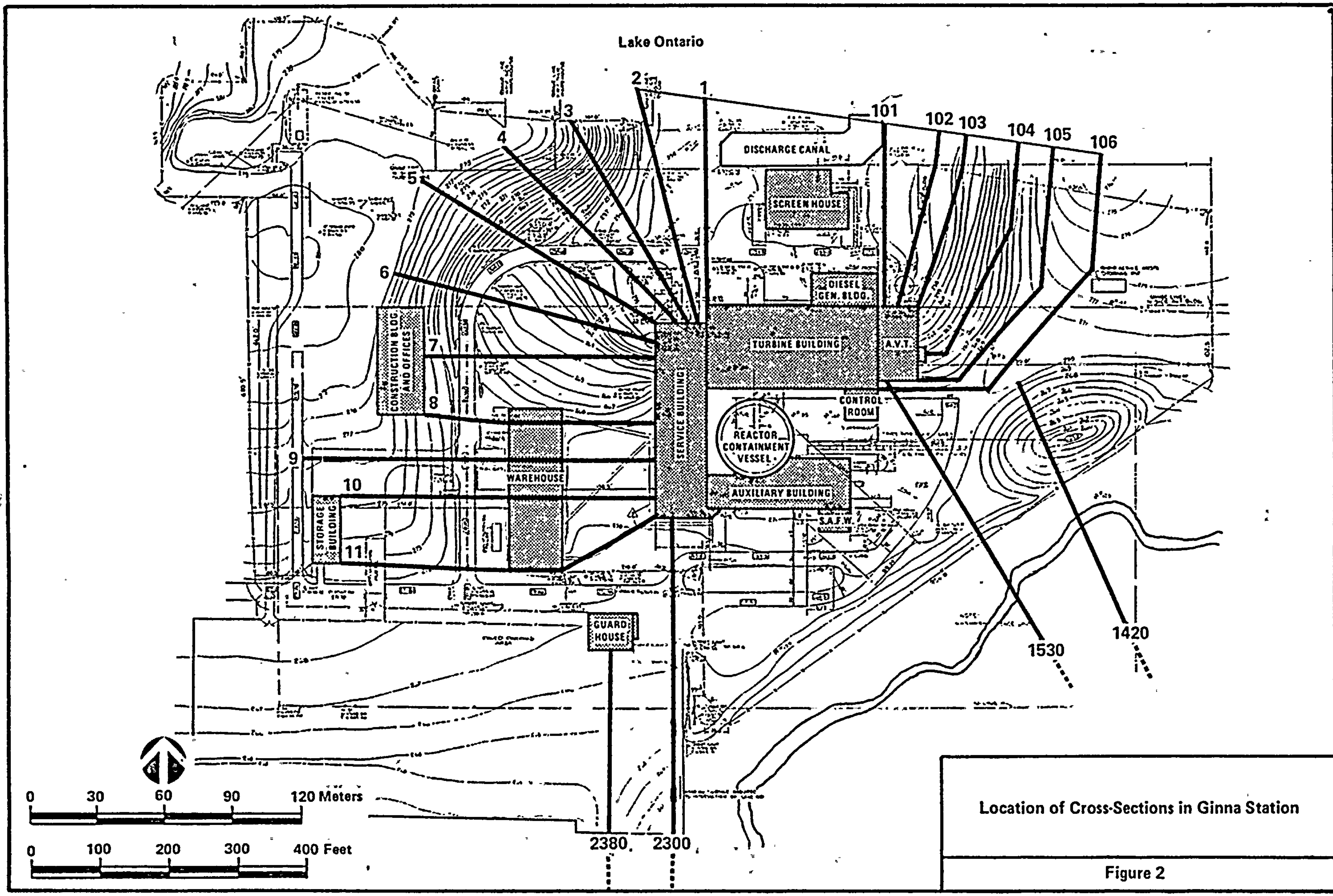
*** Flows within Ginna Station Channel West for SPF +1' and PMF are 300 and 8,700 cfs, respectively. Flows within Ginna Station Channel East for SPF +1' and PMF are 0 and 2,700 cfs, respectively.





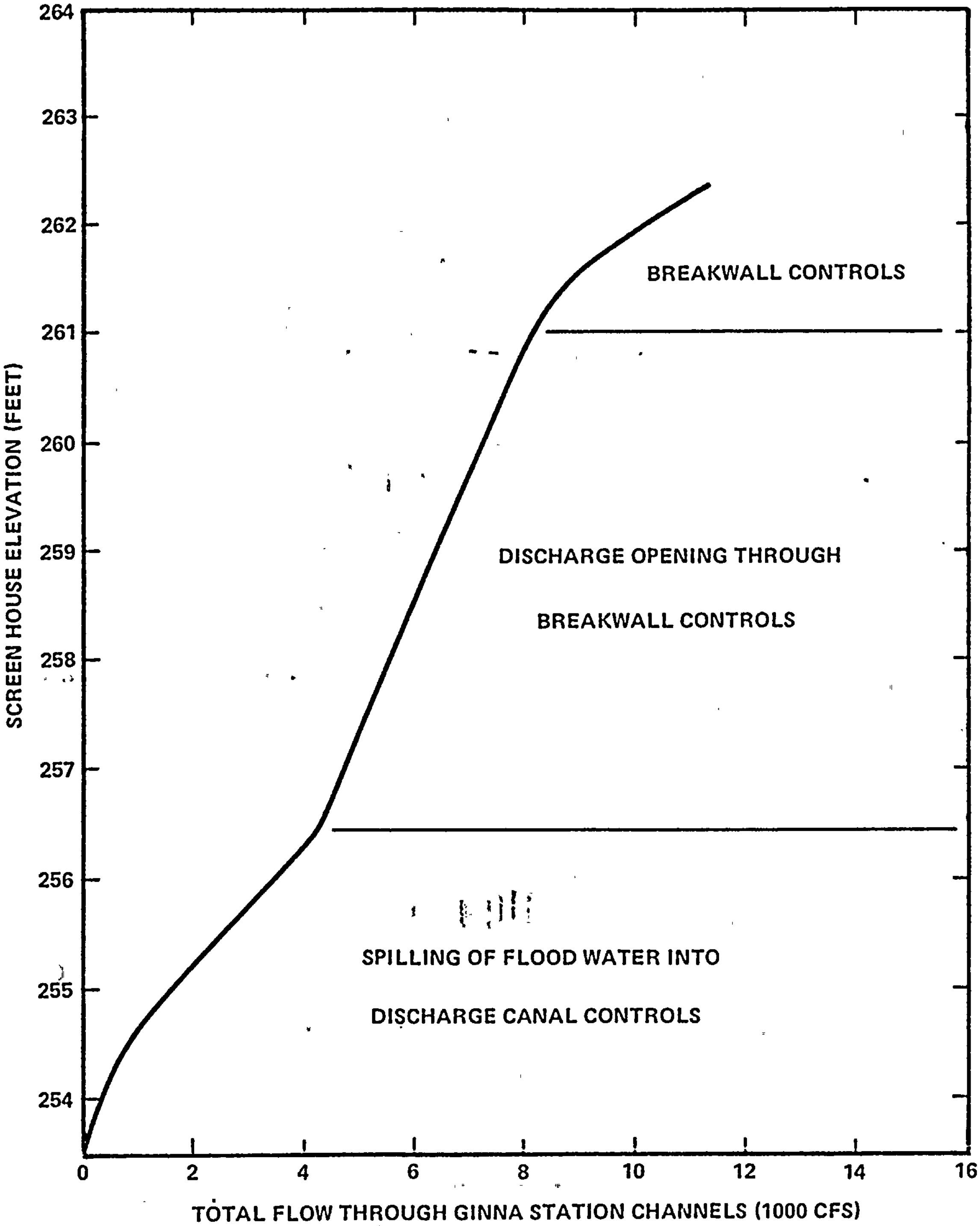
Location of Cross-Sections on Deer Creek

Figure 1



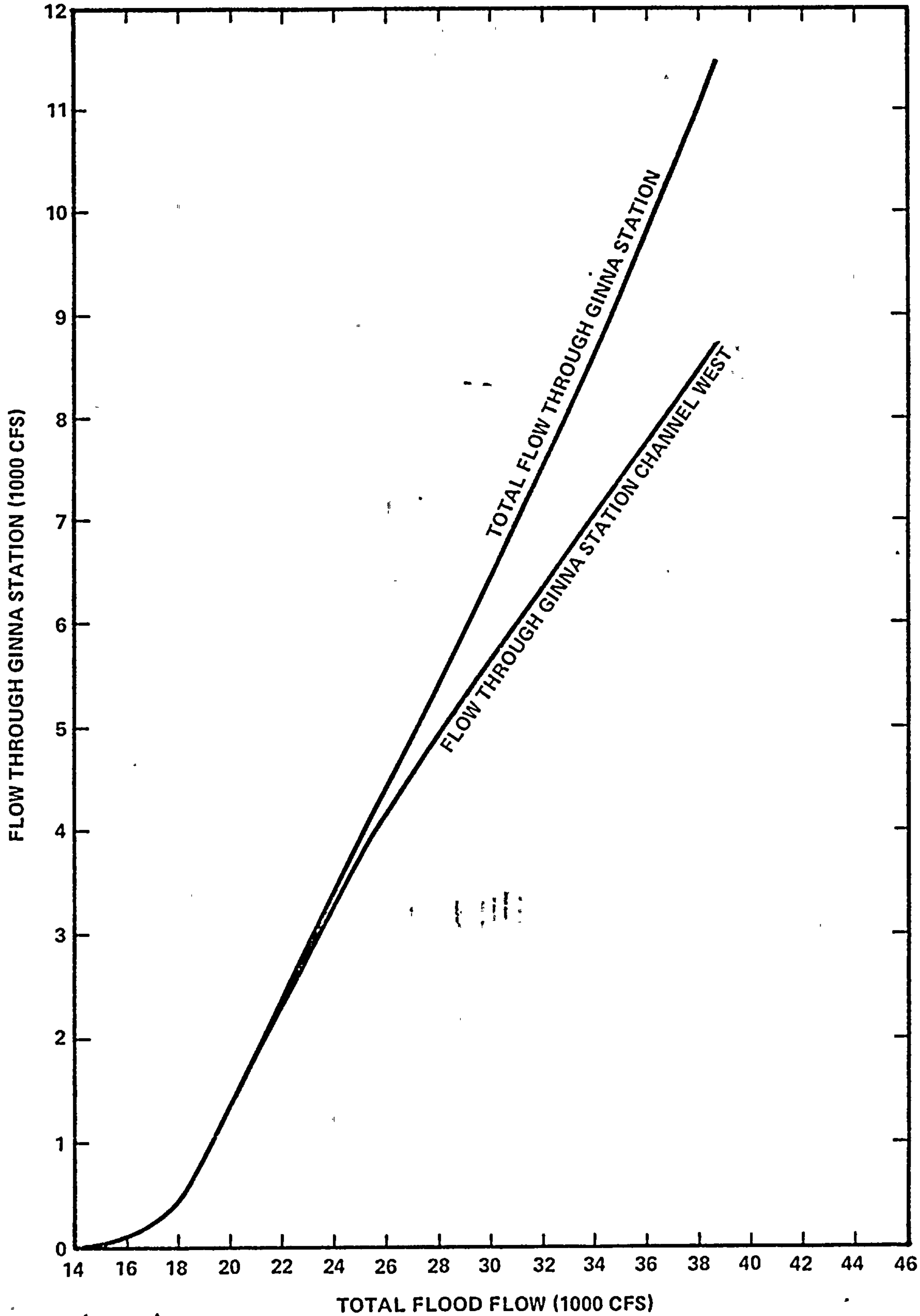
Location of Cross-Sections in Ginna Station

Figure 2



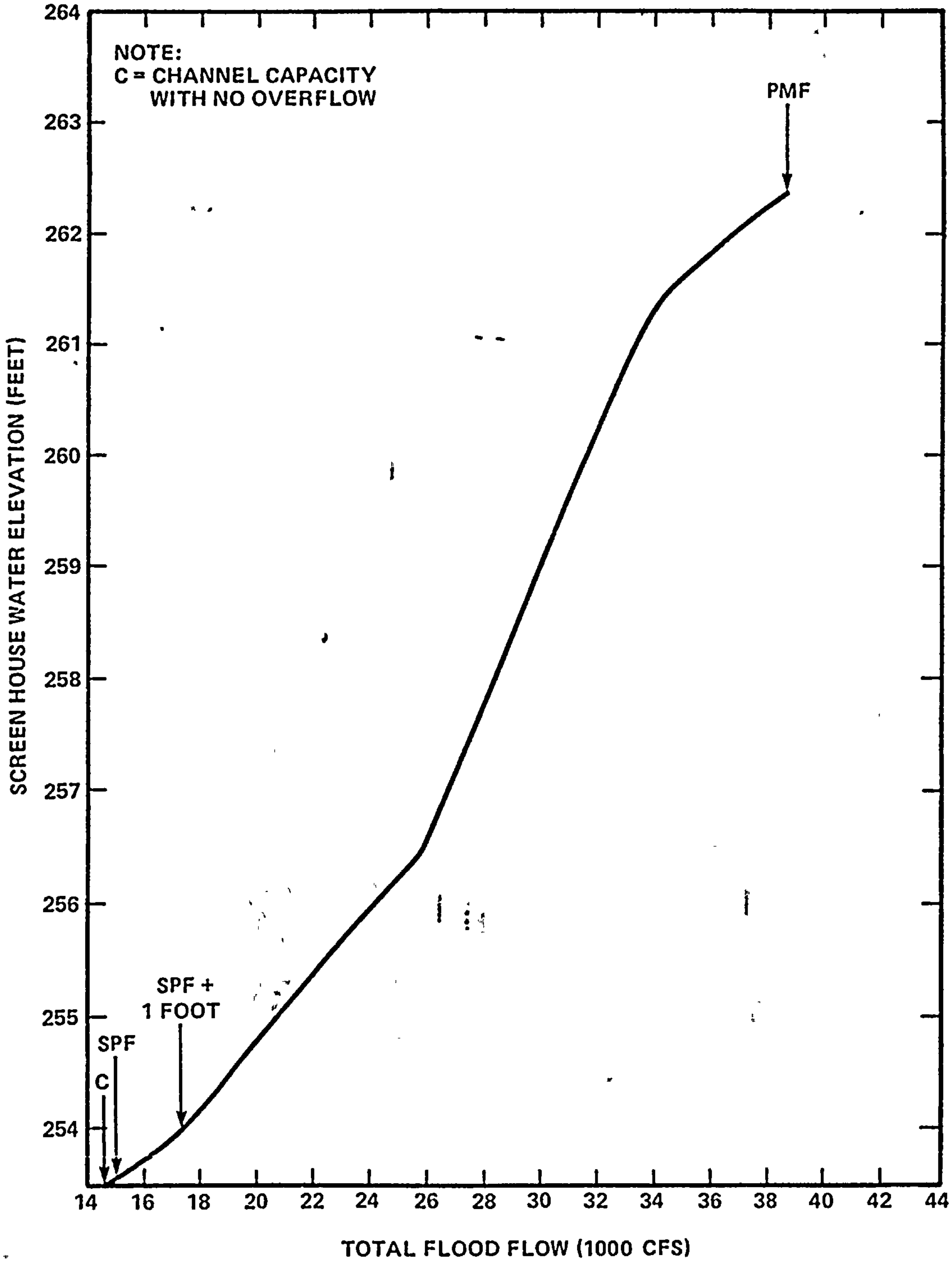
Screen House Water Elevation vs.
Total Flow Through Ginna Station

Figure 3



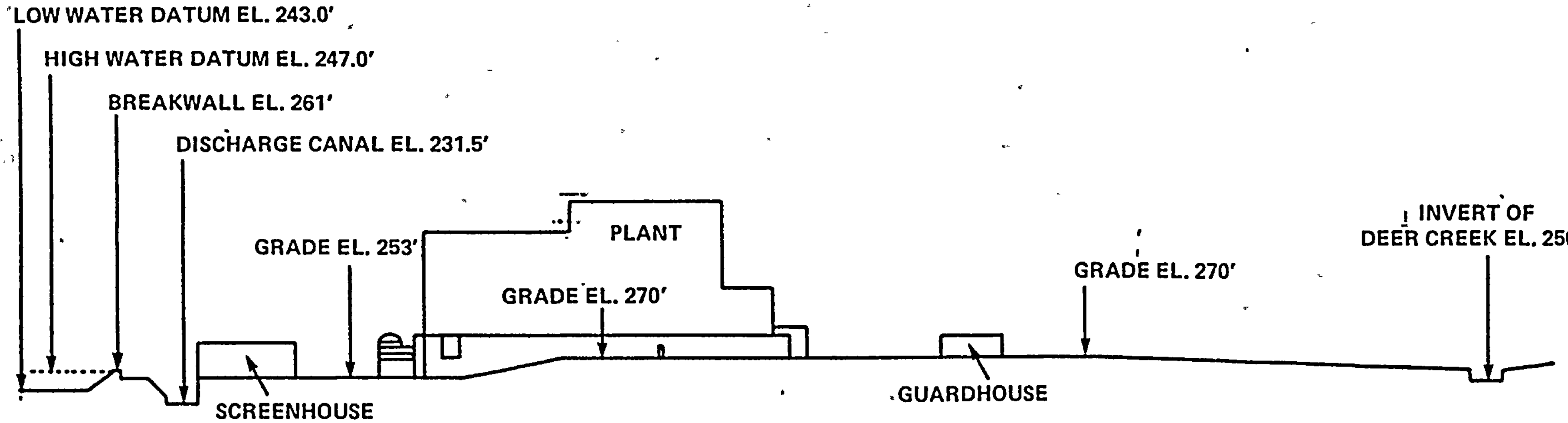
Flow Through Ginna Station vs. Total Flood Flow

Figure 4



Screen House Water Elevation vs. Total Flood Flow

Figure 5



General North-South Cross Section

Figure 6