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Feasibility Level Geological and Geotechnical Investigation for Union Park Dam

Preliminary Interim Report Phase 2

Stability Evaluation of Union Park Dam under Hydrologic Loading

By

UEBLACKER ASSOCIATES

Prepared for

Dave Miller, President

NATURAL ENERGY RESOURCES COMPANY (NECO)

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July 2004

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1. Summary and Conclusions

A preliminary hydrologic evaluation of Union Park Reservoir has been completed to estimate the flood discharge loading for Union Park Dam. The study made use of new large-scale topography (Appendix A1) prepared by LANDMARK MAPPING. The results of the stability calculations presented in Appendix A2 indicate that the inflow design flood can be safely retained by the proposed 575 ft.-high and 2,050 ft.-wide roller compacted concrete (RCC) gravity dam, requiring no emergency spillway.

2. Preliminary Hydrologic Evaluation of Union Park Reservoir

This study was performed by WRC ENGINEERING, INC. (Appendix A3), [1] under a subcontract with UEBLACKER ASSOCIATES and consisted of the following tasks:

2.1. Data Collection

Data was collected to support the hydrological/hydraulic analysis including relevant soils, vegetation, and geologic data; stream flow records; and relevant hydrologic studies for similar dams on the Colorado Western Slope.

2.2. Probable Maximum Precipitation (PMP) Analysis

Estimates of the PMP were determined using the data and procedures outlined in Hydrometerological Report No. 49.

2.3. Probable Maximum Flood (PMF) Analysis

Estimates of the PMF were developed considering two potential stream events:

a) 6-hour PMP thunderstorm; and

b) 72-hour PMP with snowmelt runoff.

This analysis provided inflow design flood hydrographs.

2.4. Reservoir Flood Routing

The two PMF events were routed through the reservoir to determine the maximum rise in water surface elevation and associated dam height. In addition a minimum reservoir freeboard was determined based upon potential wave action during the PMF event.

2.5. Recommendations for Further Study

This study included recommendations for additional more detailed hydrologic evaluations for final design purposes including evaluation of potential flood benefits to Taylor Park Reservoir through joint operation with Union Park Reservoir.

3. Stability Evaluation of Union Park Dam under Hydrologic Loading

The design inflow flood will cause the HWL of the reservoir to rise to El. 10,125'. The highest section of the non-overflow structure is located at the center of the dam at a base elevation of El. 9,565'. The resulting hydrostatic pressure head acting on the upstream face of the dam during the flood is therefore 560 ft.

3.1. Stress Analysis

3.1.1. General

Gravity dam stresses are analyzed by either approximate simplified methods or the finite element method depending on the refinement required for the particular level of design and the type and configuration of the dam. For preliminary designs, simplified methods using the cantilever beam model for two-dimensional analysis or the trial load twist method for three-dimensional analysis are appropriate as described in the US Bureau of Reclamation (USBR) "Design of Gravity Dams" [2]. The finite element method is ordinarily used for final design stages if a more exact stress investigation is required.

3.1.2. Union Park Dam

Appendix A2 includes the results of two types of stress analysis. The finite element method [3] was used to evaluate the sliding stability of the dam under load combinations for the normal operating condition (reservoir full, foundation drains open, drain efficiency 80%). The cantilever beam model [2] was used in the spreadsheet analysis developed for evaluating the sliding stability of the dam under hydrologic loading (reservoir at flood level, foundation drains clogged, drain efficiency 0%). Both methods of analysis confirmed that the base of the dam would remain in contact with the foundation at all times under these loading conditions, therefore precluding the development of a crack. Also, both analysis methods yielded acceptable safety factors concerning the sliding stability of the dam using the rock properties from our earlier report [4]. Additional analyses are required to assess the bearing capacity of the rock mass to evaluate overstressing in the toe region of the dam, which can effect overturning stability.

4. Recommendations

The stability evaluations presented in Appendix A2 are based on preliminary estimates of the strength and deformation properties of the rock mass in the dam foundation. Additional geological fieldwork supplemented by core drilling and rock testing is required to verify all design parameters. Geologic mapping and geophysical exploration of the saddle dam site, which is scheduled to be completed this fall (weather permitting), should be initiated immediately, preferably by August 15, 2004. Preliminary designs for the tunnels, underground power house, access road and outlet works of the dam, including a preliminary plan for foundation grouting and drainage should also be developed.

5. Acknowledgments

The following professionals provided assistance in conducting this study:

- Photogrammetric Mapping and Drafting: John Wedding, Gary Kuntz, Jerry Panek
- Preliminary Hydrologic Evaluation of Union Park Reservoir, Alan Leak
- Stability Evaluation of Union Park Dam under Hydrologic Loading: Horst Ueblacker
- Report: Horst Ueblacker, Randy Dorian

Professional judgments presented in this preliminary report are based partly on evaluation of technical information gathered and partly on our understanding of the prevailing geological conditions in the area and characteristics of the facility being planned. We do not guarantee the performance of the project in any respect, only that our engineering and judgments rendered meet the standard of care of our profession.

If we may be of further service in discussing the contents of this report, please call the undersigned at (303) 988-9489.

_____

Horst Ueblacker, P.E.,

Principal

6. Literature Cited

[1] WRC Engineering, Inc., Denver, Colorado, July 14, 2004; Union Park Reservoir Preliminary Hydrologic Evaluation Gunnison County, Colorado.

[2] US Bureau of Reclamation, 1976; Design of Gravity Dams.

[3] Finite Element Analysis Computer Program CG-Dams, Version 2.2.0 (Sept. 1995), EPRI, Palo Alto, California.

[4] Ueblacker Associates, Lakewood Colorado (http://www.ueblacker.us), February 2004; Feasibility Level Geological and Geotechnical Investigation for Union Park Dam, Preliminary Report Phase 1.

Union Park Dam

Appendix A1

Topography of Union Park Reservoir

DESCRIPTION OF REVISION	DATE

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DRAWN: JP

CHECKED: HU

DATE: 7/03/04

UNION PARK DAM

UNION PARK RESERVOIR

PLAN SHEET

PROJECT

SHEET 1 OF 4

LEGEND

B-24 DRILL HOLE

S-4 SEISMIC REFRACTION

600 0 600 1200

SCALE IN FEET

DESCRIPTION OF REVISION	DATE

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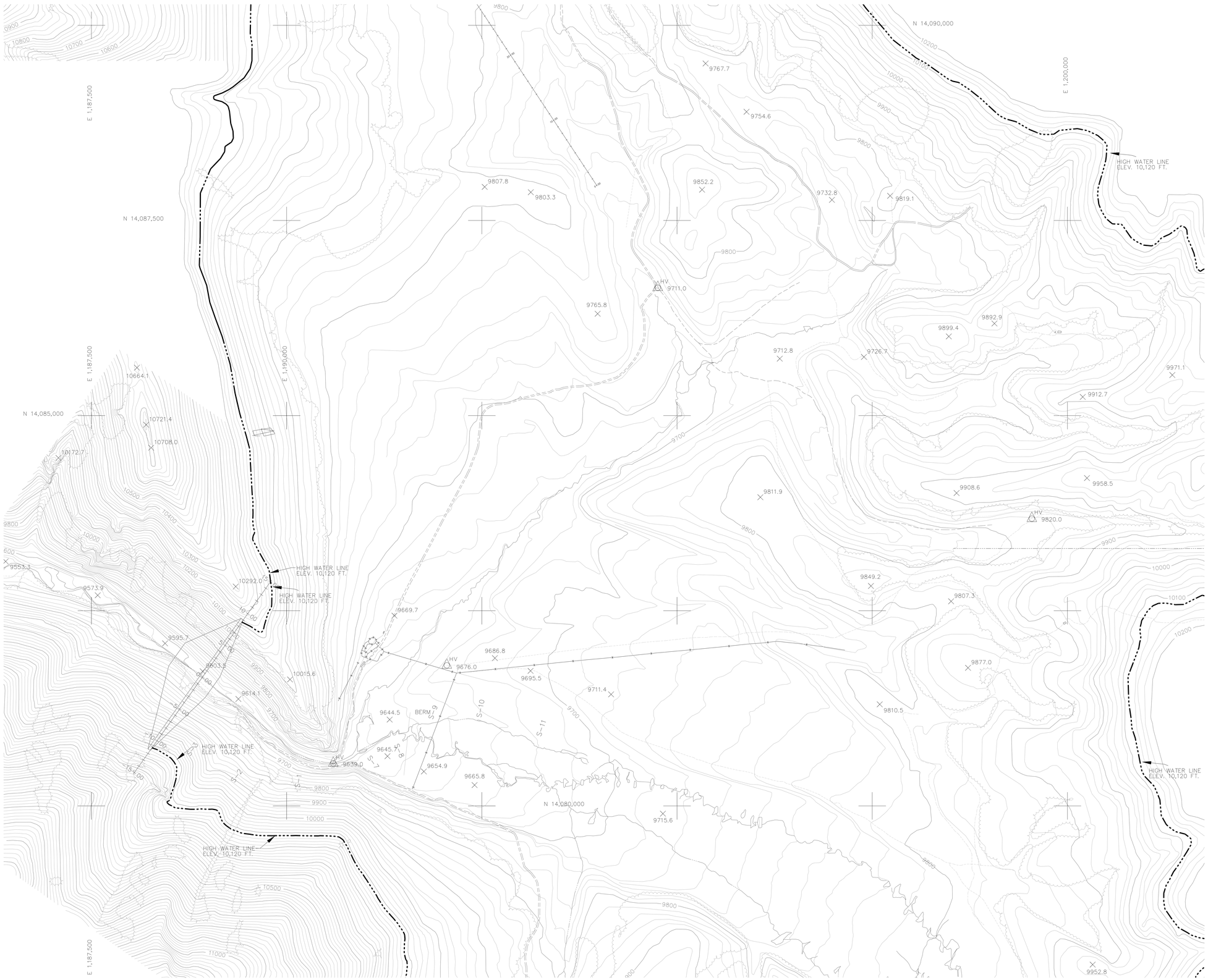
UNION PARK DAM

UNION PARK RESERVOIR

PLAN SHEET

PROJECT

SHEET 2 OF 4



600 0 600 1200
SCALE IN FEET

DESCRIPTION OF REVISION	DATE

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UNION PARK DAM

UNION PARK RESERVOIR

PLAN SHEET

PROJECT

SHEET 3 OF 4

DESCRIPTION OF REVISION	DATE

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UNION PARK DAM

UNION PARK RESERVOIR

PLAN SHEET

PROJECT

SHEET 4 OF 4

Union Park Dam

Appendix A2

Stability Analyses

Available by request only.
Please contact Horst Ueblacker, Ueblacker Associates.
hueblacker@aol.com

MATERIAL PROPERTIES AND ANALYSIS SUMMARY

Union Park Dam Modified Non-Overflow Section Crack Static Finite Element Stress Analysis UPD13_SMT
Case I Usual Loading Combination – Normal Operating Condition w/Drains Open, Reservoir at El. 10,120'
Horst Ueblacker, P.E., July 21, 2004

Elastic Modulus

Modulus of Dam (RCC) and Interface	Es	=	2,500,000 psi
Modulus of Rock Mass (Foundation)	Em	=	10.10^(Vp-3500/3000) (GPa), [20]
Average P-Wave Velocity Left Abutment	Vp	=	4,252 m/s
	Em	=	17.81 GPa
	Em	=	2,582,410 psi

(see February 2004 Feasibility Study Report, Fig. 3.3: Analysis of Rock Mass Strength Union Park Dam Granodiorite, Uniaxial Compressive Strength of Intact Rock = 29 ksi (200 MPa), GSI = 60.0218);

Poisson's Ratio

Dam (RCC) and Interface	v(RCC)	=	0.20
Rock Mass (Foundation)	v(ROCK)	=	0.25

Unit Weight

Dam (RCC) and Interface	w(RCC)	=	150 lbs/ft^3
Rock Mass (Foundation)	w(ROCK)	=	168 lbs/ft^3

Tensile Strength

Parent RCC and Bedded Lift Joints	sigma(t)-RCC(CON1)dyn.	=	300.00 psi
Rock Mass (Foundation)	sigma(t)-rock mass(ROCK1)	=	42.00 psi
Concrete/Rock Interface	sigma(t)-interface(INT1)	=	44.95 psi

Tensile Fracture Strain

Parent RCC and Bedded Lift Joints	e(t)-RCC(CON1)	=	12.000E-05
Rock Mass (Foundation)	e(t)-rock mass(ROCK1)	=	1.680E-05
Concrete/Rock Interface	e(t)-interface(INT1)	=	1.798E-05

Table A2.1: Summary of Material Properties for Crack Static Finite Element Analysis of Union Park Dam

	Unit Weight (lb/ft^3)	Elastic Modulus (psi)	Poisson's Ratio	Tensile Strength (psi)	Tensile Fracture Strain	Friction Angle (degrees)	Cohesion (psi)
Estimate							
Dam	150	2,500,000	0.20	300.00	12.00E-05	-	-
Foundation	168	2,582,410	0.25	42.00	1.626E-05	57	70
Interface	150	2,500,000	0.20	44.95	1.798E-05	57	70
Analysis							
Dam	150	2,500,000	0.20	300.00	12.00E-05	-	-
Foundation	168	2,500,000	0.25	42.00	1.68E-05	57	70
Interface	150	2,500,000	0.20	45.00	1.80E-05	57	70

Analysis Summary (Step 21)

Dam Geometry

Crest elevation	=	10140.00 ft
Base elevation at heel	=	9565.00 ft
Base length	=	612.50 ft

ROCK1 Material Properties

Elastic modulus	=	2.50E+06 psi
Poisson's ratio	=	0.25
Tensile fracture strain	=	1.68E-05

INT1 Material Properties

Elastic modulus	=	2.50E+06 psi
Poisson's ratio	=	0.20
Tensile fracture strain	=	1.80E-05

CON1 Material Properties

Elastic modulus	=	2.50E+06 psi
Poisson's ratio	=	0.20
Tensile fracture strain	=	1.20E-04

Water Elevations And Silt/Backfill Densities

Reservoir surface elevation	=	10120.00 ft
Silt elevation	=	9565.00 ft
Silt horizontal density	=	85.00 pcf
Silt vertical density	=	120.00 pcf
Tailwater surface elevation	=	9565.00 ft
Backfill elevation	=	9565.00 ft
Backfill horizontal density	=	85.00 pcf
Backfill vertical density	=	120.00 pcf

Uplift Data And Drain Location

Upstream uplift pressure	=	240.50 psi
Downstream uplift pressure	=	0.00 psi
Drain elevation	=	9590.00 ft
Drain location	=	50.00 ft
Drain efficiency	=	0.80

Interface Properties (Rough Crack Model Activated)

Unit cohesion	=	70.00 psi
Internal friction angle	=	57.00 deg

Crack Length

Cracked length	=	0.00 ft
Uncracked length	=	612.50 ft
% of base cracked	=	0.00

Uplift Force (First Appl. Method)

Initial uplift at start of analysis	=	-3203.85 kip/ft
Final uplift at end of analysis	=	-3062.77 kip/ft

Foundation Normal Forces

Reservoir vertical load on foundation	=	19913.40 kip/ft
Tailwater vertical load on foundation	=	0.00 kip/ft

Other vertical forces on foundation	=	0.00 kip/ft

Dam Normal Forces

Dam dead load	=	26860.20 kip/ft
Reservoir normal load (inc. silt)	=	2882.65 kip/ft
Tailwater normal load (inc. bkfl)	=	0.00 kip/ft
Other normal forces	=	0.00 kip/ft
Total normal forces	=	29742.85 kip/ft

Dam Lateral Forces

Reservoir (inc.silt) plus earthquake load `=		9608.82 kip/ft
Tailwater lateral load (inc.bkfl)	=	0.00 kip/ft
Other lateral forces	=	0.00 kip/ft
Total lateral forces	=	9608.82 kip/ft

Shear Friction Factor of Safety

Q=(cl + (n+U)tan(phi))/v	=	4.92

Spreadsheet Gravity Dam Stability Analysis of Proposed Union Park Dam
Case II - Unusual or Flood Discharge Loading Combination with Full Uplift
Horst Ueblacker, P. E., Ueblacker Associates, Lakewood, Colorado, July 21, 2004

Dimensions of Main Section (Non-Overflow Section) of Dam:

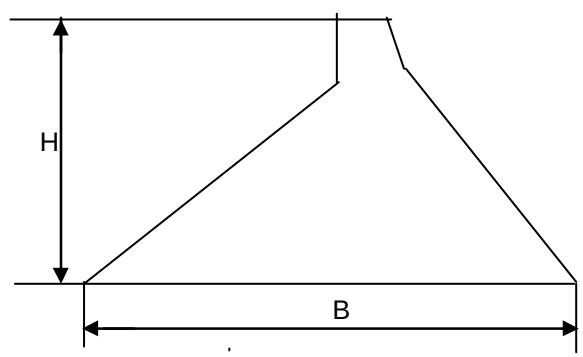
Dam Height (feet)	575.00	Flare Height	575.00	feet	Downstr.Slope	0.750	
Dam Base (feet)	612.50	Flare Base	181.25	feet	Upstr.Slope	0.315	
Crest Width (feet)	35.00	Crest Height	46.67	feet	Crest Width	35.00	feet
Crest Slope	0.00						
Pool Elevation (feet)	10,125.00	Base Elev.	9,565.00	feet	Pool Depth	**560.00**	**feet**
Tailwater Elevation (feet)	9,565.00				TailwaterDepth -		feet

Properties:

Unit Weight of Water	62.40	lb/ft^3		
Unit Weight-Concrete	150.00	lb/ft^3		
Horiz. Seismic Coeff.	0.000			
Flare Base/Pool Depth	**0.324**		**17.93**	**Degrees**
Hydrodynamic Pressure Coeff. Ke from Graph			-	
Factor Ce			**-**	**lb ft s**

Calculation:
1.0 Determination of Centroid

Item	Force(lb/LF)	Moment Arms (LF) X	Moment Arms (LF) Y	Moments about Toe (lb*LF) Mx	Moments about Toe (lb*LF) My	Location of Centroid from Toe (Feet) XX	YY	e
W1	**122,508.75**	407.917	559.440	**49,973,401.77**	**68,536,295.10**	**348.1937624**	**193.364861**	**-41.9438**
W2	**7,816,406.25**	491.667	191.667	**3,843,069,011.72**	**1,498,147,136.72**			
W3	**18,597,656.25**	287.500	191.667	**5,346,826,171.88**	**3,564,556,980.47**			
TOTALS	**26,536,571.25**			**9,239,868,585.37**	**5,131,240,412.29**			



W1=Crest Mass lb/LF
W2=Flare Mass lb/LF
W3=Core Mass lb/LF

2.0 Summation of Forces and Moments

Item	Vertical Load (lb/LF)	Horizontal Load (lb/LF)	Moment Arm (LF)	Moments about Toe (lb*LF)
V1	**26,536,571.25**		**348.194**	**9,239,868,585.37**
V2	**3,251,625.00**		548.850	**1,784,654,381.250**
V3				**-**
H1		**-**	**193.3649**	**-**
H2		**9,784,320.00**	186.667	**(1,826,406,400.00)**
H3		**-**	-	**-**
TOTALS	**29,788,196.25**	**9,784,320.00**		**9,198,116,566.618**

V1=Weight of Main Section of Dam (W1+W2+W3)	lb/LF	Max. Uplift Pressure at Heel	**34,944.00**	**PSF**
V2=Weight of Triangular Water Column above Flare	lb/LF	Resultant (U)	**10,701,600.00**	**lb/LF**
V3=Weight of Rectangular Water Column above Flare	lb/LF	Moment Arm of U from Toe	**408.33**	**LF**
H1=Seismic Inertia Force acting on Dam	lb/LF	Moment Arm of U fromCenter		
H2=Hydrostatic Force acting on Dam	lb/LF	of Base	**102.08**	**LF**
H3=Hydrodynamic Force acting on Dam	lb/LF	Moment of U about Toe	**4,369,820,000.00**	**lb*LF**
		Moment of U about Center-Base	**1,092,455,000.00**	**lb*LF**

3.0 Base Normal Stresses w/out Uplift

3.1 Location of Resultant

Distance from Toe (a)	**308.784**	**LF**	Inclination of Resultant from Vertical	**18.183** **Degrees**
Distance from Center (e)	**-2.534**	**LF**	Magnitude of Resultant	**31,353,940.00** **lb/LF**

3.2 Summation of Moments about Center of Base and Base Stresses w/out Uplift

Sum of Moments (Mo) **(75,481,465.06) lb*LF**

Base Normal Stresses:

Toe	**47,426.589**	**PSF**	**47.427**	**KSF**	**2,270.785**	**KN/m^2**	**2.271**	**Mpa**
Heel	**49,840.990**	**PSF**	**49.841**	**KSF**	**2,386.387**	**KN/m^2**	**2.386**	**Mpa**
Resultant Heel Stress								
	14,896.99	**PSF**	**14.90**	**KSF**	**713.27**	**KN/m^2**	**0.71**	**Mpa**

Note: If Resultant Heel Stress is negative, perform Cracked Base Analysis!

4.0 Cracked Base Analysis according to FERC

4.1 Location of Resultant of Applied Loads by Summation of Forces and Moments about Center of Base

Distance from Center of Base to Location of Resultant (e')	**53.28**	**LF**
Sum of Vertical Forces acting on Dam including Uplift	**19,086,596.25**	**lb/LF**
Sum of Horizontal Forces acting on Dam	**9,784,320.00**	**lb/LF**
Magnitude of Resultant	**21,448,335.00**	**lb/LF**
Inclination of Resultant from Vertical	**27.14**	**Degrees**

4.2 Length of Base in Compresion (T1) **758.90** **LF**

4.3 Length of Base in Tension or cracked (Lf) **-146.40** **LF**

4.4 Base Normal Stresses

Assume linear triangular Stress Distribution over T1

Magnitude of maximum Normal Stress at Toe (B5)	**50,300.439**	**PSF**	**50.300**	**KSF**
	2,408.385	**KN/m^2**	**2.408**	**Mpa**
Magnitude of maximum Toe Stress in Direction of Resultant	**56,524.519**	**PSF**	**56.525**	**KSF**
	2,706.394	**KN/m^2**	**2.706**	**Mpa**

4.5 Sliding Stability of Dam during Flood:

Rock Mass Physical and Strength Properties (Mohr-Coulomb Failure Envelope):

Peak Strength	Unit Weight	168.0 lb/ft^3	Residual Strength	Unit Weight	168.0 lb/ft^3
Granodiorite-Gneiss/RCC	Angle of Friction	57 degrees	Post-seismic Stab.	Angle of Friction	34.0 degrees
Contact	Cohesion	70.0 lb/ft^2		Cohesion	4.1 lb/ft^2

Safety Factor against Sliding along Uncracked Portion of Base (T1):

FS(s) **3.01** **FS(s)** **1.32**

4.6 Overturning Stability of Dam during Flood:

FS(o) **3.17**

Noter: If Resultant Heel Stress is positive, perform Uncracked Base Analysis!

5.0 Uncracked Base

5.1 Location of Resultant of Applied Loads by Summation of Forces and Moments about Center of Base

Distance from Center of Base to Location of Resultant (e')	**53.28**	**LF**
Sum of Vertical Forces acting on Dam including Uplift	**19,086,596.25**	**LF**
Sum of Horizontal Forces acting on Dam	**9,784,320.00**	**lb/LF**
Magnitude of Resultant	**21,448,335.00**	**lb/LF**
Inclination of Resultant from Vertical	**27.14**	**Degrees**

5.2 Magnitude of Base Normal Stresses (Uplift included!)

Normal to Base

Toe:	**47,426.59**	**PSF**	**47.43**	**KSF**
	2,270.79	**KN/m^2**	**2.27**	**MPa**
Heel:	**14,896.99**	**PSF**	**14.90**	**KSF**
	713.27	**KN/m^2**	**0.71**	**MPa**

In Direction of Resultant

Toe:		PSF		KSF
		KN/m^2		MPa
Heel:		PSF		KSF
		KN/m^2		MPa

5.3 Sliding Stability of Dam during Flood:

Rock Mass Physical and Strength Properties (Mohr-Coulomb Failure Envelope):

Peak Strength	Unit Weight	168.0	lb/ft^3	Residual Strength	Unit Weight	168.0	lb/ft^3
Granodiorite-Gneiss/RCC	Angle of Friction	57	degrees	Post-seismic Stab.	Angle of Friction	34.0	degrees
Contact	Cohesion	70.0	lb/ft^2		Cohesion	4.1	lb/ft^2

Safety Factor against Sliding along Uncracked Base of Dam (B):

Peak Strength	**FS(s)**	**3.01**	Residual Strength Post-seismic Stability	**FS(s)**	**1.32**

5.4 Overturning Stability of Dam during Flood:

FS(o) **3.17**

7/21/04

Union Park Dam Modified Non-overflow Sect. Crack Static Analysis, UPD13_SUM

Dam Geometry	Results	Units
Crest elevation	10140.00	ft
Base elevation at heel	9565.00	ft
Base length	612.50	ft
Water Elevations		
Reservoir surface elevation	10120.00	ft
Silt elevation	9565.00	ft
Tailwater surface elevation	9565.00	ft
Backfill elevation	9565.00	ft
Uplift Data And Drain Location		
Upstream uplift pressure	240.50	psi
Downstream uplift pressure	0.00	psi
Drain elevation	9590.00	ft
Drain location	50.00	ft
Drain efficiency	0.80	
Interface Properties (Rough Crack Model Activated)		
Unit cohesion = c	70.00	psi
Internal friction angle = phi	57.00	deg
Crack Length		
Cracked length = t	0.00	ft
Uncracked length = l	612.50	ft
% of base cracked	0.00	
Uplift Force (First Appl. Method)		
Initial uplift at start of analysis	-3203.85	kip/ft
Final uplift at end of analysis = U	**-3062.77**	**kip/ft**

Foundation Normal Forces	Results	Units
Reservoir vertical load on foundation	19913.40	kip/ft
Tailwater vertical load on foundation	0.00	kip/ft
Other vertical forces on foundation	0.00	kip/ft
Dam Normal Forces		
Dam dead load	26860.20	kip/ft
Reservoir normal load (inc. silt)	2882.65	kip/ft
Tailwater normal load (inc. bkfl)	0.00	kip/ft
Other normal forces	0.00	kip/ft
Total normal forces = n	**29742.85**	**kip/ft**
Dam Lateral Forces		
Reservoir lateral load (inc.silt)	9608.82	kip/ft
Tailwater lateral load (inc.bkfl)	0.00	kip/ft
Other lateral forces	0.00	kip/ft
Total lateral forces = v	**9608.82**	**kip/ft**
Shear Friction Factor of Safety		
Q=(cl + (n+U)tan(phi))/v	4.92	

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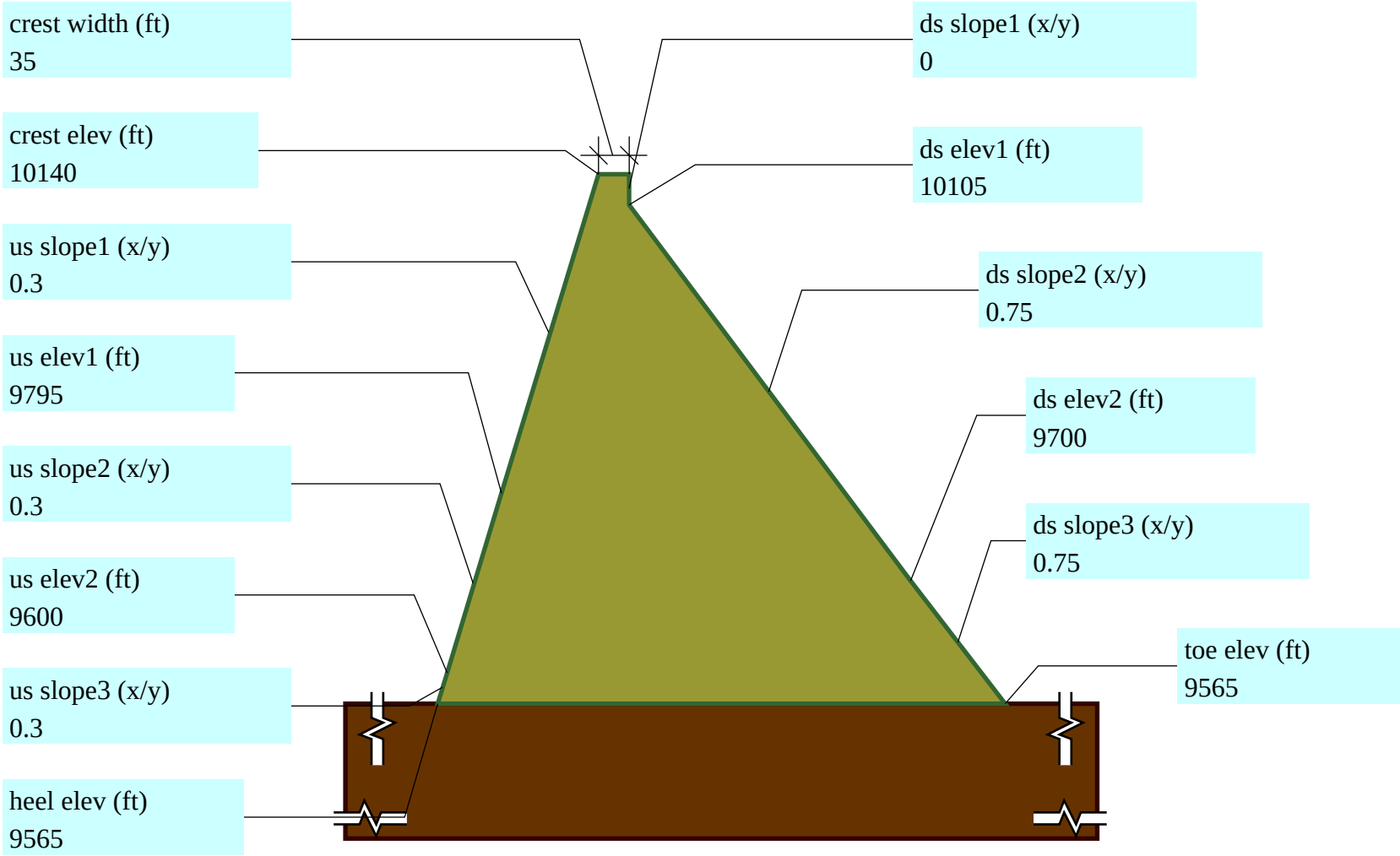
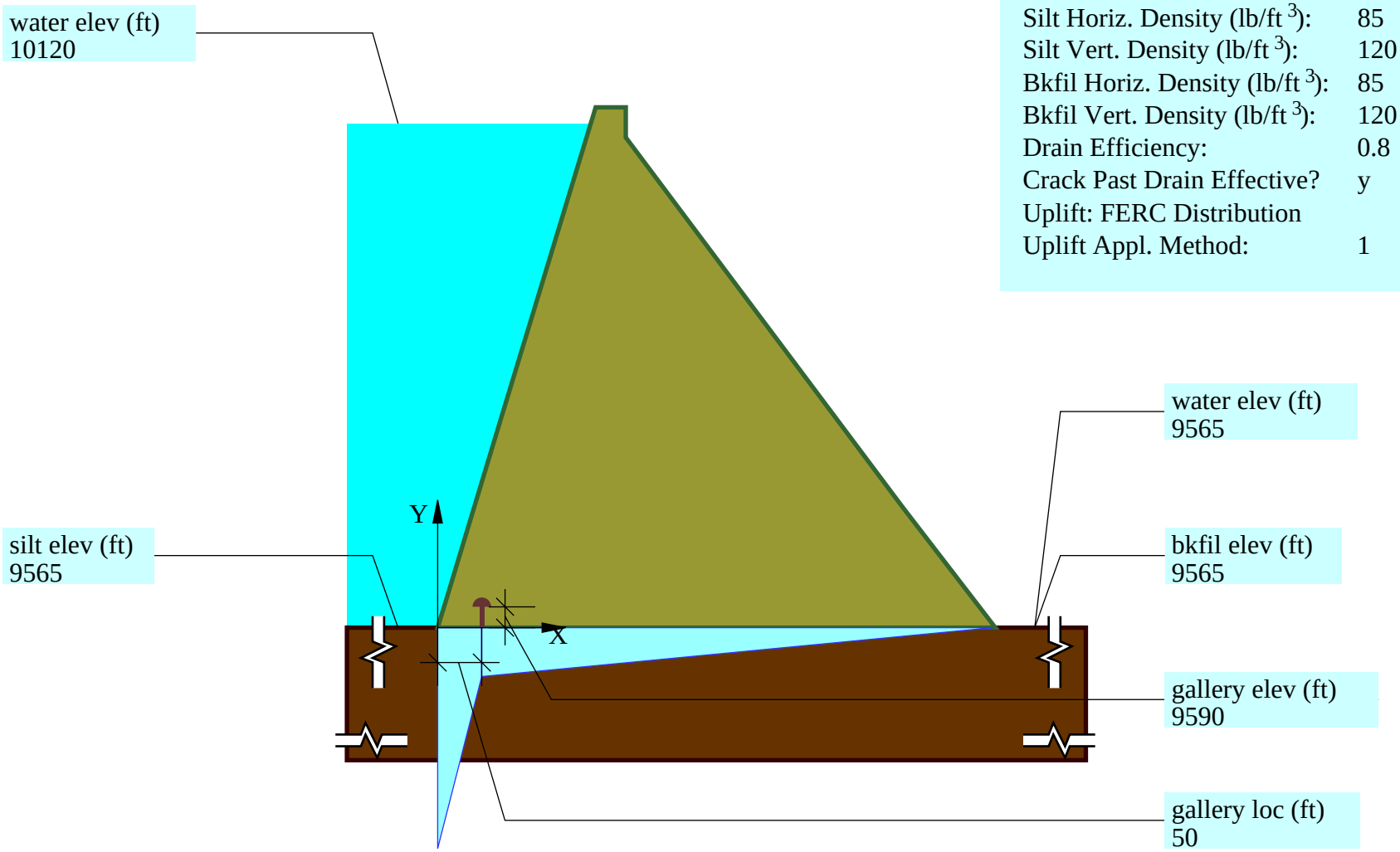
Union Park Dam Modified Non-overflow Section Geometry, UPD13_GEO



Union Park Dam Modified Non-overflow Section w/Hydrostatic Loading, UPD13_RES

7/21/04
20:53:40

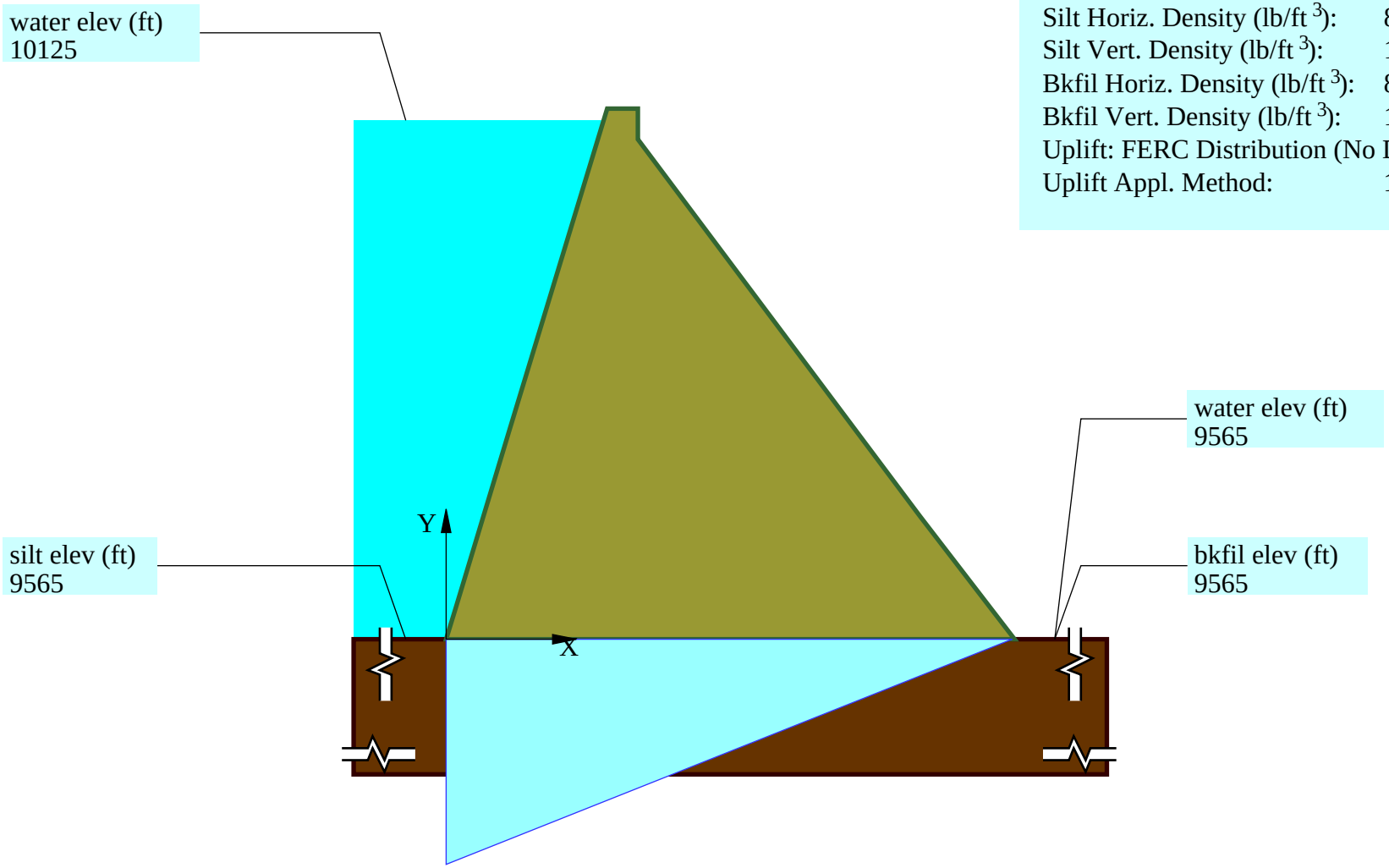
Water Density (lb/ft ^{3}):	62.4
Silt Horiz. Density (lb/ft ^{3}):	85
Silt Vert. Density (lb/ft ^{3}):	120
Bkfil Horiz. Density (lb/ft ^{3}):	85
Bkfil Vert. Density (lb/ft ^{3}):	120
Drain Efficiency:	0.8
Crack Past Drain Effective?	y
Uplift: FERC Distribution	
Uplift Appl. Method:	1



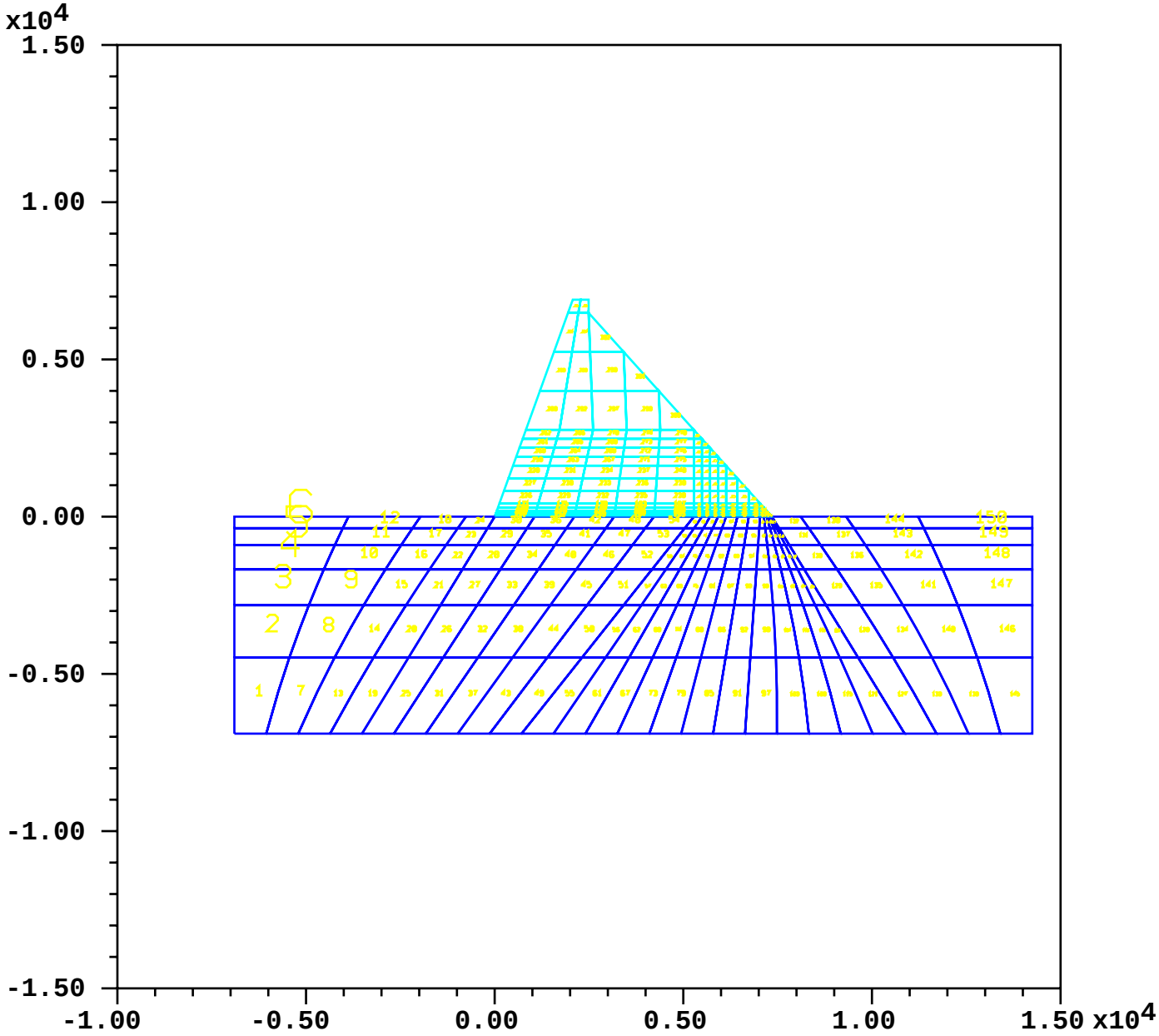
Union Park Dam Non-overflow Section w/.Flood Loading and Full Uplift, UPD_13.RES

7/21/04
19:04:48

Water Density (lb/ft ^{3}):	62.4
Silt Horiz. Density (lb/ft ^{3}):	85
Silt Vert. Density (lb/ft ^{3}):	120
Bkfil Horiz. Density (lb/ft ^{3}):	85
Bkfil Vert. Density (lb/ft ^{3}):	120
Uplift: FERC Distribution (No Drain)	
Uplift Appl. Method:	1



ELEMENT MESH



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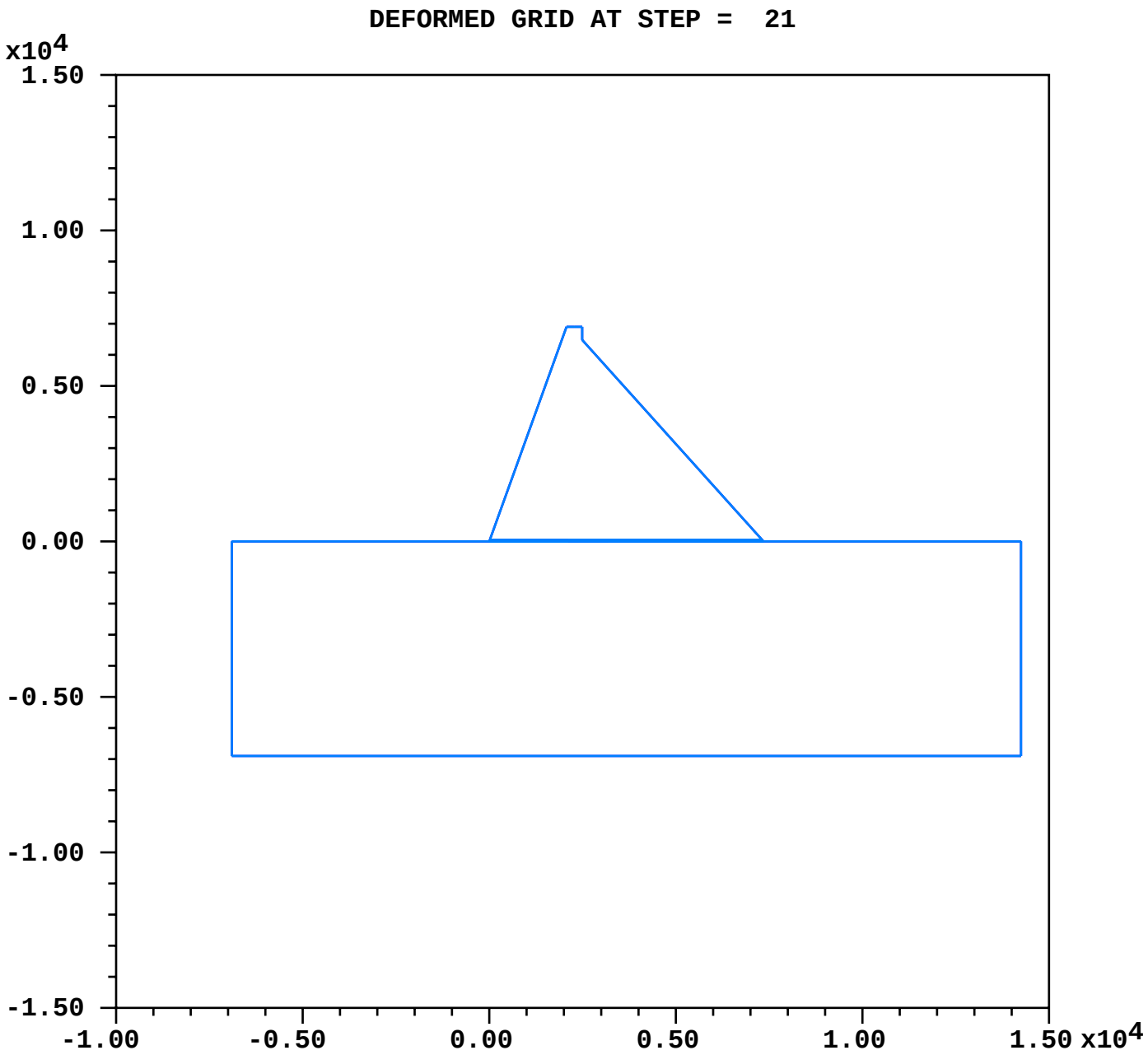

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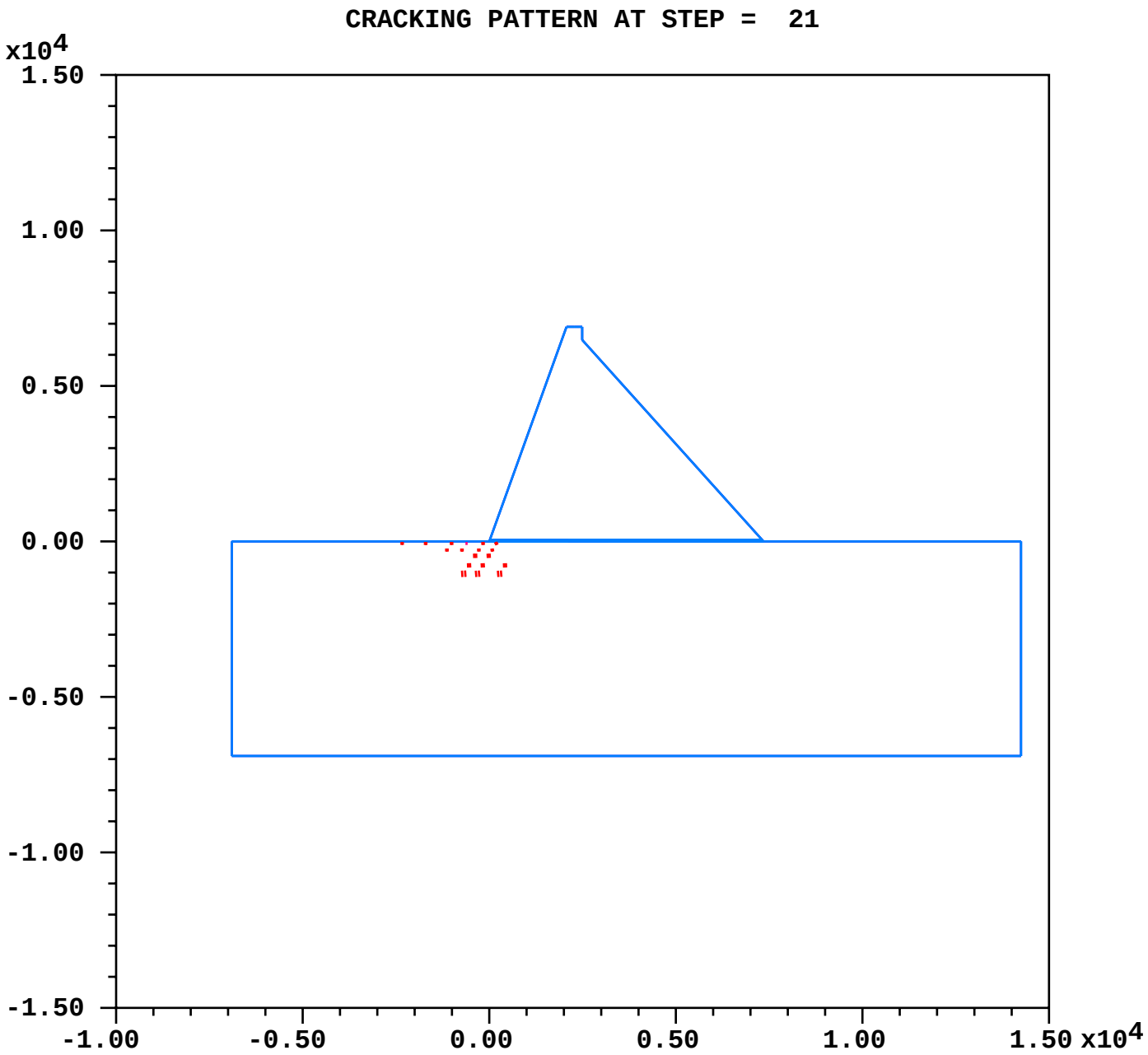

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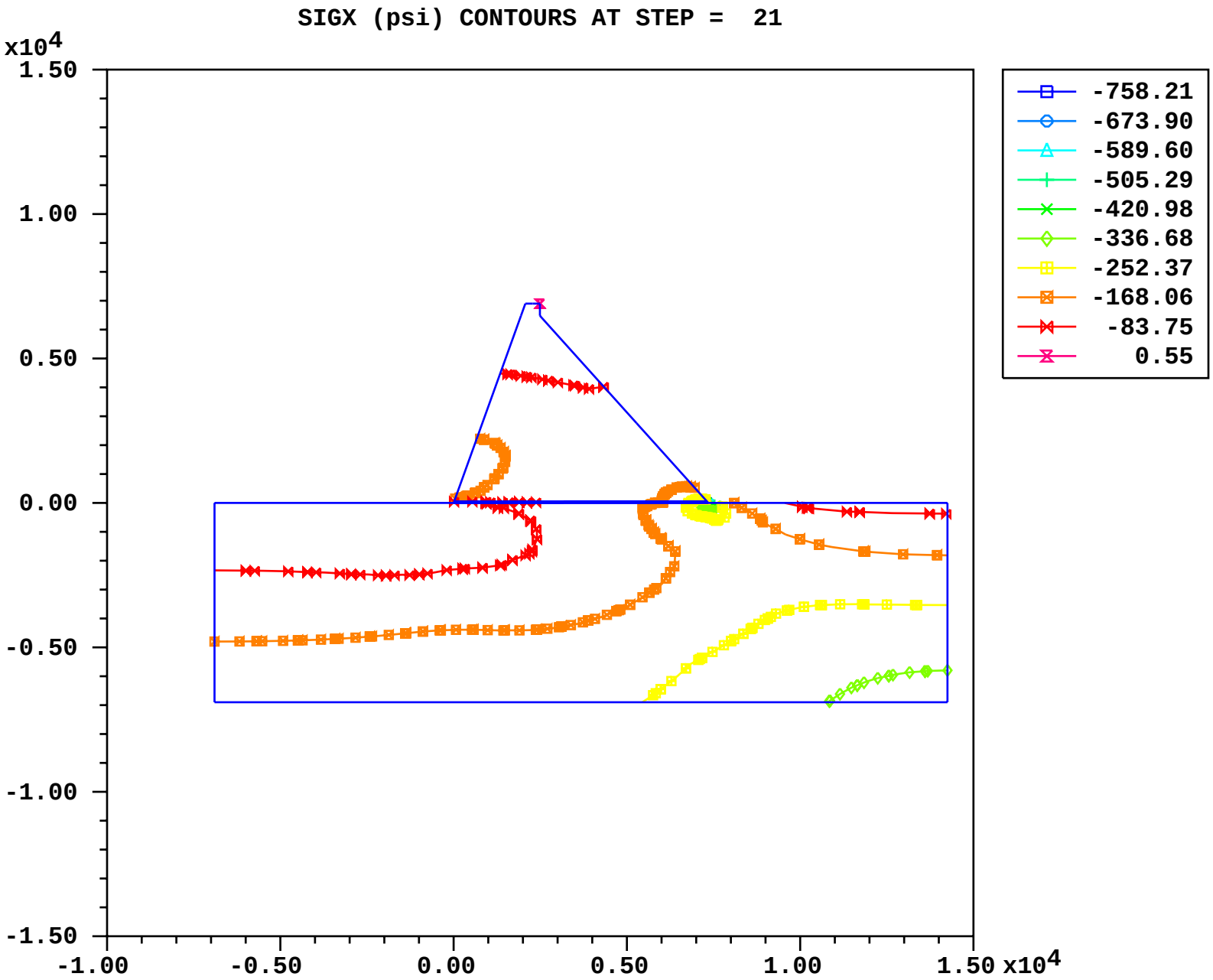

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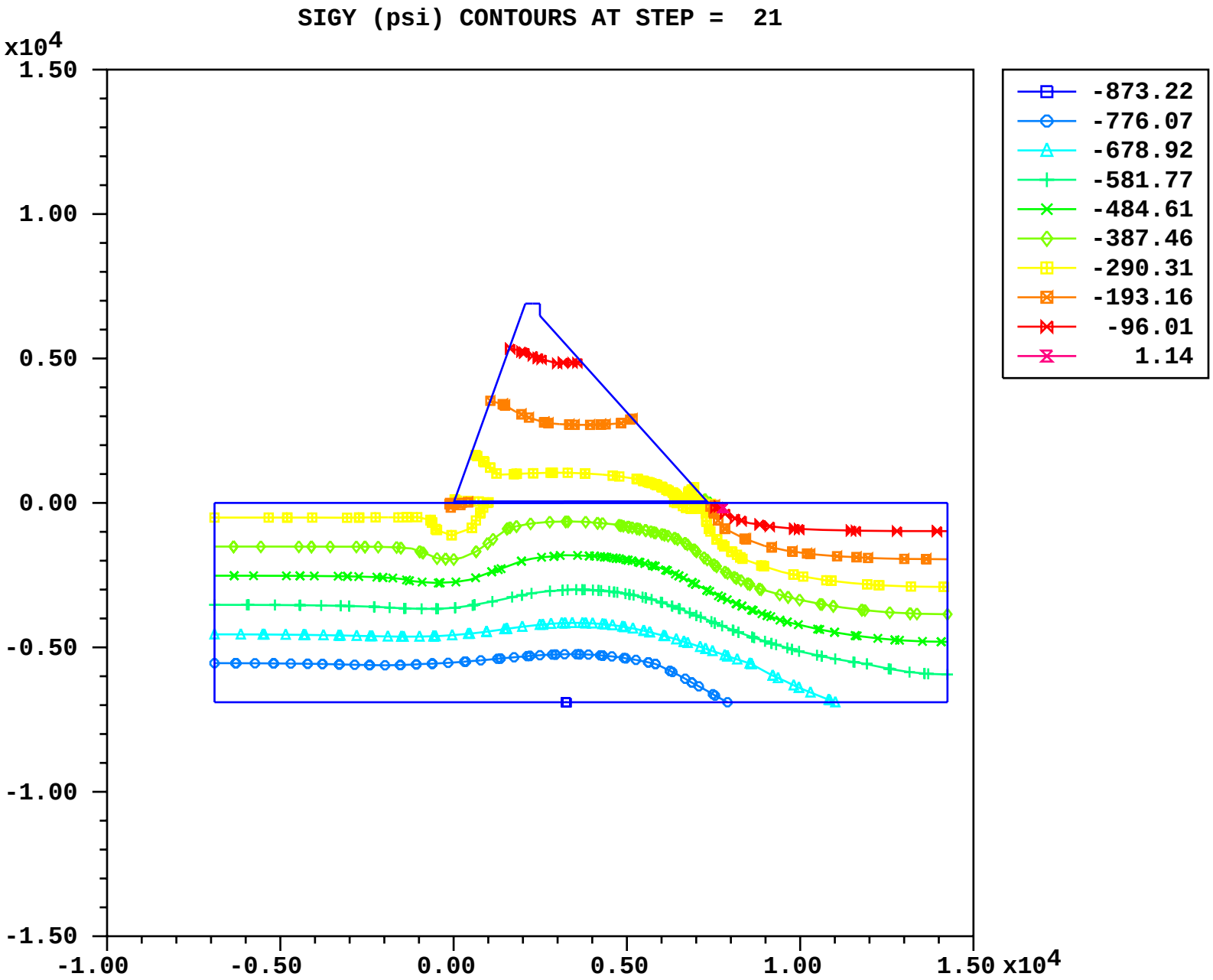

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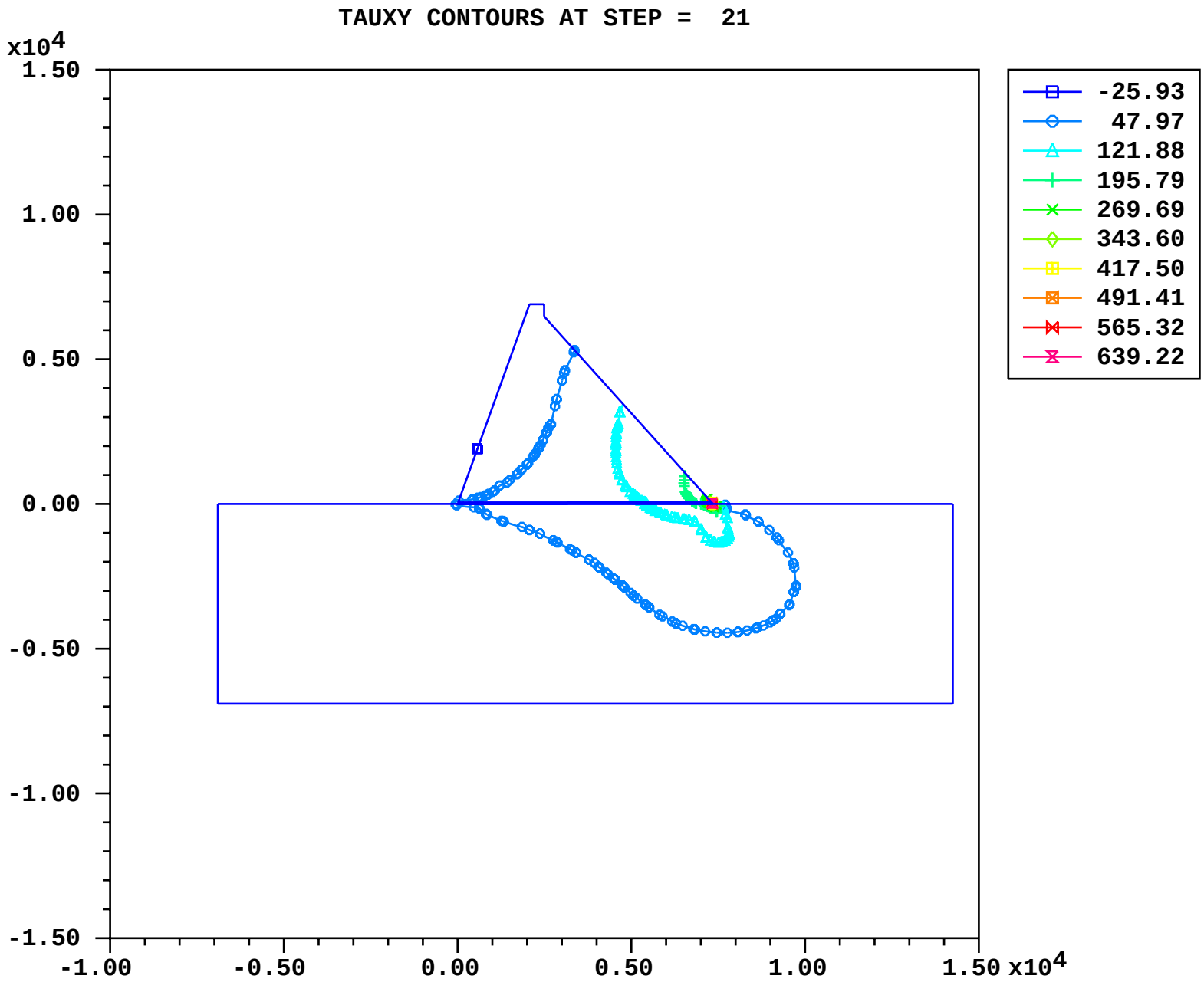

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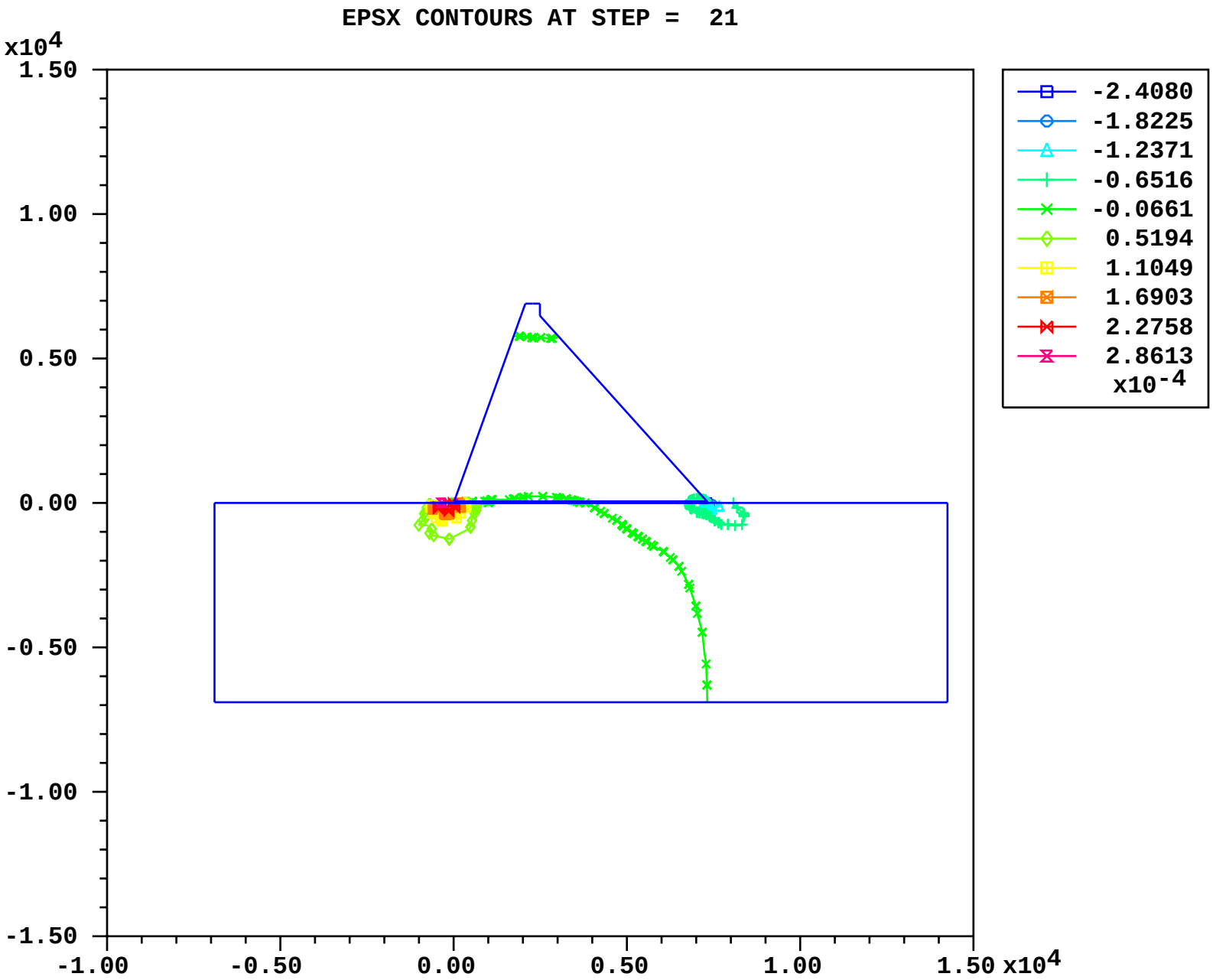

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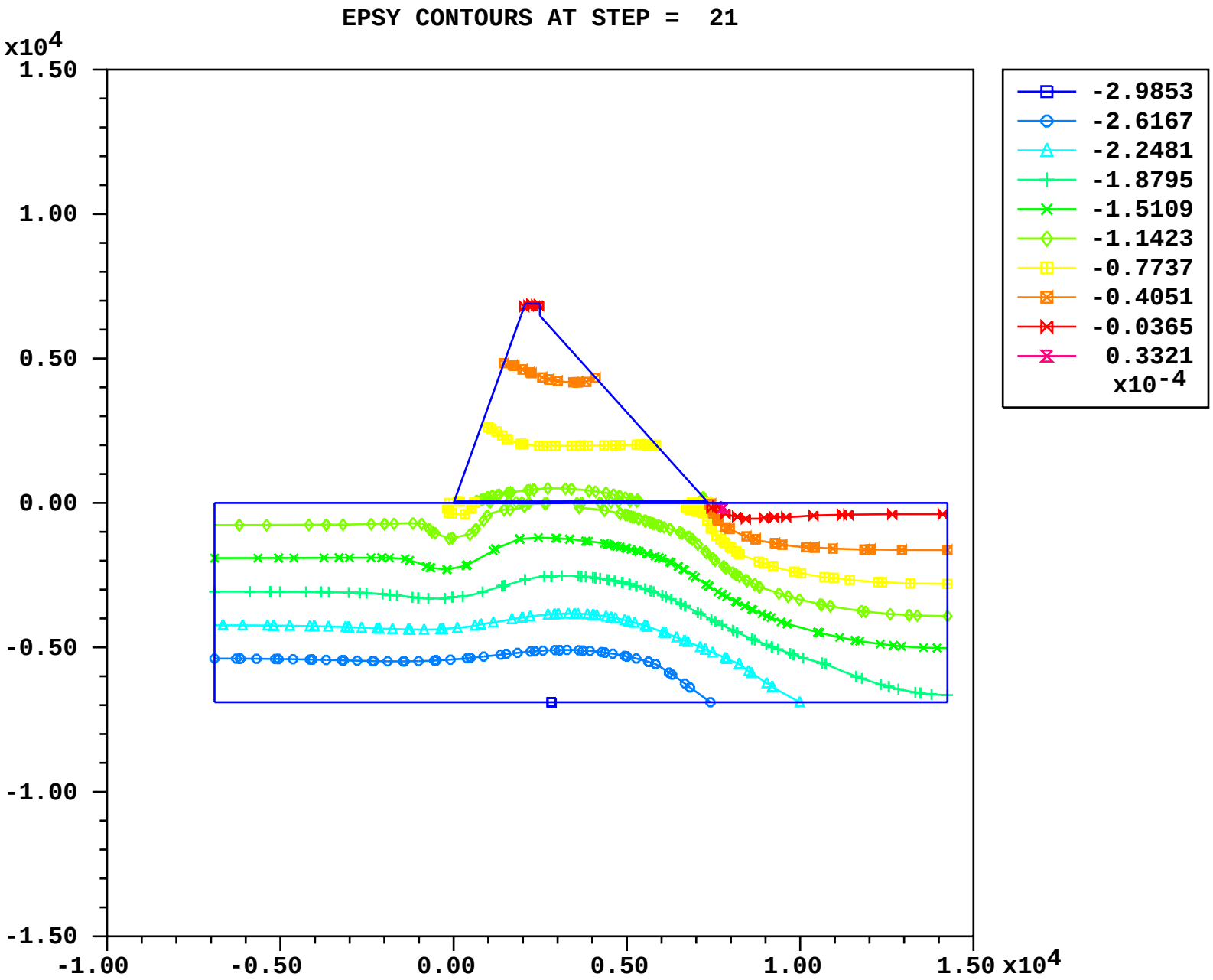

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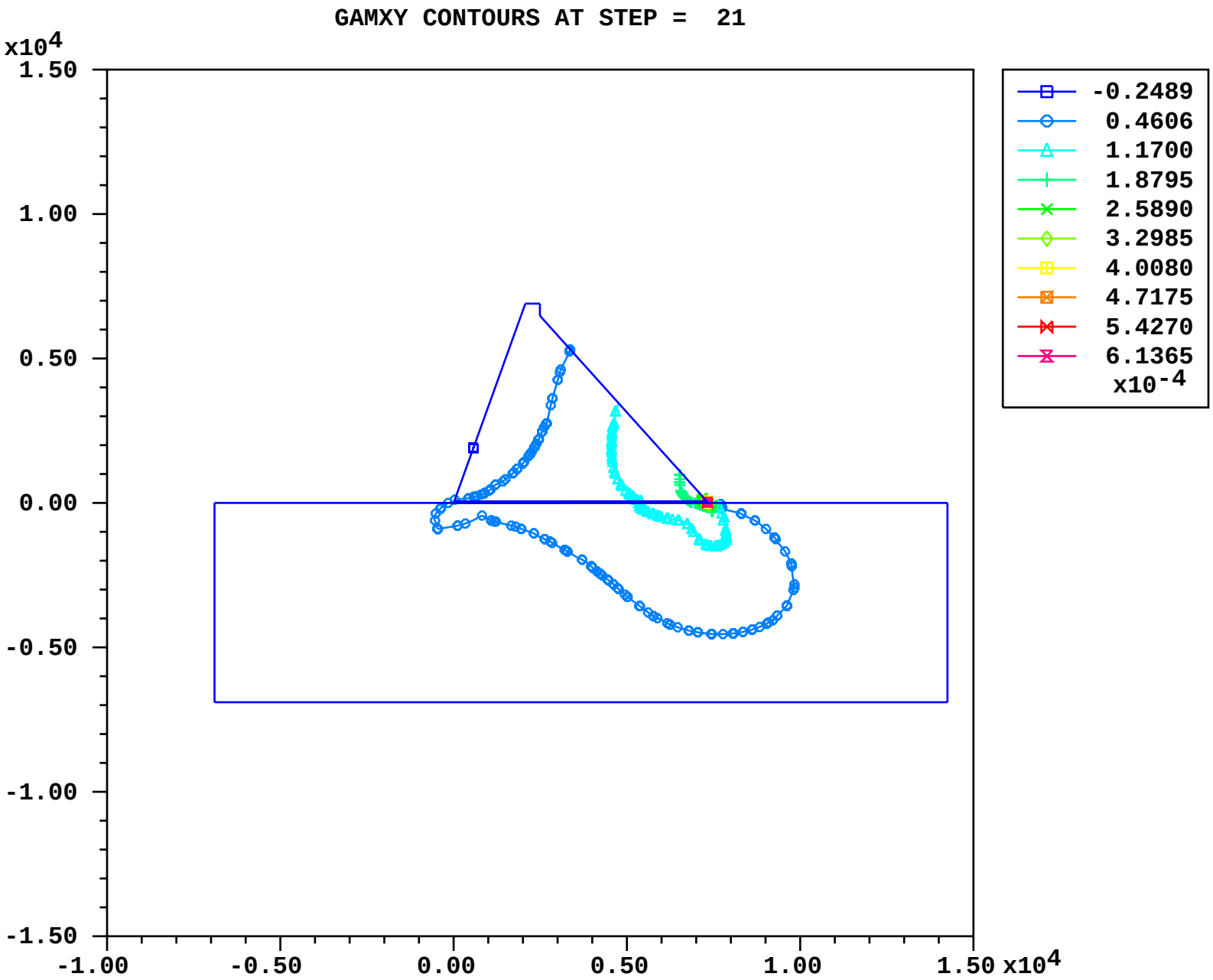

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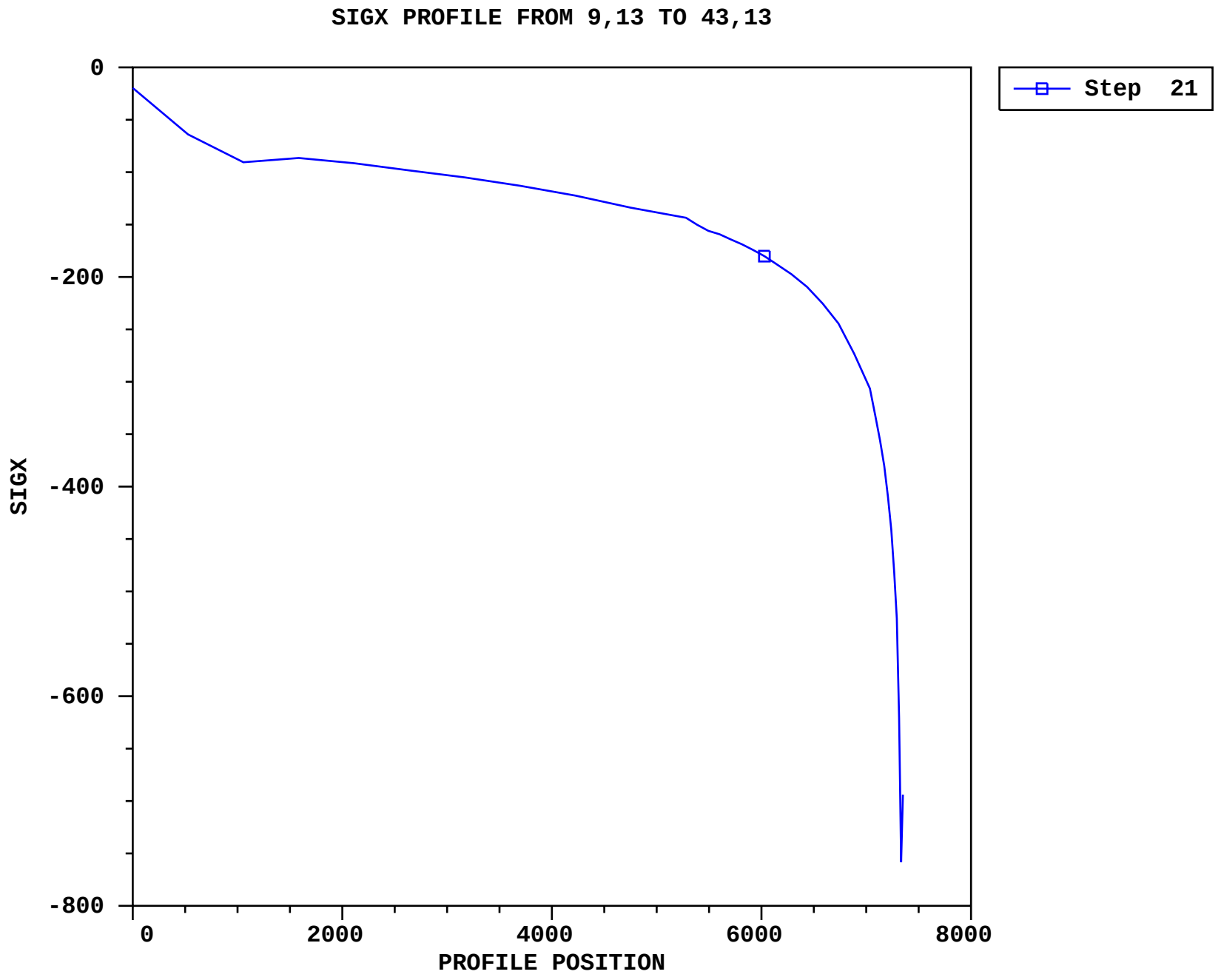

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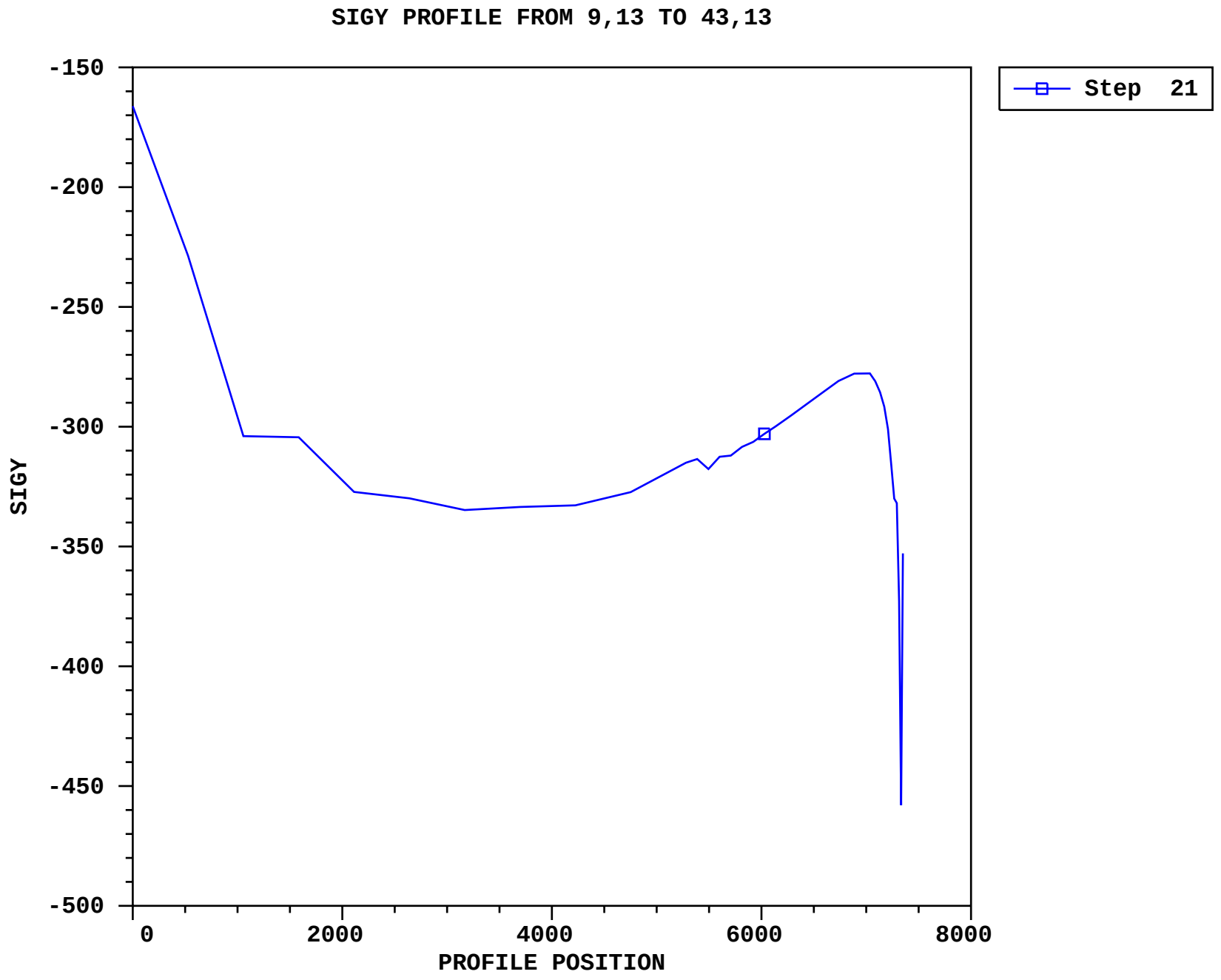

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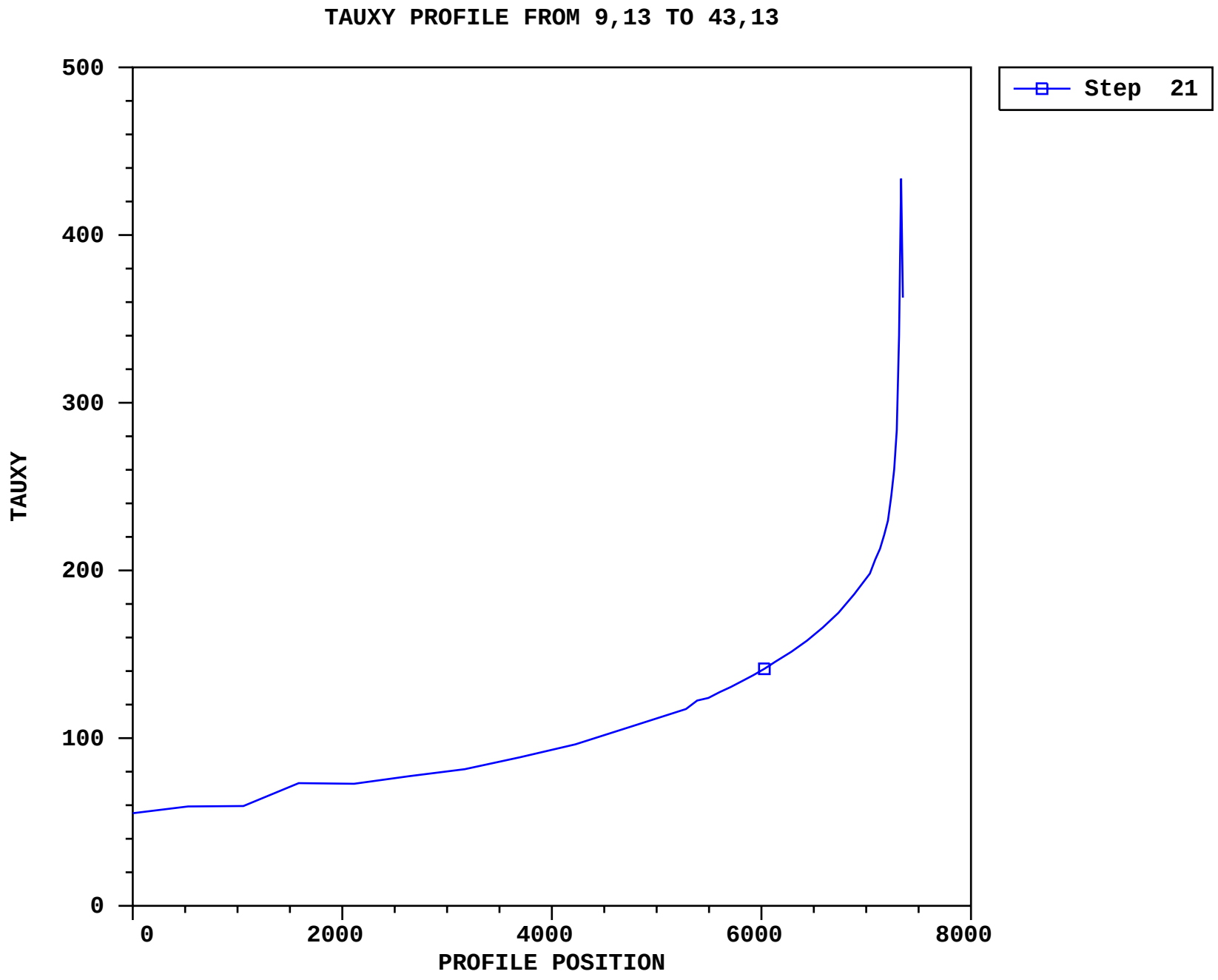

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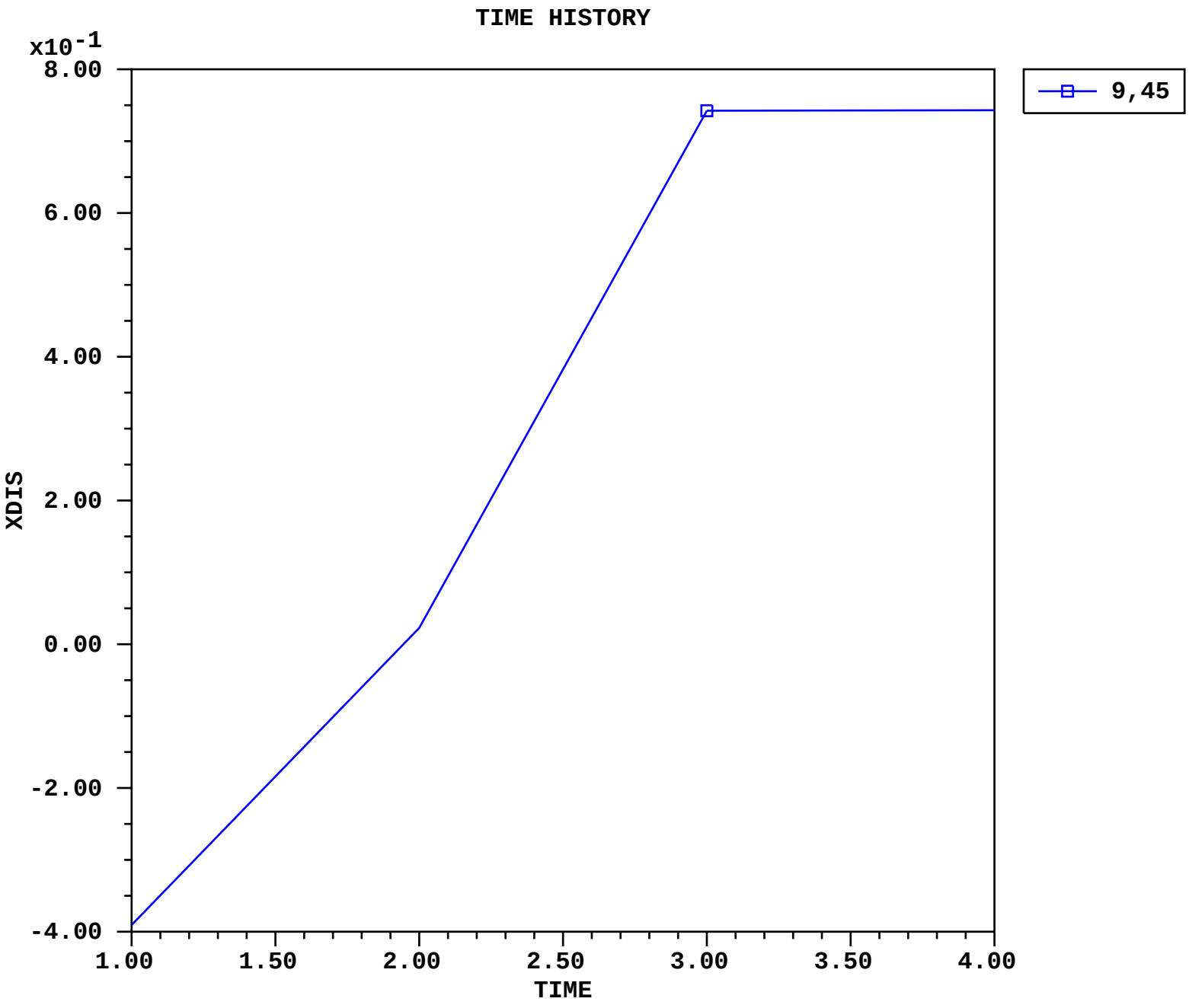

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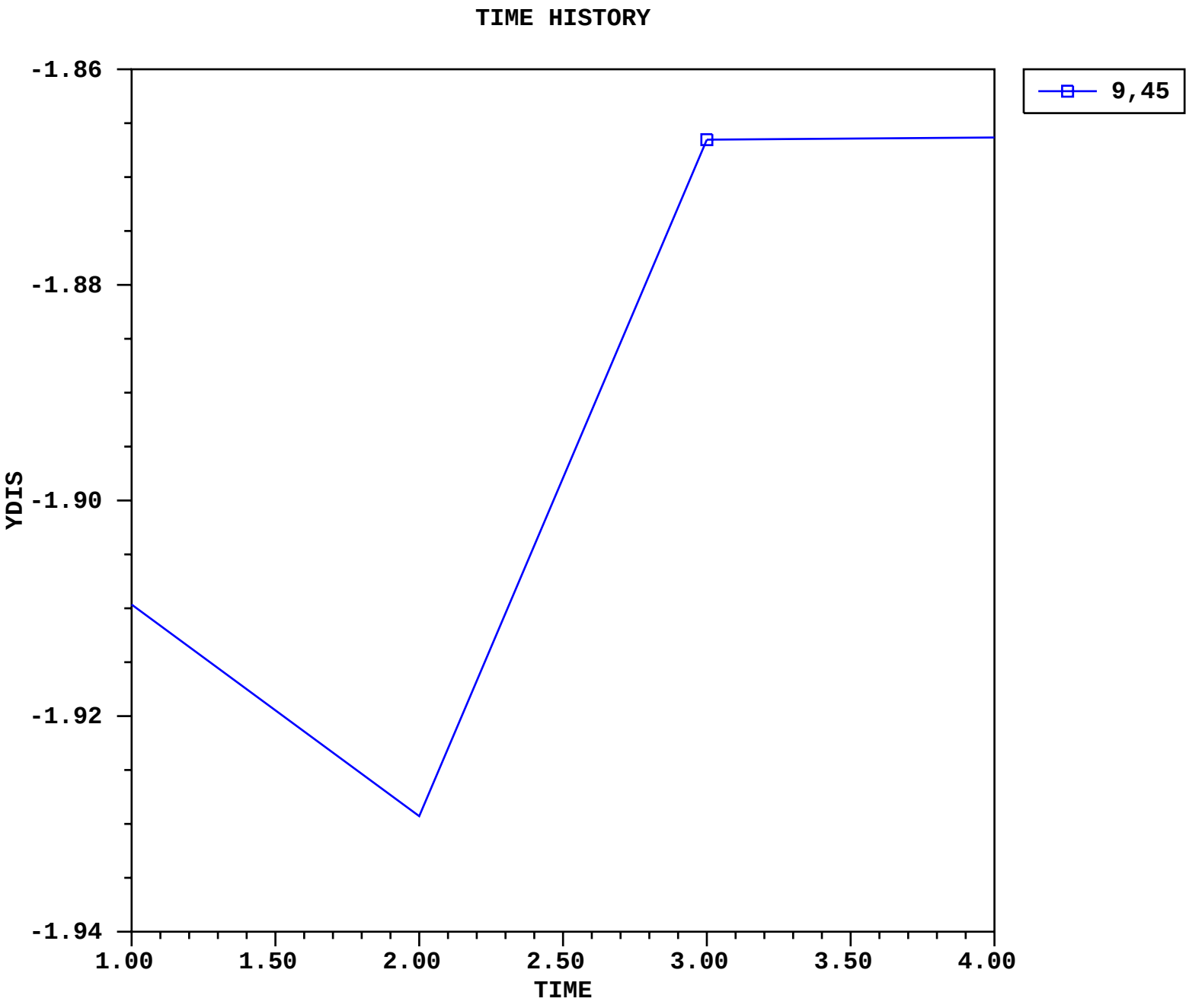

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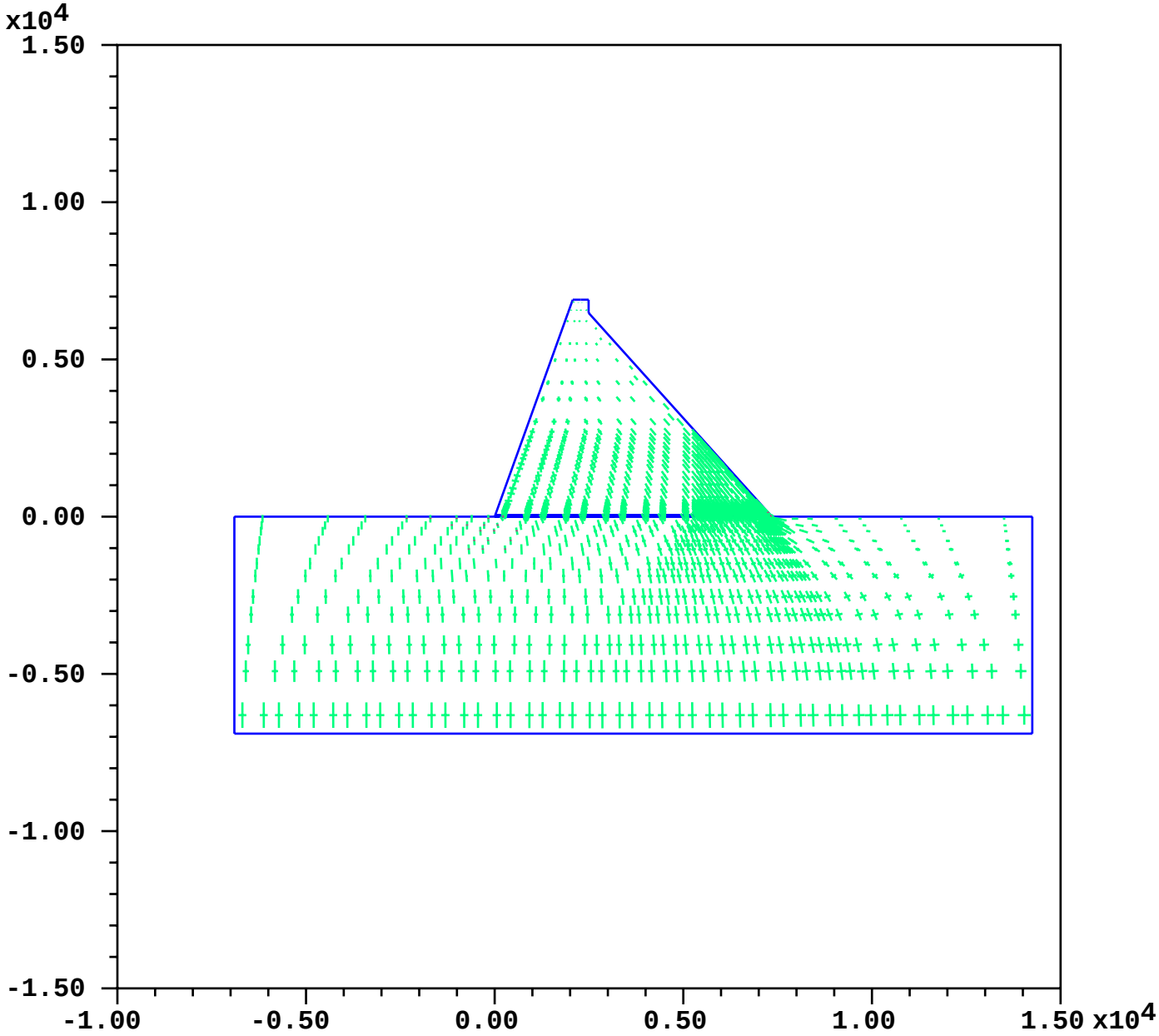
PRINCIPAL STRESS VECTORS AT STEP = 21



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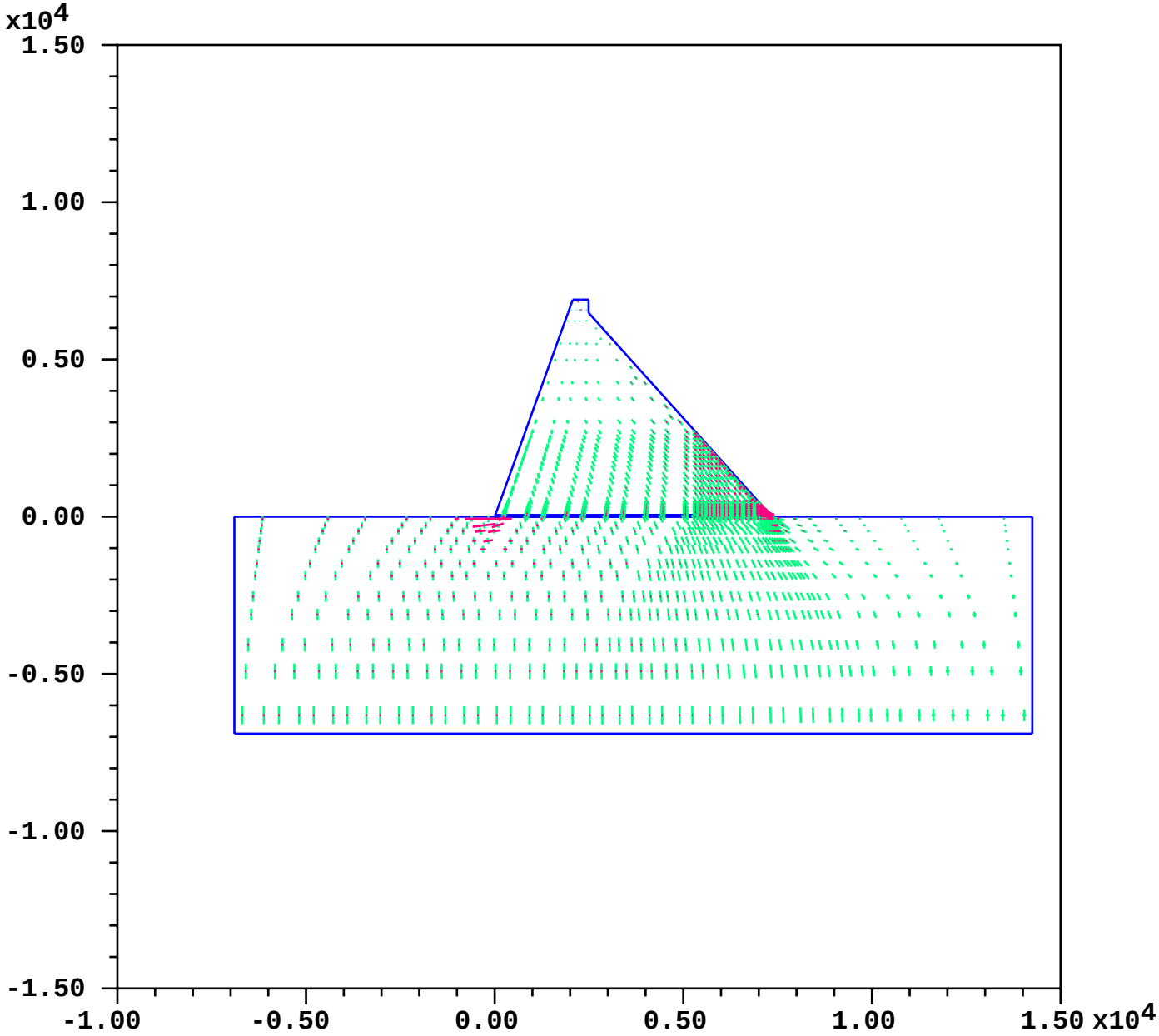
PRINCIPAL STRAIN VECTORS AT STEP = 21



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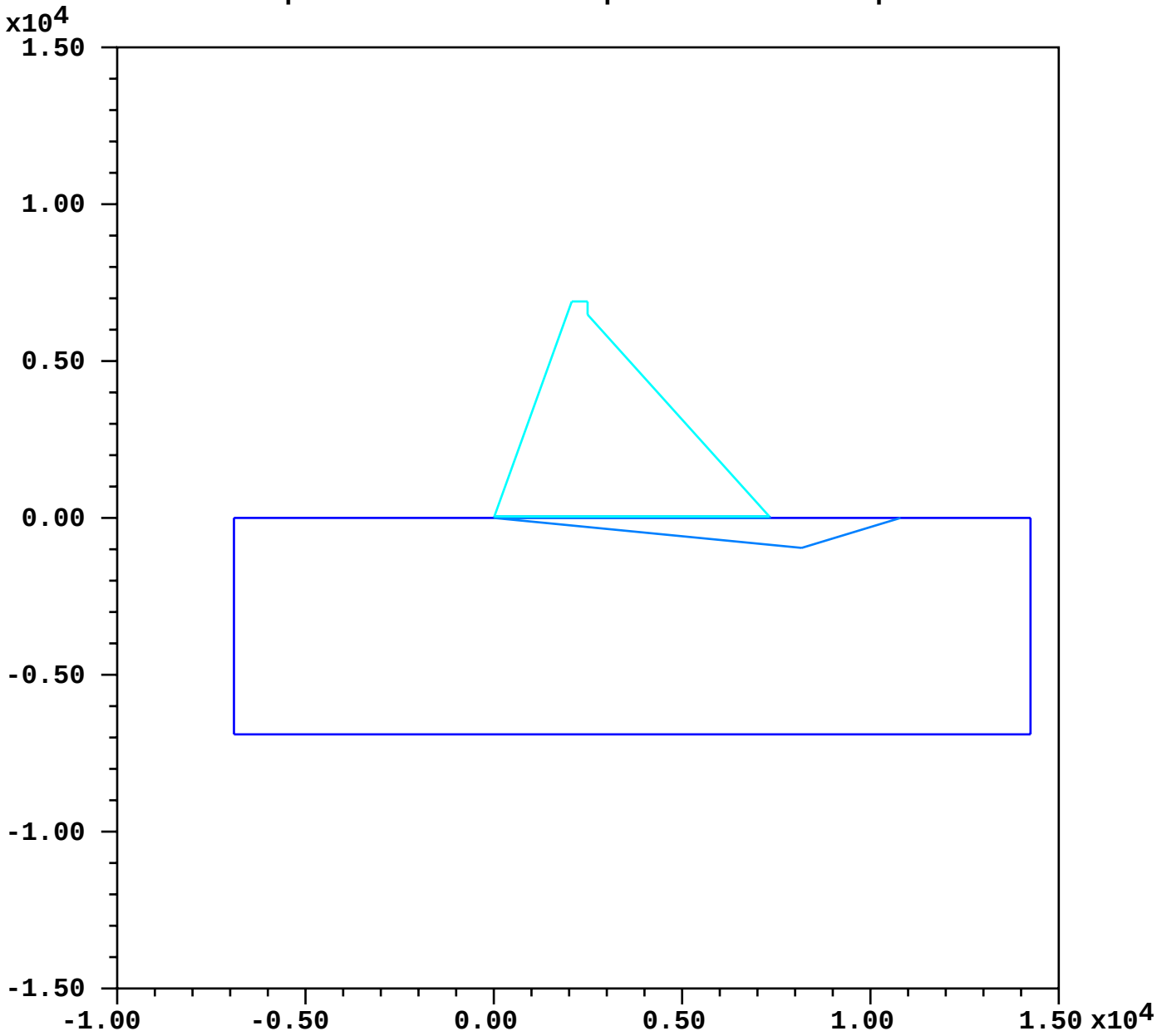
Computed Foundation Slip Surface for Step 21



Foundation Shear Friction Factor of Safety: 4.909

Frame 17 TAPE50 CG-DAMS PC-2.2.0 7/21/04 20:56:56.93

Union Park Dam

Appendix A3

Union Park Reservoir
Preliminary Hydrologic Evaluation

Union Park Reservoir
Preliminary Hydrologic Evaluation
Gunnison County, Colorado

Prepared For:

Ueblacker Associates

Prepared By:

WRC Engineering, Inc.
950 S. Cherry Street, Suite #404
Denver, CO 80246
(303) 757-8513
(303) 758-3208 Fax

Alan J. Leak, P.E.
Project Manager

July 14, 2004

Union Park Reservoir Preliminary Hydrologic Evaluation

I. Introduction

WRC Engineering, Inc. has been retained by the Ueblacker Associates to prepare this preliminary hydrologic evaluation of the Union Park Reservoir. The purpose of this preliminary evaluation is to estimate peak flow and flow volume for a Probable Maximum Flood in the Union Park Drainage area above the proposed Union Park Dam for evaluation of the dam design parameters.

The proposed reservoir is situated south of Taylor Park Reservoir in Gunnison County, Colorado, at an elevation of approx. 10,000 feet (See Figures A3.1 and A3.2). The proposed dam will be a modern roller-compacted concrete (RCC) gravity dam, about 575 feet high with a crest length of approximately 2,050 feet. The dam will be located on Lottis Creek in Union Canyon. The reservoir will have a surface area at high water level of about 5,020 acres (7.8 square miles) and will impound approximately 1,200,000 acre-feet of water at the high water elevation of 10,120 ft.

This reservoir will serve as the upper reservoir for a proposed hydroelectric pump-storage project using Taylor Park Reservoir for the lower reservoir. Studies have also been prepared which identify this site as an ideal reservoir location to provide multi-objective benefits such as drought protection, flood protection, recreational and environmental benefits, and holdover storage for future growth. (WR&PDA 1989, and others)

II. Description of Drainage Area

The contributing drainage area to the reservoir is about 26.02 square miles. Elevations within the watershed range from more than 13200 ft above mean sea level at Fairview Peak to a low point of about 9600 ft at the proposed site for the dam. The maximum length of area is approximately 8.7 miles in the approximately north-south direction.

The mountain ranges and uplands in the watershed consist mainly of complexly folded and faulted Precambrian igneous and metamorphic rocks. These Precambrian rocks include schist, gneiss and granitic gneiss. Paleozoic sedimentary rocks consist of conglomerates, quartzites, sandstones and limestones. These rocks also underlie the alluvium of the valleys. The alluvium in the area consists of rock debris derived from the consolidated rock-mountain masses. Soil survey information indicates the at the reservoir site in-situ soil is moderately to highly permeable.

Little direct information is available concerning the water-bearing/-transmitting properties of the consolidated rocks.

Fair View Lake, Cameron Creek, Cross Creek and several unnamed creeks constitute the headwaters of Lottis Creek. Lottis Creek flows in the center of the drainage area in a slightly northwest direction to nearly west direction at the exit of the drainage area. To

the north and east is the Taylor Park drainage area. South Lottis Creek drainage area is on the west side. The south divide of the Union Park drainage area is Fairview Peak.

Vegetation in the watershed is generally dense with medium to dense forest in the upper reaches of the watershed to low level grasses and brushes in the reservoir area.

III. Flood Characteristics

Historical flood records were not readily available for the Union Park Reservoir drainage area. It is assumed that most severe floods occur as a result of local thunderstorms having high-intensity rains of short duration. The watershed also has the potential for floods resulting from snowmelt, low-intensity rain of long duration, or a combination of rainfall and snowmelt.

IV. PMF Estimates

Probable Maximum Precipitation: Probable maximum precipitations (PMP) for this preliminary evaluation were determined using data and procedures of HMR 49. Two storm types were considered in this evaluation. The all season general storm PMP, most likely to occur in the spring of the year (months of April, May and June) occurring on top of a melting snow pack, will yield the maximum volume of flooding. The local storm PMP, most likely to occur in summer and late fall months, will result in the most intense rainfall and largest probable maximum flood (PMF) peak flow. The calculated PMP data is listed in the following Tables.

Table 1 All Season-General Storm PMP (Union Park, Gunnison, Colorado)

Storm Duration (hours)	PMP (inches)
6	5.0
12	7.8
18	10.0
24	11.7
48	16.7
72	19.2

Table 2 Local Storm PMP (6-hr) (Union Park, Gunnison, Colorado)

Storm Duration (hours)	PMP (inches)
0	0.0
1.00	0.2
2.00	0.8
3.00	6.1
4.00	7.1
5.00	7.5
6.00	7.7

Storm Runoff Modeling: This preliminary evaluation uses the widely used Army Corps of Engineers HEC-1 computer program to estimate flow volume and the peak inflow to the reservoir and the peak outflow from the dam. The following sections describe the input parameters to the HEC-1 model.

Loss Rates: The loss method chosen for this evaluation is the initial loss and uniform loss rate method. The initial loss value of 0.0 inches was used in this evaluation to be conservative. Larger initial loss values would result in smaller peak flow and flow volume estimates. The value of the uniform loss rate was estimated at 0.05 inches/hour. For the slopes, rock types and vegetation conditions as well as the snow covering conditions during June of a typical year in the Union Park drainage area, this small uniform loss rate is appropriate, especially for long duration storms.

Runoff Method: In this preliminary evaluation, the Bureau of Reclamation dimensionless unit hydrographs for the Rocky Mountains were chosen to estimate the runoff from the Union Park Reservoir drainage area. The Bureau of Reclamation unit hydrograph method is founded on a basin lag time. The lag time for the Union Park drainage area was determined as follows.

The lag time equation is:

$$\text{Lag} = C\,[(L \times L_{ca})/(S)^{0.5}]^{0.33} \text{ (hours)}$$

C — a runoff efficiency coefficient for a basin and storm type
L — Length of the longest water course in miles
Lca — Distance to the centroid of the basin along the longest water course in miles
S — Slope along the longest water course (ft/mile)

The required lengths and channel slopes were calculated from the available USGS 10-meter DEMs. The values listed below have conservatively taken into consideration the potential for a full reservoir water surface area which is relatively large as compared to the reservoir the drainage area. The values used in this preliminary PMF evaluation are:

L = 3.9 miles
Lca = 3.9 miles
S = 792 ft/mile

The same value of Lca and L is due to the treatment of the water surface as a separate sub-basin and the remaining portion of the drainage area as the other sub-basin. The values of Lca and L are for the remaining sub-basin.

The C coefficient was selected as 3.0 for the general storm event and as 2.0 for the local storm event. These coefficients reflect the vegetative cover, the overall slopes of the basin and the type of storms being considered and were determined with reference to

Table 4.2 of USBR Flood Hydrology Manual (1989). With these C values, the computed lag times for the area excluding the water surface at the proposed high water level are:

General Storm Lag = 2.45 hours
Local Storm Lag = 1.63 hours

Antecedent Flood Consideration: For the general storm PMF in the Union Park drainage area, snowmelt is a major contributor to the peak and volume of the PMF hydrograph. Due to a lack of gauging data and their correlation with snowmelt at the Union Park drainage area, an estimate of the snowmelt contribution can be derived from a regional correlation on the basis of nearby stream gauging data. An estimated 100-year 15-day maximum streamflow hydrograph was used to combine with the runoff hydrograph from the 72-hour general PMP storm to estimate the PMF for the Union Park reservoir drainage area.

The nearest gauging station (USGS # 07089000) is on Cottonwood Creek below Hot Springs near Buena Vista, located to the east of the Union Park drainage area. The drainage area above the gauging station is 65 square miles with a basin average slope of 0.416 ft/ft. Although this gauge is on the east side of the continental divide and the rainfall pattern may be different significantly, the Union Park drainage area and the drainage area above the Cottonwood Creek gauge are both in the Mountain Region as depicted by USGS WRIR 99-4190 that present flood frequency correlation relations for Colorado. In addition, since this is to estimate flood runoff from snowmelt, not flood runoff from direct rainfall, the snowmelt conditions at both drainage areas are assumed to be significantly similar.

The correlation for the Mountain Region for 100-year flood is:

$$Q = 39.5\,(A)^{0.706}\,(S + 1.0)^{1.577}$$

where, Q is discharge in cubic feet per second; A is drainage area in square miles; and S is mean drainage-basin slope in foot per foot

Using the above equation, the ratio of flows between the Union Park drainage area and the Cottonwood Creek drainage area is 0.377.

The 100-year 15-day maximum streamflow was found by performing a Log-Pearson III analysis on the complete 48 years of daily flow record. The 15-day streamflow hydrograph was based on the daily average flow data at the Cottonwood Creek gauge for the 15-day period from June 16, 1957 to June 30, 1957. The derived (and rearranged) hydrograph values for the Union Park drainage area are listed in Table 3.

Table 3 Projected antecedent snowmelt flood hydrograph for Union Park drainage area

Time (day)	Flow Rate (cfs)
1	60
2	73
3	82
4	95
5	119
6	141
7	190
8	201
9	163
10	130
11	116
12	95
13	81
14	71
15	59

Storm Runoff Modeling Results: The HEC-1 program was used to model the storm runoff from the PMPs. The Union Park drainage area is divided into two sub-basins with one representing the water surface at the high water level of 10120 ft and the other representing the remaining area. The inflow to the reservoir is the combination of runoff from both sub-basins.

Runoff resulting from rain on the reservoir water surface at 10120 ft was calculated assuming zero initial loss and zero uniform loss rate. This runoff is converted to unit hydrograph by the Snyder's unit hydrograph method with zero lag and a value of 0.63 for the Snyder's peaking coefficient (Cp).

Flood Routing and Dam Safety Analysis: It is assumed that the reservoir is at the high water level of 10120 ft prior to the start of the PMF hydrographs and the hydroelectric pumps are turned off. The elevation-storage data used for the dam safety analysis are listed in Table 4.

Table 4 Reservoir Elevation vs. Capacity

Elevation (ft)	Capacity (AF)
9,600	0
9,620	33
9,640	168
9,660	977
9,680	3,424
9,700	8,732
9,720	17,978
9,740	31,931
9,760	51,108
9,780	75,887
9,800	106,801
9,820	143,744
9,840	186,081
9,860	233,343
9,880	285,452
9,900	342,204
9,920	403,213
9,940	468,383
9,960	537,676
9,980	610,888
10,000	687,754
10,020	768,073
10,040	851,813
10,060	939,113
10,080	1,029,878
10,100	1,123,992
10,120	1,221,505
10,140	1,322,413

Simulation Results: The results of the HEC-1 simulations with the above considerations are listed as follows.

1. General 72-hour PMP

STATION	PEAK FLOW (cfs)	PEAK TIME (hr)	TOTAL VOLUME (AF)
Snowmelt	200	166.75	3334
Inflow Basin 1	2294	34.5	14946
Inflow Basin 2	4216	3.83	8028
Total Inflow	4340	5.75	26308
Outflow	0	---	0

The highest stage is approximately 10125.2 ft occurring at approximately 362 hours from the start of the storm.

2. Local 6-hour PMP

STATION	PEAK FLOW (cfs)	PEAK TIME (hr)	TOTAL VOLUME (AF)
Inflow 1	17966	6.53	7222
Inflow 2	26815	2.57	3220
1 & 2	27266	2.8	10442
Outflow	0	--	0

The highest stage is approximately 10122.1 ft occurring at approximately 27 hours from the start of the storm.

The computer output report for the estimates is included as an appendix to this report.

V. Other Considerations

PMF Flood Volume Comparison

As a check on the reasonableness of the PMF estimate for this study, a comparison was performed with the PMF estimates for Taylor Park Reservoir, located in an adjacent watershed to Union Park (USBR, 2000). The USBR estimate of the PMF from a June general storm for the Taylor Park drainage area (approximately 256 square miles) is 221,000 acre-ft. The runoff per unit area is approximately 863 acre-ft per acre.

The estimated PMF from a June general storm for the Union Park drainage area (approximately 26 square miles) in this study is 26308 acre-ft. The runoff per unit area is approximately 1012 acre-ft.

The runoff rate per unit area for the Union Park Drainage area is slightly higher than that for the Taylor Park drainage area. This is due to the relatively larger portion of the watershed covered with the reservoir water surface. If the water surface and snowmelt contribution is excluded, the runoff rate per unit area from the PMF June general storm for the Union Park drainage area is approximately 830 acre-ft per acre, which is close to the runoff rate per unit area (863 acre-ft per acre) computed for the Taylor Park drainage area (USBR, 2000).

Freeboard Consideration

The determination of freeboard requires an evaluation of both the PMF event and of the height and action of waves. The height of waves generated by winds in a reservoir depends on many factors such as wind velocity, duration of the wind, fetch, depth of water, width of reservoir, and texture of dam slope surface.

From the empirical data presented in the USBR Design of Small Dams the wave height would be approximately 4 ft for a wind velocity of 100 miles per hour with a maximum fetch of approximately 2.75 miles at the high water level of 10120 ft. It is recommended

that the freeboard due to wave action be at least 1.5 times the estimated height of waves resulting from a wind velocity of 100 miles per hour. Therefore, it is recommended that the freeboard height due to wave action for the proposed Union Park Dam be at least 6 ft. The crest of Union Park Dam should therefore be at least 6 feet above the PMF elevation of 10125.2. We therefore recommend a dam crest elevation of 10,132.

VI. Conclusion

The proposed Union Park reservoir is capable of containing the entire PMF from the drainage area. The probable maximum inflow rate is 27266 cfs resulting from local 6-hour PMP and the probable maximum inflow volume is 26308 acre-feet resulting from all season general 72-hour PMP with an antecedent 100-year snowmelt flood. The highest stage will be approximately 10125.2 ft. Since the entire PMP can be stored in the reservoir at a maximum depth of 5.2 feet with a full reservoir, an emergency spillway is not needed on this reservoir. However, the outlet works should be designed such that two methods of release exist in case one is impaired or closed for repairs, maintenance, or inspection.

VII. Recommendations

This Preliminary Hydrologic Evaluation was based upon standard references and methodologies for computation of PMP and PMF's at the Union Park site and is suitable for this level of site and dam evaluation. For final design of the reservoir and dam embankment, we would recommend a more thorough evaluation of adjacent and comparable stream gage records and drainage area characteristics. This analysis would further refine the dam height needed to fully ascertain the PMF event and provide sufficient freeboard to protect this dam from the risk of overtopping due to wave generation occurring during a PMF storm event. In addition, the reservoir outlet works will need to be sized to accommodate release of the PMP runoff in a reasonable time if such event occurs with the reservoir at its full storage elevation of 10,120. This release rate evaluation will need to consider the length of time needed to release the PMF as compared to the risk of a second PMF or lesser flood event occurring before the first event can be drained.

Lastly, final design of the Dam and Reservoir should also consider and evaluate the potential to use the Union Park Reservoir and hydroelectric pumps to pump flood flows out of Taylor Park Reservoir into Union Park Reservoir during severe flood events on the Taylor River. Current PMF analysis of Taylor Park Reservoir shows that the reservoir would overtop and could fail during a PMF event. Pumping of Taylor River runoff into Union Park reservoir during a PMF event would reduce the risk of failure of Taylor Park Dam. This would be a significant benefit to residents and citizens living and working downstream of both reservoir sites.

VIII. References

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Figure A3.1. Union Park Drainage Area
Vicinity Map

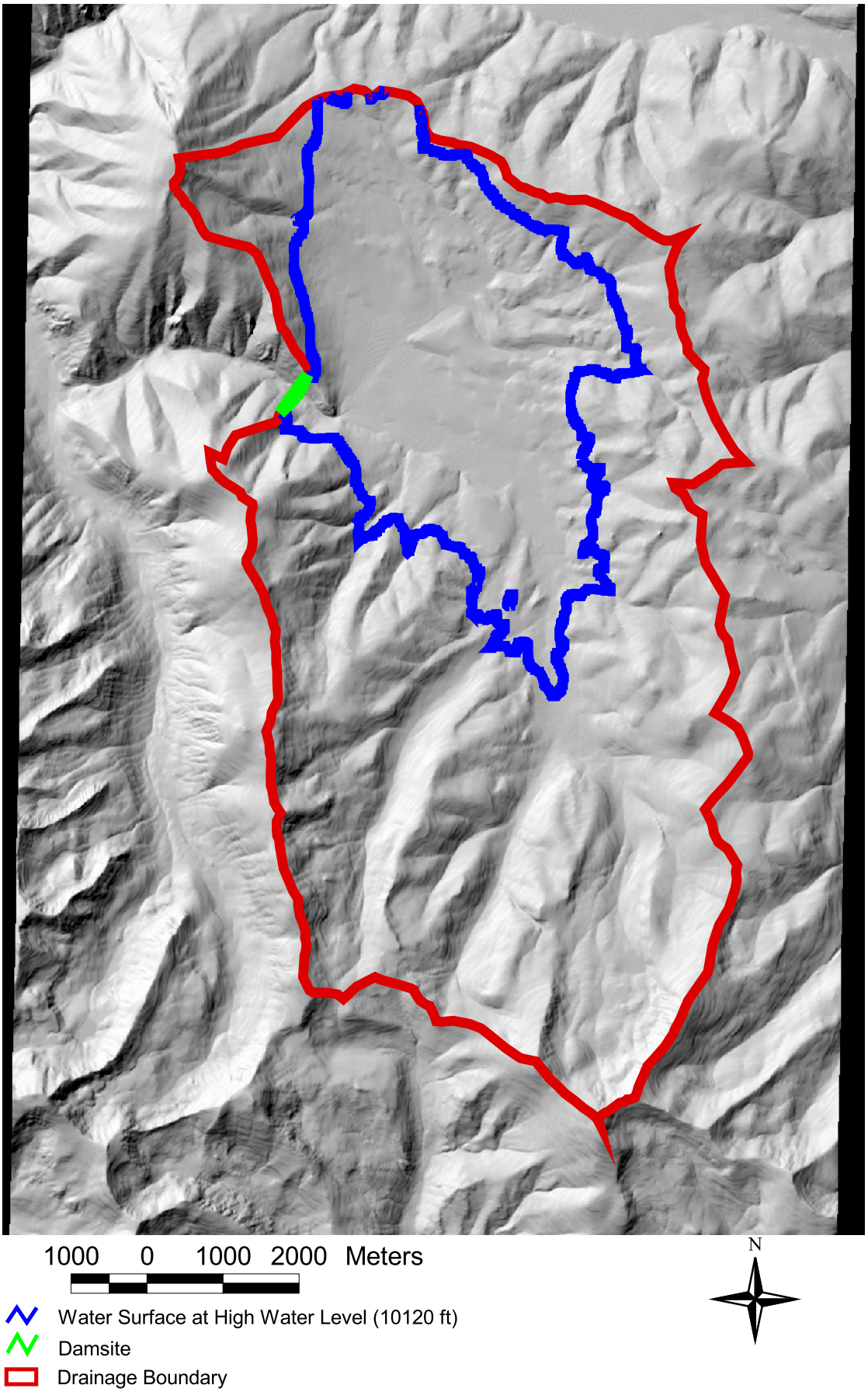

Figure A3.2 Union Park Reservoir and Drainage Area

APPENDICES

Appendix A3.1 PMP Estimates

General Storm PMP Calculations			Month:	**April**					
Drainage	Union Park, Colorado		Area	26.02	square miles.				
Latitude	38º 44' 44" N	Longitude	106º 33' 14" W	of basin center					
STEP			DURATION (hrs)						
			6	12	18	24	48	72	
A. Convergence PMP									
1. Drainage average value from one of Figures 2.5 to 2.16	9.6	in.							
2. Reduction for barrier-elevation (fig. 2.18)	30	%							
3. Barrier-Elevation reduced PMP (Step 1 x Step 2)	2.88	in.							
4. Durational variation (figs. 2.25 to 2.27) and table 2.7)			62	82	92	100	120	132	%
5. Convergence PMP for indicated durations (steps 3 x 4)			1.8	2.4	2.6	2.9	3.5	3.8	in.
6. Incremental 10 mi2 PMP (successive subtraction in step 5)			1.8	0.6	0.3	0.2	0.6	0.3	in.
7. Areal reduction (select from figs. 2.28 and 2.29)			99	99.5	99.8	99.9	100	100	%
8. Areally reduced PMP (step 6 x step 7)			1.8	0.6	0.3	0.2	0.6	0.3	in.
9. Drainage average PMP (accumulated values of step 8)			1.8	2.3	2.6	2.9	3.4	3.8	in.
B. Orographic PMP									
1. Drainage average orographic index from fig 3.11a to d.	8	in.							
2. Areal reduction (fig 3.20)	97	%							
3. Adjustment for month (one of figs 3.12 to 3.17)	92	%							
4. Areally and seasonally adjusted PMP (steps 1 x 2 x 3)	7.1	in.							
5. Durational variation (table 3.9)			30	57	80	100	157	185	%
6. Orographic PMP for given durations (steps 4 x 5)			2.1	4.1	5.7	7.1	11.2	13.2	in.
C. Total PMP									
1. Add steps A9 and B6			**3.9**	**6.4**	**8.3**	**10.0**	**14.6**	**17.0**	in.

General Storm PMP Calculations			Month	**May**					
Drainage	Union Park, Colorado		Area	26.02	square miles.				
Latitude	38º 44' 44" N	Longitude	106º 33' 14" W	of basin center					
STEP			DURATION (hrs)						
			6	12	18	24	48	72	
A. Convergence PMP									
1. Drainage average value from one of Figures 2.5 to 2.16	**11.5**		in.						
2. Reduction for barrier-elevation (fig. 2.18)	30		%						
3. Barrier-Elevation reduced PMP (Step 1 x Step 2)	3.5		in.						
4. Durational variation (figs. 2.25 to 2.27) and table 2.7)			**63**	82	93	100	118	128	%
5. Convergence PMP for indicated durations (steps 3 x 4)			2.2	2.8	3.2	3.5	4.1	4.4	in.
6. Incremental 10 mi2 PMP (successive subtraction in step 5)			2.2	0.7	0.4	0.2	0.6	0.3	in.
7. Areal reduction (select from figs. 2.28 and 2.29)			98	99	99.5	99.8	100	100	%
8. Areally reduced PMP (step 6 x step 7)			2.1	0.6	0.4	0.2	0.6	0.3	in.
9. Drainage average PMP (accumulated values of step 8)			2.1	2.8	3.2	3.4	4.0	4.4	in.
B. Orographic PMP									
1. Drainage average orographic index from fig 3.11a to d.	8		in.						
2. Areal reduction (fig 3.20)	97		%						
3. Adjustment for month (one of figs 3.12 to 3.17)	98		%						
4. Areally and seasonally adjusted PMP (steps 1 x 2 x 3)	7.6		in.						
5. Durational variation (table 3.9)			30	57	80	100	157	185	%
6. Orographic PMP for given durations (steps 4 x 5)			2.3	4.3	6.1	7.6	11.9	14.1	in.
C. Total PMP									
1. Add steps A9 and B6			**4.4**	**7.1**	**9.2**	**11.0**	**16.0**	**18.4**	in.

General Storm PMP Calculations			Month		**June**				
Drainage	Union Park, Colorado			Area	26.02	square miles.			
Latitude	38º 44' 44" N	Longitude	106º 33' 14" W		of basin center				
STEP			DURATION (hrs)						
				6	12	18	24	48	72	
A. Convergence PMP										
1. Drainage average value from one of Figures 2.5 to 2.16		**14**	in.							
2. Reduction for barrier-elevation (fig. 2.18)		30	%							
3. Barrier-Elevation reduced PMP (Step 1 x Step 2)		4.2	in.							
4. Durational variation (figs. 2.25 to 2.27) and table 2.7)				**67**	85	94	100	116	123	%
5. Convergence PMP for indicated durations (steps 3 x 4)				2.8	3.6	3.9	4.2	4.9	5.2	in.
6. Incremental 10 mi2 PMP (successive subtraction in step 5)				2.8	0.8	0.4	0.3	0.7	0.3	in.
7. Areal reduction (select from figs. 2.28 and 2.29)				98	99	99.5	99.8	100	100	%
8. Areally reduced PMP (step 6 x step 7)				2.8	0.7	0.4	0.3	0.7	0.3	in.
9. Drainage average PMP (accumulated values of step 8)				2.8	3.5	3.9	4.1	4.8	5.1	in.
B. Orographic PMP										
1. Drainage average orographic index from fig 3.11a to d.		8	in.							
2. Areal reduction (fig 3.20)		97	%							
3. Adjustment for month (one of figs 3.12 to 3.17)		98	%							
4. Areally and seasonally adjusted PMP (steps 1 x 2 x 3)		7.6	in.							
5. Durational variation (table 3.9)				30	57	80	100	157	185	%
6. Orographic PMP for given durations (steps 4 x 5)				2.3	4.3	6.1	7.6	11.9	14.1	in.
C. Total PMP										
1. Add steps A9 and B6				**5.0**	**7.8**	**10.0**	**11.7**	**16.7**	**19.2**	in.

Local-storm PMP calculation										
Drainage	Union Park, Colorado			Area	26.02	square miles				
Latitude	38º 44' 44" N	Longitude	106º 33' 14" W	Minimum Elevation	9600 ft					
STEP										
1. Average 1-hr 1-mi2 PMP for drainage (fig. 4.5)	10	in								
2. a. Reduction for elevation. (no adjustment of elevation up to 5,000 ft: 5% decrease per 1000 ft above 5,000 ft.)										
	75	%								
b. Multiply step 1 by step 2a.	7.5									
3. Average 6/1-hr ratio for drainage (fig. 4.7)	1.28									
	Duration (hr)									
	1/4	1/2	3/4	1	2	3	4	5	6	
4. Durational variation for 6/1-hr ratio of step 3 (table 4.4)	74	89	95	100	113	120	124	126	128	%
5. 1-mi2 PMP for indicated durations (step 2b x step 4)	5.6	6.7	7.1	7.5	8.5	9.0	9.3	9.5	9.6	
6. Areal reduction (fig. 4.9)	58	65	68	71	74	76	78	79	80	%
7. Areal reduced PMP (steps 5 x 6)	3.2	4.3	4.8	5.3	6.3	6.8	7.3	7.5	7.7	
8. Incremental PMP (successive subtraction (in step 7)										
5.3	0.9	0.6	0.4	0.2	0.2					
	3.2	1.1	0.5	0.5						
9. Time sequence of incremental PMP according to:										
Hourly Increments (table 4.7)				0.2	0.6	5.3	0.9	0.4	0.2	
Four Largest 15-min. increments (table 4.8)	3.2	1.1	0.5	0.5						
Cumulative Precip.	3.2	4.3	4.8	5.3						
				0.2	**0.8**	**6.1**	**7.1**	**7.5**	**7.7**	

Appendix A3.2 Unit Hydrograph Calculation

Union Park General Storm Unit Hydrograph Based on Dimensionless Hydrograph for General Storm for Rocky Mountains

Lag (h) =	2.45	Time Step	hours	Minutes
D (h) =	72.00	(Lag+0.5*D)*5%=	1.92	115.35
Lag+0.5*D=	38.45			
Drainage A (sqmi) =	18.17	basin 1		
V(day-cfs) =	488.67	for unit runoff (one inch)		

time t (% of Lag +0.5D)	q		Time (h)	Time (min)	Q (cfs)
5	0.26		1.92	115.35	3.30
10	0.9		3.84	230.69	11.44
15	2		5.77	346.04	25.42
20	3		7.69	461.38	38.13
25	5		9.61	576.73	63.55
30	6		11.53	692.08	76.26
35	7.7		13.46	807.42	97.86
40	9		15.38	922.77	114.39
45	14.51		17.30	1038.11	184.42
50	18.11		19.22	1153.46	230.17
55	21.51		21.15	1268.81	273.38
60	24.01		23.07	1384.15	305.16
65	22.81		24.99	1499.50	289.91
70	21.21		26.91	1614.85	269.57
75	19.31		28.84	1730.19	245.42
80	16.91		30.76	1845.54	214.92
85	15.21		32.68	1960.88	193.31
90	14.21		34.60	2076.23	180.60
95	13.41		36.53	2191.58	170.44
100	12.71		38.45	2306.92	161.54
105	11.91		40.37	2422.27	151.37
110	11.21		42.29	2537.61	142.47
115	10.61		44.22	2652.96	134.85
120	10.01		46.14	2768.31	127.22
125	9.4		48.06	2883.65	119.47
130	8.8		49.98	2999.00	111.84
135	8.25		51.91	3114.34	104.85
140	7.7		53.83	3229.69	97.86
145	7.25		55.75	3345.04	92.14
150	6.8		57.67	3460.38	86.43
155	6.4		59.60	3575.73	81.34
160	6		61.52	3691.07	76.26
165	5.65		63.44	3806.42	71.81

time t (% of Lag +0.5D)	q		Time (h)	Time (min)	Q (cfs)
170	5.35		65.36	3921.77	68.00
175	5		67.29	4037.11	63.55
180	4.8		69.21	4152.46	61.01
185	4.55		71.13	4267.80	57.83
190	4.3		73.05	4383.15	54.65
195	4.1		74.97	4498.50	52.11
200	3.9		76.90	4613.84	49.57
205	3.72		78.82	4729.19	47.28
210	3.55		80.74	4844.54	45.12
215	3.4		82.66	4959.88	43.21
220	3.25		84.59	5075.23	41.31
225	3.1		86.51	5190.57	39.40
230	3		88.43	5305.92	38.13
235	2.87		90.35	5421.27	36.48
240	2.75		92.28	5536.61	34.95
245	2.65		94.20	5651.96	33.68
250	2.52		96.12	5767.30	32.03
255	2.42		98.04	5882.65	30.76
260	2.33		99.97	5998.00	29.61
265	2.24		101.89	6113.34	28.47
270	2.15		103.81	6228.69	27.33
275	2.07		105.73	6344.03	26.31
280	1.99		107.66	6459.38	25.29
285	1.91		109.58	6574.73	24.28
290	1.83		111.50	6690.07	23.26
295	1.76		113.42	6805.42	22.37
300	1.7		115.35	6920.76	21.61
305	1.63		117.27	7036.11	20.72
310	1.57		119.19	7151.46	19.95
315	1.5		121.11	7266.80	19.06
320	1.45		123.04	7382.15	18.43
325	1.39		124.96	7497.50	17.67
330	1.34		126.88	7612.84	17.03
335	1.28		128.80	7728.19	16.27
340	1.23		130.73	7843.53	15.63
345	1.19		132.65	7958.88	15.12
350	1.13		134.57	8074.23	14.36
355	1.09		136.49	8189.57	13.85
360	1.05		138.42	8304.92	13.35
365	1.01		140.34	8420.26	12.84
370	0.97		142.26	8535.61	12.33
375	0.93		144.18	8650.96	11.82
380	0.9		146.11	8766.30	11.44
385	0.86		148.03	8881.65	10.93
390	0.83		149.95	8996.99	10.55
395	0.8		151.87	9112.34	10.17
400	0.77		153.79	9227.69	9.79

time t (% of Lag +0.5D)	q		Time (h)	Time (min)	Q (cfs)
405	0.74		155.72	9343.03	9.41
410	0.71		157.64	9458.38	9.02
415	0.68		159.56	9573.72	8.64
420	0.65		161.48	9689.07	8.26
425	0.63		163.41	9804.42	8.01
430	0.6		165.33	9919.76	7.63
435	0.56		167.25	10035.11	7.12
440	0.58		169.17	10150.45	7.37
445	0.54		171.10	10265.80	6.86
450	0.52		173.02	10381.15	6.61
455	0.5		174.94	10496.49	6.35
460	0.48		176.86	10611.84	6.10
465	0.46		178.79	10727.19	5.85
470	0.44		180.71	10842.53	5.59
475	0.42		182.63	10957.88	5.34
480	0.41		184.55	11073.22	5.21
485	0.4		186.48	11188.57	5.08
490	0.38		188.40	11303.92	4.83
495	0.37		190.32	11419.26	4.70
500	0.35		192.24	11534.61	4.45
505	0.34		194.17	11649.95	4.32
510	0.33		196.09	11765.30	4.19
515	0.32		198.01	11880.65	4.07
520	0.31		199.93	11995.99	3.94
525	0.29		201.86	12111.34	3.69
530	0.28		203.78	12226.68	3.56
535	0.27		205.70	12342.03	3.43
540	0.26		207.62	12457.38	3.30
545	0.25		209.55	12572.72	3.18
550	0.24		211.47	12688.07	3.05
555	0.23		213.39	12803.41	2.92
560	0.23		215.31	12918.76	2.92
565	0.22		217.24	13034.11	2.80
570	0.21		219.16	13149.45	2.67
575	0.2		221.08	13264.80	2.54
580	0.19		223.00	13380.14	2.41
585	0.19		224.92	13495.49	2.41
590	0.18		226.85	13610.84	2.29
595	0.17		228.77	13726.18	2.16
600	0.17		230.69	13841.53	2.16

Union Park Thunder Storm Unit Hydrograph Based on Dimensionless Hydrograph for Thunder Storm for Rocky Mountains

Lag (h) =	1.63	Time Step	hours	Minutes
D (h) =	6	(Lag+0.5*D)*5%=	0.23	13.90
Lag+0.5*D=	4.63			
Drainage A (sqmi) =	18.17	basin 1		
V(day-cfs) =	488.67	for unit runoff (one inch)		

time t (% of Lag +0.5D)	q		Time (h)	Time (min)	Q (cfs)
5	0.14		0.23	13.90	14.77
10	0.21		0.46	27.79	22.15
15	0.33		0.69	41.69	34.81
20	0.51		0.93	55.59	53.80
25	0.84		1.16	69.49	88.61
30	1.62		1.39	83.38	170.89
35	3.74		1.62	97.28	394.52
40	6.38		1.85	111.18	673.01
45	8.61		2.08	125.08	908.25
50	10.94		2.32	138.97	1154.03
55	13.26		2.55	152.87	1398.77
60	15.7		2.78	166.77	1656.15
65	18.23		3.01	180.67	1923.04
70	20.76		3.24	194.56	2189.92
75	23.3		3.47	208.46	2457.86
80	25.83		3.71	222.36	2724.74
85	28.36		3.94	236.26	2991.63
90	26.53		4.17	250.15	2798.58
95	24.71		4.40	264.05	2606.60
100	22.68		4.63	277.95	2392.46
105	20.76		4.86	291.85	2189.92
110	18.84		5.10	305.74	1987.39
115	16.81		5.33	319.64	1773.25
120	14.99		5.56	333.54	1581.26
125	12.86		5.79	347.43	1356.57
130	11.04		6.02	361.33	1164.58
135	9.52		6.25	375.23	1004.24
140	8.41		6.49	389.13	887.15
145	7.5		6.72	403.02	791.16
150	6.69		6.95	416.92	705.71
155	5.98		7.18	430.82	630.82
160	5.47		7.41	444.72	577.02
165	4.97		7.64	458.61	524.27
170	4.55		7.88	472.51	479.97
175	4.25		8.11	486.41	448.32
180	3.89		8.34	500.31	410.35

time t (% of Lag +0.5D)	q		Time (h)	Time (min)	Q (cfs)
185	3.59		8.57	514.20	378.70
190	3.34		8.80	528.10	352.33
195	3.13		9.03	542.00	330.18
200	2.93		9.26	555.90	309.08
205	2.75		9.50	569.79	290.09
210	2.61		9.73	583.69	275.32
215	2.44		9.96	597.59	257.39
220	2.31		10.19	611.48	243.68
225	2.17		10.42	625.38	228.91
230	2.04		10.65	639.28	215.19
235	1.95		10.89	653.18	205.70
240	1.84		11.12	667.07	194.10
245	1.76		11.35	680.97	185.66
250	1.69		11.58	694.87	178.27
255	1.62		11.81	708.77	170.89
260	1.55		12.04	722.66	163.51
265	1.49		12.28	736.56	157.18
270	1.42		12.51	750.46	149.79
275	1.36		12.74	764.36	143.46
280	1.3		12.97	778.25	137.13
285	1.24		13.20	792.15	130.80
290	1.19		13.43	806.05	125.53
295	1.14		13.67	819.95	120.26
300	1.09		13.90	833.84	114.98
305	1.05		14.13	847.74	110.76
310	1		14.36	861.64	105.49
315	0.96		14.59	875.54	101.27
320	0.92		14.82	889.43	97.05
325	0.88		15.06	903.33	92.83
330	0.84		15.29	917.23	88.61
335	0.81		15.52	931.12	85.44
340	0.77		15.75	945.02	81.23
345	0.74		15.98	958.92	78.06
350	0.71		16.21	972.82	74.90
355	0.68		16.45	986.71	71.73
360	0.65		16.68	1000.61	68.57
365	0.62		16.91	1014.51	65.40
370	0.59		17.14	1028.41	62.24
375	0.57		17.37	1042.30	60.13
380	0.55		17.60	1056.20	58.02
385	0.52		17.83	1070.10	54.85
390	0.5		18.07	1084.00	52.74
395	0.48		18.30	1097.89	50.63
400	0.46		18.53	1111.79	48.52
405	0.43		18.76	1125.69	45.36
410	0.42		18.99	1139.59	44.30
415	0.4		19.22	1153.48	42.20

time t (% of Lag +0.5D)	q		Time (h)	Time (min)	Q (cfs)
420	0.38		19.46	1167.38	40.09
425	0.36		19.69	1181.28	37.98
430	0.35		19.92	1195.18	36.92
435	0.33		20.15	1209.07	34.81
440	0.32		20.38	1222.97	33.76
445	0.31		20.61	1236.87	32.70
450	0.29		20.85	1250.76	30.59
455	0.28		21.08	1264.66	29.54
460	0.27		21.31	1278.56	28.48
465	0.26		21.54	1292.46	27.43
470	0.25		21.77	1306.35	26.37
475	0.24		22.00	1320.25	25.32
480	0.23		22.24	1334.15	24.26
485	0.22		22.47	1348.05	23.21
490	0.21		22.70	1361.94	22.15
495	0.2		22.93	1375.84	21.10
500	0.19		23.16	1389.74	20.04
505	0.18		23.39	1403.64	18.99
510	0.17		23.63	1417.53	17.93
515	0.17		23.86	1431.43	17.93
520	0.16		24.09	1445.33	16.88
525	0.16		24.32	1459.23	16.88
530	0.15		24.55	1473.12	15.82
535	0.15		24.78	1487.02	15.82
540	0.14		25.02	1500.92	14.77
545	0.14		25.25	1514.81	14.77
550	0.13		25.48	1528.71	13.71
555	0.13		25.71	1542.61	13.71
560	0.12		25.94	1556.51	12.66
565	0.12		26.17	1570.40	12.66
570	0.11		26.41	1584.30	11.60
575	0.11		26.64	1598.20	11.60
580	0.1		26.87	1612.10	10.55
585	0.1		27.10	1625.99	10.55
590	0.09		27.33	1639.89	9.49
595	0.09		27.56	1653.79	9.49
600	0.08		27.79	1667.69	8.44

Appendix A3.3 100-Year 15-Day Snowmelt Flood Estimate

100-Year Maximum 15-Day Average Flow Rate Calculation Based on Log-Pearson III Distribution for Cottonwood Drainage Area above USGS Gauge #07089000

# USGS 07089000 COTTONWOOD C BL HOT SPRINGS, NR BUENA VISTA, CO.						
Year	**max 15 Ave (cfs)**	**Log Q**		**Year**	**max 15 Ave (cfs)**	**Log Q**
1957	609.0	2.78		1972	236.7	2.37
1952	369.3	2.57		1969	232.2	2.37
1917	355.5	2.55		1968	228.7	2.36
1921	354.7	2.55		1973	226.9	2.36
1918	347.7	2.54		1960	223.2	2.35
1965	344.9	2.54		1971	221.3	2.35
1983	330.4	2.52		1951	212.9	2.33
1916	328.0	2.52		1961	198.0	2.30
1980	325.7	2.51		1975	193.9	2.29
1985	316.2	2.50		1913	190.0	2.28
1962	309.4	2.49		1959	186.3	2.27
1978	302.4	2.48		1982	185.9	2.27
1911	292.8	2.47		1955	185.7	2.27
1984	292.1	2.47		1919	180.2	2.26
1914	284.0	2.45		1950	178.1	2.25
1915	279.7	2.45		1964	163.5	2.21
1912	272.7	2.44		1976	156.5	2.19
1920	263.1	2.42		1967	150.2	2.18
1958	262.9	2.42		1966	140.0	2.15
1953	260.3	2.42		1974	129.3	2.11
1979	258.8	2.41		1963	110.8	2.04
1956	250.0	2.40		1954	100.3	2.00
1970	242.3	2.38		1981	69.8	1.84
1922	241.3	2.38		1977	52.7	1.72
MEAN				2.35		
STDEV				0.19		
SKEW				-1.07		
K (100)				1.539		
Log Q (100)				2.64		
Q (100)				438 cfs		

Union Park Drainage Area
100-Year Maximum 15-day Snowmelt Flood Estimate

Date	Cottonwood Recorded Daily Average (cfs)	Cottonwood Scaled to 100-Year Daily Average (cfs)	Union Park Flow Estimates (cfs)	Rearranged Union Park 100-Year 15-Day Snowmelt Flood
6/16/1957	261	188	70.80	60.22
6/17/1957	219	158	59.41	73.24
6/18/1957	222	160	60.22	81.65
6/19/1957	301	216	81.65	94.95
6/20/1957	426	306	115.56	119.36
6/21/1957	350	252	94.95	141.06
6/22/1957	270	194	73.24	189.89
6/23/1957	300	216	81.38	200.74
6/24/1957	350	252	94.95	162.76
6/25/1957	440	316	119.36	130.21
6/26/1957	480	345	130.21	115.56
6/27/1957	520	374	141.06	94.95
6/28/1957	600	432	162.76	81.38
6/29/1957	700	503	189.89	70.80
6/30/1957	740	532	200.74	59.41

The average flow the 15-day period at the Cottonwood gauge is 609 cfs.
Log-Pearson 100-Year 15-Day Average is 438 cfs. The scale ration is 0.72.

Flow ratio between Union Park and Cottonwood is derived from the Regression Equation from WRIR 99-4190

Q100=39.5(A)**0.706*(S+1)**1.577

The ratio is 0.377 based on the slope and area for the respective drainage area (Union Park: S= 0.416, A= 65 square miles; Cottonwood S= 0.15, A = 26 square miles).

Appendix A3.4 HEC-1 Model Results

```
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   14JUL04  TIME  14:18:39  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                   HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID        Union Park Reservoir Project
             2          ID        DAM SAFETY ANALYSIS (Local Thunderstorm 6 hr PMP)
             3          ID        ANALYSIS OF DAM OVERTOPPING WITHOUT SPILLWAY AND CLOSED LOWER OUTLETS
             4          IT      14       0       0     190
             5          IO       5

             6          KK  INFLO1  INFLOW TO UNION PARK RESERVOIR (SUBBASIN 1 NON WATER SURFACE)
             7          KO       1
             8          IN      60       0       0
             9          BA   18.17
            10          PB     7.7
            11          PC    0.00     0.2     0.8     6.1     7.1     7.5     7.7
            12          LU     0.0    0.05
            13          UI   14.77   22.15   34.81   53.80   88.61  170.89  394.52  673.01  908.25 1154.03
            14          UI  1398.8 1656.15 1923.04 2189.92 2457.86 2724.74 2991.63 2798.58 2606.60 2392.46
            15          UI  2189.9 1987.39 1773.25 1581.26 1356.57 1164.58 1004.24  887.15  791.16  705.71
            16          UI  630.82  577.02  524.27  479.97  448.32  410.35  378.70  352.33  330.18  309.08
            17          UI  290.09  275.32  257.39  243.68  228.91  215.19  205.70  194.10  185.66  178.27
            18          UI  170.89  163.51  157.18  149.79  143.46  137.13  130.80  125.53  120.26  114.98
            19          UI  110.76  105.49  101.27   97.05   92.83   88.61   85.44   81.23   78.06   74.90
            20          UI   71.73   68.57   65.40   62.24   60.13   58.02   54.85   52.74   50.63   48.52
            21          UI   45.36   44.30   42.20   40.09   37.98   36.92   34.81   33.76   32.70   30.59
            22          UI   29.54   28.48   27.43   26.37   25.32   24.26   23.21   22.15   21.10   20.04
            23          UI   18.99   17.93   17.93   16.88   16.88   15.82   15.82   14.77   14.77   13.71
            24          UI   13.71   12.66   12.66   11.60   11.60   10.55   10.55    9.49    9.49    8.44

            25          KK  INFLO2   INFLOW TO UNION PARK RESERVOIR (SUBBASIN 2 WATER SURFACE)
            26          KO       1
            27          BA    7.84
            28          LU     0.0     0.0
            29          US    0.00     0.63

            30          KK    COMB   COMBINE INFLOW FROM INFLOW1 AND INFLOW2
            31          KO       1
            32          HC       2

            33          KK     DAM    UNION PARK DAM
            34          KO       1
            35          RS       1    ELEV   10120
            36          SV       0     168    3424   17987   51108  106801  186081  285452  403213  468383
            37          SV  537676  610886  687754  768073  851813  939113 1029878 1123992 1221505 1322413
            38          SE    9600    9640    9680    9720    9760    9800    9840    9880    9920    9940
            39          SE    9960    9980   10000   10020   10040   10060   10080   10100   10120   10140
            40          SS   10139    2050    2.63     1.5
                        *   SL  9740   14.14     0.7     0.5
            41          ST   10140    2050    2.63     1.5
            42          ZZ
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   14JUL04  TIME  14:18:39  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                   Union Park Reservoir Project
                                   DAM SAFETY ANALYSIS (Local Thunderstorm 6 hr PMP)
                                   ANALYSIS OF DAM OVERTOPPING WITHOUT SPILLWAY AND CLOSED LOWER OUTLETS
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```
  5 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          14  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         190  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME        2006  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .23 HOURS
                       TOTAL TIME BASE   44.10 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT


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


           **************
           *            *
  6 KK     *    INFLO1  *       INFLOW TO UNION PARK RESERVOIR (SUBBASIN 1 NON WATER SURFACE)
           *            *
           **************

  7 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           1  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

  8 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN          60  TIME INTERVAL IN MINUTES
                     JXDATE      1    0  STARTING DATE
                     JXTIME           0  STARTING TIME

             SUBBASIN RUNOFF DATA

  9 BA          SUBBASIN CHARACTERISTICS
                      TAREA       18.17  SUBBASIN AREA

                PRECIPITATION DATA

 10 PB                STORM        7.70  BASIN TOTAL PRECIPITATION

 11 PI            INCREMENTAL PRECIPITATION PATTERN
                      .05       .05       .05       .05       .11       .14       .14       .14       .61      1.24
                     1.24      1.24      1.09       .23       .23       .23       .23       .11       .09       .09
                      .09       .07       .05       .05       .05       .03

 12 LU          UNIFORM LOSS RATE
                      STRTL         .00  INITIAL LOSS
                      CNSTL         .05  UNIFORM LOSS RATE
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 12 UI          INPUT UNITGRAPH, 120 ORDINATES,  VOLUME = 1.01
                     14.8      22.1      34.8      53.8      88.6     170.9     394.5     673.0     908.3    1154.0
                   1398.8    1656.2    1923.0    2189.9    2457.9    2724.7    2991.6    2798.6    2606.6    2392.5
                   2189.9    1987.4    1773.3    1581.3    1356.6    1164.6    1004.2     887.2     791.2     705.7
                    630.8     577.0     524.3     480.0     448.3     410.4     378.7     352.3     330.2     309.1
                    290.1     275.3     257.4     243.7     228.9     215.2     205.7     194.1     185.7     178.3
                    170.9     163.5     157.2     149.8     143.5     137.1     130.8     125.5     120.3     115.0
                    110.8     105.5     101.3      97.1      92.8      88.6      85.4      81.2      78.1      74.9
                     71.7      68.6      65.4      62.2      60.1      58.0      54.8      52.7      50.6      48.5
                     45.4      44.3      42.2      40.1      38.0      36.9      34.8      33.8      32.7      30.6
                     29.5      28.5      27.4      26.4      25.3      24.3      23.2      22.1      21.1      20.0
                     19.0      17.9      17.9      16.9      16.9      15.8      15.8      14.8      14.8      13.7
                     13.7      12.7      12.7      11.6      11.6      10.6      10.6       9.5       9.5       8.4

                                                                                  ***

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

                                                   HYDROGRAPH AT STATION   INFLO1

*****************************************************************************************************************************************
                                                                                 *
      DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q                        *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q
                                                                                 *
       1     0000    1     .00     .00     .00         0.                        *        1     2210   96     .00     .00     .00       300.
       1     0014    2     .05     .01     .04         1.                        *        1     2224   97     .00     .00     .00       287.
       1     0028    3     .05     .01     .04         1.                        *        1     2238   98     .00     .00     .00       275.
       1     0042    4     .05     .01     .04         3.                        *        1     2252   99     .00     .00     .00       264.
       1     0056    5     .05     .01     .04         4.                        *        1     2306  100     .00     .00     .00       252.
       1     0110    6     .11     .01     .10         8.                        *        1     2320  101     .00     .00     .00       242.
       1     0124    7     .14     .01     .13        16.                        *        1     2334  102     .00     .00     .00       231.
       1     0138    8     .14     .01     .13        33.                        *        1     2348  103     .00     .00     .00       222.
       1     0152    9     .14     .01     .13        61.                        *        2     0002  104     .00     .00     .00       213.
       1     0206   10     .61     .01     .60       107.                        *        2     0016  105     .00     .00     .00       205.
       1     0220   11    1.24     .01    1.23       181.                        *        2     0030  106     .00     .00     .00       196.
       1     0234   12    1.24     .01    1.23       291.                        *        2     0044  107     .00     .00     .00       188.
       1     0248   13    1.24     .01    1.22       452.                        *        2     0058  108     .00     .00     .00       180.
```

1	0302	14	1.09	.01	1.08	671.	*	2	0112	109	.00	.00	.00	172.
1	0316	15	.23	.01	.22	968.	*	2	0126	110	.00	.00	.00	165.
1	0330	16	.23	.01	.22	1447.	*	2	0140	111	.00	.00	.00	157.
1	0344	17	.23	.01	.22	2216.	*	2	0154	112	.00	.00	.00	150.
1	0358	18	.23	.01	.22	3283.	*	2	0208	113	.00	.00	.00	144.
1	0412	19	.11	.01	.10	4587.	*	2	0222	114	.00	.00	.00	138.
1	0426	20	.09	.01	.08	6075.	*	2	0236	115	.00	.00	.00	133.
1	0440	21	.09	.01	.08	7620.	*	2	0250	116	.00	.00	.00	129.
1	0454	22	.09	.01	.08	9194.	*	2	0304	117	.00	.00	.00	124.
1	0508	23	.07	.01	.05	10806.	*	2	0318	118	.00	.00	.00	120.
1	0522	24	.05	.01	.03	12428.	*	2	0332	119	.00	.00	.00	116.
1	0536	25	.05	.01	.03	14041.	*	2	0346	120	.00	.00	.00	112.
1	0550	26	.05	.01	.03	15621.	*	2	0400	121	.00	.00	.00	107.
1	0604	27	.03	.01	.02	16949.	*	2	0414	122	.00	.00	.00	103.
1	0618	28	.00	.00	.00	17735.	*	2	0428	123	.00	.00	.00	99.
1	0632	29	.00	.00	.00	17966.	*	2	0442	124	.00	.00	.00	95.
1	0646	30	.00	.00	.00	17629.	*	2	0456	125	.00	.00	.00	90.
1	0700	31	.00	.00	.00	16796.	*	2	0510	126	.00	.00	.00	86.
1	0714	32	.00	.00	.00	15860.	*	2	0524	127	.00	.00	.00	81.
1	0728	33	.00	.00	.00	14828.	*	2	0538	128	.00	.00	.00	76.
1	0742	34	.00	.00	.00	13714.	*	2	0552	129	.00	.00	.00	71.
1	0756	35	.00	.00	.00	12504.	*	2	0606	130	.00	.00	.00	63.
1	0810	36	.00	.00	.00	11291.	*	2	0620	131	.00	.00	.00	49.
1	0824	37	.00	.00	.00	10134.	*	2	0634	132	.00	.00	.00	37.
1	0838	38	.00	.00	.00	9058.	*	2	0648	133	.00	.00	.00	25.
1	0852	39	.00	.00	.00	8103.	*	2	0702	134	.00	.00	.00	15.
1	0906	40	.00	.00	.00	7263.	*	2	0716	135	.00	.00	.00	12.
1	0920	41	.00	.00	.00	6531.	*	2	0730	136	.00	.00	.00	10.
1	0934	42	.00	.00	.00	5878.	*	2	0744	137	.00	.00	.00	8.
1	0948	43	.00	.00	.00	5294.	*	2	0758	138	.00	.00	.00	5.
1	1002	44	.00	.00	.00	4783.	*	2	0812	139	.00	.00	.00	4.
1	1016	45	.00	.00	.00	4343.	*	2	0826	140	.00	.00	.00	3.
1	1030	46	.00	.00	.00	3950.	*	2	0840	141	.00	.00	.00	3.
1	1044	47	.00	.00	.00	3606.	*	2	0854	142	.00	.00	.00	2.
1	1058	48	.00	.00	.00	3304.	*	2	0908	143	.00	.00	.00	1.
1	1112	49	.00	.00	.00	3035.	*	2	0922	144	.00	.00	.00	1.
1	1126	50	.00	.00	.00	2801.	*	2	0936	145	.00	.00	.00	1.
1	1140	51	.00	.00	.00	2597.	*	2	0950	146	.00	.00	.00	0.
1	1154	52	.00	.00	.00	2418.	*	2	1004	147	.00	.00	.00	0.
1	1208	53	.00	.00	.00	2256.	*	2	1018	148	.00	.00	.00	0.
1	1222	54	.00	.00	.00	2113.	*	2	1032	149	.00	.00	.00	0.
1	1236	55	.00	.00	.00	1981.	*	2	1046	150	.00	.00	.00	0.
1	1250	56	.00	.00	.00	1861.	*	2	1100	151	.00	.00	.00	0.
1	1304	57	.00	.00	.00	1753.	*	2	1114	152	.00	.00	.00	0.
1	1318	58	.00	.00	.00	1654.	*	2	1128	153	.00	.00	.00	0.
1	1332	59	.00	.00	.00	1566.	*	2	1142	154	.00	.00	.00	0.
1	1346	60	.00	.00	.00	1488.	*	2	1156	155	.00	.00	.00	0.
1	1400	61	.00	.00	.00	1415.	*	2	1210	156	.00	.00	.00	0.
1	1414	62	.00	.00	.00	1350.	*	2	1224	157	.00	.00	.00	0.
1	1428	63	.00	.00	.00	1289.	*	2	1238	158	.00	.00	.00	0.
1	1442	64	.00	.00	.00	1231.	*	2	1252	159	.00	.00	.00	0.
1	1456	65	.00	.00	.00	1176.	*	2	1306	160	.00	.00	.00	0.
1	1510	66	.00	.00	.00	1123.	*	2	1320	161	.00	.00	.00	0.
1	1524	67	.00	.00	.00	1073.	*	2	1334	162	.00	.00	.00	0.
1	1538	68	.00	.00	.00	1026.	*	2	1348	163	.00	.00	.00	0.
1	1552	69	.00	.00	.00	981.	*	2	1402	164	.00	.00	.00	0.
1	1606	70	.00	.00	.00	939.	*	2	1416	165	.00	.00	.00	0.
1	1620	71	.00	.00	.00	899.	*	2	1430	166	.00	.00	.00	0.
1	1634	72	.00	.00	.00	861.	*	2	1444	167	.00	.00	.00	0.
1	1648	73	.00	.00	.00	824.	*	2	1458	168	.00	.00	.00	0.
1	1702	74	.00	.00	.00	790.	*	2	1512	169	.00	.00	.00	0.
1	1716	75	.00	.00	.00	756.	*	2	1526	170	.00	.00	.00	0.
1	1730	76	.00	.00	.00	724.	*	2	1540	171	.00	.00	.00	0.
1	1744	77	.00	.00	.00	693.	*	2	1554	172	.00	.00	.00	0.
1	1758	78	.00	.00	.00	664.	*	2	1608	173	.00	.00	.00	0.
1	1812	79	.00	.00	.00	635.	*	2	1622	174	.00	.00	.00	0.
1	1826	80	.00	.00	.00	609.	*	2	1636	175	.00	.00	.00	0.
1	1840	81	.00	.00	.00	583.	*	2	1650	176	.00	.00	.00	0.
1	1854	82	.00	.00	.00	558.	*	2	1704	177	.00	.00	.00	0.
1	1908	83	.00	.00	.00	534.	*	2	1718	178	.00	.00	.00	0.
1	1922	84	.00	.00	.00	511.	*	2	1732	179	.00	.00	.00	0.
1	1936	85	.00	.00	.00	489.	*	2	1746	180	.00	.00	.00	0.
1	1950	86	.00	.00	.00	468.	*	2	1800	181	.00	.00	.00	0.
1	2004	87	.00	.00	.00	448.	*	2	1814	182	.00	.00	.00	0.
1	2018	88	.00	.00	.00	430.	*	2	1828	183	.00	.00	.00	0.
1	2032	89	.00	.00	.00	412.	*	2	1842	184	.00	.00	.00	0.
1	2046	90	.00	.00	.00	393.	*	2	1856	185	.00	.00	.00	0.
1	2100	91	.00	.00	.00	376.	*	2	1910	186	.00	.00	.00	0.
1	2114	92	.00	.00	.00	360.	*	2	1924	187	.00	.00	.00	0.
1	2128	93	.00	.00	.00	344.	*	2	1938	188	.00	.00	.00	0.
1	2142	94	.00	.00	.00	328.	*	2	1952	189	.00	.00	.00	0.
1	2156	95	.00	.00	.00	314.	*	2	2006	190	.00	.00	.00	0.
							*							

****

TOTAL RAINFALL = 7.70, TOTAL LOSS = .30, TOTAL EXCESS = 7.40

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	44.10-HR
+ (CFS)	(HR)					
		(CFS)				
+ 17966.	6.53		11520.	3649.	1982.	1982.
		(INCHES)	5.731	7.407	7.453	7.453
		(AC-FT)	5554.	7178.	7222.	7222.

CUMULATIVE AREA = 18.17 SQ MI

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            *            *
  25 KK     *    INFLO2  *        INFLOW TO UNION PARK RESERVOIR (SUBBASIN 2 WATER SURFACE)
            *            *
            **************

  26 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

              SUBBASIN RUNOFF DATA

  27 BA          SUBBASIN CHARACTERISTICS
                       TAREA        7.84  SUBBASIN AREA

                 PRECIPITATION DATA

  10 PB                STORM        7.70  BASIN TOTAL PRECIPITATION

  11 PI            INCREMENTAL PRECIPITATION PATTERN
                       .05       .05       .05       .05       .11       .14       .14       .14       .61      1.24
                      1.24      1.24      1.09       .23       .23       .23       .23       .11       .09       .09
                       .09       .07       .05       .05       .05       .03

  28 LU          UNIFORM LOSS RATE
                       STRTL         .00  INITIAL LOSS
                       CNSTL         .00  UNIFORM LOSS RATE
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  29 US          SNYDER UNITGRAPH
                          TP         .00  LAG
                          CP         .60  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                  ***

TC INCREASED TO DELTA T OF   .23 HR
R INCREASED TO MINIMUM OF 0.5
CLARK DID NOT CONVERGE TO GIVEN SNYDER COEFFICIENTS
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=  .23 AND R=  .12 INTERVALS

                                                UNIT HYDROGRAPH PARAMETERS
                                          CLARK   TC=   .23 HR,       R=   .12 HR
                                         SNYDER   TP=   .18 HR,      CP=   .50

                                                    UNIT HYDROGRAPH
                                                 2 END-OF-PERIOD ORDINATES
             10842.    10842.
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HYDROGRAPH AT STATION INFLO2

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DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	*	1		2210	96	.00	.00	.00	0.
1		0014	2	.05	.00	.05	506.	*	1		2224	97	.00	.00	.00	0.
1		0028	3	.05	.00	.05	1012.	*	1		2238	98	.00	.00	.00	0.
1		0042	4	.05	.00	.05	1012.	*	1		2252	99	.00	.00	.00	0.
1		0056	5	.05	.00	.05	1012.	*	1		2306	100	.00	.00	.00	0.
1		0110	6	.11	.00	.11	1735.	*	1		2320	101	.00	.00	.00	0.
1		0124	7	.14	.00	.14	2747.	*	1		2334	102	.00	.00	.00	0.
1		0138	8	.14	.00	.14	3036.	*	1		2348	103	.00	.00	.00	0.
1		0152	9	.14	.00	.14	3036.	*	2		0002	104	.00	.00	.00	0.
1		0206	10	.61	.00	.61	8131.	*	2		0016	105	.00	.00	.00	0.
1		0220	11	1.24	.00	1.24	20021.	*	2		0030	106	.00	.00	.00	0.
1		0234	12	1.24	.00	1.24	26815.	*	2		0044	107	.00	.00	.00	0.
1		0248	13	1.24	.00	1.24	26815.	*	2		0058	108	.00	.00	.00	0.
1		0302	14	1.09	.00	1.09	25261.	*	2		0112	109	.00	.00	.00	0.
1		0316	15	.23	.00	.23	14383.	*	2		0126	110	.00	.00	.00	0.
1		0330	16	.23	.00	.23	5059.	*	2		0140	111	.00	.00	.00	0.
1		0344	17	.23	.00	.23	5059.	*	2		0154	112	.00	.00	.00	0.
1		0358	18	.23	.00	.23	5059.	*	2		0208	113	.00	.00	.00	0.
1		0412	19	.11	.00	.11	3758.	*	2		0222	114	.00	.00	.00	0.
1		0426	20	.09	.00	.09	2241.	*	2		0236	115	.00	.00	.00	0.
1		0440	21	.09	.00	.09	2024.	*	2		0250	116	.00	.00	.00	0.
1		0454	22	.09	.00	.09	2024.	*	2		0304	117	.00	.00	.00	0.
1		0508	23	.07	.00	.07	1735.	*	2		0318	118	.00	.00	.00	0.
1		0522	24	.05	.00	.05	1229.	*	2		0332	119	.00	.00	.00	0.
1		0536	25	.05	.00	.05	1012.	*	2		0346	120	.00	.00	.00	0.
1		0550	26	.05	.00	.05	1012.	*	2		0400	121	.00	.00	.00	0.
1		0604	27	.03	.00	.03	867.	*	2		0414	122	.00	.00	.00	0.
1		0618	28	.00	.00	.00	361.	*	2		0428	123	.00	.00	.00	0.
1		0632	29	.00	.00	.00	0.	*	2		0442	124	.00	.00	.00	0.
1		0646	30	.00	.00	.00	0.	*	2		0456	125	.00	.00	.00	0.
1		0700	31	.00	.00	.00	0.	*	2		0510	126	.00	.00	.00	0.
1		0714	32	.00	.00	.00	0.	*	2		0524	127	.00	.00	.00	0.
1		0728	33	.00	.00	.00	0.	*	2		0538	128	.00	.00	.00	0.
1		0742	34	.00	.00	.00	0.	*	2		0552	129	.00	.00	.00	0.
1		0756	35	.00	.00	.00	0.	*	2		0606	130	.00	.00	.00	0.
1		0810	36	.00	.00	.00	0.	*	2		0620	131	.00	.00	.00	0.
1		0824	37	.00	.00	.00	0.	*	2		0634	132	.00	.00	.00	0.
1		0838	38	.00	.00	.00	0.	*	2		0648	133	.00	.00	.00	0.
1		0852	39	.00	.00	.00	0.	*	2		0702	134	.00	.00	.00	0.
1		0906	40	.00	.00	.00	0.	*	2		0716	135	.00	.00	.00	0.
1		0920	41	.00	.00	.00	0.	*	2		0730	136	.00	.00	.00	0.
1		0934	42	.00	.00	.00	0.	*	2		0744	137	.00	.00	.00	0.
1		0948	43	.00	.00	.00	0.	*	2		0758	138	.00	.00	.00	0.
1		1002	44	.00	.00	.00	0.	*	2		0812	139	.00	.00	.00	0.

1	1016	45	.00	.00	.00	0.	*	2	0826	140	.00	.00	.00	0.
1	1030	46	.00	.00	.00	0.	*	2	0840	141	.00	.00	.00	0.
1	1044	47	.00	.00	.00	0.	*	2	0854	142	.00	.00	.00	0.
1	1058	48	.00	.00	.00	0.	*	2	0908	143	.00	.00	.00	0.
1	1112	49	.00	.00	.00	0.	*	2	0922	144	.00	.00	.00	0.
1	1126	50	.00	.00	.00	0.	*	2	0936	145	.00	.00	.00	0.
1	1140	51	.00	.00	.00	0.	*	2	0950	146	.00	.00	.00	0.
1	1154	52	.00	.00	.00	0.	*	2	1004	147	.00	.00	.00	0.
1	1208	53	.00	.00	.00	0.	*	2	1018	148	.00	.00	.00	0.
1	1222	54	.00	.00	.00	0.	*	2	1032	149	.00	.00	.00	0.
1	1236	55	.00	.00	.00	0.	*	2	1046	150	.00	.00	.00	0.
1	1250	56	.00	.00	.00	0.	*	2	1100	151	.00	.00	.00	0.
1	1304	57	.00	.00	.00	0.	*	2	1114	152	.00	.00	.00	0.
1	1318	58	.00	.00	.00	0.	*	2	1128	153	.00	.00	.00	0.
1	1332	59	.00	.00	.00	0.	*	2	1142	154	.00	.00	.00	0.
1	1346	60	.00	.00	.00	0.	*	2	1156	155	.00	.00	.00	0.
1	1400	61	.00	.00	.00	0.	*	2	1210	156	.00	.00	.00	0.
1	1414	62	.00	.00	.00	0.	*	2	1224	157	.00	.00	.00	0.
1	1428	63	.00	.00	.00	0.	*	2	1238	158	.00	.00	.00	0.
1	1442	64	.00	.00	.00	0.	*	2	1252	159	.00	.00	.00	0.
1	1456	65	.00	.00	.00	0.	*	2	1306	160	.00	.00	.00	0.
1	1510	66	.00	.00	.00	0.	*	2	1320	161	.00	.00	.00	0.
1	1524	67	.00	.00	.00	0.	*	2	1334	162	.00	.00	.00	0.
1	1538	68	.00	.00	.00	0.	*	2	1348	163	.00	.00	.00	0.
1	1552	69	.00	.00	.00	0.	*	2	1402	164	.00	.00	.00	0.
1	1606	70	.00	.00	.00	0.	*	2	1416	165	.00	.00	.00	0.
1	1620	71	.00	.00	.00	0.	*	2	1430	166	.00	.00	.00	0.
1	1634	72	.00	.00	.00	0.	*	2	1444	167	.00	.00	.00	0.
1	1648	73	.00	.00	.00	0.	*	2	1458	168	.00	.00	.00	0.
1	1702	74	.00	.00	.00	0.	*	2	1512	169	.00	.00	.00	0.
1	1716	75	.00	.00	.00	0.	*	2	1526	170	.00	.00	.00	0.
1	1730	76	.00	.00	.00	0.	*	2	1540	171	.00	.00	.00	0.
1	1744	77	.00	.00	.00	0.	*	2	1554	172	.00	.00	.00	0.
1	1758	78	.00	.00	.00	0.	*	2	1608	173	.00	.00	.00	0.
1	1812	79	.00	.00	.00	0.	*	2	1622	174	.00	.00	.00	0.
1	1826	80	.00	.00	.00	0.	*	2	1636	175	.00	.00	.00	0.
1	1840	81	.00	.00	.00	0.	*	2	1650	176	.00	.00	.00	0.
1	1854	82	.00	.00	.00	0.	*	2	1704	177	.00	.00	.00	0.
1	1908	83	.00	.00	.00	0.	*	2	1718	178	.00	.00	.00	0.
1	1922	84	.00	.00	.00	0.	*	2	1732	179	.00	.00	.00	0.
1	1936	85	.00	.00	.00	0.	*	2	1746	180	.00	.00	.00	0.
1	1950	86	.00	.00	.00	0.	*	2	1800	181	.00	.00	.00	0.
1	2004	87	.00	.00	.00	0.	*	2	1814	182	.00	.00	.00	0.
1	2018	88	.00	.00	.00	0.	*	2	1828	183	.00	.00	.00	0.
1	2032	89	.00	.00	.00	0.	*	2	1842	184	.00	.00	.00	0.
1	2046	90	.00	.00	.00	0.	*	2	1856	185	.00	.00	.00	0.
1	2100	91	.00	.00	.00	0.	*	2	1910	186	.00	.00	.00	0.
1	2114	92	.00	.00	.00	0.	*	2	1924	187	.00	.00	.00	0.
1	2128	93	.00	.00	.00	0.	*	2	1938	188	.00	.00	.00	0.
1	2142	94	.00	.00	.00	0.	*	2	1952	189	.00	.00	.00	0.
1	2156	95	.00	.00	.00	0.	*	2	2006	190	.00	.00	.00	0.
							*							

****

TOTAL RAINFALL = 7.70, TOTAL LOSS = .00, TOTAL EXCESS = 7.70

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	44.10-HR
+ (CFS)	(HR)					
		(CFS)				
+ 26815.	2.57		6637.	1637.	883.	883.
		(INCHES)	7.652	7.700	7.700	7.700
		(AC-FT)	3199.	3220.	3220.	3220.

CUMULATIVE AREA = 7.84 SQ MI

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            **************
            *            *
  30 KK     *      COMB  *        COMBINE INFLOW FROM INFLOW1 AND INFLOW2
            *            *
            **************

  31 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

  32 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
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HYDROGRAPH AT STATION COMB
SUM OF 2 HYDROGRAPHS

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		1112	49	3035.	1		2224	97	287.	2		0936	145	1.
1		0014	2	506.	1		1126	50	2801.	1		2238	98	275.	2		0950	146	0.
1		0028	3	1013.	1		1140	51	2597.	1		2252	99	264.	2		1004	147	0.
1		0042	4	1014.	1		1154	52	2418.	1		2306	100	252.	2		1018	148	0.
1		0056	5	1016.	1		1208	53	2256.	1		2320	101	242.	2		1032	149	0.
1		0110	6	1743.	1		1222	54	2113.	1		2334	102	231.	2		1046	150	0.

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    1     0124    7     2763.   *    1     1236   55     1981.   *    1     2348  103      222.   *    2     1100  151        0.
    1     0138    8     3069.   *    1     1250   56     1861.   *    2     0002  104      213.   *    2     1114  152        0.
    1     0152    9     3097.   *    1     1304   57     1753.   *    2     0016  105      205.   *    2     1128  153        0.
    1     0206   10     8238.   *    1     1318   58     1654.   *    2     0030  106      196.   *    2     1142  154        0.
    1     0220   11    20202.   *    1     1332   59     1566.   *    2     0044  107      188.   *    2     1156  155        0.
    1     0234   12    27106.   *    1     1346   60     1488.   *    2     0058  108      180.   *    2     1210  156        0.
    1     0248   13    27266.   *    1     1400   61     1415.   *    2     0112  109      172.   *    2     1224  157        0.
    1     0302   14    25931.   *    1     1414   62     1350.   *    2     0126  110      165.   *    2     1238  158        0.
    1     0316   15    15352.   *    1     1428   63     1289.   *    2     0140  111      157.   *    2     1252  159        0.
    1     0330   16     6506.   *    1     1442   64     1231.   *    2     0154  112      150.   *    2     1306  160        0.
    1     0344   17     7275.   *    1     1456   65     1176.   *    2     0208  113      144.   *    2     1320  161        0.
    1     0358   18     8342.   *    1     1510   66     1123.   *    2     0222  114      138.   *    2     1334  162        0.
    1     0412   19     8345.   *    1     1524   67     1073.   *    2     0236  115      133.   *    2     1348  163        0.
    1     0426   20     8315.   *    1     1538   68     1026.   *    2     0250  116      129.   *    2     1402  164        0.
    1     0440   21     9644.   *    1     1552   69      981.   *    2     0304  117      124.   *    2     1416  165        0.
    1     0454   22    11218.   *    1     1606   70      939.   *    2     0318  118      120.   *    2     1430  166        0.
    1     0508   23    12541.   *    1     1620   71      899.   *    2     0332  119      116.   *    2     1444  167        0.
    1     0522   24    13657.   *    1     1634   72      861.   *    2     0346  120      112.   *    2     1458  168        0.
    1     0536   25    15053.   *    1     1648   73      824.   *    2     0400  121      107.   *    2     1512  169        0.
    1     0550   26    16633.   *    1     1702   74      790.   *    2     0414  122      103.   *    2     1526  170        0.
    1     0604   27    17816.   *    1     1716   75      756.   *    2     0428  123       99.   *    2     1540  171        0.
    1     0618   28    18096.   *    1     1730   76      724.   *    2     0442  124       95.   *    2     1554  172        0.
    1     0632   29    17966.   *    1     1744   77      693.   *    2     0456  125       90.   *    2     1608  173        0.
    1     0646   30    17629.   *    1     1758   78      664.   *    2     0510  126       86.   *    2     1622  174        0.
    1     0700   31    16796.   *    1     1812   79      635.   *    2     0524  127       81.   *    2     1636  175        0.
    1     0714   32    15860.   *    1     1826   80      609.   *    2     0538  128       76.   *    2     1650  176        0.
    1     0728   33    14828.   *    1     1840   81      583.   *    2     0552  129       71.   *    2     1704  177        0.
    1     0742   34    13714.   *    1     1854   82      558.   *    2     0606  130       63.   *    2     1718  178        0.
    1     0756   35    12504.   *    1     1908   83      534.   *    2     0620  131       49.   *    2     1732  179        0.
    1     0810   36    11291.   *    1     1922   84      511.   *    2     0634  132       37.   *    2     1746  180        0.
    1     0824   37    10134.   *    1     1936   85      489.   *    2     0648  133       25.   *    2     1800  181        0.
    1     0838   38     9058.   *    1     1950   86      468.   *    2     0702  134       15.   *    2     1814  182        0.
    1     0852   39     8103.   *    1     2004   87      448.   *    2     0716  135       12.   *    2     1828  183        0.
    1     0906   40     7263.   *    1     2018   88      430.   *    2     0730  136       10.   *    2     1842  184        0.
    1     0920   41     6531.   *    1     2032   89      412.   *    2     0744  137        8.   *    2     1856  185        0.
    1     0934   42     5878.   *    1     2046   90      393.   *    2     0758  138        5.   *    2     1910  186        0.
    1     0948   43     5294.   *    1     2100   91      376.   *    2     0812  139        4.   *    2     1924  187        0.
    1     1002   44     4783.   *    1     2114   92      360.   *    2     0826  140        3.   *    2     1938  188        0.
    1     1016   45     4343.   *    1     2128   93      344.   *    2     0840  141        3.   *    2     1952  189        0.
    1     1030   46     3950.   *    1     2142   94      328.   *    2     0854  142        2.   *    2     2006  190        0.
    1     1044   47     3606.   *    1     2156   95      314.   *    2     0908  143        1.   *
    1     1058   48     3304.   *    1     2210   96      300.   *    2     0922  144        1.   *
                                 *                                  *                                 *
 ************************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     44.10-HR
+   (CFS)       (HR)
                            (CFS)
+   27266.      2.80                15059.       5271.       2865.        2865.
                         (INCHES)     5.233       7.474       7.527        7.527
                          (AC-FT)     7260.      10369.      10442.       10442.

                          CUMULATIVE AREA =   26.01 SQ MI


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


             **************
             *            *
   33 KK     *       DAM  *         UNION PARK DAM
             *            *
             **************

   34 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

                HYDROGRAPH ROUTING DATA

   35 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC    10120.00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

   36 SV            STORAGE          .0     168.0    3424.0   17987.0   51108.0  106801.0  186081.0  285452.0  403213.0  468383.0
                                537676.0  610886.0  687754.0  768073.0  851813.0  939113.0 1029878.0 1123992.0 1221505.0 1322413.0

   38 SE          ELEVATION     9600.00   9640.00   9680.00   9720.00   9760.00   9800.00   9840.00   9880.00   9920.00   9940.00
                                 9960.00   9980.00  10000.00  10020.00  10040.00  10060.00  10080.00  10100.00  10120.00  10140.00

   40 SS          SPILLWAY
                         CREL    10139.00  SPILLWAY CREST ELEVATION
                        SPWID     2050.00  SPILLWAY WIDTH
                         COQW        2.63  WEIR COEFFICIENT
                         EXPW        1.50  EXPONENT OF HEAD

   41 ST          TOP OF DAM
                        TOPEL    10140.00  ELEVATION AT TOP OF DAM
                       DAMWID     2050.00  DAM WIDTH
                         COQD        2.63  WEIR COEFFICIENT
                         EXPD        1.50  EXPONENT OF HEAD

                                                                  ***

                                                COMPUTED OUTFLOW-ELEVATION DATA

                                                (EXCLUDING FLOW OVER DAM)
```

OUTFLOW	.00	.00	.85	7.71	24.38	59.93	115.53	200.27	317.51	472.37
ELEVATION	9600.00	10139.00	10139.00	10139.01	10139.03	10139.05	10139.08	10139.11	10139.15	10139.20

OUTFLOW	673.94	924.25	1228.44	1596.90	2030.35	2533.94	3119.35	3786.02	4539.06	5391.50
ELEVATION	10139.25	10139.31	10139.37	10139.44	10139.52	10139.60	10139.69	10139.79	10139.89	10140.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	168.00	3424.00	17987.00	51108.00	106801.00	186081.00	285452.00	403213.00	468383.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9600.00	9640.00	9680.00	9720.00	9760.00	9800.00	9840.00	9880.00	9920.00	9940.00

STORAGE	537676.00	610886.00	687754.00	768073.00	851813.00	939113.00	1029878.00	1123992.00	1221505.00	1317368.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9960.00	9980.00	10000.00	10020.00	10040.00	10060.00	10080.00	10100.00	10120.00	10139.00

STORAGE	1317432.00	1317506.00	1317619.00	1317757.00	1317929.00	1318131.00	1318363.00	1318629.00	1318925.00	1319250.00
OUTFLOW	7.71	24.38	59.93	115.53	200.27	317.51	472.37	673.94	924.25	1228.44
ELEVATION	10139.01	10139.03	10139.05	10139.08	10139.11	10139.15	10139.20	10139.25	10139.31	10139.37

STORAGE	1319610.00	1319999.00	1320418.00	1320871.00	1321354.00	1321866.00	1322413.00
OUTFLOW	1596.90	2030.35	2533.94	3119.35	3786.02	4539.06	5391.50
ELEVATION	10139.44	10139.52	10139.60	10139.69	10139.79	10139.89	10140.00

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HYDROGRAPH AT STATION DAM

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.1221	505.0	10120.0	1		1456	65	0.1231	468.0	10122.0	2		0552	129	0.1231	951.0	10122.1
1		0014	2	0.1221	510.0	10120.0	1		1510	66	0.1231	492.0	10122.0	2		0606	130	0.1231	951.0	10122.1
1		0028	3	0.1221	525.0	10120.0	1		1524	67	0.1231	512.0	10122.0	2		0620	131	0.1231	951.0	10122.1
1		0042	4	0.1221	544.0	10120.0	1		1538	68	0.1231	532.0	10122.0	2		0634	132	0.1231	951.0	10122.1
1		0056	5	0.1221	564.0	10120.0	1		1552	69	0.1231	552.0	10122.0	2		0648	133	0.1231	951.0	10122.1
1		0110	6	0.1221	589.0	10120.0	1		1606	70	0.1231	571.0	10122.0	2		0702	134	0.1231	951.0	10122.1
1		0124	7	0.1221	633.0	10120.0	1		1620	71	0.1231	591.0	10122.0	2		0716	135	0.1231	951.0	10122.1
1		0138	8	0.1221	687.0	10120.0	1		1634	72	0.1231	606.0	10122.0	2		0730	136	0.1231	951.0	10122.1
1		0152	9	0.1221	746.0	10120.0	1		1648	73	0.1231	620.0	10122.0	2		0744	137	0.1231	951.0	10122.1
1		0206	10	0.1221	855.0	10120.1	1		1702	74	0.1231	635.0	10122.0	2		0758	138	0.1231	951.0	10122.1
1		0220	11	0.1222	131.0	10120.1	1		1716	75	0.1231	650.0	10122.0	2		0812	139	0.1231	951.0	10122.1
1		0234	12	0.1222	589.0	10120.2	1		1730	76	0.1231	665.0	10122.0	2		0826	140	0.1231	951.0	10122.1
1		0248	13	0.1223	111.0	10120.3	1		1744	77	0.1231	680.0	10122.0	2		0840	141	0.1231	951.0	10122.1
1		0302	14	0.1223	624.0	10120.4	1		1758	78	0.1231	694.0	10122.0	2		0854	142	0.1231	951.0	10122.1
1		0316	15	0.1224	023.0	10120.5	1		1812	79	0.1231	709.0	10122.0	2		0908	143	0.1231	951.0	10122.1
1		0330	16	0.1224	235.0	10120.5	1		1826	80	0.1231	719.0	10122.0	2		0922	144	0.1231	951.0	10122.1
1		0344	17	0.1224	368.0	10120.6	1		1840	81	0.1231	729.0	10122.0	2		0936	145	0.1231	951.0	10122.1
1		0358	18	0.1224	520.0	10120.6	1		1854	82	0.1231	739.0	10122.0	2		0950	146	0.1231	951.0	10122.1
1		0412	19	0.1224	683.0	10120.6	1		1908	83	0.1231	749.0	10122.0	2		1004	147	0.1231	951.0	10122.1
1		0426	20	0.1224	846.0	10120.7	1		1922	84	0.1231	758.0	10122.0	2		1018	148	0.1231	951.0	10122.1
1		0440	21	0.1225	018.0	10120.7	1		1936	85	0.1231	768.0	10122.0	2		1032	149	0.1231	951.0	10122.1
1		0454	22	0.1225	220.0	10120.7	1		1950	86	0.1231	778.0	10122.0	2		1046	150	0.1231	951.0	10122.1
1		0508	23	0.1225	447.0	10120.8	1		2004	87	0.1231	788.0	10122.0	2		1100	151	0.1231	951.0	10122.1
1		0522	24	0.1225	698.0	10120.8	1		2018	88	0.1231	798.0	10122.0	2		1114	152	0.1231	951.0	10122.1
1		0536	25	0.1225	974.0	10120.9	1		2032	89	0.1231	808.0	10122.0	2		1128	153	0.1231	951.0	10122.1
1		0550	26	0.1226	279.0	10120.9	1		2046	90	0.1231	818.0	10122.0	2		1142	154	0.1231	951.0	10122.1
1		0604	27	0.1226	610.0	10121.0	1		2100	91	0.1231	827.0	10122.0	2		1156	155	0.1231	951.0	10122.1
1		0618	28	0.1226	954.0	10121.1	1		2114	92	0.1231	832.0	10122.0	2		1210	156	0.1231	951.0	10122.1
1		0632	29	0.1227	304.0	10121.1	1		2128	93	0.1231	837.0	10122.0	2		1224	157	0.1231	951.0	10122.1
1		0646	30	0.1227	649.0	10121.2	1		2142	94	0.1231	842.0	10122.0	2		1238	158	0.1231	951.0	10122.1
1		0700	31	0.1227	979.0	10121.3	1		2156	95	0.1231	847.0	10122.0	2		1252	159	0.1231	951.0	10122.1
1		0714	32	0.1228	295.0	10121.3	1		2210	96	0.1231	852.0	10122.1	2		1306	160	0.1231	951.0	10122.1
1		0728	33	0.1228	590.0	10121.4	1		2224	97	0.1231	857.0	10122.1	2		1320	161	0.1231	951.0	10122.1
1		0742	34	0.1228	866.0	10121.5	1		2238	98	0.1231	862.0	10122.1	2		1334	162	0.1231	951.0	10122.1
1		0756	35	0.1229	118.0	10121.5	1		2252	99	0.1231	867.0	10122.1	2		1348	163	0.1231	951.0	10122.1
1		0810	36	0.1229	349.0	10121.6	1		2306	100	0.1231	872.0	10122.1	2		1402	164	0.1231	951.0	10122.1
1		0824	37	0.1229	556.0	10121.6	1		2320	101	0.1231	877.0	10122.1	2		1416	165	0.1231	951.0	10122.1
1		0838	38	0.1229	743.0	10121.6	1		2334	102	0.1231	882.0	10122.1	2		1430	166	0.1231	951.0	10122.1
1		0852	39	0.1229	911.0	10121.7	1		2348	103	0.1231	887.0	10122.1	2		1444	167	0.1231	951.0	10122.1
1		0906	40	0.1230	059.0	10121.7	2		0002	104	0.1231	891.0	10122.1	2		1458	168	0.1231	951.0	10122.1
1		0920	41	0.1230	192.0	10121.7	2		0016	105	0.1231	896.0	10122.1	2		1512	169	0.1231	951.0	10122.1
1		0934	42	0.1230	310.0	10121.7	2		0030	106	0.1231	901.0	10122.1	2		1526	170	0.1231	951.0	10122.1
1		0948	43	0.1230	418.0	10121.8	2		0044	107	0.1231	906.0	10122.1	2		1540	171	0.1231	951.0	10122.1
1		1002	44	0.1230	517.0	10121.8	2		0058	108	0.1231	911.0	10122.1	2		1554	172	0.1231	951.0	10122.1
1		1016	45	0.1230	606.0	10121.8	2		0112	109	0.1231	916.0	10122.1	2		1608	173	0.1231	951.0	10122.1
1		1030	46	0.1230	684.0	10121.8	2		0126	110	0.1231	921.0	10122.1	2		1622	174	0.1231	951.0	10122.1
1		1044	47	0.1230	758.0	10121.8	2		0140	111	0.1231	926.0	10122.1	2		1636	175	0.1231	951.0	10122.1
1		1058	48	0.1230	827.0	10121.8	2		0154	112	0.1231	931.0	10122.1	2		1650	176	0.1231	951.0	10122.1
1		1112	49	0.1230	886.0	10121.9	2		0208	113	0.1231	936.0	10122.1	2		1704	177	0.1231	951.0	10122.1
1		1126	50	0.1230	941.0	10121.9	2		0222	114	0.1231	941.0	10122.1	2		1718	178	0.1231	951.0	10122.1
1		1140	51	0.1230	995.0	10121.9	2		0236	115	0.1231	946.0	10122.1	2		1732	179	0.1231	951.0	10122.1
1		1154	52	0.1231	044.0	10121.9	2		0250	116	0.1231	951.0	10122.1	2		1746	180	0.1231	951.0	10122.1
1		1208	53	0.1231	088.0	10121.9	2		0304	117	0.1231	951.0	10122.1	2		1800	181	0.1231	951.0	10122.1
1		1222	54	0.1231	133.0	10121.9	2		0318	118	0.1231	951.0	10122.1	2		1814	182	0.1231	951.0	10122.1
1		1236	55	0.1231	172.0	10121.9	2		0332	119	0.1231	951.0	10122.1	2		1828	183	0.1231	951.0	10122.1
1		1250	56	0.1231	212.0	10121.9	2		0346	120	0.1231	951.0	10122.1	2		1842	184	0.1231	951.0	10122.1
1		1304	57	0.1231	246.0	10121.9	2		0400	121	0.1231	951.0	10122.1	2		1856	185	0.1231	951.0	10122.1
1		1318	58	0.1231	281.0	10121.9	2		0414	122	0.1231	951.0	10122.1	2		1910	186	0.1231	951.0	10122.1
1		1332	59	0.1231	310.0	10121.9	2		0428	123	0.1231	951.0	10122.1	2		1924	187	0.1231	951.0	10122.1
1		1346	60	0.1231	340.0	10121.9	2		0442	124	0.1231	951.0	10122.1	2		1938	188	0.1231	951.0	10122.1
1		1400	61	0.1231	369.0	10122.0	2		0456	125	0.1231	951.0	10122.1	2		1952	189	0.1231	951.0	10122.1
1		1414	62	0.1231	394.0	10122.0	2		0510	126	0.1231	951.0	10122.1	2		2006	190	0.1231	951.0	10122.1
1		1428	63	0.1231	418.0	10122.0	2		0524	127	0.1231	951.0	10122.1							
1		1442	64	0.1231	443.0	10122.0	2		0538	128	0.1231	951.0	10122.1							

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 PEAK OUTFLOW IS        0. AT TIME    .00 HOURS


  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     44.10-HR
+   (CFS)       (HR)
                           (CFS)
+       0.       .00                 0.          0.          0.          0.
                        (INCHES)    .000        .000        .000        .000
                         (AC-FT)     0.          0.          0.          0.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     44.10-HR
+  (AC-FT)      (HR)
  1231951.     26.83             1231950.    1231933.    1230380.    1230380.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     44.10-HR
+   (FEET)      (HR)
  10122.07     26.83             10122.06    10122.06    10121.78    10121.78

                        CUMULATIVE AREA =   26.01 SQ MI

1
                                                   RUNOFF SUMMARY
                                              FLOW IN CUBIC FEET PER SECOND
                                            TIME IN HOURS,  AREA IN SQUARE MILES

                                      PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION     FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                          6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                         INFLO1     17966.    6.53       11520.       3649.       1982.      18.17

          HYDROGRAPH AT
+                         INFLO2     26815.    2.57        6637.       1637.        883.       7.84

          2 COMBINED AT
+                           COMB     27266.    2.80       15059.       5271.       2865.      26.01

          ROUTED TO
+                            DAM         0.     .00           0.          0.          0.      26.01
+                                                                                                          10122.07       26.83
1                                 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION      DAM
                            (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ...............                 INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                ELEVATION       10120.00          10139.00         10140.00
                                STORAGE         1221505.          1317368.         1322413.
                                OUTFLOW               0.                0.            5392.


                     RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                       OF     RESERVOIR     DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                      PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                     1.00     10122.07         .00    1231951.         0.       .00          .00         .00


 *** NORMAL END OF HEC-1 ***
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1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   14JUL04  TIME  14:10:36  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************


                                                X     X  XXXXXXX   XXXXX           X
                                                X     X  X        X     X         XX
                                                X     X  X        X                X
                                                XXXXXXX  XXXX     X        XXXXX   X
                                                X     X  X        X                X
                                                X     X  X        X     X          X
                                                X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                   HEC-1 INPUT                                                PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID        Union Park Reservoir Project
             2          ID        DAM SAFETY ANALYSIS (General Spring Storm 72 hr PMP)
             3          ID        ANALYSIS OF DAM OVERTOPPING WITHOUT SPILLWAY AND CLOSED LOWER OUTLETS
             4          IT  115.35       0       0     190
             5          IO       5

             6          KK  SNOWME  15 DAY 100-YEAR SNOWMELT FLOOD HYDROGRAPH
             7          KO       1
             8          IN    1440       0       0
             9          BA       0
            10          QI   60.22   73.24   81.65   94.95  119.36  141.06  189.89  200.74  162.76  130.21
            11          QI  115.26   94.95   81.38   70.80   59.41

            12          KK  INFLO1  INFLOW TO UNION PARK RESERVOIR (SUBBASIN 1 NON WATER SURFACE)
            13          KO       1
            14          IN     360       0       0
            15          BA   18.17
            16          PB    19.2
            17          PC    0.00     5.0    7.80    10.0    11.7   12.95    14.2   15.45    16.7   17.32
            18          PC   17.95   18.58    19.2
            19          LU     0.0    0.05
            20          UI    3.30   11.44   25.42   38.13   63.55   76.26   97.86  114.39  184.42  230.17
            21          UI  237.38  305.16  289.91  269.57  245.42  214.92  193.31  180.60  170.44  161.54
            22          UI  151.37  142.47  134.85  127.22  119.47  111.84  104.85   97.86   92.14   86.43
            23          UI   81.34   76.26   81.81   68.00   63.55   61.01   57.83   54.65   52.11   49.57
            24          UI   47.28   45.12   43.21   41.31   39.40   38.13   36.48   34.95   33.68   32.03
            25          UI   30.76   29.61   28.47   27.33   26.31   25.29   24.28   23.26   22.37   21.61
            26          UI   20.72   19.95   19.06   18.43   17.67   17.03   16.27   15.63   15.12   14.36
            27          UI   13.85   13.35   12.84   12.33   11.82   11.44   10.93   10.55   10.17    9.79
            28          UI    9.41    9.02    8.64    8.26    8.01    7.63    7.37    7.12    6.86    6.61
            29          UI    6.35    6.10    5.85    5.59    5.34    5.21    5.08    4.83    4.70    4.45
            30          UI    4.32    4.19    4.07    3.94    3.69    3.56    3.43    3.30    3.18    3.05
            31          UI    2.92    2.92    2.80    2.67    2.54    2.41    2.41    2.29    2.16    2.16

            32          KK  INFLO2   INFLOW TO UNION PARK RESERVOIR (SUBBASIN 2 WATER SURFACE)
            33          KO       1
            34          BA    7.84
            35          LU     0.0     0.0
            36          US    0.00     0.63

            37          KK    COMB   COMBINE INFLOW FROM SNOWMELD FLOOD, INFLOW1 AND INFLOW2
            38          KO       1
            39          HC       3

            40          KK     DAM    UNION PARK DAM
            41          KO       1
            42          RS       1    ELEV   10120
            43          SV       0     168    3424   17987   51108  106801  186081  285452  403213  468383
            44          SV  537676  610886  687754  768073  851813  939113 1029878 1123992 1221505 1322413
            45          SE    9600    9640    9680    9720    9760    9800    9840    9880    9920    9940
            46          SE    9960    9980   10000   10020   10040   10060   10080   10100   10120   10140
            47          SS   10139    2050    2.63     1.5
                        *  SL  9740   14.14     0.7     0.5
            48          ST   10140    2050    2.63     1.5
            49          ZZ
1****************************************                                                    ****************************************
 *                                      *                                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                    *          609 SECOND STREET           *
 *                                      *                                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   14JUL04  TIME  14:10:36  *                                                    *           (916) 756-1104             *
 *                                      *                                                    *                                      *
 ****************************************                                                    ****************************************
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                              Union Park Reservoir Project
                              DAM SAFETY ANALYSIS (General Spring Storm 72 hr PMP)
                              ANALYSIS OF DAM OVERTOPPING WITHOUT SPILLWAY AND CLOSED LOWER OUTLETS

  5 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN         115  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         190  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     16    0  ENDING DATE
                     NDTIME        0215  ENDING TIME
                     ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL    1.92 HOURS
                       TOTAL TIME BASE  362.25 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT


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


           **************
           *            *
  6 KK     *    SNOWME  *       15 DAY 100-YEAR SNOWMELT FLOOD HYDROGRAPH
           *            *
           **************

  7 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           1  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

  8 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN        1440  TIME INTERVAL IN MINUTES
                     JXDATE      1    0  STARTING DATE
                     JXTIME           0  STARTING TIME

             SUBBASIN RUNOFF DATA

  9 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .00  SUBBASIN AREA

                                                                  ***

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

                                                HYDROGRAPH AT STATION   SNOWME

*****************************************************************************************************************************
                                 *                                 *                                 *
  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW    *  DA MON HRMN  ORD      FLOW
                                 *                                 *                                 *
   1     0000    1       60.    *   4     2000   49      115.    *   8     1600   97      175.    *  12     1200  145       88.
   1     0155    2       61.    *   4     2155   50      117.    *   8     1755   98      172.    *  12     1355  146       87.
   1     0350    3       62.    *   4     2350   51      119.    *   8     1950   99      169.    *  12     1550  147       86.
   1     0545    4       63.    *   5     0145   52      121.    *   8     2145  100      166.    *  12     1745  148       85.
   1     0740    5       64.    *   5     0340   53      123.    *   8     2340  101      163.    *  12     1940  149       84.
   1     0935    6       65.    *   5     0535   54      124.    *   9     0135  102      161.    *  12     2135  150       83.
   1     1130    7       66.    *   5     0730   55      126.    *   9     0330  103      158.    *  12     2330  151       82.
   1     1325    8       67.    *   5     0925   56      128.    *   9     0525  104      155.    *  13     0125  152       81.
   1     1520    9       69.    *   5     1120   57      130.    *   9     0720  105      153.    *  13     0320  153       80.
   1     1715   10       70.    *   5     1315   58      131.    *   9     0915  106      150.    *  13     0515  154       79.
   1     1910   11       71.    *   5     1510   59      133.    *   9     1110  107      148.    *  13     0710  155       78.
   1     2105   12       72.    *   5     1705   60      135.    *   9     1305  108      145.    *  13     0905  156       77.
   1     2300   13       73.    *   5     1900   61      137.    *   9     1500  109      142.    *  13     1100  157       77.
   2     0055   14       74.    *   5     2055   62      138.    *   9     1655  110      140.    *  13     1255  158       76.
   2     0250   15       74.    *   5     2250   63      140.    *   9     1850  111      137.    *  13     1450  159       75.
   2     0445   16       75.    *   6     0045   64      143.    *   9     2045  112      135.    *  13     1645  160       74.
   2     0640   17       76.    *   6     0240   65      146.    *   9     2240  113      132.    *  13     1840  161       73.
   2     0835   18       76.    *   6     0435   66      150.    *  10     0035  114      130.    *  13     2035  162       72.
   2     1030   19       77.    *   6     0630   67      154.    *  10     0230  115      129.    *  13     2230  163       71.
   2     1225   20       78.    *   6     0825   68      158.    *  10     0425  116      127.    *  14     0025  164       71.
   2     1420   21       78.    *   6     1020   69      162.    *  10     0620  117      126.    *  14     0220  165       70.
   2     1615   22       79.    *   6     1215   70      166.    *  10     0815  118      125.    *  14     0415  166       69.
   2     1810   23       80.    *   6     1410   71      170.    *  10     1010  119      124.    *  14     0610  167       68.
   2     2005   24       80.    *   6     1605   72      174.    *  10     1205  120      123.    *  14     0805  168       67.
   2     2200   25       81.    *   6     1800   73      178.    *  10     1400  121      121.    *  14     1000  169       66.
   2     2355   26       82.    *   6     1955   74      182.    *  10     1555  122      120.    *  14     1155  170       65.
   3     0150   27       83.    *   6     2150   75      185.    *  10     1750  123      119.    *  14     1350  171       64.
   3     0345   28       84.    *   6     2345   76      189.    *  10     1945  124      118.    *  14     1545  172       63.
   3     0540   29       85.    *   7     0140   77      191.    *  10     2140  125      117.    *  14     1740  173       62.
   3     0735   30       86.    *   7     0335   78      192.    *  10     2335  126      116.    *  14     1935  174       62.
   3     0930   31       87.    *   7     0530   79      192.    *  11     0130  127      114.    *  14     2130  175       61.
   3     1125   32       88.    *   7     0725   80      193.    *  11     0325  128      112.    *  14     2325  176       60.
   3     1320   33       89.    *   7     0920   81      194.    *  11     0520  129      111.    *  15     0120  177       59.
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3	1515	34	90.	*	7	1115	82	195.	*	11	0715	130	109.	*	15	0315	178	59.
3	1710	35	91.	*	7	1310	83	196.	*	11	0910	131	108.	*	15	0510	179	59.
3	1905	36	92.	*	7	1505	84	197.	*	11	1105	132	106.	*	15	0705	180	59.
3	2100	37	93.	*	7	1700	85	198.	*	11	1300	133	104.	*	15	0900	181	59.
3	2255	38	94.	*	7	1855	86	198.	*	11	1455	134	103.	*	15	1055	182	59.
4	0050	39	96.	*	7	2050	87	199.	*	11	1650	135	101.	*	15	1250	183	59.
4	0245	40	98.	*	7	2245	88	200.	*	11	1845	136	99.	*	15	1445	184	59.
4	0440	41	100.	*	8	0040	89	200.	*	11	2040	137	98.	*	15	1640	185	59.
4	0635	42	102.	*	8	0235	90	197.	*	11	2235	138	96.	*	15	1835	186	59.
4	0830	43	104.	*	8	0430	91	194.	*	12	0030	139	95.	*	15	2030	187	59.
4	1025	44	106.	*	8	0625	92	191.	*	12	0225	140	94.	*	15	2225	188	59.
4	1220	45	107.	*	8	0820	93	188.	*	12	0420	141	92.	*	16	0020	189	59.
4	1415	46	109.	*	8	1015	94	185.	*	12	0615	142	91.	*	16	0215	190	59.
4	1610	47	111.	*	8	1210	95	181.	*	12	0810	143	90.	*				
4	1805	48	113.	*	8	1405	96	178.	*	12	1005	144	89.	*				
				*					*					*				

****

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	362.25-HR
+		(CFS)			
+ 200.	166.75	200.	197.	182.	111.
		(INCHES) .000	.000	.000	.000
		(AC-FT) 95.	374.	1068.	3334.

CUMULATIVE AREA = .00 SQ MI

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              **************
              *            *
   12 KK      *    INFLO1  *       INFLOW TO UNION PARK RESERVOIR (SUBBASIN 1 NON WATER SURFACE)
              *            *
              **************

   13 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

   14 IN          TIME DATA FOR INPUT TIME SERIES
                        JXMIN         360  TIME INTERVAL IN MINUTES
                       JXDATE      1    0  STARTING DATE
                       JXTIME           0  STARTING TIME

                SUBBASIN RUNOFF DATA

   15 BA          SUBBASIN CHARACTERISTICS
                        TAREA       18.17  SUBBASIN AREA

                  PRECIPITATION DATA

   16 PB                STORM       19.20  BASIN TOTAL PRECIPITATION

   17 PI            INCREMENTAL PRECIPITATION PATTERN
                       1.60      1.60      1.60       .99       .89       .89       .75       .70       .70       .61
                        .54       .54       .47       .40       .40       .40       .40       .40       .40       .40
                        .40       .40       .40       .40       .40       .21       .20       .20       .20       .20
                        .20       .20       .20       .20       .20       .20       .20       .11

   19 LU          UNIFORM LOSS RATE
                        STRTL         .00  INITIAL LOSS
                        CNSTL         .05  UNIFORM LOSS RATE
                        RTIMP         .00  PERCENT IMPERVIOUS AREA

   19 UI          INPUT UNITGRAPH, 120 ORDINATES,  VOLUME =  .99
                        3.3      11.4      25.4      38.1      63.5      76.3      97.9     114.4     184.4     230.2
                      237.4     305.2     289.9     269.6     245.4     214.9     193.3     180.6     170.4     161.5
                      151.4     142.5     134.9     127.2     119.5     111.8     104.8      97.9      92.1      86.4
                       81.3      76.3      81.8      68.0      63.5      61.0      57.8      54.7      52.1      49.6
                       47.3      45.1      43.2      41.3      39.4      38.1      36.5      35.0      33.7      32.0
                       30.8      29.6      28.5      27.3      26.3      25.3      24.3      23.3      22.4      21.6
                       20.7      20.0      19.1      18.4      17.7      17.0      16.3      15.6      15.1      14.4
                       13.9      13.4      12.8      12.3      11.8      11.4      10.9      10.6      10.2       9.8
                        9.4       9.0       8.6       8.3       8.0       7.6       7.4       7.1       6.9       6.6
                        6.3       6.1       5.8       5.6       5.3       5.2       5.1       4.8       4.7       4.4
                        4.3       4.2       4.1       3.9       3.7       3.6       3.4       3.3       3.2       3.0
                        2.9       2.9       2.8       2.7       2.5       2.4       2.4       2.3       2.2       2.2
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HYDROGRAPH AT STATION INFLO1

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DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	*	8		1405	96	.00	.00	.00	133.
1		0155	2	1.60	.10	1.50	5.	*	8		1600	97	.00	.00	.00	128.
1		0350	3	1.60	.10	1.50	22.	*	8		1755	98	.00	.00	.00	123.
1		0545	4	1.60	.10	1.50	60.	*	8		1950	99	.00	.00	.00	118.
1		0740	5	.99	.10	.89	116.	*	8		2145	100	.00	.00	.00	114.
1		0935	6	.89	.10	.80	204.	*	8		2340	101	.00	.00	.00	110.
1		1130	7	.89	.10	.80	302.	*	9		0135	102	.00	.00	.00	105.
1		1325	8	.75	.10	.66	422.	*	9		0330	103	.00	.00	.00	101.
1		1520	9	.70	.10	.61	550.	*	9		0525	104	.00	.00	.00	98.

1	1715	10	.70	.10	.61	770.	*	9	0720	105	.00	.00	.00	94.
1	1910	11	.61	.10	.51	1042.	*	9	0915	106	.00	.00	.00	90.
1	2105	12	.54	.10	.45	1307.	*	9	1110	107	.00	.00	.00	87.
1	2300	13	.54	.10	.45	1625.	*	9	1305	108	.00	.00	.00	84.
2	0055	14	.47	.10	.38	1880.	*	9	1500	109	.00	.00	.00	80.
2	0250	15	.40	.10	.30	2088.	*	9	1655	110	.00	.00	.00	77.
2	0445	16	.40	.10	.30	2202.	*	9	1850	111	.00	.00	.00	74.
2	0640	17	.40	.10	.30	2259.	*	9	2045	112	.00	.00	.00	72.
2	0835	18	.40	.10	.30	2288.	*	9	2240	113	.00	.00	.00	69.
2	1030	19	.40	.10	.30	2294.	*	10	0035	114	.00	.00	.00	67.
2	1225	20	.40	.10	.30	2294.	*	10	0230	115	.00	.00	.00	64.
2	1420	21	.40	.10	.30	2293.	*	10	0425	116	.00	.00	.00	62.
2	1615	22	.40	.10	.30	2278.	*	10	0620	117	.00	.00	.00	59.
2	1810	23	.40	.10	.30	2252.	*	10	0815	118	.00	.00	.00	57.
2	2005	24	.40	.10	.30	2224.	*	10	1010	119	.00	.00	.00	55.
2	2200	25	.40	.10	.30	2193.	*	10	1205	120	.00	.00	.00	53.
2	2355	26	.40	.10	.30	2159.	*	10	1400	121	.00	.00	.00	51.
3	0150	27	.21	.10	.11	2127.	*	10	1555	122	.00	.00	.00	46.
3	0345	28	.20	.10	.10	2096.	*	10	1750	123	.00	.00	.00	41.
3	0540	29	.20	.10	.10	2064.	*	10	1945	124	.00	.00	.00	37.
3	0735	30	.20	.10	.10	2034.	*	10	2140	125	.00	.00	.00	34.
3	0930	31	.20	.10	.11	2000.	*	10	2335	126	.00	.00	.00	31.
3	1125	32	.20	.10	.11	1966.	*	11	0130	127	.00	.00	.00	28.
3	1320	33	.20	.10	.11	1928.	*	11	0325	128	.00	.00	.00	25.
3	1515	34	.20	.10	.11	1903.	*	11	0520	129	.00	.00	.00	23.
3	1710	35	.20	.10	.11	1852.	*	11	0715	130	.00	.00	.00	21.
3	1905	36	.20	.10	.10	1791.	*	11	0910	131	.00	.00	.00	19.
3	2100	37	.20	.10	.10	1725.	*	11	1105	132	.00	.00	.00	18.
3	2255	38	.20	.10	.10	1653.	*	11	1300	133	.00	.00	.00	16.
4	0050	39	.11	.10	.02	1585.	*	11	1455	134	.00	.00	.00	15.
4	0245	40	.00	.00	.00	1520.	*	11	1650	135	.00	.00	.00	14.
4	0440	41	.00	.00	.00	1461.	*	11	1845	136	.00	.00	.00	13.
4	0635	42	.00	.00	.00	1408.	*	11	2040	137	.00	.00	.00	11.
4	0830	43	.00	.00	.00	1357.	*	11	2235	138	.00	.00	.00	10.
4	1025	44	.00	.00	.00	1308.	*	12	0030	139	.00	.00	.00	9.
4	1220	45	.00	.00	.00	1260.	*	12	0225	140	.00	.00	.00	8.
4	1415	46	.00	.00	.00	1212.	*	12	0420	141	.00	.00	.00	8.
4	1610	47	.00	.00	.00	1160.	*	12	0615	142	.00	.00	.00	7.
4	1805	48	.00	.00	.00	1106.	*	12	0810	143	.00	.00	.00	6.
4	2000	49	.00	.00	.00	1053.	*	12	1005	144	.00	.00	.00	5.
4	2155	50	.00	.00	.00	996.	*	12	1200	145	.00	.00	.00	4.
4	2350	51	.00	.00	.00	940.	*	12	1355	146	.00	.00	.00	3.
5	0145	52	.00	.00	.00	888.	*	12	1550	147	.00	.00	.00	3.
5	0340	53	.00	.00	.00	840.	*	12	1745	148	.00	.00	.00	3.
5	0535	54	.00	.00	.00	797.	*	12	1940	149	.00	.00	.00	2.
5	0730	55	.00	.00	.00	758.	*	12	2135	150	.00	.00	.00	2.
5	0925	56	.00	.00	.00	721.	*	12	2330	151	.00	.00	.00	2.
5	1120	57	.00	.00	.00	686.	*	13	0125	152	.00	.00	.00	1.
5	1315	58	.00	.00	.00	654.	*	13	0320	153	.00	.00	.00	1.
5	1510	59	.00	.00	.00	621.	*	13	0515	154	.00	.00	.00	1.
5	1705	60	.00	.00	.00	592.	*	13	0710	155	.00	.00	.00	1.
5	1900	61	.00	.00	.00	565.	*	13	0905	156	.00	.00	.00	0.
5	2055	62	.00	.00	.00	540.	*	13	1100	157	.00	.00	.00	0.
5	2250	63	.00	.00	.00	515.	*	13	1255	158	.00	.00	.00	0.
6	0045	64	.00	.00	.00	492.	*	13	1450	159	.00	.00	.00	0.
6	0240	65	.00	.00	.00	471.	*	13	1645	160	.00	.00	.00	0.
6	0435	66	.00	.00	.00	450.	*	13	1840	161	.00	.00	.00	0.
6	0630	67	.00	.00	.00	431.	*	13	2035	162	.00	.00	.00	0.
6	0825	68	.00	.00	.00	413.	*	13	2230	163	.00	.00	.00	0.
6	1020	69	.00	.00	.00	396.	*	14	0025	164	.00	.00	.00	0.
6	1215	70	.00	.00	.00	379.	*	14	0220	165	.00	.00	.00	0.
6	1410	71	.00	.00	.00	363.	*	14	0415	166	.00	.00	.00	0.
6	1605	72	.00	.00	.00	348.	*	14	0610	167	.00	.00	.00	0.
6	1800	73	.00	.00	.00	333.	*	14	0805	168	.00	.00	.00	0.
6	1955	74	.00	.00	.00	320.	*	14	1000	169	.00	.00	.00	0.
6	2150	75	.00	.00	.00	307.	*	14	1155	170	.00	.00	.00	0.
6	2345	76	.00	.00	.00	295.	*	14	1350	171	.00	.00	.00	0.
7	0140	77	.00	.00	.00	283.	*	14	1545	172	.00	.00	.00	0.
7	0335	78	.00	.00	.00	272.	*	14	1740	173	.00	.00	.00	0.
7	0530	79	.00	.00	.00	261.	*	14	1935	174	.00	.00	.00	0.
7	0725	80	.00	.00	.00	251.	*	14	2130	175	.00	.00	.00	0.
7	0920	81	.00	.00	.00	241.	*	14	2325	176	.00	.00	.00	0.
7	1115	82	.00	.00	.00	232.	*	15	0120	177	.00	.00	.00	0.
7	1310	83	.00	.00	.00	223.	*	15	0315	178	.00	.00	.00	0.
7	1505	84	.00	.00	.00	214.	*	15	0510	179	.00	.00	.00	0.
7	1700	85	.00	.00	.00	206.	*	15	0705	180	.00	.00	.00	0.
7	1855	86	.00	.00	.00	198.	*	15	0900	181	.00	.00	.00	0.
7	2050	87	.00	.00	.00	190.	*	15	1055	182	.00	.00	.00	0.
7	2245	88	.00	.00	.00	182.	*	15	1250	183	.00	.00	.00	0.
8	0040	89	.00	.00	.00	175.	*	15	1445	184	.00	.00	.00	0.
8	0235	90	.00	.00	.00	169.	*	15	1640	185	.00	.00	.00	0.
8	0430	91	.00	.00	.00	162.	*	15	1835	186	.00	.00	.00	0.
8	0625	92	.00	.00	.00	156.	*	15	2030	187	.00	.00	.00	0.
8	0820	93	.00	.00	.00	150.	*	15	2225	188	.00	.00	.00	0.
8	1015	94	.00	.00	.00	144.	*	16	0020	189	.00	.00	.00	0.
8	1210	95	.00	.00	.00	138.	*	16	0215	190	.00	.00	.00	0.
							*							

****

TOTAL RAINFALL = 19.20, TOTAL LOSS = 3.64, TOTAL EXCESS = 15.56

	PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	362.25-HR
+	(CFS)	(HR)				
			(CFS)			
+	2294.	34.50	2293.	2237.	1841.	499.
		(INCHES)	1.124	4.388	11.135	15.423
		(AC-FT)	1090.	4252.	10791.	14946.

CUMULATIVE AREA = 18.17 SQ MI

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


            **************
            *            *
  32 KK     *    INFLO2  *        INFLOW TO UNION PARK RESERVOIR (SUBBASIN 2 WATER SURFACE)
            *            *
            **************

  33 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

               SUBBASIN RUNOFF DATA

  34 BA          SUBBASIN CHARACTERISTICS
                       TAREA        7.84  SUBBASIN AREA

                 PRECIPITATION DATA

  16 PB                STORM       19.20  BASIN TOTAL PRECIPITATION

  17 PI            INCREMENTAL PRECIPITATION PATTERN
                     1.60      1.60      1.60       .99       .89       .89       .75       .70       .70       .61
                      .54       .54       .47       .40       .40       .40       .40       .40       .40       .40
                      .40       .40       .40       .40       .40       .21       .20       .20       .20       .20
                      .20       .20       .20       .20       .20       .20       .20       .11

  35 LU          UNIFORM LOSS RATE
                       STRTL         .00  INITIAL LOSS
                       CNSTL         .00  UNIFORM LOSS RATE
                       RTIMP         .00  PERCENT IMPERVIOUS AREA

  36 US          SNYDER UNITGRAPH
                         TP         .00  LAG
                         CP         .60  PEAKING COEFFICIENT

                 SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                                  ***

TC INCREASED TO DELTA T OF  1.92 HR
R INCREASED TO MINIMUM OF 0.5
CLARK DID NOT CONVERGE TO GIVEN SNYDER COEFFICIENTS
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.92 AND R=  .96 INTERVALS

                                                   UNIT HYDROGRAPH PARAMETERS
                                             CLARK   TC=  1.92 HR,       R=   .96 HR
                                            SNYDER   TP=  1.51 HR,      CP=   .50

                                                       UNIT HYDROGRAPH
                                                   2 END-OF-PERIOD ORDINATES
             1320.     1320.
*****************************************************************************************************************************************

                                                 HYDROGRAPH AT STATION   INFLO2

*****************************************************************************************************************************************
                                                                          *
       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q               *       DA MON HRMN  ORD    RAIN    LOSS  EXCESS     COMP Q
                                                                          *
        1     0000    1     .00     .00     .00         0.               *        8     1405   96     .00     .00     .00         0.
        1     0155    2    1.60     .00    1.60      2108.               *        8     1600   97     .00     .00     .00         0.
        1     0350    3    1.60     .00    1.60      4216.               *        8     1755   98     .00     .00     .00         0.
        1     0545    4    1.60     .00    1.60      4216.               *        8     1950   99     .00     .00     .00         0.
        1     0740    5     .99     .00     .99      3410.               *        8     2145  100     .00     .00     .00         0.
        1     0935    6     .89     .00     .89      2482.               *        8     2340  101     .00     .00     .00         0.
        1     1130    7     .89     .00     .89      2361.               *        9     0135  102     .00     .00     .00         0.
        1     1325    8     .75     .00     .75      2174.               *        9     0330  103     .00     .00     .00         0.
        1     1520    9     .70     .00     .70      1921.               *        9     0525  104     .00     .00     .00         0.
        1     1715   10     .70     .00     .70      1855.               *        9     0720  105     .00     .00     .00         0.
        1     1910   11     .61     .00     .61      1727.               *        9     0915  106     .00     .00     .00         0.
        1     2105   12     .54     .00     .54      1516.               *        9     1110  107     .00     .00     .00         0.
        1     2300   13     .54     .00     .54      1433.               *        9     1305  108     .00     .00     .00         0.
        2     0055   14     .47     .00     .47      1343.               *        9     1500  109     .00     .00     .00         0.
        2     0250   15     .40     .00     .40      1153.               *        9     1655  110     .00     .00     .00         0.
        2     0445   16     .40     .00     .40      1054.               *        9     1850  111     .00     .00     .00         0.
        2     0640   17     .40     .00     .40      1054.               *        9     2045  112     .00     .00     .00         0.
        2     0835   18     .40     .00     .40      1054.               *        9     2240  113     .00     .00     .00         0.
        2     1030   19     .40     .00     .40      1054.               *       10     0035  114     .00     .00     .00         0.
        2     1225   20     .40     .00     .40      1054.               *       10     0230  115     .00     .00     .00         0.
        2     1420   21     .40     .00     .40      1054.               *       10     0425  116     .00     .00     .00         0.
        2     1615   22     .40     .00     .40      1054.               *       10     0620  117     .00     .00     .00         0.
        2     1810   23     .40     .00     .40      1054.               *       10     0815  118     .00     .00     .00         0.
        2     2005   24     .40     .00     .40      1054.               *       10     1010  119     .00     .00     .00         0.
        2     2200   25     .40     .00     .40      1054.               *       10     1205  120     .00     .00     .00         0.
        2     2355   26     .40     .00     .40      1054.               *       10     1400  121     .00     .00     .00         0.
        3     0150   27     .21     .00     .21       800.               *       10     1555  122     .00     .00     .00         0.
        3     0345   28     .20     .00     .20       534.               *       10     1750  123     .00     .00     .00         0.
        3     0540   29     .20     .00     .20       523.               *       10     1945  124     .00     .00     .00         0.
        3     0735   30     .20     .00     .20       526.               *       10     2140  125     .00     .00     .00         0.
        3     0930   31     .20     .00     .20       531.               *       10     2335  126     .00     .00     .00         0.
        3     1125   32     .20     .00     .20       531.               *       11     0130  127     .00     .00     .00         0.
        3     1320   33     .20     .00     .20       531.               *       11     0325  128     .00     .00     .00         0.
        3     1515   34     .20     .00     .20       531.               *       11     0520  129     .00     .00     .00         0.
        3     1710   35     .20     .00     .20       531.               *       11     0715  130     .00     .00     .00         0.
        3     1905   36     .20     .00     .20       529.               *       11     0910  131     .00     .00     .00         0.
        3     2100   37     .20     .00     .20       525.               *       11     1105  132     .00     .00     .00         0.
        3     2255   38     .20     .00     .20       523.               *       11     1300  133     .00     .00     .00         0.
        4     0050   39     .11     .00     .11       409.               *       11     1455  134     .00     .00     .00         0.
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4	0245	40	.00	.00	.00	148.	*	11	1650	135	.00	.00	.00	0.
4	0440	41	.00	.00	.00	0.	*	11	1845	136	.00	.00	.00	0.
4	0635	42	.00	.00	.00	0.	*	11	2040	137	.00	.00	.00	0.
4	0830	43	.00	.00	.00	0.	*	11	2235	138	.00	.00	.00	0.
4	1025	44	.00	.00	.00	0.	*	12	0030	139	.00	.00	.00	0.
4	1220	45	.00	.00	.00	0.	*	12	0225	140	.00	.00	.00	0.
4	1415	46	.00	.00	.00	0.	*	12	0420	141	.00	.00	.00	0.
4	1610	47	.00	.00	.00	0.	*	12	0615	142	.00	.00	.00	0.
4	1805	48	.00	.00	.00	0.	*	12	0810	143	.00	.00	.00	0.
4	2000	49	.00	.00	.00	0.	*	12	1005	144	.00	.00	.00	0.
4	2155	50	.00	.00	.00	0.	*	12	1200	145	.00	.00	.00	0.
4	2350	51	.00	.00	.00	0.	*	12	1355	146	.00	.00	.00	0.
5	0145	52	.00	.00	.00	0.	*	12	1550	147	.00	.00	.00	0.
5	0340	53	.00	.00	.00	0.	*	12	1745	148	.00	.00	.00	0.
5	0535	54	.00	.00	.00	0.	*	12	1940	149	.00	.00	.00	0.
5	0730	55	.00	.00	.00	0.	*	12	2135	150	.00	.00	.00	0.
5	0925	56	.00	.00	.00	0.	*	12	2330	151	.00	.00	.00	0.
5	1120	57	.00	.00	.00	0.	*	13	0125	152	.00	.00	.00	0.
5	1315	58	.00	.00	.00	0.	*	13	0320	153	.00	.00	.00	0.
5	1510	59	.00	.00	.00	0.	*	13	0515	154	.00	.00	.00	0.
5	1705	60	.00	.00	.00	0.	*	13	0710	155	.00	.00	.00	0.
5	1900	61	.00	.00	.00	0.	*	13	0905	156	.00	.00	.00	0.
5	2055	62	.00	.00	.00	0.	*	13	1100	157	.00	.00	.00	0.
5	2250	63	.00	.00	.00	0.	*	13	1255	158	.00	.00	.00	0.
6	0045	64	.00	.00	.00	0.	*	13	1450	159	.00	.00	.00	0.
6	0240	65	.00	.00	.00	0.	*	13	1645	160	.00	.00	.00	0.
6	0435	66	.00	.00	.00	0.	*	13	1840	161	.00	.00	.00	0.
6	0630	67	.00	.00	.00	0.	*	13	2035	162	.00	.00	.00	0.
6	0825	68	.00	.00	.00	0.	*	13	2230	163	.00	.00	.00	0.
6	1020	69	.00	.00	.00	0.	*	14	0025	164	.00	.00	.00	0.
6	1215	70	.00	.00	.00	0.	*	14	0220	165	.00	.00	.00	0.
6	1410	71	.00	.00	.00	0.	*	14	0415	166	.00	.00	.00	0.
6	1605	72	.00	.00	.00	0.	*	14	0610	167	.00	.00	.00	0.
6	1800	73	.00	.00	.00	0.	*	14	0805	168	.00	.00	.00	0.
6	1955	74	.00	.00	.00	0.	*	14	1000	169	.00	.00	.00	0.
6	2150	75	.00	.00	.00	0.	*	14	1155	170	.00	.00	.00	0.
6	2345	76	.00	.00	.00	0.	*	14	1350	171	.00	.00	.00	0.
7	0140	77	.00	.00	.00	0.	*	14	1545	172	.00	.00	.00	0.
7	0335	78	.00	.00	.00	0.	*	14	1740	173	.00	.00	.00	0.
7	0530	79	.00	.00	.00	0.	*	14	1935	174	.00	.00	.00	0.
7	0725	80	.00	.00	.00	0.	*	14	2130	175	.00	.00	.00	0.
7	0920	81	.00	.00	.00	0.	*	14	2325	176	.00	.00	.00	0.
7	1115	82	.00	.00	.00	0.	*	15	0120	177	.00	.00	.00	0.
7	1310	83	.00	.00	.00	0.	*	15	0315	178	.00	.00	.00	0.
7	1505	84	.00	.00	.00	0.	*	15	0510	179	.00	.00	.00	0.
7	1700	85	.00	.00	.00	0.	*	15	0705	180	.00	.00	.00	0.
7	1855	86	.00	.00	.00	0.	*	15	0900	181	.00	.00	.00	0.
7	2050	87	.00	.00	.00	0.	*	15	1055	182	.00	.00	.00	0.
7	2245	88	.00	.00	.00	0.	*	15	1250	183	.00	.00	.00	0.
8	0040	89	.00	.00	.00	0.	*	15	1445	184	.00	.00	.00	0.
8	0235	90	.00	.00	.00	0.	*	15	1640	185	.00	.00	.00	0.
8	0430	91	.00	.00	.00	0.	*	15	1835	186	.00	.00	.00	0.
8	0625	92	.00	.00	.00	0.	*	15	2030	187	.00	.00	.00	0.
8	0820	93	.00	.00	.00	0.	*	15	2225	188	.00	.00	.00	0.
8	1015	94	.00	.00	.00	0.	*	16	0020	189	.00	.00	.00	0.
8	1210	95	.00	.00	.00	0.	*	16	0215	190	.00	.00	.00	0.
							*							

****

TOTAL RAINFALL = 19.20, TOTAL LOSS = .00, TOTAL EXCESS = 19.20

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	362.25-HR
+ (CFS)	(HR)					
		(CFS)				
+ 4216.	3.83		3730.	2420.	1348.	268.
		(INCHES)	4.240	11.000	18.890	19.200
		(AC-FT)	1773.	4600.	7899.	8028.

CUMULATIVE AREA = 7.84 SQ MI

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              **************
              *            *
   37 KK      *      COMB  *        COMBINE INFLOW FROM SNOWMELD FLOOD, INFLOW1 AND INFLOW2
              *            *
              **************

   38 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

   39 HC          HYDROGRAPH COMBINATION
                        ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE
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HYDROGRAPH AT STATION COMB
SUM OF 3 HYDROGRAPHS

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	60.	4		2000	49	1168.	8		1600	97	303.	12		1200	145	92.

```
    1     0155    2     2174.   *    4     2155   50     1113.   *    8     1755   98      295.   *   12     1355  146       90.
    1     0350    3     4301.   *    4     2350   51     1059.   *    8     1950   99      288.   *   12     1550  147       89.
    1     0545    4     4340.   *    5     0145   52     1009.   *    8     2145  100      280.   *   12     1745  148       88.
    1     0740    5     3590.   *    5     0340   53      963.   *    8     2340  101      273.   *   12     1940  149       86.
    1     0935    6     2751.   *    5     0535   54      921.   *    9     0135  102      266.   *   12     2135  150       85.
    1     1130    7     2729.   *    5     0730   55      884.   *    9     0330  103      259.   *   12     2330  151       83.
    1     1325    8     2664.   *    5     0925   56      849.   *    9     0525  104      253.   *   13     0125  152       82.
    1     1520    9     2540.   *    5     1120   57      816.   *    9     0720  105      247.   *   13     0320  153       81.
    1     1715   10     2695.   *    5     1315   58      785.   *    9     0915  106      241.   *   13     0515  154       80.
    1     1910   11     2840.   *    5     1510   59      754.   *    9     1110  107      235.   *   13     0710  155       79.
    1     2105   12     2895.   *    5     1705   60      727.   *    9     1305  108      229.   *   13     0905  156       78.
    1     2300   13     3131.   *    5     1900   61      702.   *    9     1500  109      223.   *   13     1100  157       77.
    2     0055   14     3296.   *    5     2055   62      678.   *    9     1655  110      217.   *   13     1255  158       76.
    2     0250   15     3315.   *    5     2250   63      655.   *    9     1850  111      212.   *   13     1450  159       75.
    2     0445   16     3331.   *    6     0045   64      635.   *    9     2045  112      206.   *   13     1645  160       74.
    2     0640   17     3388.   *    6     0240   65      617.   *    9     2240  113      201.   *   13     1840  161       73.
    2     0835   18     3418.   *    6     0435   66      601.   *   10     0035  114      196.   *   13     2035  162       72.
    2     1030   19     3425.   *    6     0630   67      586.   *   10     0230  115      193.   *   13     2230  163       71.
    2     1225   20     3425.   *    6     0825   68      571.   *   10     0425  116      189.   *   14     0025  164       71.
    2     1420   21     3425.   *    6     1020   69      558.   *   10     0620  117      186.   *   14     0220  165       70.
    2     1615   22     3411.   *    6     1215   70      545.   *   10     0815  118      182.   *   14     0415  166       69.
    2     1810   23     3386.   *    6     1410   71      532.   *   10     1010  119      179.   *   14     0610  167       68.
    2     2005   24     3358.   *    6     1605   72      521.   *   10     1205  120      176.   *   14     0805  168       67.
    2     2200   25     3328.   *    6     1800   73      511.   *   10     1400  121      172.   *   14     1000  169       66.
    2     2355   26     3295.   *    6     1955   74      501.   *   10     1555  122      166.   *   14     1155  170       65.
    3     0150   27     3010.   *    6     2150   75      493.   *   10     1750  123      160.   *   14     1350  171       64.
    3     0345   28     2714.   *    6     2345   76      484.   *   10     1945  124      155.   *   14     1545  172       63.
    3     0540   29     2672.   *    7     0140   77      474.   *   10     2140  125      150.   *   14     1740  173       62.
    3     0735   30     2646.   *    7     0335   78      463.   *   10     2335  126      146.   *   14     1935  174       62.
    3     0930   31     2618.   *    7     0530   79      454.   *   11     0130  127      142.   *   14     2130  175       61.
    3     1125   32     2585.   *    7     0725   80      444.   *   11     0325  128      138.   *   14     2325  176       60.
    3     1320   33     2548.   *    7     0920   81      435.   *   11     0520  129      134.   *   15     0120  177       59.
    3     1515   34     2524.   *    7     1115   82      427.   *   11     0715  130      130.   *   15     0315  178       59.
    3     1710   35     2474.   *    7     1310   83      419.   *   11     0910  131      127.   *   15     0510  179       59.
    3     1905   36     2412.   *    7     1505   84      411.   *   11     1105  132      124.   *   15     0705  180       59.
    3     2100   37     2343.   *    7     1700   85      403.   *   11     1300  133      120.   *   15     0900  181       59.
    3     2255   38     2270.   *    7     1855   86      396.   *   11     1455  134      117.   *   15     1055  182       59.
    4     0050   39     2090.   *    7     2050   87      389.   *   11     1650  135      115.   *   15     1250  183       59.
    4     0245   40     1766.   *    7     2245   88      383.   *   11     1845  136      112.   *   15     1445  184       59.
    4     0440   41     1561.   *    8     0040   89      375.   *   11     2040  137      109.   *   15     1640  185       59.
    4     0635   42     1510.   *    8     0235   90      365.   *   11     2235  138      107.   *   15     1835  186       59.
    4     0830   43     1461.   *    8     0430   91      356.   *   12     0030  139      104.   *   15     2030  187       59.
    4     1025   44     1414.   *    8     0625   92      346.   *   12     0225  140      102.   *   15     2225  188       59.
    4     1220   45     1368.   *    8     0820   93      337.   *   12     0420  141      100.   *   16     0020  189       59.
    4     1415   46     1321.   *    8     1015   94      329.   *   12     0615  142       98.   *   16     0215  190       59.
    4     1610   47     1272.   *    8     1210   95      320.   *   12     0810  143       96.   *
    4     1805   48     1220.   *    8     1405   96      311.   *   12     1005  144       94.   *
                                  *                                *                                *
 ********************************************************************************************************************************

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR    362.25-HR
+   (CFS)       (HR)
                            (CFS)
+    4340.      5.75                 3841.       3376.       3006.         879.
                         (INCHES)    1.316       4.625      12.701       18.965
                          (AC-FT)    1825.       6416.      17619.       26308.

                          CUMULATIVE AREA =   26.01 SQ MI


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


            **************
            *            *
   40 KK    *       DAM  *         UNION PARK DAM
            *            *
            **************

   41 KO          OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

                HYDROGRAPH ROUTING DATA

   42 RS          STORAGE ROUTING
                        NSTPS           1  NUMBER OF SUBREACHES
                         ITYP        ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC    10120.00  INITIAL CONDITION
                            X         .00 WORKING R AND D COEFFICIENT

   43 SV            STORAGE          .0     168.0    3424.0   17987.0   51108.0  106801.0  186081.0  285452.0  403213.0  468383.0
                                537676.0  610886.0  687754.0  768073.0  851813.0  939113.0 1029878.0 1123992.0 1221505.0 1322413.0

   45 SE          ELEVATION     9600.00   9640.00   9680.00   9720.00   9760.00   9800.00   9840.00   9880.00   9920.00   9940.00
                                9960.00   9980.00  10000.00  10020.00  10040.00  10060.00  10080.00  10100.00  10120.00  10140.00

   47 SS          SPILLWAY
                         CREL    10139.00  SPILLWAY CREST ELEVATION
                        SPWID     2050.00  SPILLWAY WIDTH
                         COQW        2.63  WEIR COEFFICIENT
                         EXPW        1.50  EXPONENT OF HEAD

   48 ST          TOP OF DAM
                        TOPEL    10140.00  ELEVATION AT TOP OF DAM
                       DAMWID     2050.00  DAM WIDTH
                         COQD        2.63  WEIR COEFFICIENT
                         EXPD        1.50  EXPONENT OF HEAD
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COMPUTED OUTFLOW-ELEVATION DATA

(EXCLUDING FLOW OVER DAM)

OUTFLOW	.00	.00	.85	7.71	24.38	59.93	115.53	200.27	317.51	472.37
ELEVATION	9600.00	10139.00	10139.00	10139.01	10139.03	10139.05	10139.08	10139.11	10139.15	10139.20
OUTFLOW	673.94	924.25	1228.44	1596.90	2030.35	2533.94	3119.35	3786.02	4539.06	5391.50
ELEVATION	10139.25	10139.31	10139.37	10139.44	10139.52	10139.60	10139.69	10139.79	10139.89	10140.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	168.00	3424.00	17987.00	51108.00	106801.00	186081.00	285452.00	403213.00	468383.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9600.00	9640.00	9680.00	9720.00	9760.00	9800.00	9840.00	9880.00	9920.00	9940.00
STORAGE	537676.00	610886.00	687754.00	768073.00	851813.00	939113.00	1029878.00	1123992.00	1221505.00	1317368.00
OUTFLOW	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELEVATION	9960.00	9980.00	10000.00	10020.00	10040.00	10060.00	10080.00	10100.00	10120.00	10139.00
STORAGE	1317432.00	1317506.00	1317619.00	1317757.00	1317929.00	1318131.00	1318363.00	1318629.00	1318925.00	1319250.00
OUTFLOW	7.71	24.38	59.93	115.53	200.27	317.51	472.37	673.94	924.25	1228.44
ELEVATION	10139.01	10139.03	10139.05	10139.08	10139.11	10139.15	10139.20	10139.25	10139.31	10139.37
STORAGE	1319610.00	1319999.00	1320418.00	1320871.00	1321354.00	1321866.00	1322413.00			
OUTFLOW	1596.90	2030.35	2533.94	3119.35	3786.02	4539.06	5391.50			
ELEVATION	10139.44	10139.52	10139.60	10139.69	10139.79	10139.89	10140.00			

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HYDROGRAPH AT STATION DAM

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.1221	505.0	10120.0	6		0240	65	0.1243	722.0	10124.4	11		0520	129	0.1247	033.0	10125.1
1		0155	2	0.1221	682.0	10120.0	6		0435	66	0.1243	820.0	10124.4	11		0715	130	0.1247	052.0	10125.1
1		0350	3	0.1222	195.0	10120.1	6		0630	67	0.1243	914.0	10124.4	11		0910	131	0.1247	072.0	10125.1
1		0545	4	0.1222	880.0	10120.3	6		0825	68	0.1244	007.0	10124.5	11		1105	132	0.1247	092.0	10125.1
1		0740	5	0.1223	505.0	10120.4	6		1020	69	0.1244	096.0	10124.5	11		1300	133	0.1247	111.0	10125.1
1		0935	6	0.1224	008.0	10120.5	6		1215	70	0.1244	185.0	10124.5	11		1455	134	0.1247	131.0	10125.1
1		1130	7	0.1224	442.0	10120.6	6		1410	71	0.1244	268.0	10124.5	11		1650	135	0.1247	151.0	10125.1
1		1325	8	0.1224	870.0	10120.7	6		1605	72	0.1244	352.0	10124.5	11		1845	136	0.1247	171.0	10125.1
1		1520	9	0.1225	284.0	10120.7	6		1800	73	0.1244	436.0	10124.5	11		2040	137	0.1247	190.0	10125.1
1		1715	10	0.1225	698.0	10120.8	6		1955	74	0.1244	515.0	10124.6	11		2235	138	0.1247	205.0	10125.1
1		1910	11	0.1226	137.0	10120.9	6		2150	75	0.1244	594.0	10124.6	12		0030	139	0.1247	220.0	10125.1
1		2105	12	0.1226	590.0	10121.0	6		2345	76	0.1244	673.0	10124.6	12		0225	140	0.1247	235.0	10125.1
1		2300	13	0.1227	068.0	10121.1	7		0140	77	0.1244	746.0	10124.6	12		0420	141	0.1247	249.0	10125.1
2		0055	14	0.1227	575.0	10121.2	7		0335	78	0.1244	820.0	10124.6	12		0615	142	0.1247	264.0	10125.1
2		0250	15	0.1228	098.0	10121.3	7		0530	79	0.1244	894.0	10124.6	12		0810	143	0.1247	279.0	10125.1
2		0445	16	0.1228	625.0	10121.4	7		0725	80	0.1244	963.0	10124.6	12		1005	144	0.1247	294.0	10125.1
2		0640	17	0.1229	157.0	10121.5	7		0920	81	0.1245	032.0	10124.7	12		1200	145	0.1247	309.0	10125.1
2		0835	18	0.1229	694.0	10121.6	7		1115	82	0.1245	101.0	10124.7	12		1355	146	0.1247	323.0	10125.1
2		1030	19	0.1230	236.0	10121.7	7		1310	83	0.1245	170.0	10124.7	12		1550	147	0.1247	338.0	10125.1
2		1225	20	0.1230	778.0	10121.8	7		1505	84	0.1245	234.0	10124.7	12		1745	148	0.1247	353.0	10125.1
2		1420	21	0.1231	320.0	10121.9	7		1700	85	0.1245	298.0	10124.7	12		1940	149	0.1247	368.0	10125.1
2		1615	22	0.1231	862.0	10122.1	7		1855	86	0.1245	362.0	10124.7	12		2135	150	0.1247	382.0	10125.1
2		1810	23	0.1232	399.0	10122.2	7		2050	87	0.1245	426.0	10124.7	12		2330	151	0.1247	397.0	10125.1
2		2005	24	0.1232	931.0	10122.3	7		2245	88	0.1245	485.0	10124.8	13		0125	152	0.1247	412.0	10125.1
2		2200	25	0.1233	458.0	10122.4	8		0040	89	0.1245	545.0	10124.8	13		0320	153	0.1247	427.0	10125.1
2		2355	26	0.1233	981.0	10122.5	8		0235	90	0.1245	604.0	10124.8	13		0515	154	0.1247	442.0	10125.1
3		0150	27	0.1234	478.0	10122.6	8		0430	91	0.1245	663.0	10124.8	13		0710	155	0.1247	456.0	10125.1
3		0345	28	0.1234	932.0	10122.7	8		0625	92	0.1245	717.0	10124.8	13		0905	156	0.1247	471.0	10125.1
3		0540	29	0.1235	360.0	10122.7	8		0820	93	0.1245	771.0	10124.8	13		1100	157	0.1247	481.0	10125.1
3		0735	30	0.1235	779.0	10122.8	8		1015	94	0.1245	825.0	10124.8	13		1255	158	0.1247	491.0	10125.2
3		0930	31	0.1236	198.0	10122.9	8		1210	95	0.1245	875.0	10124.8	13		1450	159	0.1247	501.0	10125.2
3		1125	32	0.1236	612.0	10123.0	8		1405	96	0.1245	924.0	10124.8	13		1645	160	0.1247	511.0	10125.2
3		1320	33	0.1237	021.0	10123.1	8		1600	97	0.1245	973.0	10124.8	13		1840	161	0.1247	520.0	10125.2
3		1515	34	0.1237	425.0	10123.2	8		1755	98	0.1246	023.0	10124.9	13		2035	162	0.1247	530.0	10125.2
3		1710	35	0.1237	819.0	10123.2	8		1950	99	0.1246	067.0	10124.9	13		2230	163	0.1247	540.0	10125.2
3		1905	36	0.1238	208.0	10123.3	8		2145	100	0.1246	111.0	10124.9	14		0025	164	0.1247	550.0	10125.2
3		2100	37	0.1238	583.0	10123.4	8		2340	101	0.1246	156.0	10124.9	14		0220	165	0.1247	560.0	10125.2
3		2255	38	0.1238	947.0	10123.5	9		0135	102	0.1246	200.0	10124.9	14		0415	166	0.1247	570.0	10125.2
4		0050	39	0.1239	292.0	10123.5	9		0330	103	0.1246	239.0	10124.9	14		0610	167	0.1247	580.0	10125.2
4		0245	40	0.1239	598.0	10123.6	9		0525	104	0.1246	279.0	10124.9	14		0805	168	0.1247	589.0	10125.2
4		0440	41	0.1239	859.0	10123.6	9		0720	105	0.1246	318.0	10124.9	14		1000	169	0.1247	599.0	10125.2
4		0635	42	0.1240	100.0	10123.7	9		0915	106	0.1246	358.0	10124.9	14		1155	170	0.1247	609.0	10125.2
4		0830	43	0.1240	337.0	10123.7	9		1110	107	0.1246	397.0	10124.9	14		1350	171	0.1247	619.0	10125.2
4		1025	44	0.1240	563.0	10123.8	9		1305	108	0.1246	432.0	10124.9	14		1545	172	0.1247	629.0	10125.2
4		1220	45	0.1240	785.0	10123.8	9		1500	109	0.1246	466.0	10124.9	14		1740	173	0.1247	639.0	10125.2
4		1415	46	0.1240	997.0	10123.9	9		1655	110	0.1246	500.0	10125.0	14		1935	174	0.1247	649.0	10125.2
4		1610	47	0.1241	204.0	10123.9	9		1850	111	0.1246	535.0	10125.0	14		2130	175	0.1247	658.0	10125.2
4		1805	48	0.1241	401.0	10123.9	9		2045	112	0.1246	569.0	10125.0	14		2325	176	0.1247	668.0	10125.2
4		2000	49	0.1241	588.0	10124.0	9		2240	113	0.1246	604.0	10125.0	15		0120	177	0.1247	678.0	10125.2
4		2155	50	0.1241	770.0	10124.0	10		0035	114	0.1246	634.0	10125.0	15		0315	178	0.1247	688.0	10125.2
4		2350	51	0.1241	943.0	10124.1	10		0230	115	0.1246	663.0	10125.0	15		0510	179	0.1247	698.0	10125.2
5		0145	52	0.1242	105.0	10124.1	10		0425	116	0.1246	693.0	10125.0	15		0705	180	0.1247	708.0	10125.2
5		0340	53	0.1242	263.0	10124.1	10		0620	117	0.1246	722.0	10125.0	15		0900	181	0.1247	717.0	10125.2
5		0535	54	0.1242	411.0	10124.1	10		0815	118	0.1246	752.0	10125.0	15		1055	182	0.1247	727.0	10125.2
5		0730	55	0.1242	554.0	10124.2	10		1010	119	0.1246	781.0	10125.0	15		1250	183	0.1247	737.0	10125.2
5		0925	56	0.1242	692.0	10124.2	10		1205	120	0.1246	811.0	10125.0	15		1445	184	0.1247	747.0	10125.2
5		1120	57	0.1242	825.0	10124.2	10		1400	121	0.1246	840.0	10125.0	15		1640	185	0.1247	757.0	10125.2
5		1315	58	0.1242	953.0	10124.3	10		1555	122	0.1246	865.0	10125.0	15		1835	186	0.1247	767.0	10125.2
5		1510	59	0.1243	076.0	10124.3	10		1750	123	0.1246	890.0	10125.0	15		2030	187	0.1247	777.0	10125.2
5		1705	60	0.1243	194.0	10124.3	10		1945	124	0.1246	914.0	10125.0	15		2225	188	0.1247	786.0	10125.2
5		1900	61	0.1243	308.0	10124.3	10		2140	125	0.1246	939.0	10125.0	16		0020	189	0.1247	796.0	10125.2
5		2055	62	0.1243	416.0	10124.3	10		2335	126	0.1246	964.0	10125.0	16		0215	190	0.1247	806.0	10125.2

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   5     2250  63       0.1243520.0 10124.4 * 11     0130 127       0.1246988.0 10125.1 *
   6     0045  64       0.1243623.0 10124.4 * 11     0325 128       0.1247013.0 10125.1 *
                                            *                                              *
 ***********************************************************************************************************************

 PEAK OUTFLOW IS        0. AT TIME    .00 HOURS


  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR    362.25-HR
+   (CFS)       (HR)
                         (CFS)
+       0.       .00                 0.          0.          0.           0.
                       (INCHES)     .000        .000        .000         .000
                        (AC-FT)      0.          0.          0.           0.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR    362.25-HR
+  (AC-FT)      (HR)
  1247806.    362.25             1247792.    1247747.    1247623.     1242757.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR    362.25-HR
+   (FEET)      (HR)
  10125.21    362.25             10125.21    10125.21    10125.18     10124.21

                       CUMULATIVE AREA =   26.01 SQ MI

1
                                                   RUNOFF SUMMARY
                                              FLOW IN CUBIC FEET PER SECOND
                                            TIME IN HOURS,  AREA IN SQUARE MILES

                                     PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
         OPERATION       STATION     FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                        6-HOUR     24-HOUR     72-HOUR

         HYDROGRAPH AT
+                        SNOWME      200.  166.75         200.        197.        182.        .00

         HYDROGRAPH AT
+                        INFLO1     2294.   34.50        2293.       2237.       1841.      18.17

         HYDROGRAPH AT
+                        INFLO2     4216.    3.83        3730.       2420.       1348.       7.84

         3 COMBINED AT
+                          COMB     4340.    5.75        3841.       3376.       3006.      26.01

         ROUTED TO
+                          DAM         0.     .00           0.          0.          0.      26.01
+                                                                                                          10125.21      362.25
1                                 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION      DAM
                             (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)


      PLAN  1 ...............                 INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                                   ELEVATION       10120.00          10139.00         10140.00
                                   STORAGE         1221505.          1317368.         1322413.
                                   OUTFLOW               0.                0.            5392.


                      RATIO     MAXIMUM      MAXIMUM    MAXIMUM    MAXIMUM    DURATION     TIME OF     TIME OF
                        OF     RESERVOIR      DEPTH     STORAGE    OUTFLOW    OVER TOP   MAX OUTFLOW   FAILURE
                       PMF      W.S.ELEV    OVER DAM     AC-FT       CFS       HOURS        HOURS       HOURS

                      1.00     10125.21         .00    1247806.         0.       .00          .00         .00


 *** NORMAL END OF HEC-1 ***
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