DR-65
#314

HYDRAULIC DRAINAGE STUDY

For

19th Ave. and Unser Blvd. Box Culverts – Extension under Westside Blvd.

for

CURB NORTH, INC
5160 SAN FRANCISCO NE
ALBUQUERQUE, NEW MEXICO 87109

June 5, 2007

Prepared By:

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HYDRAULIC DRAINAGE STUDY
FOR
19th Ave. and Unser Blvd. Box Culverts – Extension under Westside Blvd.

PURPOSE

This drainage report proposes to convey the storm water discharge from the existing concrete box culvert (CBC) at 19th Ave. and Unser Blvd. through an extension under Westside Blvd. to a surface channel conveyance. The developer intends to fill the existing arroyo for use as development. This report will demonstrate that the proposed stormwater conveyance system is capable of safely conveying the recommended flowrates from the Black Arroyo Watershed Management Plan (WMP) (August, 2002, ASCG Incorporated).

PROJECT LOCATION

Exhibit 1 – Vicinity Map

The project is located north of the intersection of 19th Ave. and Unser Blvd, and is part of the master planned Cabezon development. The site is currently undeveloped and in its natural condition. The existing CBC at the Unser Blvd. crossing is a four-barrel ten foot span by eight foot height culvert (4-10'x8' CBC).

RELATED REPORTS

The Black Arroyo Watershed Management Plan (August, 2002, ASCG Incorporated) provides the following data concerning the existing CBC crossing:

- Estimated Capacity w/ 2" FB (cfs): **2680**
- FEMA Hydrology (Existing Conditions) (cfs): 2687
- DEVEX FLOW 100 yr 6 hr (cfs): 5143
- DEVEX FLOW 100 yr 24 hr (cfs) 5105

This report and plans titled "Westside Blvd. Crossing of the West Branch Arroyo Concrete Box Culvert" are designed for 2680 cfs.

FLOOD HAZARD ZONES

Per FEMA's Flood Insurance Rate Map (FIRM) 35043C0894 C, dated July 16, 1996, the project site includes FEMA 100-year Flood Hazard Zone (Zone AE, Base Flood Elevations Determined). See **Exhibit 2**.

JURISDICTIONS OF PUBLIC AGENCIES

Local

This project is located entirely within the City of Rio Rancho (CoRR) Municipal Limits and is therefore within their jurisdiction and must comply with the City's development requirements.

Regional

This project is located within the jurisdiction of the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) and is therefore subject to their review.

METHODOLOGY

This report analyzes a proposed extension of the existing CBC under Unser Blvd. The extension was analyzed by two methods as follows:

Analysis 1: The system was analyzed using HEC-RAS software.

Analysis 2: The system was analyzed using STORMCAD software. The hydraulic model included junctions at the connection between the existing CBC and the proposed CBC, and at the 45 degree bend of the proposed CBC.

The design flowrate used for both Analysis 1 & 2 is 2680 cfs, the "Estimated Capacity w/ 2' Freeboard" from the WMP. CulvertMaster was used to verify this value (page **A-1**), and this report concurs that the existing structure is capable of 2680 cfs.

RESULTS

Analysis 1

The hydraulic model includes cross sections upstream of the existing CBC and downstream of the proposed CBC. The results are shown on page **A-2** and **A-3**. As shown on these pages the proposed CBC will adequately convey 2680 cfs.

Analysis 2

The hydraulic model includes a junction to model the 45 degree bend. The headloss calculations are shown on page **A-6**. An absolute headloss of 1.8 ft was assigned to the 45 degree bend in the proposed CBC. The results of this analysis are shown graphically on page **A-5**. As shown on this page the proposed CBC will adequately convey 2680 cfs.

CONCLUSION

This report recommends that the proposed CBC extension will safely and effectively convey the WMP design event (2680 cfs) through the design reach. A downstream conveyance will be required, but design or analysis of downstream conveyance is currently beyond the scope of this report.

Four 10'x8' concrete box culverts will be required. A plan view of the proposed pipe system layout is presented on page **A-4**.

Culvert Calculator Report
Worksheet-1

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5,281.50	ft	Headwater Depth/Height	1.06	
Computed Headwater Elev	5,281.50	ft	Discharge	2,778.18	cfs
Inlet Control HW Elev.	5,281.37	ft	Tailwater Elevation	5,270.00	ft
Outlet Control HW Elev.	5,281.50	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	5,273.00	ft	Downstream Invert	5,270.00	ft
Length	121.00	ft	Constructed Slope	0.024793	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	3.40	ft
Slope Type	Steep		Normal Depth	2.67	ft
Flow Regime	Supercritical		Critical Depth	5.31	ft
Velocity Downstream	20.41	ft/s	Critical Slope	0.003705	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 8 ft		Rise	8.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	5,281.50	ft	Upstream Velocity Head	2.66	ft
Ke	0.20		Entrance Loss	0.53	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,281.37	ft	Flow Control	Unsubmerged	
Inlet Type	90° headwall w 45° bevels		Area Full	320.0	ft²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

A-1

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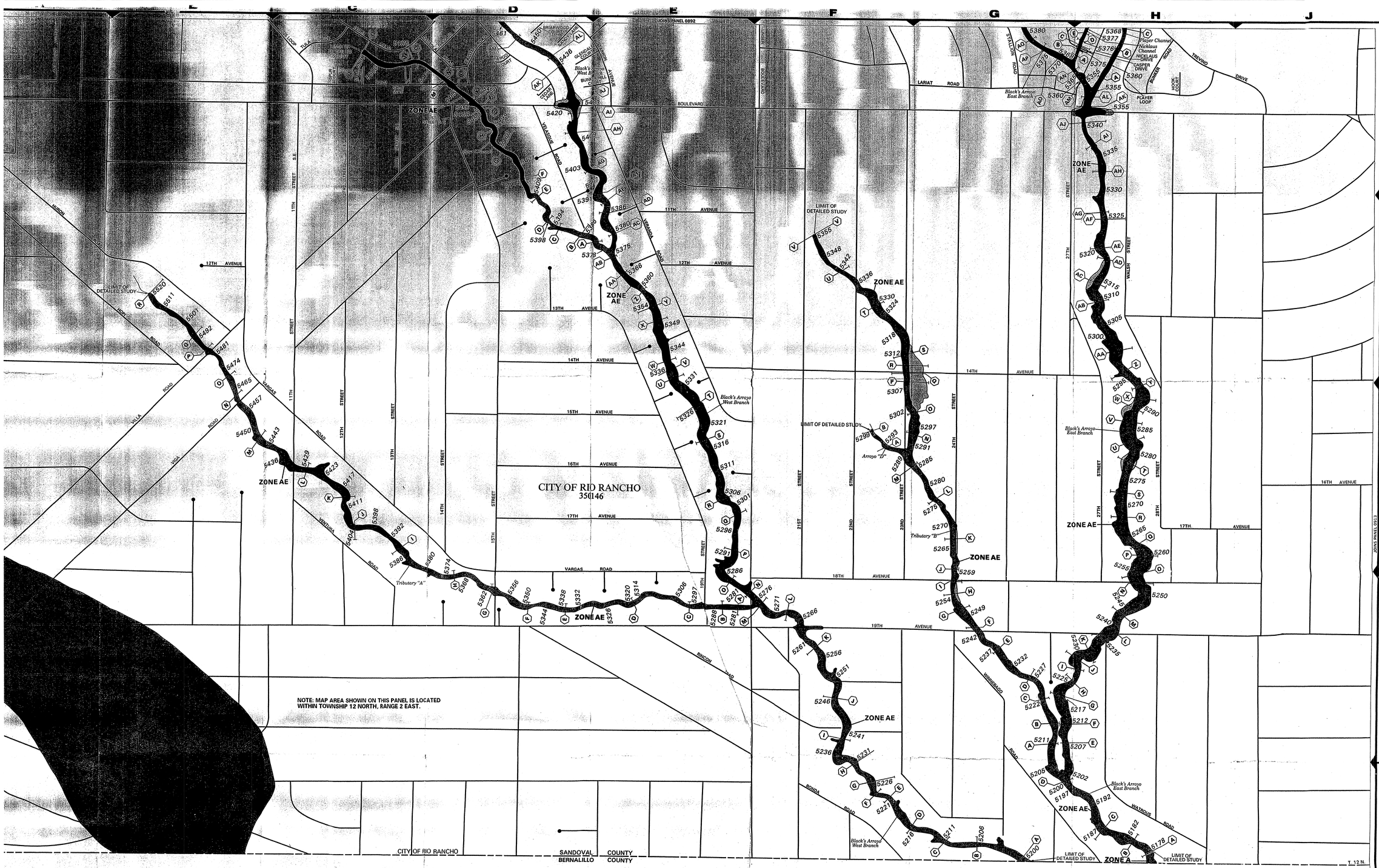
37 Brookside Road Waterbury, CT 06708 USA +1-203-755-1666



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

$RM7_X$ — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of the map.

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels see separately printed Map Index

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
JULY 16, 1996

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SANDOVAL COUNTY, NEW MEXICO AND INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
RIO RANCHO, CITY OF	350146	0894	C

MAP NUMBER
35043C0894 C

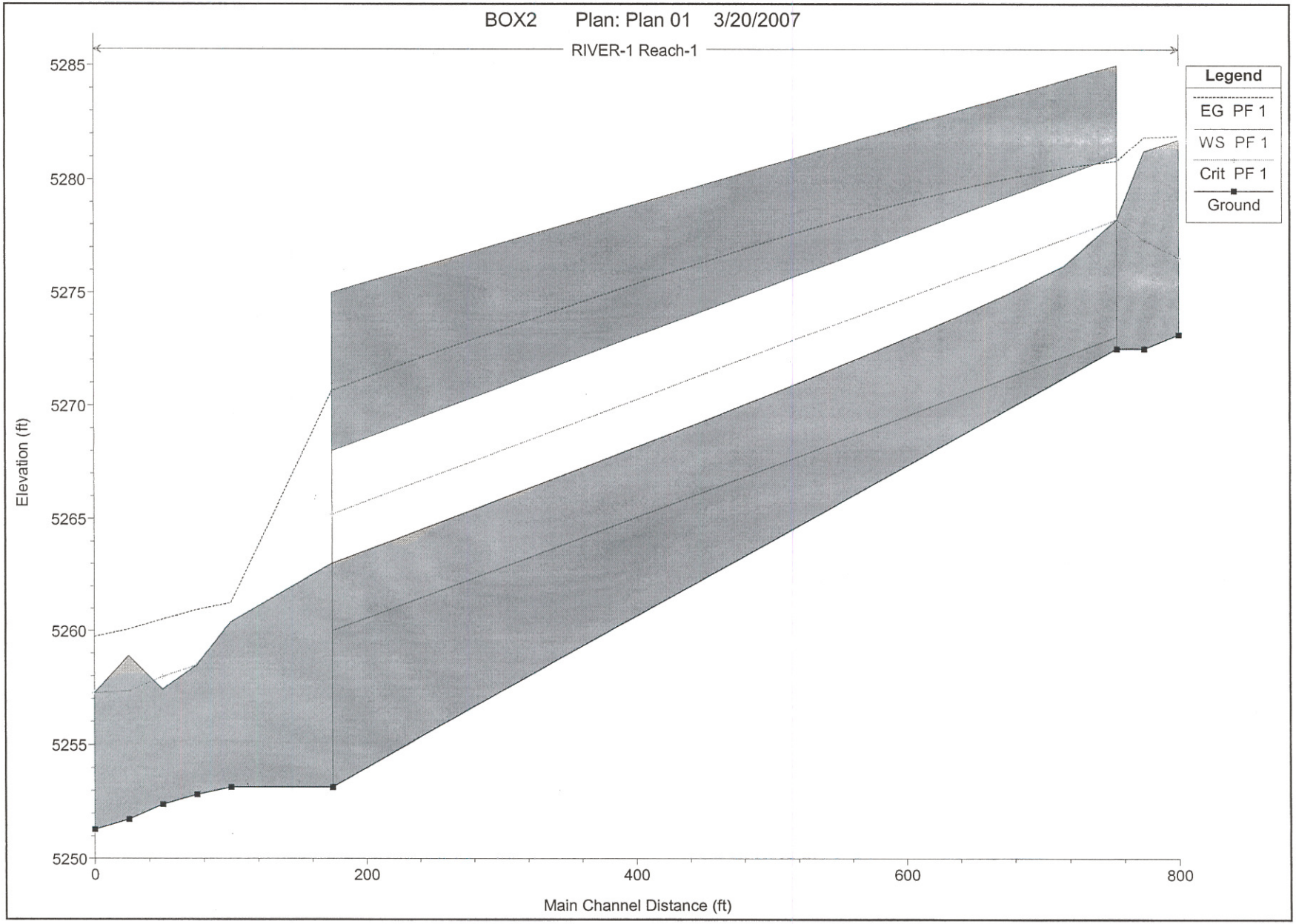
EFFECTIVE DATE:
JULY 16, 1996

Federal Emergency Management Agency

EXHIBIT 2

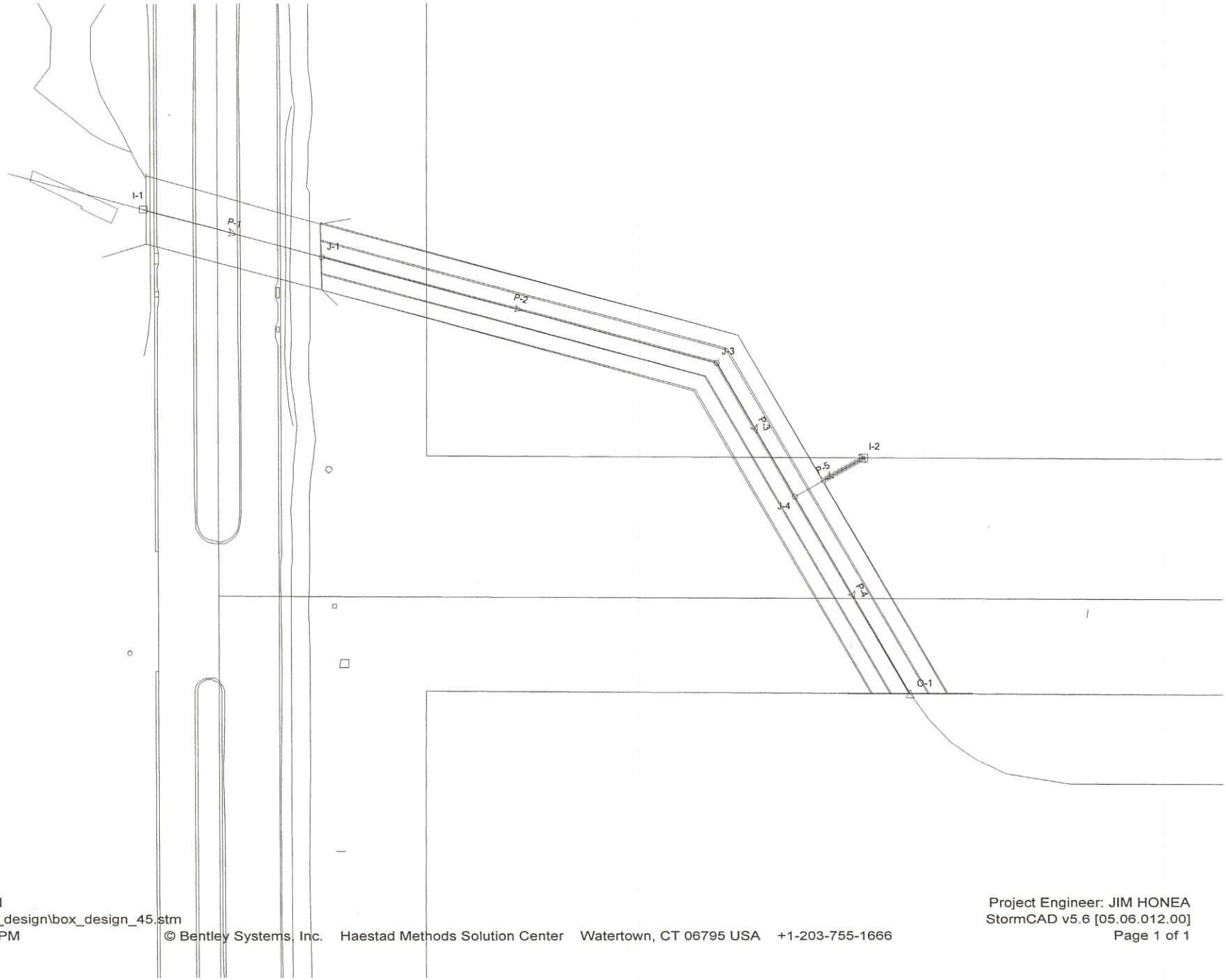
HEC-RAS Plan: R1 River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	33	PF 1	2680.00	5273.10	5281.72	5276.52	5281.88	0.000571	2.98	825.44	133.60	0.22
Reach-1	32	PF 1	2680.00	5272.49	5281.21	5277.28	5281.81	0.002013	5.66	433.20	65.83	0.42
Reach-1	31		Culvert									
Reach-1	5	PF 1	2680.00	5253.15	5260.39		5261.24	0.003293	7.43	360.92	63.93	0.55
Reach-1	4	PF 1	2680.00	5252.83	5258.47	5258.47	5260.94	0.012246	12.62	212.30	43.43	1.01
Reach-1	3	PF 1	2680.00	5252.40	5257.42	5257.97	5260.52	0.017897	14.13	189.71	43.54	1.19
Reach-1	2	PF 1	2680.00	5251.75	5258.88	5257.33	5260.06	0.005005	8.70	307.88	56.57	0.66
Reach-1	1	PF 1	2680.00	5251.30	5257.24	5257.24	5259.74	0.012976	12.67	211.51	42.72	1.00


BOX2 Plan: Plan 01 3/20/2007
RIVER-1 Reach-1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
5285
5280
5275
5270
5265
5260
5255
5250
0
200
400
600
800
Main Channel Distance (ft)

A-3

Scenario: Base



A-5

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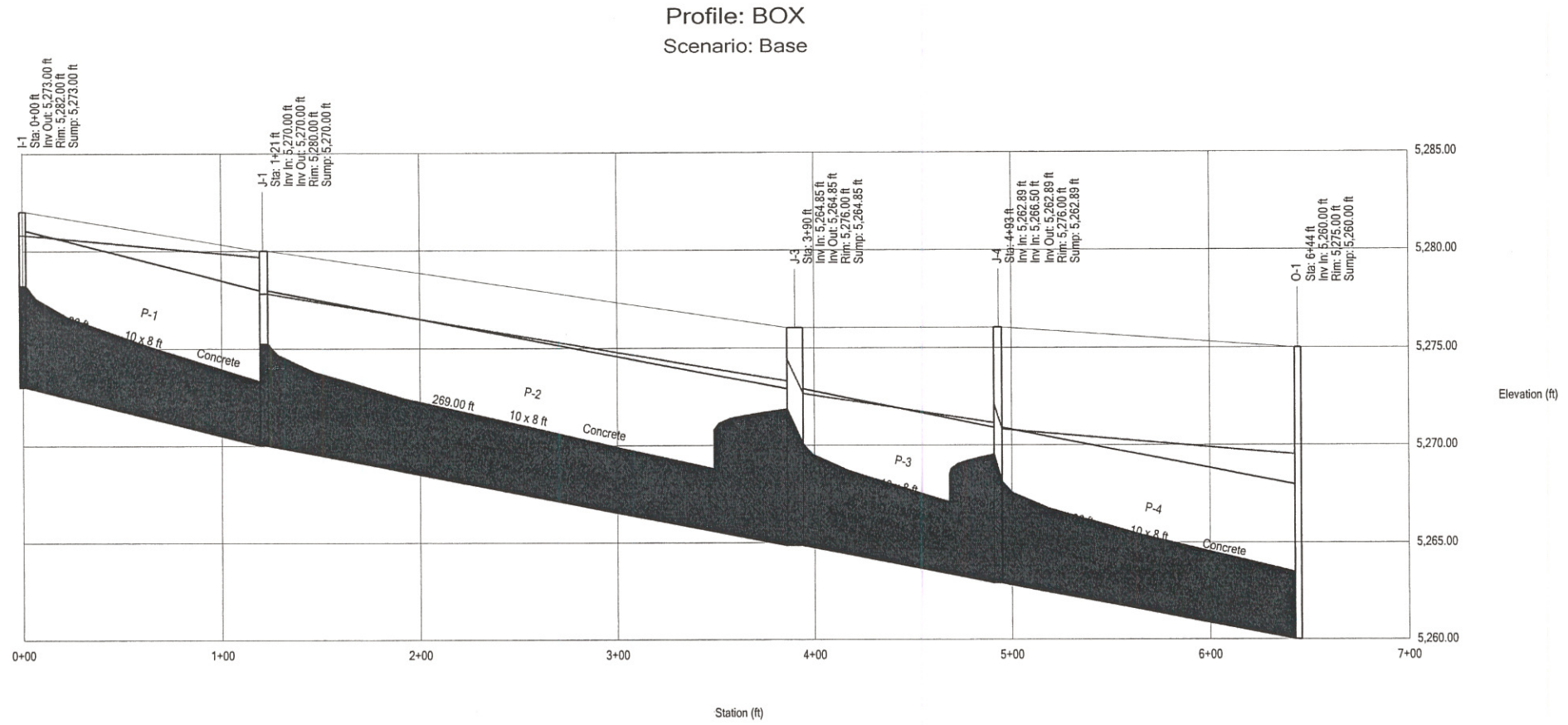
Project Engineer: JIM HONEA
StormCAD v5.6 [05.06.012.00]

Profile
Scenario: Base



A-5

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Project Engineer: JIM HONEA
StormCAD v5.6 [05.06.012.00]

Bend Losses

V = velocity = 25.53 ft/s

g = gravitational constant = 32.2 ft/s^2

ϕ = central angle of bend in degrees = 45°

$$H_b = k_b \frac{V^2}{2g}$$

$$k_b = 0.25\sqrt{\frac{\phi}{90}}$$

$$k_b = 0.25\sqrt{\frac{45}{90}} = 0.177$$

$$H_b = 0.177 \frac{(25.53)^2}{2(32.2)} = \underline{1.08}$$