City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

August 2, 1999

Kevin Patton, P.E.
Bohannan-Huston, Inc.
7500 Jefferson NE
Albuquerque, New Mexico 87109

RE: ***Drainage Report for the High Desert Street Culvert Crossing, (E23/D6) Submitted for Work Order Approval, and Grading and Paving Permit Approval, Engineer's Stamp Dated 7/8/99.***

Dear Mr. Patton:

Based on the information provided in the submittal of July 8, 1999, the above referenced design report for the culvert crossing at High Desert Street is approved for the change order to the Work Order plans.

Please have the change order construction plans for this culvert crossing routed to me for signature. These improvements will be done with city Project # 6078681, therefore, separate Grading and Paving permits may not be required.

If you have any questions, or if I may be of further assistance to you, please call me at 924-3982.

Sincerely,

Susan M. Calongne, P.E.
City/County Floodplain Administrator

c: Jack Eichorn, High Desert Investment Corp.
Terri Martin, City Project # 6078681
File

DRAINAGE REPORT
TO SUPPORT THE
HIGH DESERT STREET CULVERT CROSSING

July 7, 1999

PREPARED BY:

BOHANNAN HUSTON, INC.
COURTYARD I
7500 JEFFERSON STREET NE
ALBUQUERQUE, NM 87109

PREPARED FOR:

HIGH DESERT INVESTMENT CORPORATION
13000 ACADEMY ROAD NE
ALBUQUERQUE, NM. 87111

PREPARED BY:

Yolanda Padilla 7/8/99
Yolanda Padilla, E.I. Date

UNDER THE SUPERVISION OF:

Kevin Patton 7/8/99
Kevin Patton, P.E. Date

KEVIN G. PATTON
NEW MEXICO
13685
REGISTERED PROFESSIONAL ENGINEER

P:\99397\CDP\REPORTS\99397DRAINRPT.DOC

I. PURPOSE

The purpose of this report is to provide support for the culvert crossing at High Desert Street. This includes, the culvert crossing analysis, erosion control analysis, prudent line analysis, and existing pond capacity.

This report will reference the following City of Albuquerque and the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) approved studies prepared for the High Desert Development: 1) the *High Desert Drainage Management Master Plan*, dated December 1993; 2) *Drainage Report for High Desert –Tract 14A The Overlook*, dated June 12, 1998; 3) *Final High Desert Phase I Hydrology and Design Drainage Report*, dated March 1994; and 4) *Master Drainage Report for Desert Mountain at High Desert (Phase One and Two)*, dated December, 1998.

The *High Desert Drainage Management Master Plan*, dated December 1993, was prepared to support future drainage plans submitted for the development of individual land parcels within High Desert and to provide design guidance for the design of primary drainage infrastructure to be constructed by High Desert in advance of or simultaneously with individual parcel development. In addition, it provides fully developed flow rates for basins that influence the Highlands Subdivision in the High Desert Development.

The *Drainage Report for High Desert-Tract 14A The Overlook*, dated June 12, 1998, was prepared to support the development of The Overlook Phase 1 & 2. In this report it is shown that in Phase 2 Basin B1 will drain to the southwest down a cobblestone rundown and into Basin 1R.

The *Final High Desert Phase I Hydrology an Design Drainage Report*, dated March 1994, was prepared to provide supplementary hydrology and drainage infrastructure design documentation to the "Drainage Management Master Plan for High Desert Subdivision", dated November 1993. This report documents the hydrological and hydraulic data for the drainage infrastructure design, which include all ponds. In this report it stated that Pond #3 has a 100-year design flow-rate of 404-cfs.

The *Master Drainage Report for Desert Mountain at High Desert (Phase One and Two)*, dated December 1998, was prepared t support the development of Desert Mountain Phase One and Two. In this report it shows that all lots on the south side of the tract boundary will drain into SlateRidge Place and not into Basin C.

II. PRUDENT LINES

The concept of the "prudent line" was established by AMAFCA. The prudent line represents the minimum setback necessary to provide protection for development from an active arroyo. The prudent line concept encompasses not only the flood plain necessary to pass the 100-year storm, but also represents the potential for natural arroyos to move laterally and degrade over time. The long-term effects are based on potential erosion associated with "representative" storm events occurring for a 30-year period. Prudent lines established for this analysis are shown on the drainage basin map (Exhibit 1). The prudent lines were established by offsetting the swale centerline of Basin C by 43.5' on both sides. By doing this, it caused a portion of the prudent line in some areas to cross over the existing easement/tract boundary and into Tract 11 (Desert Mountain Subdivision). This additional easement was granted in the Tract 11 Bulk Land Plat, see Exhibit 5. For analysis on the prudent lines see Appendix E.

III. METHODOLOGIES

Please refer to the above referenced reports for the specific methodologies used in preparing those individual reports or plans.

Site conditions are analyzed for a 100-year, 6-hour storm events in accordance with the City of Albuquerque Drainage Ordinance and the Development Process Manual (DPM), Volume 2, Design Criteria, Section 22.2, Hydrology for the City of Albuquerque, January 1993. The modified rational method contained within this edition of the Development Process Manual (DPM) was utilized to determine the hydrologic discharges and volumes generated by this development.

Part A of the DPM, Section 22.2, which provides a simplified procedure for projects with sub-basins smaller than 40 acres, was used. Although some of the basins exceed 40 acres, we believe the simplified procedure provided in the City of Albuquerque Development Processing Manual will generate a more conservative flow rate, which will be compared to those calculated in the Master Plan.

IV. SITE LOCATION AND CHARACTERISTICS

For location of the site, please refer to the vicinity map on the grading and drainage plan enclosed with this report. This site consists of the basins which feed the Pond #3 located northeast of the Imperata/Spain intersection. These basins are Basin B1 located in the southern most part of The Overlook Phase 2; Basin 1R which is located directly south of The Overlook Phase 2; Basin A-1 which is located south of Basin 1R and east of High Desert Street; Basin A-2 which is a portion of High Desert Street directly over the culvert; and Basin C which is south of Tract 11, Desert Mountain Subdivision, and north of Spain Road.

Vegetation consists primarily of prairie grasses and a few juniper trees. Slopes in the project site range from 2% to 15%, with the majority of the project sloping at 2% to 8%. The Soil Conservation Service has classified the soils on this site as Embudo-Tijeras complex, Embudo gravely fine sandy loam and Tijeras gravely fine sandy loam, all of which correspond to a common hydrological soil group classification B.

V. EXISTING HYDROLOGIC AND SITE DRAINAGE CONDITIONS

The above referenced reports support the development in and around the above-mentioned site. The above reports also provide existing and developed flow rates, which will flow through the culvert and into the existing pond.

The existing flow rates for the area within and around this site will vary due to the ongoing construction of individual lots within The Overlook and The Desert Mountains Subdivisions. Thus, this report will focus on the fully developed conditions, and how it will affect the proposed culvert, erosion control and existing pond.

VI. DEVELOPED HYDROLOGICAL AND HYDRAULIC CONDITIONS

Please refer to the *High Desert Drainage Management Master Plan*, dated December 1993 and the Grading and Drainage plans enclosed with this report.

Pond #3 can currently handle a 100-year flow-rate of 404-cfs. This pond will be feed by the new culvert just under High Desert Street north of Spain Road, the upstream basin and a portion of High Desert Street itself. The Bear Arroyo/Bear Canyon Arroyo Training Dike just upstream of Basin 1R diverts any flow from west of the dike from flowing into the basins in this analysis, see Exhibit 6.

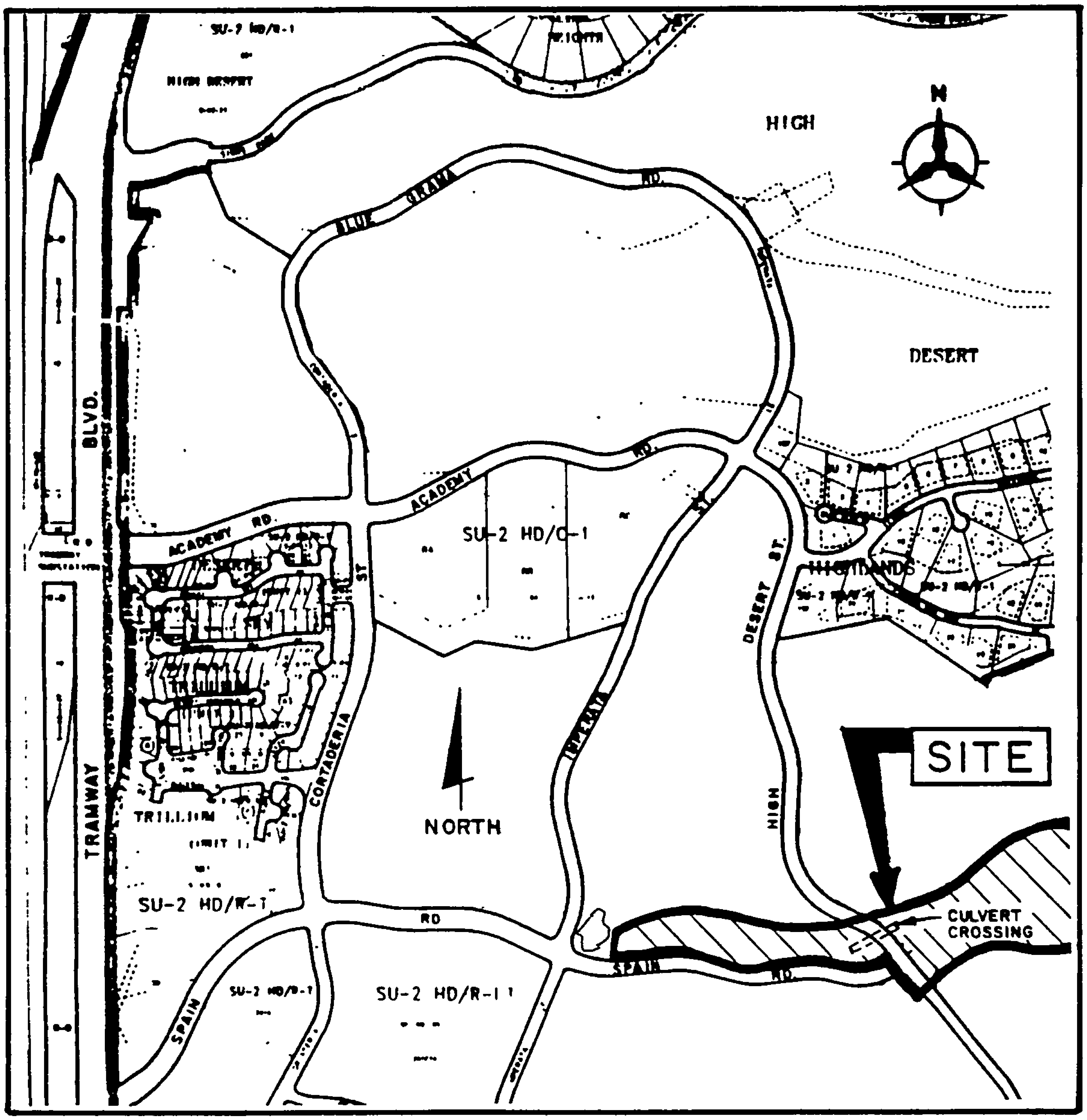
A portion of The Overlook Phase 2, Basin B1, discharges 23.45-cfs of fully developed flow down a cobblestone rundown and into Basin 1R, through the culvert and into Pond #3, see Exhibit 2. However, no portion of Tract 11, Desert Mountain, discharges into Basin C. All the runoff from this tract flows toward SlateRidge Place, which is then collected by inlets and a storm drain and carried down Imperata Street, down Spain Road, and out past Tramway Boulevard. Basin A-1 discharges 3.39-cfs into Basin A-2, which has a runoff of 3.26-cfs. The total 6.65-cfs flow is collected by inlets just above the culvert at High Desert Street and then carried to Pond #3.

Our analysis determined that three 36" RCP culverts would be required, see Appendix C. The headwall used will be NMSHTD Serial H-1-61. Our analysis determined that the erosion control required would be a 22" wide concrete apron along with 9" dumped riprap 20' long, 19' wide, and 4' deep will be used. See Appendix D for details of headwall and erosion control analysis.

VII. CONCLUSION

As stated above, currently pond #3 has been designed and constructed to handle a 100-year runoff of 404-cfs. The fully developed contributing basins have a combined 100-year flow of 99.40-cfs, thus the existing pond is adequate.

The primary goal of this drainage plan is to provide sound and innovative drainage management schemes. The utilization of drainage schemes outlined in this report accomplishes this goal in a safe and adequate manner.



VICINITY MAP	NO SCALE	ZONE ATLAS E-23

LEGAL DESCRIPTION
HIGH DESERT STREET CULVERT CROSSING

A-1/1

PROPOSED CONDITIONS TO SUPPORT
THE CULVERT CROSSING AT HIGH DESERT STREET
Jul-99

BASIN ID	AREA (ACRES)	% LAND TREATMENT* A	B	C	D	PEAK DISCHARGE - (CFS/ACRE)** A	B	C	D	Q(100-YR) DEVELOPED (CFS)
B1***	7.44	63.20	6.00	2.00	28.80	2.20	2.92	3.73	5.25	23.45
1R***	22.57	90.00	8.00	0.00	2.00	2.20	2.92	3.73	5.25	52.33
A-1	1.49	90.00	10.00	0.00	0.00	2.20	2.92	3.73	5.25	3.39
A-2	0.65	0.00	10.00	0.00	90.00	2.20	2.92	3.73	5.25	3.26
C	7.47	90.00	10.00	0.00	0.00	2.20	2.92	3.73	5.25	16.97
TOTAL	39.62									99.40

NOTES:

1. Obtained from Section 22.2, Hydrology of the Development Process Manual, Volume 2, Design Criteria for the City of Albuquerque, January , 1993.
   * Table A-4 and adjusted from the High Desert Drainage Master Plan
   ** Table A-9
   *** Obtained and modified from _Drainage Report for High Desert - Tract 14A The Overlook @ High Desen_

B-11

Culverts under High Desert Street

- Station = 27+00 (High Desert Street)
- upstream invert = 6171.2'
  (based on 2' contour interval mapping)
- Total Q_{100} = 82 cfs (includes bulking)
- 3-36" diameter culverts suggested
  - RCP
  - $\frac{82}{3} \triangleq 28$ cfs per culvert
  - assumed groove end with headwall
  - HW = 2.4' (based on inlet control of pipes)

3-36" RCP

Clearance- Invert to Edge Rd = 5'

- HW elevation = 6171.2' + 2.4' = 6173.6'
- ~~Minimum elevation difference between HW elevation and edge of road = 2'~~

~~Edge of road - min. elevation = 6175.6'~~
6171.2' + 3' + 2' → 6176.2

- Note: - based on preliminary road grades for High Desert Street, road will need to be raised in this area to provide enough elevation for HW.

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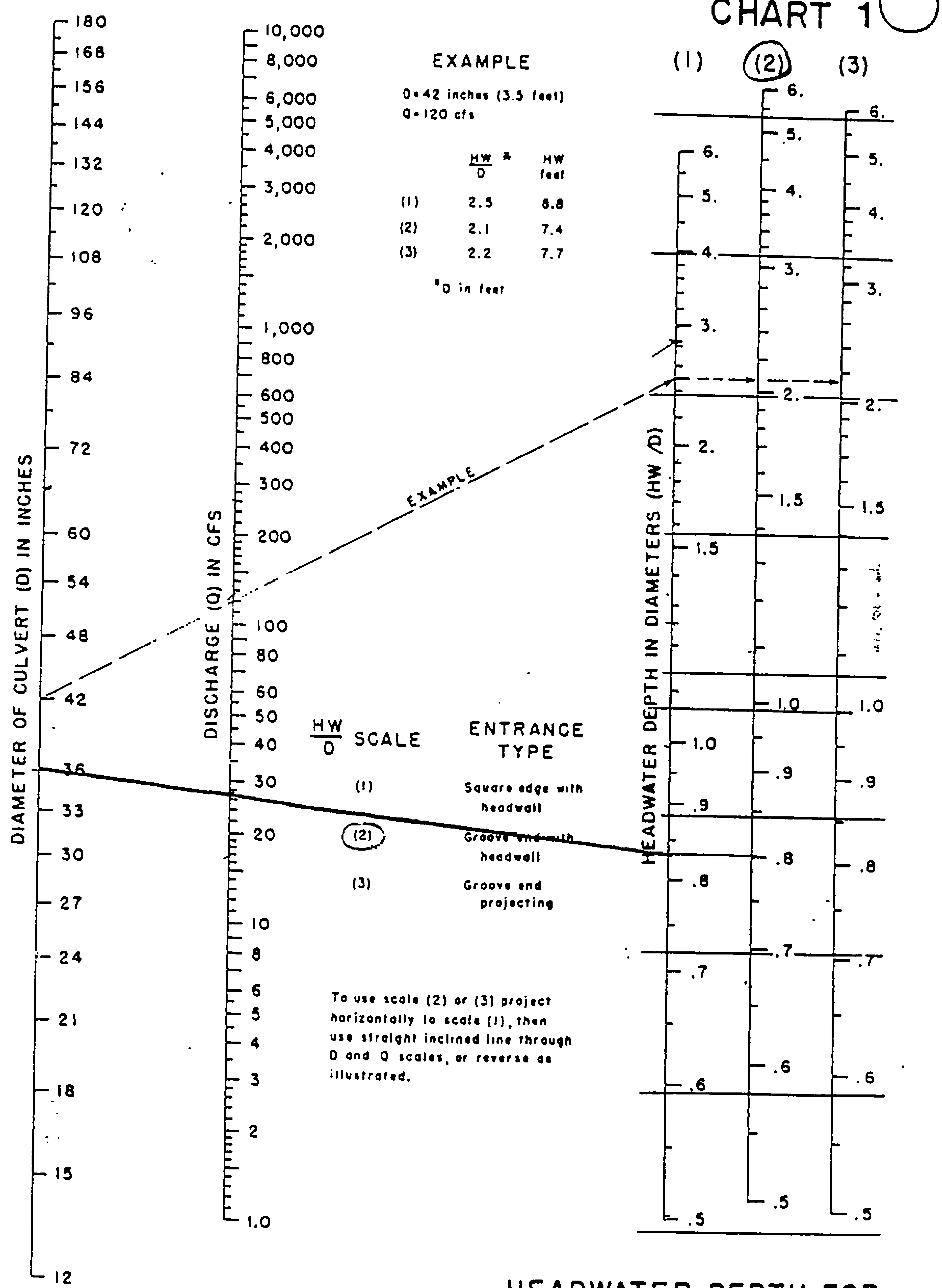
PROJECT NAME High Desert-Tr. 14 SHEET 1 OF 6
PROJECT NO. BY sjg DATE 6/3/98
SUBJECT HD St. Culverts CH'D DATE

3-36" Ø Culverts under High Desert Street for Basin NMBA-1

CHART 1



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

181

-Assumed groove end with headwall

$\frac{HW}{D}=0.8$

$HW = 0.8(36"/12) = 2.4'$

Sheet 2.5
Sjg 6/3/98
C-2 HD St. Culvert

• Can also use CBC in place of RCP - may reduce erosion at crossing outlet.

• Equivalent CBC size for 36" Ø RCP = 4'×2'

3-2'H×4'W CBC

~~Clearance - Invert to~~ Edge of Rd = 4'

H=2' Q_{TOT}=82cfs Q/box=28cfs

Q/B = 28/4 = 7

$\frac{HW}{D}$ = 0.9'

HW = 1.8' (min = ht box = 2')

HW elev = 6171.2' + 2' = 6173.2'

Min. elevation - edge of road = 6173' + 2' = 6175.2

• Also, look at 3'×3' CBC

⇒ 2-3'×3' CBC

H=3' Q_{TOT}=82cfs Q/box = 41cfs

~~Q/B = 41/3 = 14~~

$\frac{HW}{D}$ = 2.9 HW = 8.7 (too high)

3-3'×3' CBC clearance - invert to edge rd = 5'

⇒ 3-3'×3' CBC

H=3' Q_{TOT}=82cfs Q/box=28cfs

Q/B = 28/3 = 9.3

$\frac{HW}{D}$ = 0.7 HW = 2.1

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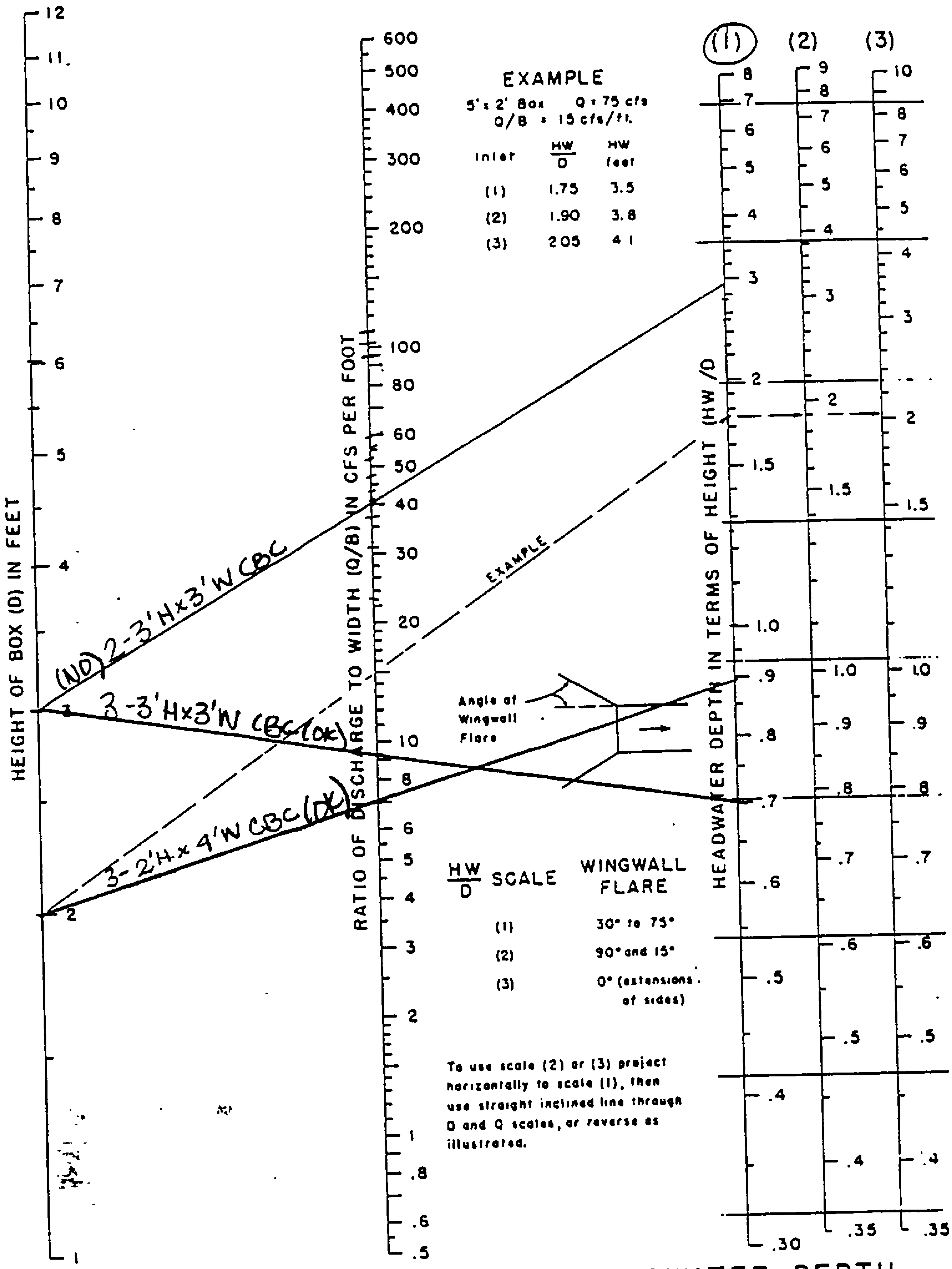
PROJECT NAME High Desert - Tr 14 SHEET 3 OF 5

PROJECT NO. BY SJG DATE 6/4/98

SUBJECT HD St Culverts CH'D DATE

CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN 1963

HD. St. Crossi
6/4/98
sjg
p. 4/5 C-4

HIGH DESERT SUBDIVISION
TRACT 14 - DRAINAGE

CROSSING CULVERTS FOR HIGH DESERT STREET, NORTH OF SPAIN ROAD

Total Q 82 cfs

Culvert Option	HW Depth Based on Inlet Control	Minimum Depth from Culvert Invert to Edge of Road
3-36" RCP	2.4 feet	5 feet
3-2' H x 4' W CBC	1.8 feet	4 feet
3 - 3' H x 3' W CBC	2.1 feet	5 feet

NOTES:
1. Head Water (HW) depth based on Hwy. Department Nomographs for inlet control. Assumed Q was evenly divided among culverts. RCP calculation assumed inlet with groove end and headwall. CBC calculation assumed inlet with wingwalls.
2. Minimum depth from culvert invert (upstream) to edge of road determined using HW depth plus 2' or top of pipe plus 2' cover (whichever was larger).
3. Once CD&P determines final grade of road in area of crossing, a final crossing structure can be determined.

3-36" CULVERTS UNDER HIGH DESERT STREET

LOCAL SCOUR @ OUTLET

SOURCES: AMAFCA SEDIMENT + EROSION DESIGN GUIDE, pg 3-94
COLORADO URBAN STORM DRAINAGE CRITERIA MANUAL, VOL. 2

SCOUR HOLE GEOMETRY:

$$A^* = \alpha \left(\frac{Q}{\sqrt{g}D^{5/2}}\right)^{\beta} \left(\frac{t}{t_0}\right)^{\theta} \qquad A^* = \frac{h_s}{D}, \frac{W_s}{D}, \frac{L_s}{D} \text{ OR } \frac{V_s}{D^3}$$

where α, β + θ are determined from Table 3-11 for depth, width + length (h_s, W_s + L_s)
use uniform sand d_{50} = 2mm ($d_{50} \approx$ 1mm)

TOT Q_{100} = 82 cfs - HOWEVER ÷ 3 since 3 culverts assume flow equally divided -
∴ Q = 28 cfs

D = 3' $D^{5/2}$ = 15.59

$$\frac{Q}{\sqrt{g}D^{5/2}} = 0.32$$

t_0 = 316 minutes
t = 30 minutes

> t/t_0 = 0.095

$$A^* = \alpha (0.32)^{\beta} (0.095)^{\theta}$$

$\frac{h_s}{D}$ = 1.108 (0.81) = 0.9'
$\frac{W_s}{D}$ = 1.3'
$\frac{L_s}{D}$ = 6.85'

~~(if an equivalent depth is used to represent all 3 culverts & Q_{TOTAL} is used for Q~~
~~h_s = 1.26~~
~~$y_e = \sqrt{A/2}$ = 3.25'~~ ~~A = 3(7.07) = 21.2 SF~~

h_s = 2.7' use 3'
W_s = 3.9' use 4'
L_s = 20.6' use 20'

DUMPED RIPRAP IN SCOUR HOLE
use a d_{50} = 9" for dumped riprap

CONT

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ENGINEERS PLANNERS PHOTOGRAMMETRISTS SURVEYORS SOFTWARE DEVELOPERS

PROJECT NAME High Desert SHEET 1 OF 2
PROJECT NO. 993971B1.04 BY BGM DATE 4-27-99
SUBJECT Scour at culverts CH'D ____ DATE ____

if $d_{50} = 0.2mm$

$\frac{h_s}{D} = 1.4'$ — $h_s = 4.2'$

$\frac{W_s}{D} = 2.9'$ — $W_s = 8.7'$

$\frac{L_s}{D} = 5.6'$ — $L_s = 16.7'$

SINCE actual d_{50} falls between the range of 0.2mm and 2mm, use dimensions of Riprap as follows:

$h_s = 4'$

$L_s = 20'$

$W_s = \frac{8.7+3.9}{2} = 6.3$

$6.3 - 3 = 3.3'$ OR 1.65' each side of pipe ($\sim 2'$)

Width of 3-36" RCP spaced per NMSHTD serial H-1-61 = 15'. ADD 2' to each side for a total of 19'.

(.79)
(0.65) 1,40

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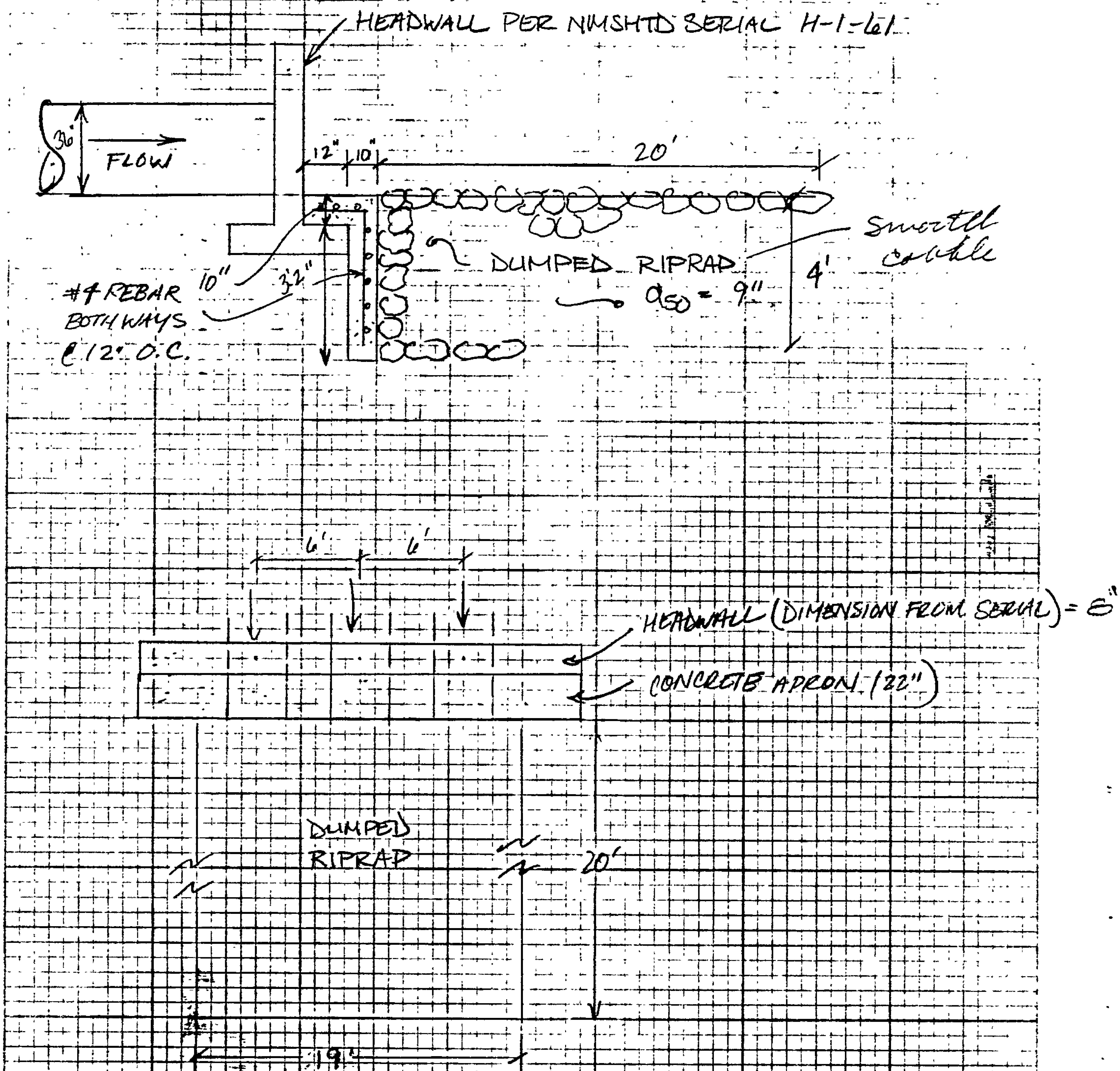
ENGINEERS PLANNERS PHOTOGRAMMETRISTS SURVEYORS SOFTWARE DEVELOPERS

PROJECT NAME		SHEET	2	OF	2
PROJECT NO.	99397 BL.C4	BY	BJM	DATE	5-4-99
SUBJECT		CH'D		DATE	

EROSION CONTROL FOR 3-36" CULVERTS UNDER HIGH DESERT STREET

CONCRETE APRON & CUTOFF WALL & RIPRAP VOLUME



CC: WR FILE EROSION CONTR. DETAIL

Bohannan ▲ Huston

ENGINEERS PLANNERS PHOTOGRAMMETRISTS SURVEYORS SOFTWARE DEVELOPERS

PROJECT NAME High Desert SHEET 1 OF 1

PROJECT NO. 99397 B1.04 BY BGM DATE 4-30-99

SUBJECT Erosion Control CH'D DATE

Approximate Maximum Erosion Method

M = total channel length along meander
λ = meander wavelength
K = sinuosity

L (typ. meander) = 10-14 channel widths

for $Q_D < 200$ $\qquad \lambda / W_D = 10$

$\lambda / 14.5 = 10$

$\lambda = 145'$

Δmax ~ when $\frac{Rc}{W}$ = min or K = 1.5

$\Delta max = 2.5\, W_D = 2.5(14.5) = 36.25$

$Qd = 0.2\, Q_{100}$ (5-10 yr peak Q)

$\lambda = 145'$ $\qquad \frac{\lambda}{2} = Lv = 72.5'$

where $\Delta max = 43.5'$

reference = AMAFCA Sed. + Erosion Design Guide (p.3-70)

Bohannan ▲ Huston

PROJECT NAME HD Tract 14 SHEET 1 OF 2
PROJECT NO. 99237A.07 BY Ejg DATE 6/5/98
SUBJECT Prudent Line CH'D DATE

E-1

HIGH DESERT PRUDENT LINE ANALYSIS
ARROYO SOUTH OF TRACT 11 AND NORTH OF SPAIN ROAD
APPROXIMATE MAXIMUM EROSION METHOD

Arroyo	Bulked Q100	Dominant Discharge	Dominant Width	Sc	Average Slope	Lambda	Delta Max	Setback from Bank	Setback from Centerline
	cfs	cfs	ft	ft/ft	ft/ft	ft	ft	ft	ft
Trib NMBA3A	88	17.6	14.5	0.0253	0.0440	144.9	36.2	36.2	43.5

Notes:
1. Formulas from AMAFCA Sediment and Erosion Design Guide.
2. Delta Max based on S>Sc, Qd<200 cfs.

p. 2/2
Prudent line E-2


N
SCALE: 1"=50'
2' contour interval
43.5'
43.5'
ND. UTILITIES
High Desert Street
upstream end of analysis
Spain Road
ROAD
High Desert Tract 14
E-3


E-3
Imperata Street
T303
Pond 3
FUTURE ROADWAY AND UTILITIES
Scale 1"=50'
2' contour interval
43.5
43.5
SPAIN
Down Stream end of analysis
E-4


Imperata Street
SPAIN
FUTURE ROADWAY AND UTILITIES
E-3
E-3


9-3
JUNC 1998
N
SCALE: 1"=50'
2' contour interval
43.5'
43.5'
High Desert Street
crossing culve
3-36" Ø
(10' wide)
(Prudent Li
Confined
Culve
E-6