HYDROLOGY C19/D1 NO PLANS

C19/D1

No Plans

FILE 77-187

JAMES D. SMITH
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October 13, 1977

Mr. Raymond W. Macy
Bohannan, Huston, Inc.
4125 Carlisle Blvd., N. E.
Albuquerque, New Mexico 87107

Reference: Drainage Report for Bella Vista Baptist Church

Dear Mr. Macy:

Preliminary plans for site grading of Bella Vista Baptist Church are hereby approved.

Sincerely yours,

James D. Smith

James D. Smith
Executive Engineer

sls

FILE 77-137

JAMES D. SMITH
EXECUTIVE ENGINEER

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WILLIAM V. HEREFORD, VICE-CHAIRMAN
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DRAINAGE REPORT

FOR

BELLA VISTA BAPTIST CHURCH

PURPOSE

The purpose of this study is to determine the runoff generated by a 100-year frequency storm falling within the proposed Bella Vista Baptist Church property and to determine measures for removing Phase One construction from the 100-year flood plain of the North Arroyo De Domingo Baca. This report provides guidelines for development of Phase One in an attempt to satisfy drainage requirements established by AMAFCA.

PROJECT LOCATION AND DESCRIPTION

The development site is located in north Albuquerque, east of I-25 (Plate I). Carmel Avenue lies north of the site and Louisiana Boulevard is at the west edge.

The property contains approximately 6.8 acres covered by sparse amounts of native grasses. A natural gradient averaging 2½% exists throughout the area, falling from southeast to northwest.

Development of the site will occur in three phases; however, this report is concerned only with the first phase of development, 1.45 acres, to include construction of the Bella Vista Baptist Church and two parking lots. A tennis

court, swimming pool, bus garage, and an additional church parking lot will be constructed during Phase Two. Phase Three will involve construction of a bible college, bookstore, and ball field parking lot.

HYDROLOGY

The rational equation, Q=CIA, was used to determine peak runoff rates within the proposed development site. Rainfall intensity values were determined from figures presented in the Master Plan of Drainage for the City of Albuquerque, by Gordon Herkenhoff and Associates, Inc., 1963.

The proposed development site of Phase One was divided into two runoff basins to permit an analysis of the drainage flows within the Bella Vista Baptist Church property. Upland flows and the resulting 100-year flood plain boundary were taken from the Northeast Heights Drainage Management Plan, April 1975, by Leonard Rice Consulting Water Engineers for the North Arroyo De Domingo Baca.

DRAINAGE BEFORE DEVELOPMENT

The existing peak runoff within basins A and B are approximately 2.6 CFS and 1.1 CFS, respectively.

The 100-year flood plain illustrated in the Leonard Rice report covers more than two-thirds of the total development site (Plates II and III).

DRAINAGE AFTER DEVELOPMENT, PHASE ONE

Development during Phase One will increase peak flows from basins A and B, requiring runoff control to satisfy AMAFCA regulations. Roof and parking lot detention will be exercised to control runoff from basins A and B.

Utilizing a church roof runoff flow of 0.6 CFS (taken from information presented in Practices in Detention of Urban Storm Water Runoff, 1974, APWA, Report No. 43) and discharging one-half of the roof runoff, 0.3 CFS, onto the parking lot of basin A produces an uncontrolled runoff of 3.8 CFS from basin A after development. The remaining 0.3 CFS of church roof runoff will be discharged onto the undeveloped area of Bella Vista Baptist Church property. Uncontrolled runoff within basin B after developed conditions of Phase One produces 3.0 CFS. Constructing storm water detention ponds with controlled discharge devices in the parking lots will restrict the peak runoff to undeveloped rates for the 100-year storm.

TABLE 1

Recommended detention pond volumes and discharge openings (orifice plate) for controlling storm water runoff from Phase One development.

| Basin | Volume Detained ($ft^3$) | Discharge (CFS) | Orifice Size (in.) |
|---|---|---|---|
| A | 1,000 | 2.0 | 6" dia. (9"x12") |
| B | 1,700 | 1.0 | 4" dia. (6"x9") |

The total storm water runoff after development of Phase One within basins A and B, 3.0 CFS, will be discharged onto Louisiana Boulevard where it will continue north to the North Arroyo De Domingo Baca.

Under existing conditions, the proposed church site is partially located within the existing 100-year flood plain (see Plates II and III). It is proposed to set the west end of the church above the flood plain by placing it on fill material. Due to the great width of the 100-year flood plain, 1,600 feet, the small amount of fill required to place the church above the 100-year flood plain boundary will produce negligible effects upon the northern boundary of the flood plain. The finished church floor elevation will be a minimum of 2.5 feet above the 100-year frequency flood plain boundary at the west end.

Construction of a dike is proposed near the east end of the church. The dike will be set 2.5 feet higher than the water surface elevation of the 100-year flood plain.

CONCLUSION

Development of the Bella Vista Baptist Church property will require storm water detention to control developed run-off.

The use of fill material will be used to raise the church above the flood plain on the west and to form a berm along the northeast edge.

RECOMMENDATIONS

1. Controlled discharge of storm water runoff should be exercised in basins A and B. Storm water runoff may be detained by utilizing the parking lots as detention ponds with controlled discharge.

2. The proposed site of the church building will require fill material to reduce erosion and flooding conditions during a 100-year frequency storm. A berm should be constructed northeast of the proposed church site that will lessen the flooding potential during a 100-year frequency storm (Plate III).

3. Louisiana Boulevard and Sacramento Avenue should be improved adjacent to the site so that storm water can be conveyed to the North Arroyo De Domingo Baca.

# HYDROLOGY

RATIONAL EQUATION $Q = CIA$

$Q$ = FLOW (CFS)
$I$ = RAINFALL INTENSITY (IN/HR)
$C$ = COEFFICIENT OF RUNOFF (UNIT LESS)
$A$ = AREA (ACRES)

$C = 0.35$ : VEGETATED AREAS
$C = 0.95$ : PAVED AREAS – ROOFS, PARKING LOTS, etc.

RAINFALL INTENSITY CURVES PRESENTED IN THE MASTER DRAINAGE PLAN FOR THE ALBUQUERQUE AREA BY GORDON HERRENHOFF AND ASSOCIATES, 1963 WERE USED TO DETERMINE THE RAINFALL INTENSITY FOR A 100-YEAR FREQUENCY STORM:

$$I = \frac{189}{T_c + 25}$$

$$T_c = \log^{-1}(0.3641\,B + 0.3854 \log L - 0.197 \log S - 0.3613)$$

$T_c$ = TIME CONCENTRATION (MIN)
$B$ = RUNOFF FACTOR (UNIT LESS)
= 0.77 FOR PAVED AREAS
= 1.52 FOR VEGETATED AREAS
$L$ = LENGTH OF WATER COURSE (FEET)
$S$ = SLOPE OF WATER COURSE (%)

NOTE: IF $T_c$ IS CALCULATED TO BE LESS THAN 10 MINUTES, USE $T_c$ EQUAL 10 MINUTES

PROJECT NAME BELLA VISTA BAPTIST CHURCH SHEET 1 OF
PROJECT NO. 77-189 BY DATE
SUBJECT DRAINAGE REPORT CH'D DATE

BEFORE DEVELOPMENT

BASIN A

L = 300 FT.

S = 2.67 %

B = 1.52

$T_c$ = 11.56 MIN.

I = 5.17 IN

A = 1.45 ACRE

C 0.35

$Q_{BASIN\ B}$ = 2.62 CFS
UNDEVELOPED

BASIN B

L = 100 FT

S = 2.00 %

B = 1.52

$T_c$ = 8.01 MIN : USE 10.00 MIN.

I = 5.4 IN/HR.

A = 0.60 ACRE

C = 0.35

$Q_{BASIN\ C}$ = 1.13 CFS
UNDEVELOPED

TOTAL Q UNDEVELOPED 3.75 CFS

PROJECT NAME Bella Vista Baptist Church SHEET 2 OF
PROJECT NO. 72-189 BY JJ DATE
SUBJECT Drainage Report CH'D DATE

## AFTER DEVELOPMENT - PHASE ONE

BASIN A

$Q = CIA$

A = PARKING AREA = 0.60 ACRE
CHURCH AREA = 0.60 ACRE
GRASS AREA = 0.25 ACRE

CHURCH WILL UTILIZE CONTROLLED ROOF RUNOFF EQUAL 0.6 CFS, TAKEN FROM PRACTICES IN DETENTION OF URBAN STORMWATER RUNOFF, 1974, APWA, REPORT NO. 43. ONE HALF THE ROOF RUNOFF WILL BE DISCHARGED ONTO THE PARKING LOT AND THE REMAINDER WILL BE DISCHARGED ONTO THE UNDEVELOPED AREA OF BELLA VISTA BAPTISH CHURCH.

C PAVED AREA = 0.95
GRASS AREA = 0.35

ADJ. "C" $= 0.95\left(\frac{0.60}{0.85}\right) + 0.35\left(\frac{0.25}{0.85}\right) = 0.77$

$I = 189/T_c + 25$

L = 250 FT.
S = 3.0%
B = 0.77
$T_c = 5.61$ MIN ; USE $T_c = 10.0$ MIN.
I = 5.4 IN/HR.

UNCONTROLLED PARKING LOT RUNOFF $= CIA = (0.77)\left(5.4\frac{IN}{HR}\right)(0.85\,ACRE) = 3.53\,CFS$

CONTROLLED CHURCH RUNOFF = 0.3 CFS

PROJECT NAME BELLA VISTA BAPTIST CHURCH SHEET 3 OF
PROJECT NO. 77-189 BY DATE
SUBJECT DRAINAGE REPORT CH'D DATE

$Q_{BASIN\ A}$ = 3.53 CFS + 0.3 CFS = 3.83 CFS

PHASE ONE UNCONTROLLED — PARKING LOT RUNOFF — CHURCH RUNOFF

BASIN B — DEVELOPED

Q = CIA

PARKING AREA = 0.58 ACRE
GRASS AREA = 0.02 ACRE

"C" PARKING AREA = 0.95
"C" GRASS AREA = 0.35
ADJ. "C" FACTOR

$$\text{ADJ. "C"} = \frac{0.95\,(0.58)}{0.60} + \frac{0.35\,(0.02)}{0.60}$$

$$= 0.93$$

$$I = \frac{189}{T_c + 25}$$

L = 100 FT.
S = 2.0 %
B = 0.77
$T_c$ = 4.27 MIN. ∴ USE $T_c$ = 10.0 MIN.
I = 5.4 IN/HR.

$Q_{BASIN\ B}$ = 3.0 CFS
PHASE 1
UNCONTROLLED

PROJECT NAME Bella Vista Baptist Church SHEET 4 OF
PROJECT NO. 77-189 BY DATE
SUBJECT Drainage Report CH'D DATE

# FACTORS OF CONTROLLED RUNOFF

BASIN A

BEFORE DEVELOPMENT Q = 2.62 CFS
AFTER DEVELOPMENT Q = 3.83 CFS

DISCHARGE 2.0 CFS TO SATISFY AMAFCA REGULATIONS

RETENTION POND DESIGN – DISCHARGE 2 CFS

| $T_c$ (MIN) | I (IN/HR.) | Q (CFS) | $V_{FILL}$ ($FT^3$) | $V_{DISCHARGE}$ ($FT^3$) | $\Delta V$ ($FT^3$) |
|---|---|---|---|---|---|
| 10 | 5.4 | 3.53 | 2121 | 1200 | 921 |
| 15 | 4.7 | 3.09 | 2783 | 1800 | 983 |
| 20 | 4.2 | 2.75 | 3299 | 2400 | 899 |

1000 $FT^3$ RETENTION POND @ 2CFS DISCHARGE
ET. 20'x50'x1'

OUTLET ORIFICE SIZING @ Q = 2CFS

$Q = a A \sqrt{2gh}$ a = 0.61 Eh = 0.3

RECT OPENING = 3/4'x1'
CIRC. OPENING = 6 INCH DIA.

PROJECT NAME Bella Vista Baptist Church SHEET 5 OF
PROJECT NO. 77-189 BY JG DATE
SUBJECT DRAINAGE REPORT CH'D DATE

BASIN B

BEFORE DEVELOPMENT (BEFORE PHASE ONE) Q = 1.13 CFS

AFTER DEVELOPMENT (AFTER PHASE ONE) Q = 3.0 CFS
UNCONTROLLED

UTILIZE CONTROLLED DISCHARGE @ 1.0 CFS

RETENTION POND DESIGN - DISCHARGE 1.0 CFS

| Tc (MIN) | I (IN/HR.) | Q (CFS) | $V_{FILL}$ ($FT^3$) | $V_{DISCHARGE}$ ($FT^3$) | $\Delta V$ ($FT^3$) |
|---|---|---|---|---|---|
| 10 | 5.4 | 3.01 | 1808 | 600 | 1208 |
| 20 | 4.2 | 2.34 | 2812 | 1200 | 1612 |
| 30 | 3.4 | 1.92 | 3452 | 1800 | 1652 |
| 40 | 2.9 | 1.62 | 3894 | 2400 | 1494 |
| 25 | 3.8 | 2.11 | 3164 | 1500 | 1664 |

1700 $FT^3$ RETENTION POND @ 1 CFS DISCHARGE
EX. 20' x 85' x 1'

OUTLET ORIFICE SIZING $Q = a A \sqrt{2gh}$

h = 0.3 FT

RECT. OPENING 1/2' x 3/4'

CIRC. OPENING 8.3" DIA.

PROJECT NAME BELLA VISTA BAPTIST CHURCH SHEET 6 OF
PROJECT NO. 77-089 BY AJ DATE
SUBJECT DRAINAGE REPORT CH'D DATE

ROOF DISCHARGE WEIR FOR CHURCH ROOF

H = 3 INCHES = MAXIMUM WATER DEPTH ON ROOF

GENERAL TRAPEZOIDAL WEIR EQUATION IS

$$Q = \frac{2}{3}(2g)^{1/2} L H^{3/2} + \frac{4}{15} 2 Z (2g)^{1/2} H^{5/2}$$

Q = FLOW (CFS)

g = GRAVITATIONAL CONSTANT = 32.16 $\frac{FT}{SEC^2}$

L = LENGTH OF BASE (FT)

H = HEIGHT OF WATER LEVEL (FT)

Z = RATIO OF THE SIDE SLOPE

UTILIZING AN INCLINATION (Z) OF 1 HORIZONTAL TO 4 VERTICAL (1:4) TO OFFSET THE EFFECT OF END CONTRACTIONS THE GENERAL EQUATION BECOMES $Q = 3.367 L H^{3/2}$

WEST HALF OF

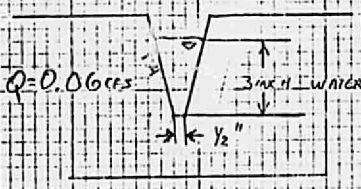
$Q_{TOTAL} = 0.30$ CFS

5 WEIRS ARE NEEDED

$$Q_{WEIR} = \frac{0.30}{5} = 0.06 \text{ CFS} = 3.367 L H^{3/2}$$

H = 3 INCH = 0.25 FT

∴ L = 0.5 INCH = 0.05 FT




PROJECT NAME BELLA VISTA BAPTIST CHURCH SHEET 7 OF

PROJECT NO. 77-189 BY DATE

SUBJECT DRAINAGE REPORT CH'D DATE

EAST HALF OF ROOF

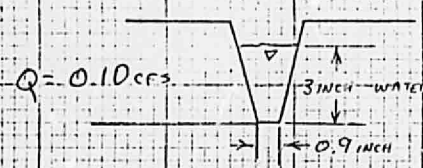
$Q_{TOTAL} = 0.30$ CFS

3 WEIRS ARE NEEDED

$Q_{WEIR} = 0.10 \text{ CFS} = 3.367 L H^{2/3}$

$H = 3$ INCH $= 0.25$ FT.

$\therefore L = 0.075$ FT $= 0.9$ INCH




PROJECT NAME Bella Vista Baptist Church SHEET 8 OF

PROJECT NO. 77-189 BY DATE

SUBJECT Drainage Report CH'D DATE

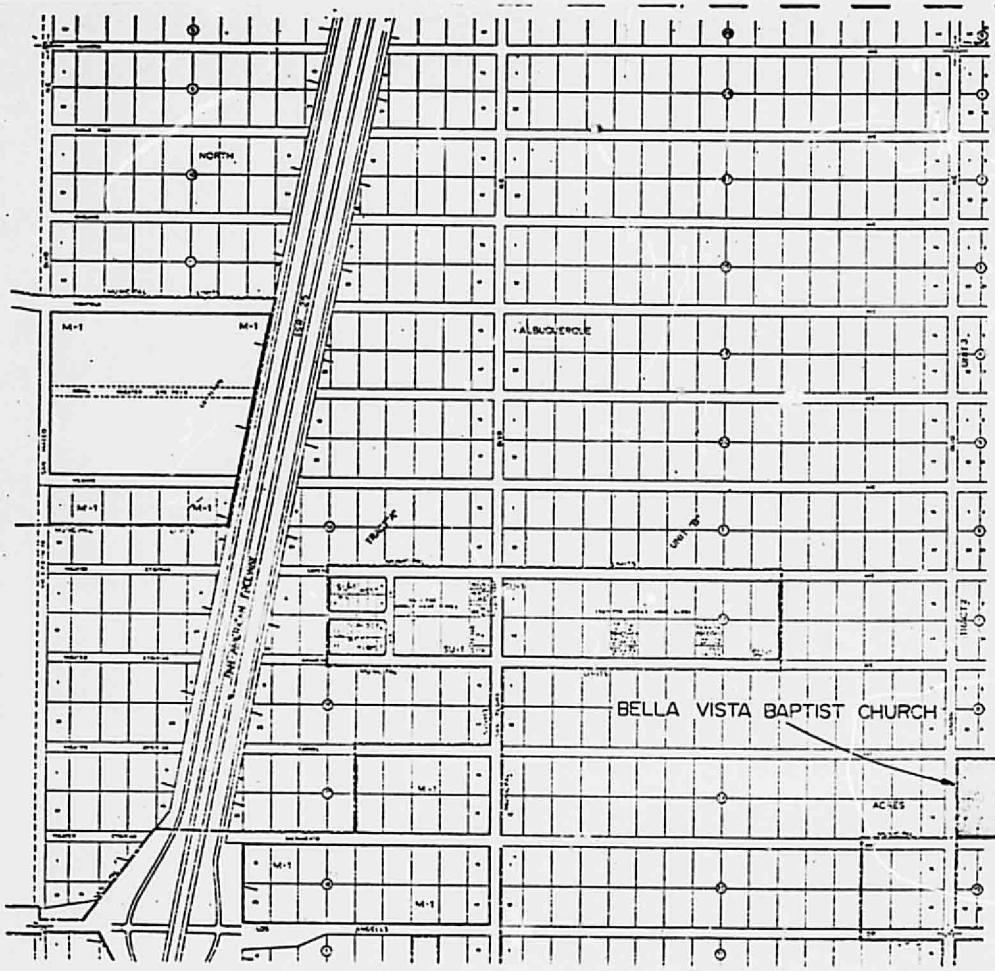



PLATE I
LOCATION MAP

C-18-Z

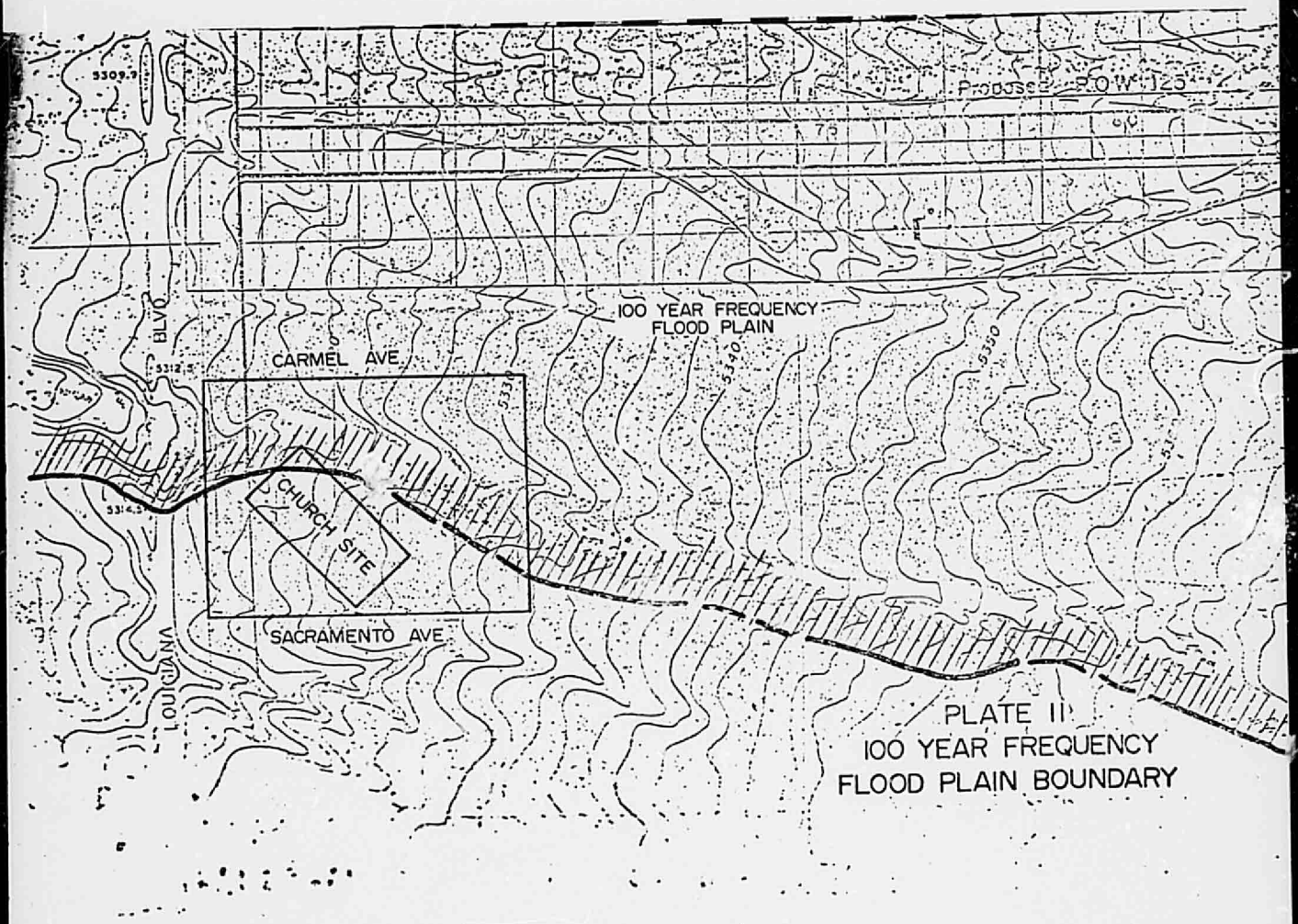



PLATE II
100 YEAR FREQUENCY
FLOOD PLAIN BOUNDARY