HYDROLOGY K22/D8 1 PLAN

K22/D8

1 Plan

PRELIMINARY DRAINAGE REPORT

for

MANZANO MANOR

A Subdivision
in

Albuquerque, New Mexico

Prepared By:

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N.M.P.E.& L.S. # 2544

Date:

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PRELIMINARY DRAINAGE REPORT

INTRODUCTION:

The study, or "Project" area is situate in Section 22, T.10 N., R.4 E., N.M.P.M.; in the "Northeast Heights" portion of Albuquerque, N.M. It is bounded on the North by Albuquerque Public School Lands (Manzano High School), on the East by Chelwood Park Blvd., a dirt street; on the South by Copper Ave., a paved street with all City Utilities and on the West, by unplatted land under the same ownership as the project area.

Geologically, the Project is located on a portion of a vast Alluvial Fan, the result of outwash from numerous canyons on the Western slope of the Sandia Mountains, which lie about three miles directly East of the Project. The general character of the soil within the Project area and also the tributary drainage area, would best be described under Bureau of Public Roads classification "A-3", a clean sand & gravel mixture, with occasional colloidal deposits of Calcium Carbonate salts in fine, silty sand ("Caliche") which have a high plasticity, but occur in such small quantities as to be easily be combined with the sand-gravel soils, to achieve any desired stability or degree of compaction for road or foundation subgrade.

Erosion presents no major problem in the vicinity of the Project, since the surface of the Project area, as well as most of the watershed area leading to the Project, has moderate-to-good grass cover in the form of native range grass. Several small ephemeral streams carry storm runoff to the vicinity of the proposed development, but there are no major watercourses which affect this area. Although land to the East of the Project is presently not developed, a platted and recorded subdivision known as "Vista Oriente" exists there and streets in that subdivision are so platted as to intercept the greatest part of the runoff from the tributary drainage area serving Manzano Heights, and to divert that water to Copper Ave., about 1,000 feet East of the Project, whence such runoff would flow West on Copper Ave., along the South boundary of the Project, without damaging effect.

Directly North of the Project, a 30' easement for street purposes exists along the South boundary of Manzano High School. This would have been the School Board's share of right-of-way for future extension of Marquette Ave. However, the extension of that street adjacent to the school, would only create additional traffic and pedestrian hazards, and would result in a devaluation of any lots in this proposed Project, if such lots fronted on Marquette Ave. and faced the School land. It appears that the School Board would be wise to have their portion of this street easement vacated back to them as owners.

Through the Project, running diagonally Southeast-Northwest, A.T.&T. has Transcontinental transmission lines. Lots have been platted to provide access, while also "screening" that facility.

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SCOPE:

Included in this Report are investigations of the drainage area tributary to the Project and also of drainage within the Project, itself; the latter item also being concerned with the means by which the drainage within the Project is to be handled as regards streets, easements, etc.

Portions of two (2) United States Geological Survey 0°-15' Quadrangle Maps are combined to provide the Location and Drainage Map for the Project. This is listed as "Exhibit 1." and follows the written section of this Report.

The method for handling drainage within the Project is discussed and illustrated, also. The illustration is listed as "Exhibit 2." and consists of a Planning Study and basic (5') Contour Map, scale 1"= 100', on which are superimposed flows (in cu.ft./sec.) and drainage areas (acres), with arrows indicating direction of flow.

Engineering calculations, using widely-accepted formulae and carefully-chosen criteria are used hereafter in this Report to make those determinations from which the final conclusions and recommendations are drawn.

CRITERIA TO BE USED FOR CALCULATION PURPOSES:

Storm Frequency:..... 100 Years

Runoff Coefficient:..... c = 0.65
(From the "Rational" Formula)

Rainfall Intensity (i):..... Based on Intensity-Duration Frequency Curves for the Albuquerque, N.M. Area; Sandia Conservancy District-1954.

(Note that above criteria for Storm Frequency and Runoff Coefficient exceed the minimum requirements of the Federal Housing Administration. In the event that this drainage study is submitted to the City of Albuquerque in conjunction with plat approval, the City's Master Plan of Drainage calls for streets to have a design carrying-capacity for runoff from a 100-year frequency storm and the City Engineer is also of the opinion that a runoff coefficient of 0.65 is a more realistic ratio of runoff to total rainfall.)

Formulae Used:

Q = Aci ("Rational" Method) for determining runoff from Watershed area.

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Formulae (Cont'd.):

$Q = a \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}}$ (Manning's Equation) for computing flow in open channels.

Additional Reference: SEELYE "DESIGN" Engineering Data Book; Tables and Nomograph on Pg. 5-00 for computing Overland Flow Time on Watershed areas.

CALCULATIONS:

Area (1): A small area whose drainage is collected by Marquette and Nambe Avenues in Vista Oriente Addition, immediately East of the Project. Actually the above streets are not graded out, but when graded will intercept runoff from the same area and carry it to Chelwood Blvd. at approximately the same area as shown on the Drainage Map.

A = 12.18 acres.

c = 0.65 (Ratio of Runoff/Total Rainfall)

i = Intensity in inches/hr., based on Inlet (Project Boundary) Time of Concentration, which is a combination of Overland (Sheet) Flow Time, plus Channel (Man-made or natural) Flow Time.

Overland Flow Time (from SEELYE, Pg.5-00) for max. length of 210 ft.; grade of 6.5% with average grass surface = 13.4 min.

Channel Flow Time (Manning Formula):

$V = \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}}$; where:

n = 0.050 for natural channel, winding; with some weeds and stones.
$R^{2/3}$ = 0.743 for cross-sect. area 17.25 ft. and wetted perimeter of 26.80 ft.
$S^{\frac{1}{2}}$ = 0.2718 for slope of 0.0739'/ft.

$V = \frac{1.486}{0.050} \cdot 0.743 \cdot 0.2718 = 6.01$ ft./sec.

Length of channel = 1370 ft: $\frac{1370}{6.01 \cdot 60} = 3.8$ min. Flow Time

Total Flow Time = 13.4 + 3.8 = 17.2 min.

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CALCULATIONS (Cont'd.):

Area (1): From Sandia Conserv. Dist. Curves - Albuquerque Area (1954), for a 100-year storm with a Duration (Total Flow Time) of 17.2 minutes, Intensity (i) = 4.3 in./hr.

Then, Q = Aci = 12.18 • 0.65 • 4.3 = 34.04 cu. ft./sec.

Max. runoff for Area 1, from a 100-year storm.

Area (2): A larger area whose watershed extends well into a small canyon on the West slope of the Sandia Mountains. Although it is likely that future development to the East of the Project will eventually intercept much of the runoff from this Area and divert it South to Copper Ave., the calculations are made to show the potentially worst condition, in which no development would take place to the East for a number of years, and the existing watershed would continue to drain entirely, directly into this proposed Project area.

A = 261.17 acres.

c = 0.65 (Ratio of Runoff/Total Rainfall).

i = Intensity in inches/hr., as noted in calculations for Area (1).

Overland Flow Time, for a maximum length of 2,425 ft., at an average grade of 25%, with a ground condition varying between bare soil and hard-rock (From SEELYE, Pg.5-00) = 11.0 min. approx.

Channel Flow Time is computed as a summation of flows in three separate sections, due to different cross-sections, slopes and channel terrain conditions. Total length of channel is approximately 12,650 ft., of which Upper Section constitutes 1,600 ft., Middle Section constitutes 2,600 ft. and the remaining 8,450 feet complete the Lower Section.

Upper Section:

Cross-section area (a) = 36.75 sq.ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{36.75}{23.78} = 1.55$

Then, $R^{2/3} = 1.332$

CALCULATIONS (Cont'd.):

Area (2):

Gradient, or Slope of channel = 0.187

Then, $S^{\frac{1}{2}}$ = 0.3296

And, Roughness Coefficient (n) for a clean, but winding stream channel with some weeds and stones = 0.040.

$V = \frac{1.486}{0.040} \cdot 1.339 \cdot 0.3296 =$ 16.39 ft./sec.

Channel Flow Time = $\frac{1600}{16.39 \cdot 60}$ = 1.6 min. approx.

Middle Section:

Cross-section area (a) = 78.26 sq. ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{78.26}{66.41} = 1.18$

Then, $R^{2/3}$ = 1.117

Gradient, or Slope of channel = 0.085

Then, $S^{\frac{1}{2}}$ = 0.2915

And, Roughness Coefficient for channel remains 0.040

$V = \frac{1.486}{0.040} \cdot 1.117 \cdot 0.2915 =$ 12.10 ft./sec.

Channel Flow Time = $\frac{2600}{12.1 \cdot 60}$ = 3.6 min. approx.

Lower Section:

Cross-section area (a) = 113.6 sq.ft.

Hydraulic Radius (R) = $\frac{\text{area}}{\text{wetted perimeter}} = \frac{113.6}{63.44} = 1.79$

Then, $R^{2/3}$ = 1.474

Gradient, or Slope of channel = 0.041

Then, $S^{\frac{1}{2}}$ = 0.2025

And, Roughness Coefficient (n) for channel increases to 0.050. (Winding Channel; weeds and stones; less effective grades and cross-sections).

$V = \frac{1.486}{0.050} \cdot 1.474 \cdot 0.2025 =$ 8.87 ft./sec.

Channel Flow Time = $\frac{8,450}{8.87 \cdot 60}$ = 15.9 min. approx.

CALCULATIONS (Cont'd.):

Area (2): Total Flow Time (Duration) = 11.0 + 1.6 + 3.6 + 15.9

= 32.1 minutes

From Sandia Conserv. Dist. Curves- Albuquerque Area (1954), for a 100-year storm with a Duration of 32.1 minutes, Intensity (i) = 3.12 in./hr.

Then, Q = Aci = 261.17 • 0.65 • 3.12 = 529.65 cfs

Max. Runoff for Area 2, from a 100- year storm.

Total anticipated flow to reach this Project from a 100-year frequency storm is: 34.04 + 529.65, or 563.69 cfs, from the two drainage areas computed.

Street-carrying capacity:

It will be noted from the contours on Exhibit 2, that Chelwood Park Blvd. has a fall of approximately 15 feet in 1,320 feet, along the East boundary of the Project. This amounts to a slope of 0.0114, from North to South. Chelwood Park Blvd. is designated a "Collector" type street by the City of Albuquerque, meaning that this street will be constructed 48 feet in width, face-to-face of curb, with City Standard 8" high curb, whenever it is paved.

Using the Manning Equation, with roughness coeff. (n) = 0.015, the carrying-capacity of a 48' wide street with no crown, on a slope of 0.0114, is:

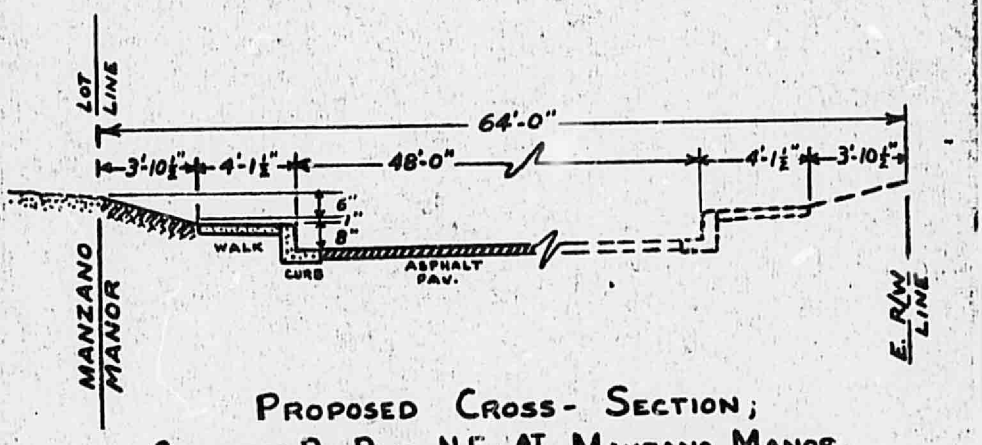
$$Q = a \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot S^{\frac{1}{2}} = 32 \cdot \frac{1.486}{0.015} \cdot 0.75 \cdot 0.107$$

or,
Q = 253 cfs approx. This is obviously not sufficient to carry the anticipated 564 cfs (approx.) runoff from a 100-year storm, assuming Chelwood Park Blvd. would be made the water-carrier to intercept all drainage reaching the Project area. However, by raising the grade of all abutting lots to a Lot-Line elevation of 7" above top-of-curb, or 15" above gutter flow-line, and providing water-blocks 15" (1.25') in height along the West side of Chelwood Park Blvd. at each intersecting street (and alley) in the Project, the carrying-capacity of Chelwood can be increased to approx. 722 cfs, with all runoff still confined to the street

CALCULATIONS (Cont'd.):

Street-carrying capacity:

right-of-way. Shown below is a sketch giving a suggested cross-section for Chelwood Park Blvd. and adjacent property on the proposed Project:



PROPOSED CROSS-SECTION;
CHELWOOD PK. BLVD., N.E. AT MANZANO MANOR.
(NOT TO SCALE)

There are many other means besides raising Lot grades as shown on the sketch, to protect the lots from high water: Masonry unit screen walls (reinforced to meet City Building Code Requirements), or low concrete or masonry retainer walls at the Property Line would perform as well or better; although these alternates would be more costly to install. In any case, the 1.25 ft. water-block would be needed at both intersecting streets and at the alley, to prevent overflow from Chelwood, into the Project.

CALCULATIONS (Cont'd.):

Drainage Within The Project:

Exhibit 2 incorporates a Topographic Map with contours at 5' intervals (all elevations correspond to U.S.G.S. datum), and a Preliminary Layout Map indicating means for moving storm water through the Project.

The project boundaries contain seventeen separate drainage areas, the individual areas being broken down to show approximate drainage limits after lots are graded. However, this is not to be construed as any type of actual Grading Plan.

The general intent, as concerns handling of storm water through the Project, is to so grade the site that all external drainage will be prevented from entering the Project and only the runoff generated from rainfall on the site, itself, will need to be considered in designing street and lot grades within the subdivision. It has already been demonstrated in the preceding calculations, that, with construction of water-blocks and a slight raising of lot grades along Chelwood, all external drainage can be intercepted by Chelwood Park Blvd. and carried South to Copper Ave., where it will by-pass the Project.

Since sample calculations have been shown above, for all external drainage, the computed quantities for runoff within the Project will be shown below in Tabular form only, for simplification. The "Rational" Formula is again employed, and the resulting quantity, Q, in Column 5, is the product of Column 2 x Column 3 x Column 4. Column 1 carries the corresponding Area Designation shown on the Preliminary Layout Map:

1. Area Designation	2. Acreage (A)	3. Coeff. (c)	4. Intens.(i) 100-Year	5. Quantity (Q) Runoff
A	4.45	0.65	4.7	13.7
B	1.08	0.65	4.6	3.2
C	1.76	0.65	4.6	5.3
D	6.60	0.65	3.8	16.3
E	0.65	0.65	4.6	1.9
F	0.77	0.65	4.5	2.2
G	0.75	0.65	4.15	2.0
H	4.65	0.65	4.6	13.9
I	0.89	0.65	3.6	2.1

CALCULATIONS (Cont'd.):

Drainage Within The Project:

TABULATION OF CALCULATED RUNOFF WITHIN PROJECT

1. Area Designation	2. Acreage (A)	3. Coeff. (c)	4. Intens.(i) 100-Year	5. Quantity (Q) Runoff
J	1.76	0.65	4.2	4.8
K	2.52	0.65	5.03	8.2
L	0.78	0.65	4.03	2.0
M	2.16	0.65	4.36	6.1
N	2.01	0.65	5.25	6.9
O	2.03	0.95*	5.5	10.6
O_1	1.29	0.95*	5.5	6.7
P	2.50	0.65	5.04	8.2
Q	3.35	0.65	5.2	11.3

* Full paving anticipated in this area after development.

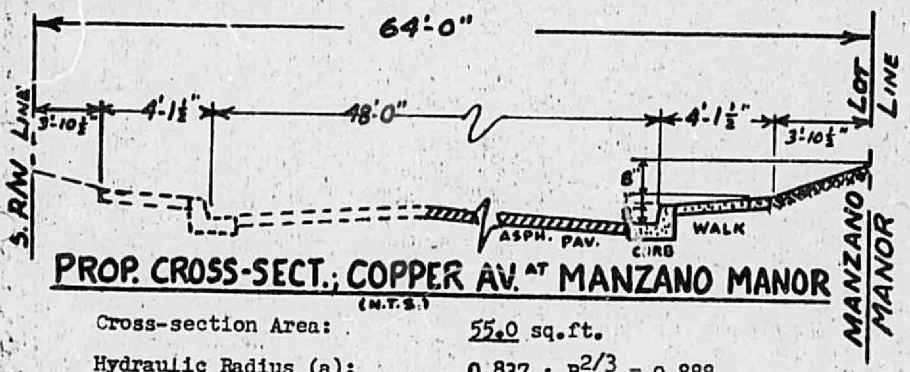
Taking the above-calculated runoff values from the respective drainage areas and combining them to form cumulative totals at successive intersections, it is seen on the Preliminary Layout Map (Exhibit 2.) that the worst condition for runoff occurs on the North-South street at the West end of the Project, also identified as Burma Drive, N.E. This street may be expected to receive a peak flow of 65.6 cfs. It has an average grade of 1.25%. A 32' curb-to-curb street with a 6" crown, on a slope of 0.0125, can carry 84.0 cfs, running full. Therefore, neither this street (Burma Drive) nor any other street within the Project is in any danger of overflow, during the period of peak runoff from a 100-year frequency storm.

To be considered, also, is the large accumulated flow on Copper Ave., N.E., along the South Boundary of the Project. This street can be expected to carry approximately 771 cfs maximum, in the vicinity of the Southwest corner of the Project.

CALCULATIONS (Cont'd.):

Drainage Within The Project
(Copper Ave., a perimeter street):

Copper Ave. is 48' in width, curb-to-curb; has a grade of approximately 3.35%. It is inadequate in width to carry the anticipated peak runoff without additional protective grading at lot-lines abutting this street. The sketch shown below gives a recommended cross-section, showing property-line elevations above existing curb and a calculation of carrying-capacity if these recommendations are followed:



PROP. CROSS-SECT.; COPPER AV. AT MANZANO MANOR
(N.T.S.)

Cross-section Area: 55.0 sq.ft.

Hydraulic Radius ($\frac{a}{p}$): 0.837 ; $R^{2/3}$ = 0.888

Slope (Longitudinal): 0.0335; $S^{\frac{1}{2}}$ = 0.1831

Roughness Coefficient: n = 0.015

$Q = 55.0 \cdot \frac{1.486}{0.015} \cdot 0.888 \cdot 0.1831 =$ 883 cfs aproximate carrying-capacity within the street right-of-way.

Since 883 cfs capacity exceeds anticipated maximum runoff from a 100-year frequency storm of 771 cfs, the design may be considered adequate.

CONCLUSIONS AND RECOMMENDATIONS:

Of primary importance, it may be concluded from the preceding sets of calculations that this Project is in no danger from storm flooding, if some minor lot-grading is done along the Eastern and Southern perimeter streets, and water-blocks are established.

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CONCLUSIONS AND RECOMMENDATIONS (Cont'd.):

It is also reasonable to conclude that a runoff coefficient of 0.65 is too high (conservative) for the undeveloped land presently comprising the tributary drainage areas for this Project; hence the computed maximum runoff figures indicate more flow than would likely occur. True, if the land is developed to the East of the Project, the ratio of runoff/rainfall could increase to a value of 0.65. However, future development will cause streets to be platted which will intercept some of the flow from the tributary drainage areas and divert it elsewhere. For example, construction of Tramway Blvd. between Interstate 40 and the North City Limits will cause these smaller drainageways to be intercepted one-half mile East of the Project and diverted South to Central Ave., or North to the Embudo Arroyo major drainageway, thus eliminating 70% or more, of the tributary drainage. An interceptor ditch is also planned by the City Engineer's office, which will intercept a major portion of the runoff East of Tramway Blvd. and South of the Embudo Arroyo drainage area; so the outlook for supplemental flood protection in the vicinity of this Project is good.

Since land development in this City has often shown erratic, "Leap Frog" patterns, it is not impossible for such development to occur along the habitable portions of the drainage areas leading to this Project, before major construction of interceptor ditches or improved arterial streets could take place. It is, therefore, believed that the precautionary measures indicated for lots abutting Copper Ave. and Chelwood Park Blvd. are reasonable and perhaps essential, and the same are recommended, herewith.

Within the Project, itself, no flood dangers exist from interior street and Lot platting; hence, no special measures are recommended for either Lots or streets inside Project boundaries.

Respectfully Submitted,

George E. Paul

George E. Paul,
N.M.P.E.&L.S. # 2544

(SEAL)
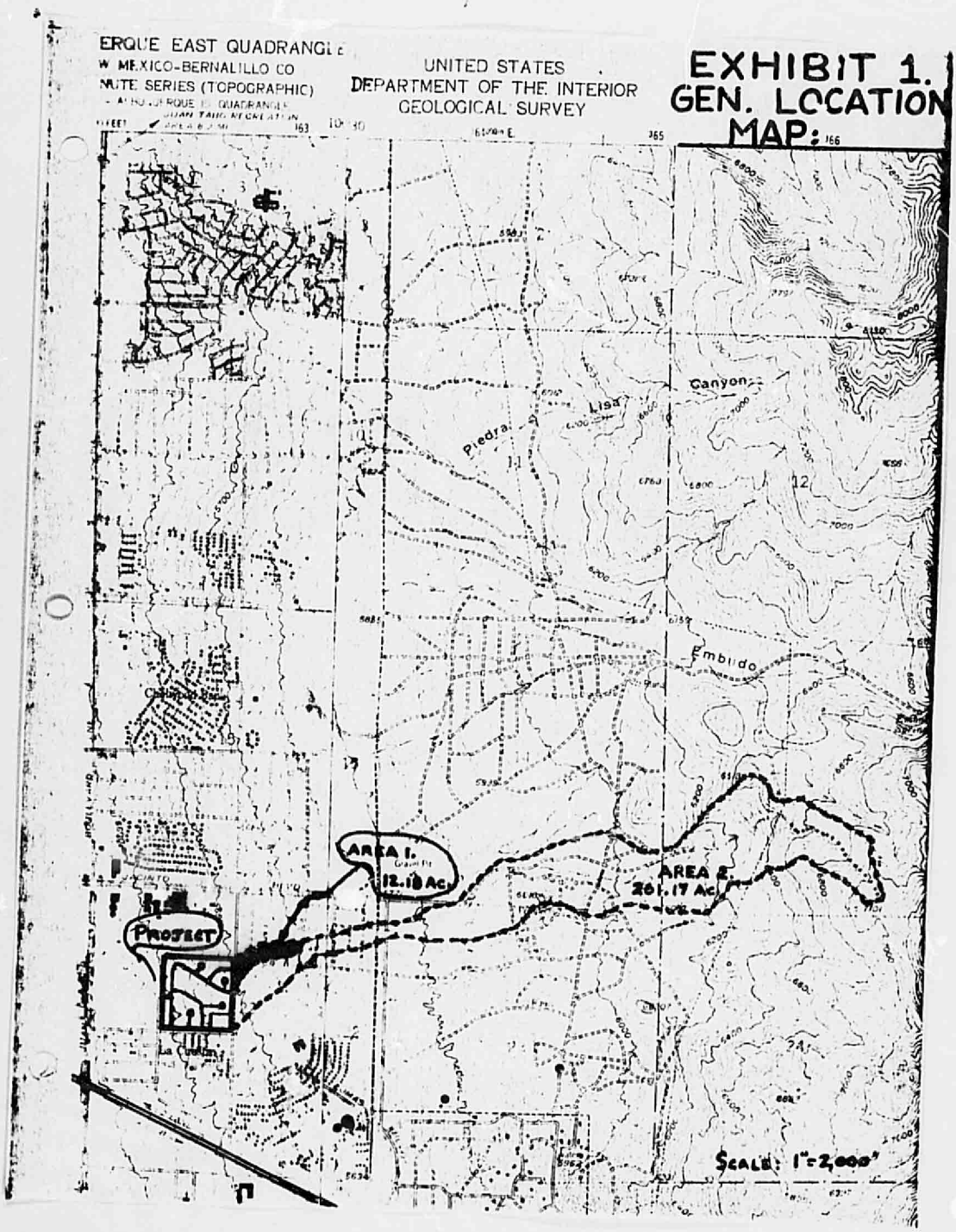
EXHIBIT 1.
GEN. LOCATION MAP: