EAST BAY MUNICIPAL UTILITY DISTRICT

ENGINEERING & OPERATIONS OFFICE

Oakland, California

SUPPORTING CALCULATIONS

for

DINGEE RESERVOIR

April 14, 1975

Submitted in Fulfillment of the Requirements of

Senate Bill No. 896, State of California

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9 SHEETS

Project: INVUNDATION MAPS
Subject: DINGEE RESERVOIR
METHOD OF ANALYSIS

Done by: S.P.D. 3-10-75
Chkd by: P.M.J 4/4/75

METHOD USED IN DERIVING THE AREA OF INUNDATION IS COMPRISED OF THE FOLLOWING STEPS:

1. FOR THE RESERVOIR ANALYZED, THE BREACH SECTION(S) WAS LOCATED ON A TOPOGRAPHIC MAP, ON THE BASIS OF SOILS AND FOUNDATION CONSIDERATIONS.
2. MAXIMUM BREACH SECTION OUTFLOW WAS DETERMINED USING THE RELATION:

$$Q_{MAX} = f(C_T)\, d^{2.5}$$

WHERE Q_{MAX} = MAXIMUM DISCHARGE, CFS

C_T = BREACH SHAPE COEFFICIENT

$f(C_T) = Q_{MAX} / d^{2.5}$ FROM PLATE NO. 2

d = DEPTH OF WATER AT ONE HALF RESERVOIR CAPACITY.

(REF.: CORPS OF ENGINEERS, "FLOW THROUGH A BREACHED DAM" MILITARY HYDROLOGY BULLETIN NO. 9, JUNE 1957 & O.E.S. LETTER OF OCT. 11, 1974)

3. THE COURSE(S) THAT BREACH FLOW WILL FOLLOW WAS DELINEATD FROM THE STUDY OF CONTOUR MAPS, TOPOGRAPHIC FEATURES, AND FIELD VISITS TO THE AREA INVOLVED

PROJECT INUNDATION MAPS
SUBJECT DINGEE RESERVOIR
METHOD OF ANALYSIS

Comp. by SPD Date 3-10-75
Chk'd by PMJ Date 4/4/75

4. TIME REQUIRED TO DRAIN THE RESERVOIR UNDER BREACH FLOW CONDITIONS WAS COMPUTED IN ORDER TO DETERMINE POSSIBLE APPLICABILITY OF FLOOD ROUTING ANALYSIS. FOR A SHORT DURATION BREACH FLOW HYDROGRAPH OR FOR INUNDATION AREAS WITH ILL DEFINED MULTIPLE FLOW DIRECTIONS AND PONDING, ROUTING ANALYSIS CANNOT BE USED EFFECTIVELY.

5. INUNDATION IN AREAS WITH ILL DEFINED — MULTIPLE FLOW DIRECTIONS AND PONDING WAS ANALYZED BY USE OF FLOOD PRONE AREA MAPS AND OTHER AVAILABLE INFORMATION SUCH AS CAPACITY OF ROADWAYS TO CARRY THE BREACH FLOW.

6. TIME REQUIRED TO REACH FLOOD LEVEL AT SELECTED LANDMARKS IS COMPUTED ON THE BASIS OF THE DISTANCE OF THE LANDMARK FROM THE RESERVOIR AND THE VELOCITY OF FLOOD WAVE. TRAVEL TIMES OF MORE THAN FIFTEEN MINUTES ARE SHOWN ON THE MAP.

INUNDATION MAPS
DINGEE RESERVOIR
RESERVOIR DETAILS

S.P.D. 3-10-75
P.M.J. 4/4/75

DINGEE RESERVOIR

TYPE: OPEN CUT, LINED AND WITH ROOF

YEAR IN OPERATION: 1894/1939

OVERFLOW ELEV.: 772.0

1/2 CAPACITY ELEV.: 766.2 (CAPACITY CURVE)

INFLOW ELEV.: 755.9

CAPACITY: 4.182 MG = 559,100 CFT = 12.84 ACRE-FEET

DINGEE RESERVOIR IS ONE OF THE OLDER STRUCTURES BUILT BY A PREDECESSOR WATER COMPANY. THE ROOF OF THIS CONCRETE LINED RESERVOIR WAS REPLACED IN 1939.

MATERIALS ENGINEERING SECTION, ON THE BASIS OF GEOLOGIC AND SOILS STABILITY CONSIDERATIONS, INDICATES THAT ONLY THE WEST SIDE OF THE RESERVOIR EMBANKMENT IS VULNERABLE TO POTENTIAL FAILURE.

A ROAD "ESTATES DRIVE" RUNS ALONG THE WEST SIDE OF THE RESERVOIR, ABOUT 15 FEET BELOW THE TOP OF THE EMBANKMENT AND 50 FEET TO THE WEST, A NATURAL DEPRESSION IN THE DIRECTION OF INDICATED BREACH RUNS FROM ESTATES DRIVE TO

INUNDATION MAPS
DINGEE RESERVOIR

S.P.D. 3-10-75
PMJ 4/4/75

HARBORD DRIVE, ABOUT 300 FEET AWAY. HARBORD DRIVE RUNS DOWNHILL IN A NORTHWESTERLY DIRECTION FOR ABOUT 500 FEET. AT THIS POINT A NARROW, DEEP (ABOUT 60 FEET) VALLEY ON THE WEST SIDE RUNS TOWARDS MORAGA AVENUE, APPROXIMATELY 1200 FEET AWAY. MORAGA AVENUE ALSO RUNS DOWNHILL IN A WESTERLY DIRECTION FOR ABOUT 2000 FEET. AT THIS LOCATION, ON THE NORTH, ANOTHER VALLEY IS SITUATED, WHICH DRAINS INTO FOUR DETENTION BASINS HAVING A TOTAL DROP OF 60 FEET IN ELEVATION. THESE BASINS ARE REGULATED BY MOUNTAIN VIEW CEMETERY THROUGH CONTROLLED DISCHARGE OUTLET LINES TO GLEN ECHO CREEK. PARTIALLY CULVERTED GLEN ECHO CREEK DRAINS INTO LAKE MERRITT. LAKE MERRITT, WITH SURFACE AREA ABOUT 135 ACRES, IS A POND WITH AN OUTLET TO THE BAY.

CAPACITIES OF VARIOUS SECTIONS WITHIN THE INUNDATION AREA TO CARRY BREACH FLOW ARE COMPUTED ON SHEET 4.

ILL-DEFINED MULTI-DIRECTIONAL FLOW AND PONDING MAKE ANY FLOOD ROUTING ANALYSIS INEFFECTIVE.

INUNDATION MAPS — Made by SPD — Date 3-10-75
DINGEE RESERVOIR — Checked by PMJ — Date 4/4/75

BREACH FLOW

ASSUMING A TRIANGULAR BREACH OF FULL DEPTH AND TOP WIDTH EQUAL TO FULL DEPTH, AREA OF BREACH FLOW AT ½ RESERVOIR CAPACITY IS: $\frac{1}{2} \times 10.3 \times 10.3 = 53$ SQ. FT

AREA OF RESERVOIR SECTION AT ½ RESERVOIR CAPACITY $= \frac{160+200}{2} 10.3 = 1854$ SQ. FT.

AS THE AREA OF BREACH IS LESS THAN ONE SIXTH AREA OF RESERVOIR 53 SQ FT $< \frac{1}{6}(1854) = 309$ SQ FT.

THE BREACH IS CONSIDERED TO BE SMALL.

MAX. OUTFLOW $= f(C_t)\, d^{2.5}$

REF: MILITARY HYDROLOGY BULLETIN NO. 9
"FLOW THROUGH A BREACHED DAM"
CORPS OF ENGINEERS, JUNE 1957

$$C_t = \frac{6t}{2d} = \frac{10.3}{2(10.3)} = 0.5$$

FROM PLATE NO. 2

FOR $C_t = 0.5$, $f(C_t) = \frac{Q_{MAX}}{d^{2.5}} = 1.2$

$Q_{MAX} = 1.2\, d^{2.5} = 1.2 \times 10.3^{2.5} = 408.58$ CFS **SAY 410 CFS**

TIME TO DRAIN $= \text{VOL.} / \frac{1}{2} Q_{MAX} = \frac{559{,}100 \text{ CF}}{\frac{1}{2}(400)} = 2727.3$ SEC
$= 45.46$ MIN.
SAY 46 MIN.

INUNDATION MAPS
DINGEE RESERVOIR
SECTION - ELEV. - VELOCITY - DISCHARGE

S.P.D. 3-10-75
PMA 4/4/75

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RESERVOIR=DINGEE
SECTION =HARBORD DR NEAR MCANDREW DR
BED EL =670
NO. OF TRIAL DEPTHS =2
SLOPE=.111
MANNINGS N=.04
671,50,52,672,100,54
ELEV          VEL.          FLOW
 FT           FPS            CFS
 671    12.090006    604.50032
 672    18.718935    1871.8935
SECTION =MORAGA AVE AT PIEDMONT CITY LIMITS
BED EL =498
NO. OF TRIAL DEPTHS =2
SLOPE=.056
MANNINGS N=.04
499,110,112,500,220,114
ELEV          VEL.          FLOW
 FT           FPS            CFS
 499    8.7096518    958.06169
 500    13.666606    3006.6534
SECTION =MORAGA AVE NEAR PALA AVE
BED EL =385
NO. OF TRIAL DEPTHS =2
SLOPE=.02
MANNINGS N=.04
386,105,107,387,210,109
ELEV          VEL.          FLOW
 FT           FPS            CFS
 386    5.2020624    546.21655
 387    8.1582699    1713.2367
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INUNDATION MAPS
DINGEE RESERVOIR
BREACH FLOW PATH

SPD 3-10-75
Pmg 4/4/75

BREACH FLOW WILL TRAVERSE THE TOPOGRAPHIC PATH DESCRIBED IN DETAIL (SHEET 1 AND 2) EARLIER AS FOLLOWS:

BREACH SECTION IN RESERVOIR, ACROSS ESTATES DRIVE → HARBORD DRIVE → MORAGA AVENUE → DETENTION BASINS IN MOUNTAIN VIEW CEMETERY.

BREACH FLOW WILL REACH LAKE MERRITT VIA PARTIALLY CULVERTED GLEN ECHO CREEK AT A MODERATE RATE OF FLOW CONTROLLED BY DETENTION BASINS IN MOUNTAIN VIEW CEMETERY. LAKE MERRITT OUTLETS TO THE INNER HARBOR BORDERING ALAMEDA.

INUNDATION MAPS
DINGEE RESERVOIR
TRAVEL TIME CALCULATIONS

SPD 3-10-75
PMJ 4/4/75

THE FOLLOWING COMPUTATIONS REPRESENT THE FLOOD WAVE TRAVEL TIME TO VARIOUS POINTS ALONG THE BREACH FLOW PATH.

$$\text{TIME} = \frac{\text{DISTANCE}}{\text{AVG. VELOCITY}}$$

LOCATION	DISTANCE (FT)	VELOCITY (FPS)	AVG. VEL. (FPS)	TRAVEL TIME Δ (MIN)	TRAVEL TIME Σ
DINGEE RESERVOIR		7.5			
	350		9.0	.65	
HARBORD DRIVE NEAR MCANDREW DR.		10.5 3¼			.65
	1700		8.35	3.39	
MORAGA AVE AT PIEDMONT CITY LIMITS		6.2 ½ 3¼			4.04
	2000		5.5	6.06	
MORAGA AVE NEAR PALA AVE. - END OF INUNDATION AREA		4.8 3¼ 1¼			10.1