LEGIBILITY NOTICE

A major purpose of the Technical Information Center is to provide the broadest dissemination possible of information contained in DOE's Research and Development Reports to business, industry, the academic community, and federal, state and local governments.

Although a small portion of this report is not reproducible, it is being made available to expedite the availability of information on the research discussed herein.

ORNL/TM-10112

ornl

OAK RIDGE
NATIONAL
LABORATORY

MARTIN MARIETTA

Subsurface-Controlled Geological Maps for the Y-12 Plant and Adjacent Areas of Bear Creek Valley

Helen L. King
C. Stephen Haase

Environmental Sciences Division
Publication No. 2892

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A06 Microfiche A01

ORNL/TM--10112

DE87 011961

ENVIRONMENTAL SCIENCES DIVISION

SUBSURFACE-CONTROLLED GEOLOGICAL MAPS FOR THE Y-12 PLANT AND ADJACENT AREAS OF BEAR CREEK VALLEY

Helen L. King
C. Stephen Haase

Environmental Sciences Division
Publication No. 2892

Date of Issue -- April 1987

Prepared for the Y-12 Assessment and Remediation Program
L. L. McCauley, Program Manager

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GEOLOGICAL MAPS

ABSTRACT

King, H. L., and C. S. Haase. 1987. Subsurface-controlled geological maps for the Y-12 Plant and adjacent areas of Bear Creek Valley. ORNL/TM-10112. Oak Ridge National Laboratory. 34 pp.

Bear Creek Valley in the vicinity of the U. S. Department of Energy Y-12 Plant is underlain by Middle to Late Cambrian strata of the Conasauga Group. The group consists of interbedded limestones, shales, mudstones, and siltstones, and it can be divided into six discrete formations. Bear Creek Valley is bordered on the north by Pine Ridge, which is underlain by sandstones, siltstones, and shales of the Rome Formation, and on the south by Chestnut Ridge, which is underlain by dolostones of the Knox Group.

Subsurface-controlled geological maps illustrating stratigraphic data and formational contacts for the formations within the Conasauga Group have been prepared for the Y-12 Plant vicinity and selected areas in Bear Creek Valley westward from the plant. The maps are consistent with all available surface and subsurface data for areas where sufficient data exist to make map construction feasible.

1. INTRODUCTION

A series of geological maps and companion structural cross sections were constructed for selected portions of Bear Creek Valley in the vicinity of the U. S. Department of Energy Y-12 Plant. The geological maps were prepared in support of environmental assessment and remediation activities at that facility. Because of the important part that bedrock geology and subsurface features play in controlling groundwater movement, accurate geological maps are essential to the interpretation of subsurface hydrological data and to the planning and implementation of remediation efforts.

1.1 Purpose and Background

The purpose of this report is to present structural cross sections and bedrock geological maps for the Y-12 Plant vicinity and selected areas of Bear Creek Valley where sufficient subsurface data exist for detailed map interpretation. Previous geological maps of the area, or selected portions thereof, had been prepared by McMaster (1963; see Fig. 1), Law Engineering (1975; 1983), and Hoos and Bailey (1986). With the exception of a geological map for a section of Bear Creek Valley referred to as the Exxon Nuclear Site (Law Engineering 1975) and the summary-scale map for all of Bear Creek Valley, earlier maps were based on surface observations. Because of pervasive weathering of bedrock and the scarcity of outcrops, such maps were generalized and unable to delineate the detailed stratigraphy of the major rock units or to precisely locate formational contacts. In an attempt to more precisely determine bedrock geology in selected areas of Bear Creek Valley, the geological maps and cross sections presented in this report were prepared. Subsurface data obtained from core holes and geophysical logs from deep boreholes were used to further constrain and enhance bedrock geological interpretations made solely from surface data.

1.2 Location

The study area is illustrated in Fig. 2. The area is located on the U. S. Department of Energy Oak Ridge Reservation, within Bear Creek Valley and the immediately adjacent portions of Pine Ridge to the north and Chestnut Ridge to the south. It is approximately 10 miles long and 1 mile wide. Within the study area, nine contiguous, approximately rectangular areas (see Fig. 2) have been defined in a previous summary of well boring information for Bear Creek Valley (Haase, Gillis, and King 1987b). Of the nine areas shown in Fig. 2, geological maps were prepared for the five crosshatched areas where there were sufficient subsurface data. Rectangles 2 through 4 include the Y-12 Plant, S3 Ponds, and Y-12 Burial Grounds localities. Rectangle 7 includes the Gum Branch Road locality, and rectangle 8 includes the Exxon Nuclear Site.

2. CONSTRUCTION OF GEOLOGICAL MAPS AND CROSS SECTIONS

2.1 Selection of Base Maps

A previously compiled, nine-map series of borehole location maps (Haase, Gillis, and King 1987b) was used as a base for construction of the various geological maps and cross

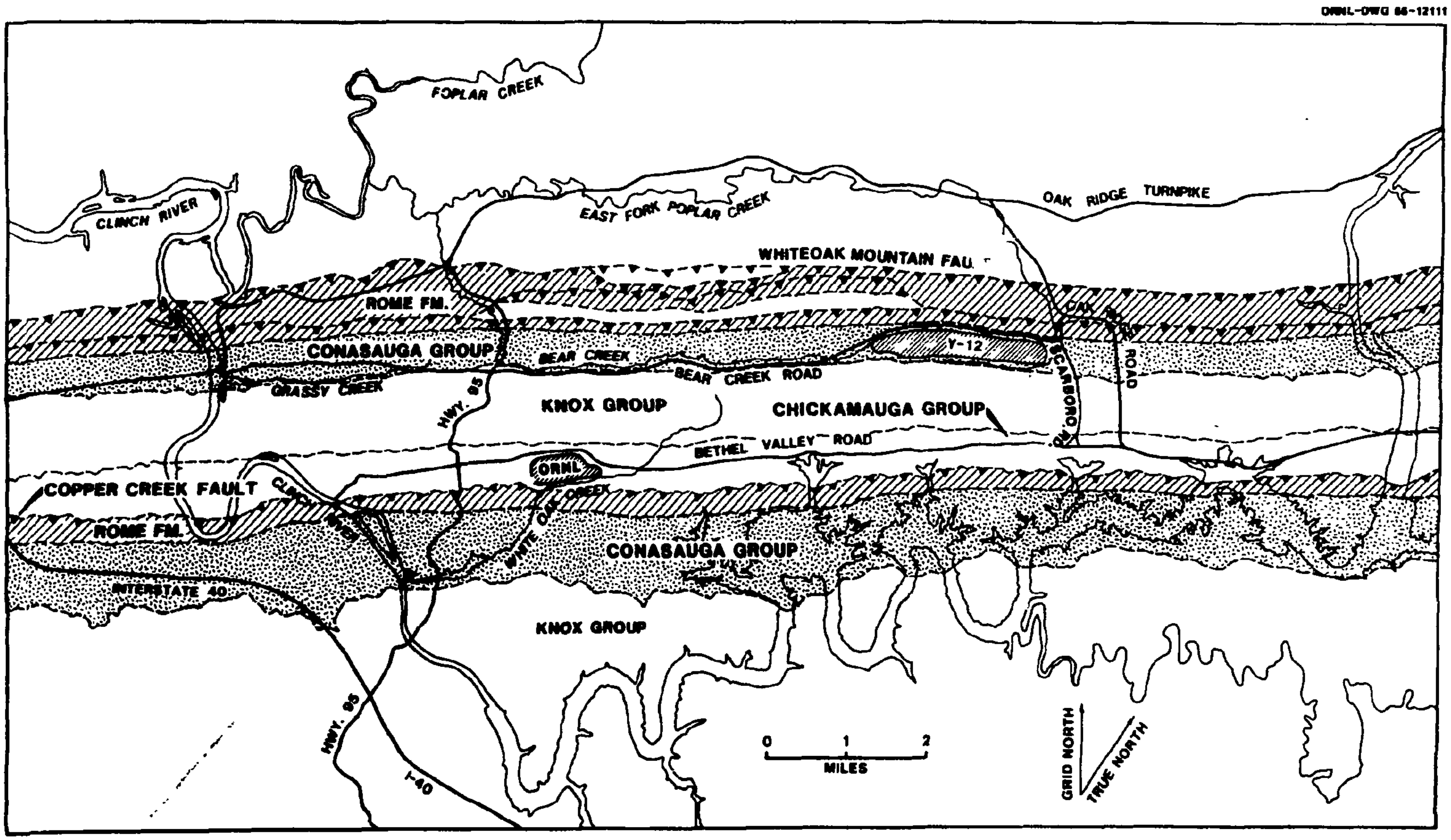


Fig. 1. Generalized geological map of the U. S. Department of Energy Oak Ridge Reservation (after McMaster 1963). Major stratigraphic units and thrust faults are illustrated. The study area is within the Conasauga Group outcrop belt containing the Y-12 Plant.

ORNL-DWG 86-12110A

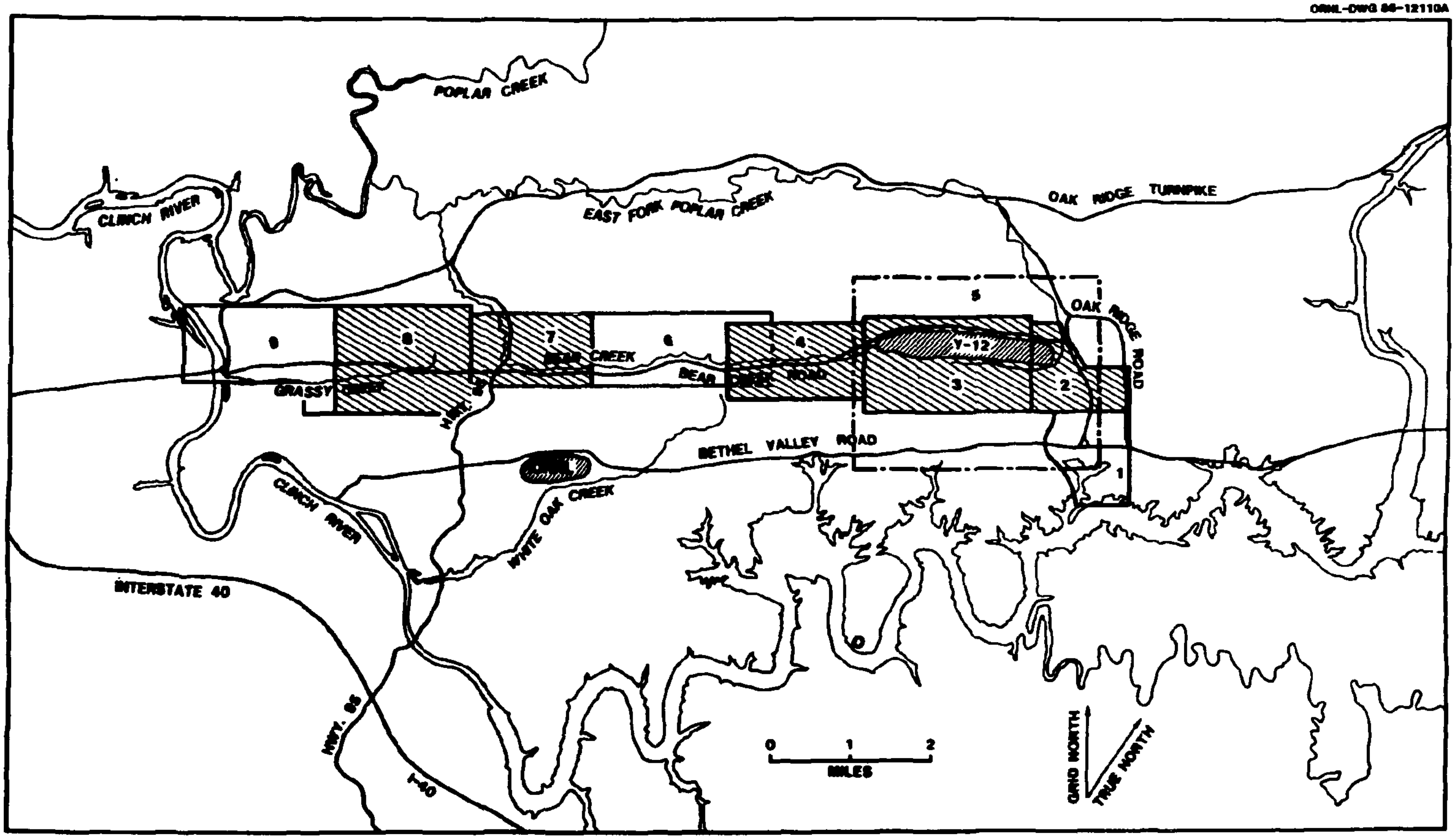


Fig. 2. Map illustrating the Bear Creek Valley study area. Areas outlined delineate regions for which Borehole Location Maps have been prepared (Haase, Gillis, and King 1987b), and crosshatched areas denote regions for which subsurface-controlled geological maps have been prepared (this report).

sections (Fig. 2). To enhance the readability of the geological information presented, only names of boreholes used to construct cross sections remain on the maps. To avoid confusion, each geological map is numbered the same as the corresponding borehole location map. Thus, the geological maps comprise a five-map series that are numbered, from east to west, sheets 2, 3, 4, 7, and 8 (see pocket on rear cover of this report). The area covered by each of the five geological maps is shown in Fig. 2. Cross sections are designated A-A' through E-E' (Figs. 3 through 7), which correspond to section lines on companion geological maps. Also, the title of each cross section contains the name of the nearest prominent cultural or geographical feature. For example, the cross section entitled Scarboro Road corresponds to section line A-A' located on Geological Map 2.

2.2 Data Sources

Multiple data sources were used to construct the geological maps and cross sections. Primary geological and geophysical subsurface data were obtained directly from a series of deep core holes (GW-128 through GW-140) drilled throughout Bear Creek Valley during the summer and fall of 1985. These data serve as the basis for most of the cross sections. Drilling and construction details for these core holes are summarized in Haase, Gillis, and King (1987a), and the geological data obtained from them are treated in detail in Haase, King, and Baxter (1987).

Previous site-specific geological and hydrological investigations also provided subsurface control data for cross section construction. The Exxon Nuclear Site Report (Law Engineering 1975) contains stratigraphic and structural information pertaining to the area covered by Map 8. The LL/HAZ-series core holes in the Gum Branch Road area (Map 7) and several of the BC-series core holes in the Exxon Nuclear Site area (Map 8) provided stratigraphic data summarized in Haase (1987). Hydrogeological studies conducted by Geraghty and Miller (1986) provided subsurface information pertaining to the Y-12 Burial Grounds (Map 4) and S3 Ponds (Map 3) areas. These and other borehole data are also summarized in Haase, Gillis and King (1987b).

2.3 Structural Cross Sections

Cross sections were positioned perpendicular to geological strike so as to encounter true dips and thicknesses of stratigraphic units (Figs. 3 through 7). The trend of the Pine Ridge crest, which is underlain by the erosion-resistant Rome Formation, was used to determine strike. To verify this strike locally, one or more three-point planar solutions were derived wherever sufficient subsurface information existed. Boreholes were then projected along strike to section lines and were plotted, utilizing borehole deviation data where available.

The depths below ground surface of stratigraphic contacts were determined from analysis and interpretation of geophysical logs, drill cores, and existing geological records. This information is summarized in Table 1 and in Haase, Gillis and King (1987b). To consistently identify these contacts in core holes GW-128 through GW-140, geophysical logs were correlated with drill core. The basis for determining these contacts is discussed by Haase, King, and Baxter (1987). Formational contacts were subsequently plotted and extended between adjacent boreholes comprising a section line. The known attitude of these contacts constrained the attitude of contacts not penetrated by more than one borehole in a particular area.

Table 1. Downhole depths of stratigraphic-contact intersections for Bear Creek Valley core holes and boreholes used to construct geological maps and cross sections (Haase, Gillis, and King 1987). All values given are measured in feet below ground surface.

Boring	RM[a]	PV	RT	RG	MR	NL	MY	CR
1033	-	-	-	-	b	-	-	-
1043	-	-	-	-	b	-	-	-
1044	-	-	-	-	-	-	b	-
BC-3	-	-	-	-	223	b	-	-
BC-6	-	-	-	253	b	-	-	-
BC-7	-	-	237	115	b	-	-	-
BC-8	-	180	58	b	-	-	-	-
BC-9		b	-	-	-	-	-	-
BC-10	263	b	-	-	-	-	-	-
BC-11	180	b	-	-	-	-	-	-
CH-157	-	-	-	-	-	-	-	b
GW-71	-	-	-	-	-	b	-	-
GW-111	-	-	-	-	-	245	b	-
GW-116	-	-	-	-	-	b	-	-
GW-117	-	-	-	-	-	100	b	-
GW-118	-	-	-	-	-	158	b	-
GW-119	-	-	-	-	-	100	b	-
GW-123	-	-	-	-	-	62	b	-
GW-128	847	469	304	136	b	-	-	-
GW-129	-	-	908	791	269	b	-	-
GW-130	-	-	-	-	1051	442	b	-
GW-131	-	-	-	-	-	-	586	b
GW-132	638	257	101	b	-	-	-	-
GW-133	-	-	570	448	b	-	-	-
GW-134	-	-	-	-	708	113	b	-
GW-135	-	-	-	-	-	1260	690	b
GW-136	-	-	-	-	594	b	-	-
GW-137	-	-	-		910	314	b	-
GW-138	-	-	-	-	-	1013	435	b
GW-139	-	-	-	846	483	b	-	-
GW-140	-	-	-	-	-	1056	485	b
GW-164	197	b	-	-	-	-	-	-
LL/HAZ-13	-	98	b	-	-	-	-	-
LL/HAZ-14	-	-	-	205	b	-	-	-
LL/HAZ-15	-	-	-	-	94	b	-	-

[a] Abbreviations: RM - Rome; PV - Pumpkin Valley; RT - Rutledge; RG - Rogersville; MR - Maryville; NL - Nolichucky; MY - Maynardville; CR - Copper Ridge.

[b] Collared in this formation. Where no other entry occurs, the boring is entirely within the formation indicated and does not intersect a stratigraphic contact.

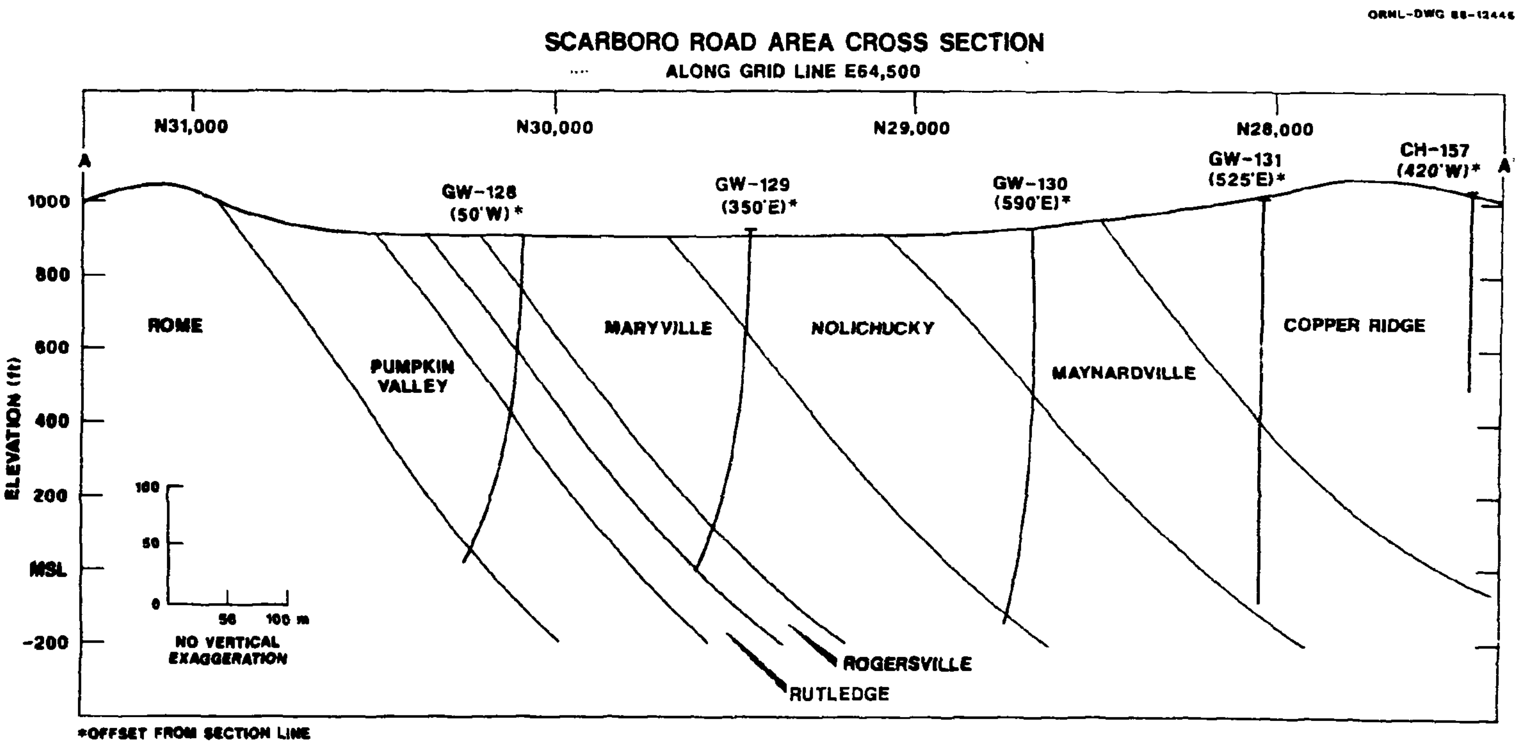


Fig. 3. Structural cross section in the Scarboro Road area (area 2 in Fig. 2). Traces of core holes GW-128 through GW-131 and CH-157 are projected onto the line of section.

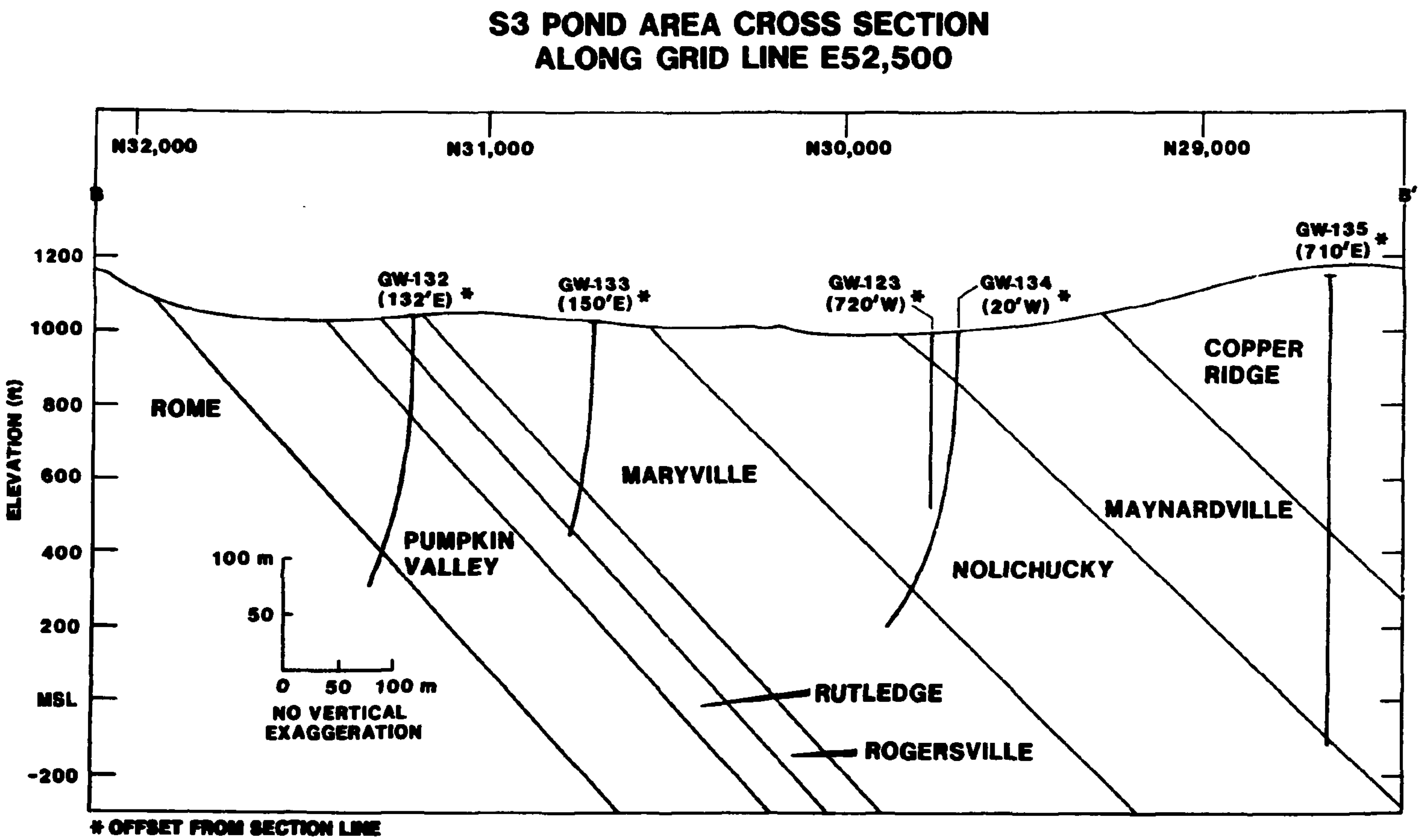


Fig. 4. Structural cross section in the S3 Ponds area (area 3 in Fig. 2). Traces of core holes GW-132 through GW-135 and borehole GW-123 are projected onto the line of section.

2.4 Geological Maps

To construct map outcrop patterns of formational contacts within the study area, subsurface contacts penetrated by core holes were extrapolated to the surface along cross section lines. From these control points, contacts were extended laterally, utilizing (1) known topographic expressions of the various formations, (2) rules governing the geometric configuration of the intersecting sloping terrain and dipping strata, and (3) methods for predicting outcrop patterns as described by Ragan (1973).

To construct the bedrock geological maps, structural contour lines drawn on the dipping strata were superposed on topographic contour lines using a common datum and equal contour interval. Each intersection of a structural contour with its corresponding topographic contour represents an outcrop point. By joining successive outcrop points, the positions of stratigraphic contacts were established. Stratigraphic contacts were not, however, projected into areas in which little or no subsurface control exists.

2.5 Cross-Strike Faults

Tear faults in the structural block containing Bear Creek Valley and adjacent ridges were inferred from abrupt offsets or changes in the strike of Pine Ridge. The fault traces illustrated on the geological maps represent the approximate locations of faults whose offsets were accompanied by discontinuities in expected outcrop patterns of the various stratigraphic units or by anomalies in subsurface data. Other tear faults can be inferred, as there are a number of prominent ridge-crest offsets and linear erosional trends throughout Bear Creek Valley. Becasue of the lack of subsurface geological data in the vicinity of such features, however, they are not indicated on the geological maps.

The nature of these tear faults is not known in detail. They appear to be approximately north-striking, high-angle, cross-strike faults that die out within the floor of Bear Creek Valley before reaching Chestnut Ridge. Displacement direction along the faults is complex, and maximum offset appears to be no more than several tens to a few hundreds of feet. Similar features have been noted on the leading edge of the Copper Creek thrust sheet (Haase, Zucker, and Stow 1985) that occurs to the south of the study area.

3. GEOLOGY OF THE STUDY AREA

3.1 Geological Setting

Bear Creek Valley is located on the leading edge of the White Oak Mountain thrust sheet (Fig. 1), which is in the Valley and Ridge Province of the Appalachian Orogenic Belt. The bedrock stratigraphy of the valley and adjacent ridges consists of sediments of Cambrian through Ordovician age. The stratigraphic units, from oldest to youngest, are the Early Cambrian Rome Formation, Middle and Late Cambrian Conasauga Group, and the Late Cambrian and Early Ordovician Knox Group. In the study area, the Rome Formation crops out on Pine Ridge, which forms the north side of Bear Creek Valley, the Conasauga Group underlies the Valley, and the Knox Group crops out along Chestnut Ridge, which forms the south side of the valley. The strike of strata varies locally from N47°E to N67°E. The dip of the rocks near the surface is 35° to 50° to the southeast.

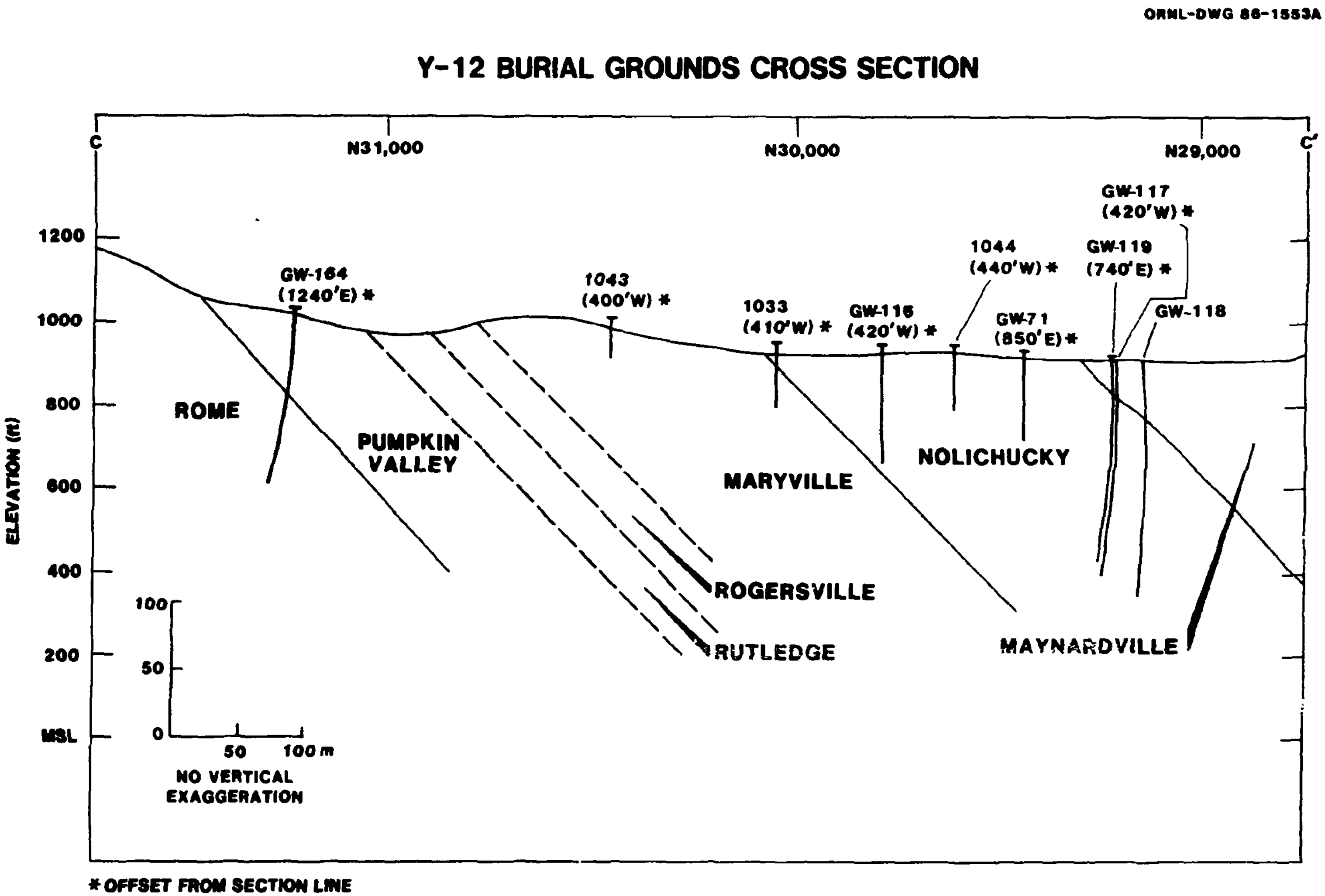


Fig. 5. Structural cross section in the Y-12 Burial Grounds area (area 4 in Fig. 2). Traces of boreholes 1033, 1043, 1044, GW-71, GW-116 through GW-119, and GW-164 are projected onto the line of section.

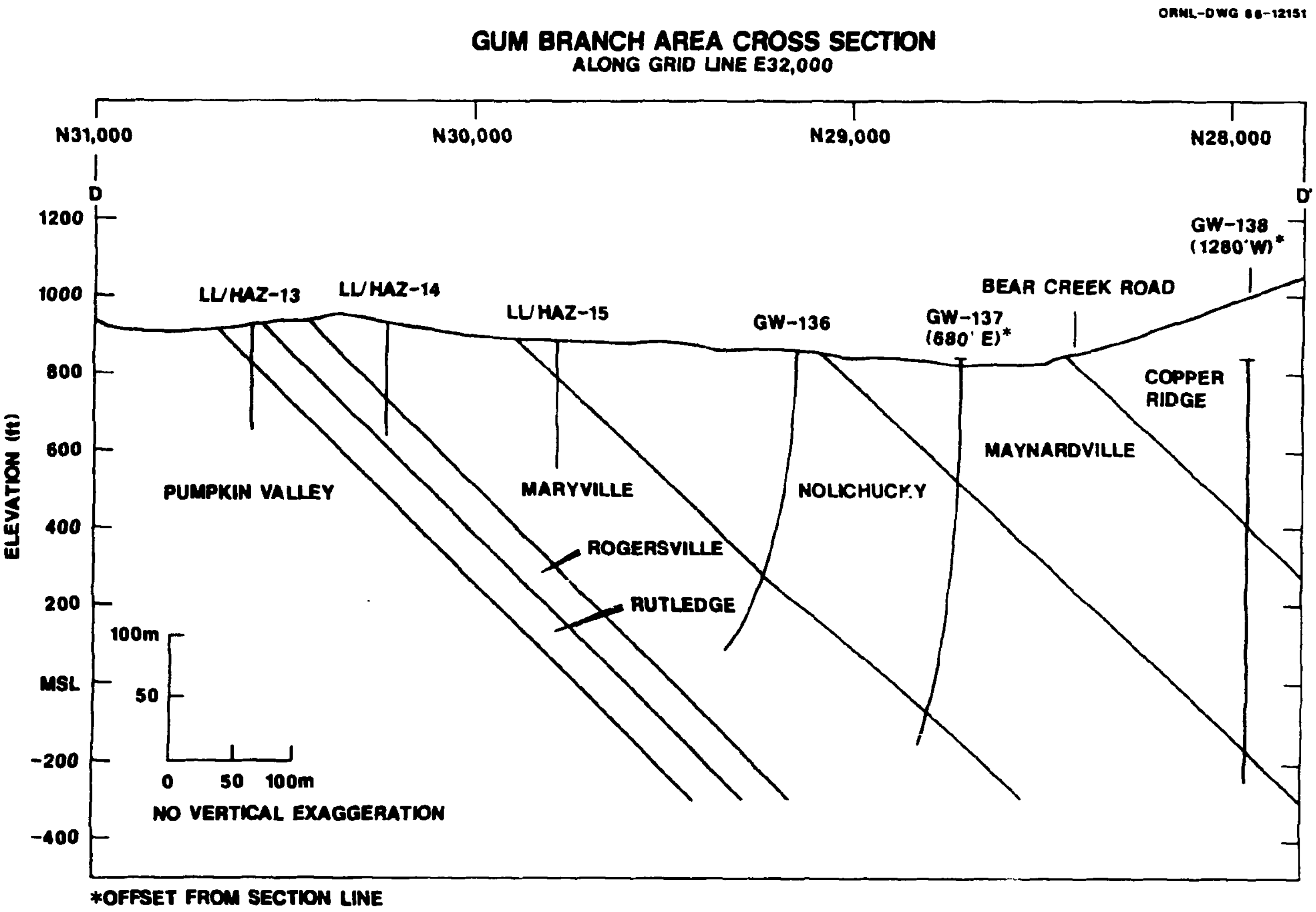


Fig. 6. Structural cross section in the Gum Branch Road area (area 7 in Fig. 2). Traces of core holes GW-136 through GW-138 and LL/HAZ-13 through LL/HAZ-15 are projected onto the line of section.

3.2 Stratigraphy

The following section contains a brief summary of the lithologic and stratigraphic details of the rock formations underlying the study area. A more comprehensive discussion of the stratigraphy of the study area, based on drill core data from core holes GW-128 through GW-140, is presented in Haase, King, and Baxter (1987).

3.2.1 Rome Formation

Within the study area, the upper portion of the Rome Formation was inters[illegible] by only two core holes (GW-128 and GW-132). Core drilling conducted during other investigations (Law Engineering 1975) also did not penetrate the entire Rome Formation; consequently, the total stratigraphic thickness of the unit in this vicinity cannot be determined. The uppermost 100 ft of the Rome Formation penetrated by core holes GW-128 and GW-132 consists of massive to thinly-bedded, maroon to gray-green sandstones interbedded with greatly subordinate amounts of thinly-bedded, silty mudstones and shales (Haase, King, and Baxter 1987).

3.2.2 Conasauga Group

The Conasauga Group in Bear Creek Valley consists primarily of calcareous shales interbedded with limestones and siltstones. The total thickness of the group varies from 1890 ft in the eastern portion of the study area to 1717 ft in the western portion (Table 2). Six formations can be recognized within the group. They are, in ascending order, the Pumpkin Valley Shale, the Rutledge Limestone, the Rogersville Shale, the Maryville Limestone, the Nolichucky Shale, and the Maynardville Limestone. Thicknesses of each formation vary throughout the study area and are summarized in Table 2.

Table 2. Stratigraphic thicknesses of formations of the Conasauga Group in Bear Creek Valley. All values given are in feet.

Geological Map	PV[a]	RT	RG	MR	NL	MY
2	320	120	120	400	490	440
3	320	115	100	382	528	418
4	260	100	100	445	550	b
7	b	90	90	348	520	430
8	302	98	99	346	422	450

[a] Abbreviations: PV - Pumpkin Valley; RT - Rutledge; RG - Rogersville; MR - Maryville; NL - Nolichucky; MY - Maynardville.

[b] Total stratigraphic thickness not penetrated in map area.

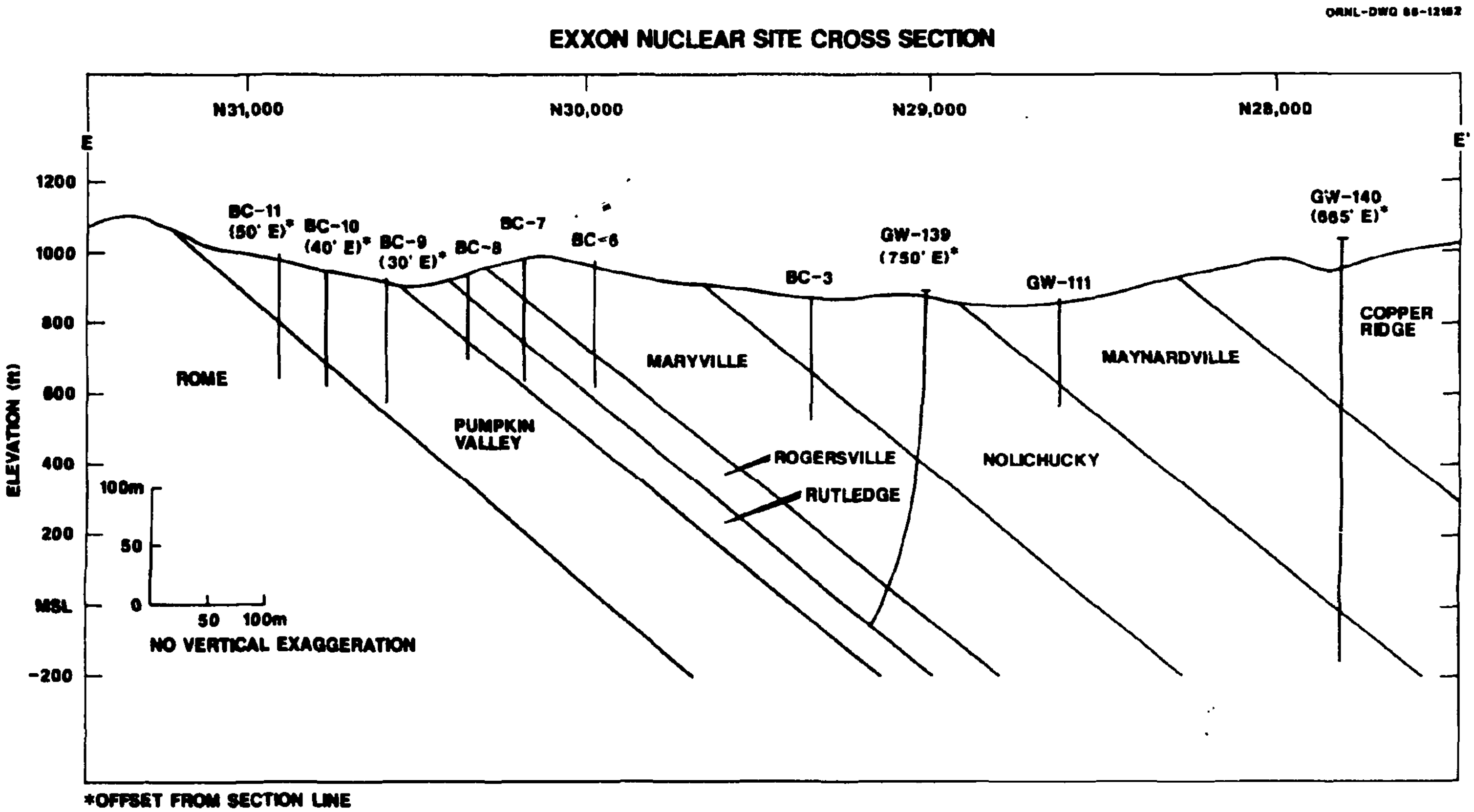


Fig. 7. Structural cross section in the Exxon Nuclear Site area (area 8 in Fig. 2). Traces of core holes BC-3, BC-6 through BC-11, GW-111, GW-139, and GW-140 are projected onto the line of section.

The Pumpkin Valley Shale ranges from 260 to 320 ft in thickness throughout the valley and consists of massive to thinly-bedded, maroon-brown to gray mudstones and shales interbedded with thinly-bedded to laminated glauconitic siltstones. Two members can be identified, with the upper one being more shale- and mudstone-rich than the lower one. The lower member contains abundant zones of mottled, bioturbated shaly siltstones interbedded with thinly bedded shales and siltstones (Law Engineering 1975; Haase, King, and Baxter 1987)

The Rutledge Limestone is 90 to 120 ft thick (Table 2) and consists of light gray to white, medium- to thinly-bedded limestones and shaly limestones interbedded with medium to dark gray, thinly-bedded to laminated, calcareous mudstones and shales. A persistent, 5-to-10-ft-thick interval of maroon to maroon-gray mudstone occurs toward the base of this formation and serves as a marker bed within the lower Conasauga Group throughout Bear Creek Valley (Law Engineering 1975; Haase, King, and Baxter 1987).

The Rogersville Shale is composed predominantly of massive to medium-bedded, gray to maroon mudstones interbedded with medium- to very thinly-bedded, gray to maroon-brown shales. The shales and mudstones contain subordinate amounts of thinly-bedded, glauconite-rich, locally calcareous siltstone. The Rogersville Shales varies from 90 to 120 ft in thickness (Table 2) throughout the study area (Law Engineering 1975; Haase, King, and Baxter 1987).

The Maryville Limestone consists of light to dark gray, fine to coarsely crystalline limestone interbedded with subordinate amounts of dark gray, medium to thinly-bedded, calcareous shales and shaly siltstones. The Maryville Limestone can be divided into two members (Haase and Tank 1985), with zones of limestone-pebble conglomerates and oolite-rich beds being locally abundant in the upper member (Haase, King, and Baxter 1987). The lower member consists of medium to thinly bedded calcareous shales and siltstones with subordinate amounts of crystalline limestones. Limestone-pebble conglomerates and oolite-rich beds are rare to nonexistent in the lower member (Haase and Tank 1985; Haase, King, and Baxter 1987). Thicknesses of the Maryville Limestone in Bear Creek Valley vary from 346 to 445 ft (Table 2).

The Nolichucky Shale ranges in thickness from 422 to 550 ft (Table 2). The formation consists of maroon-brown to rare green-gray, massive to very thinly-bedded, locally calcareous mudstones and shales interstratified with thinly-bedded, medium gray limestones and calcareous siltstones. The maroon-brown color of the shales is characteristic of the Nolichucky Shale, and serves to differentiate shales of this formation from those of the underlying Maryville Limestone (Haase, King, and Baxter 1987). The interbedded limestones typically contain limestone-pebble conglomerates and oolite-rich beds similar to those occurring in the underlying Maryville Limestone. Throughout much of the Nolichucky Shale, mudstone/shale and limestone lithologies alternate on a scale of 1 to 3 ft, giving the formation a thickly bedded appearance (Haase, King, and Baxter 1987).

The Maynardville Limestone is composed of light gray to tan, massive to thinly-bedded limestone with subordinate amounts of dolostone. This formation can be divided into members on the Oak Ridge Reservation (Haase, Walls, and Farmer1985). The uppermost Chances Branch member contains subordinate amounts of interbedded dolostone, and the lower Low Hollow member is locally dolomitic and contains abundant oolite-rich horizons.

Both members are locally stylolitic. Within the study area, the Maynardville Formation varies from 418 to 450 ft in thickness (Table 2).

3.2.3 Knox Group

Only the lowermost formation of the Knox Group, the Copper Ridge Dolomite, occurs within the study area. The lower portions of this formation were intersected by core holes (CH-157, GW-131, GW-135, and GW-140); consequently, total stratigraphic thickness of the unit was not determined. The cored interval of the Copper Ridge Dolomite is composed of tan to medium gray, massive to thinly bedded, locally chert-rich dolostone containing abundant stylolites.

3.3 Geological Summary of Individual Map Areas

The following is a brief discussion and summary of the geology exhibited in each of the mapped areas within the Bear Creek Valley study area.

3.3.1 Map 2 - Scarboro Road Area

The area covered by Geological Map 2 is located at the eastern end of the Y-12 Plant facility. Subsurface control for this area was provided by core holes GW-128 through GW-131 and CH-157. The depths at which stratigraphic contacts were penetrated by these core holes are listed in Table 1, and thicknesses of the various formations are given in Table 2.

The strike of the strata within the Map 2 area ranges from N57°E to N67°E, and dips average 50° to the southeast. The dips of the Nolichucky Shale-Maynardville Limestone and Maynardville Limestone-Copper Ridge Dolomite contacts decrease to approximately 37° in the deep subsurface, interpreted as a flattening at depth of the White Oak Mountain thrust sheet.

A tear fault transects the northwest portion of Map 2 and extends into the southeast portion of Map 3. This fault is inferred from a relatively abrupt change in the strikes of Pine Ridge and Chestnut Ridge. This change in orientation is best observed on a smaller-scale map, such as those of McMaster (1963) or Hoos and Bailey (1986).

3.3.2 Map 3 - S3 Ponds and Y-12 Plant Area

Map 3 covers the Y-12 Plant area and includes the S3 Ponds located at the westernmost edge of the complex. Subsurface data for this area were provided by core holes GW-132 through GW-135 and borehole GW-123. The depths at which stratigraphic contacts were intersected are listed in Table 1, and thicknesses of the various units are given in Table 2.

Local strike within the Map 3 area varies from N50°E to N66°E, and dips average 45° to the southeast. The significant variance in strike is explained by the presence of two tear faults that transect the central and western portions of the plant. Evidence for faulting exists in the abrupt change in strike of Pine Ridge. In the case of the westernmost fault, a corresponding offset occurs in Chestnut Ridge. Displacement along the central tear fault, however, appears to decrease within the Conasauga Group, which underlies the valley floor. In addition, subsurface data from boreholes located within the Y-12 plant constrain the placement of stratigraphic contacts throughout the map area. The changes in strike of these contacts correspond to those of Pine and Chestnut Ridges.

3.3.3 Map 4 - Y-12 Burial Grounds Area

The area covered by Map 4 is located west of the Y-12 Plant and includes the Y-12 Burial Grounds and Oil Landfarm. The geology of this area is poorly understood, because of a lack of adequate deep subsurface information. Stratigraphic contacts were intersected by boreholes GW-164, GW-117 through GW-119, and 1033, which range from 160 to 575 ft in total depth. The depths at which stratigraphic contacts were encountered are listed in Table 1. However, only the Nolichucky Shale-Maynardville Limestone contact was penetrated by more than one borehole, and the contacts between the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, and Maryville Limestone were not intersected at all. The topographic expression of the different strata and data provided by relatively shallow boreholes constrained the positions of outcrop patterns of these stratigraphic units. These shallow boreholes include 1043, 1044, GW-71, and GW-116, which range from 150 to 285 ft in depth.

Thicknesses of the various formations are given in Table 2. The 260-ft thickness of the Pumpkin Valley Shale represents an anomaly. To the east and west of this location, this unit measures approximately 300 ft or more. Because sufficient subsurface data do not exist within the Burial Grounds area to define the Pumpkin Valley Shale-Rutledge Limestone contact, this stratigraphic thickness is questionable. Positioning of the Rutledge and Rogersville Formations relative to the Pumpkin Valley Shale and Maryville Limestone relied on topographic expression of the units and shallow borehole data within the immediate vicinity. In addition, the dip of the Rome Formation-Pumpkin Valley Shale contact could not be determined directly, so 48° was used to correspond with the known dip exhibited by the Nolichucky Shale-Maynardville Limestone contact. However, outcrops in the Pumpkin Valley Shale near the base of Pine Ridge show bedding dips up to 70° to the southeast. These steep dips are probably due to intraformational thrust faulting and are not interpreted to reflect the true orientation of the stratigraphic contact between the Rome and Pumpkin Valley Formations (R. B. Dreier, Oak Ridge National Laboratory, personal communication, 1986).

Local strike ranges from N47°E to N52°E. A moderate change in the strike of Pine Ridge is noted in the eastern portion of the map and is interpreted to be a result of tear faulting. Chestnut Ridge, however, does not show a corresponding variance in orientation, which indicates that the fault displacement decreases within the Conasauga Group.

3.3.4 Map 7 - Gum Branch Road Area

Map 7 covers the Gum Branch Road area of Bear Creek Valley. This area is located east of Highway 95 and approximately 2 miles west of the Y-12 Burial Grounds. Subsurface data were provided by deep core holes GW-136 through GW-138 and by a shallow series of core holes LL/HAZ-13 through LL/HAZ-15. The positions of stratigraphic contacts and bedding dips are well constrained by these data. The depths at which contacts were intersected in the subsurface are listed in Table 1, and stratigraphic thicknesses are given in Table 2.

Local strike within the Gum BranchRoad locality varies little, ranging from N53°E to N56°E, and dips consistently measure 43° to the southeast. Although faulting is not evidenced from topography, a considerable amount of deformation was noted in drill cores from GW-136 and GW-137. Also, a moderate offset in Pine Ridge and the small line of knolls held up by the Maryville Limestone is observed just east of the Map 7 area (See Borehole Location Map 6, Haase, Gillis, and King 1987b). These observations indicate that some faulting has occurred either within or near the margin of the Gum Branch Road map area.

3.3.5 Map 8 - Exxon Nuclear Site Area

Map 8 includes the Exxon Nuclear Site area, which is located approximately 2 miles east of the Clinch River and 1 mile west of Highway 95 along Bear Creek Road. Subsurface control at this locality was provided by core holes GW-111, GW-139, GW-140, BC-3, and BC-6 through BC-11. The depths at which stratigraphic contacts were intersected are listed in Table 1, and stratigraphic thicknesses are given in Table 2.

Geological strike at this locality varies from N50°E to N55°E, and dips average 39° to the southeast. Evidence of tear faulting is absent within the mapped area itself, but considerable offset in the line of knolls underlain by Maryville Limestone is observed west of grid line E19,000 on the map. Lack of any subsurface control in that area, however, precludes confirmation of the existence of tear faulting.

4. SUMMARY

The five geological maps and structural cross sections for Bear Creek Valley presented in this report provide a detailed summary of bedrock geology underlying the Y-12 Plant, Bear Creek Valley waste disposal sites and selected portions of Bear Creek Valley west of the Y-12 Plant. Stratigraphic information and formational contacts illustrated are consistent with all available surface and subsurface data for each of the map areas. The bedrock geology illustrated represents the most detailed information presently available for the areas covered by the maps.

5. REFERENCES

Geraghty and Miller, Inc. 1986. Phase IV Monitor-Well Drilling Program in the Bear Creek Valley Waste Disposal Area. Y/SUB/85-00206C/8.

Haase, C. S. 1987. Geological data for the Middle to Late Cambrian Conasauga Group on the U. S. Department of Energy Oak Ridge Reservation. ORNL/TM-9158 (in preparation).

Haase, C. S., G. A. Gillis, and H. L. King 1987a. Fiscal year 1985 groundwater investigation drilling program at the Y-12 Plant, Oak Ridge, Tennessee. ORNL/TM-9999.

Haase, C. S., G. A. Gillis, and H. L. King 1987b. Subsurface data for the Y-12 Plant and vicinity. ORNL/TM-10000.

Haase, C. S., H. L. King, and P. M. Baxter 1987. Geological data for Bear Creek Valley. ORNL/TM-10113 (in preparation).

Haase, C. S. and R. W. Tank 1985. Stratigraphy and clay mineralogy of the Maryville Limestone near Oak Ridge, Tennessee (abstract). Geol. Soc. Am. Abstracts with Programs, v. 17.

Haase, C. S., E. C. Walls, and C. D. Farmer 1985. Structural and stratigraphic data for the Conasauga Group and Rome Formation on the Copper Creek thrust sheet near Oak Ridge Tennessee: Preliminary data from test borehole ORNL-Joy No. 2. ORNL/TM-9159.

Haase, C. S., C. L. Zucker, and S. H. Stow 1985. Geology of the host formation at the New Hydraulic Fracturing Facility at Oak Ridge National Laboratory. IN R. G. Post and M. E. Wacks, (eds.), Proceedings of Waste Management '85, Tucson, AZ, March 25-28, 1985, University of Arizona Press, Tucson, AZ.

Hoos, A. B., and Z. C. Bailey 1986. Reconnaissance of Surficial Geology, Regolith Thickness, and Configuration of the Bedrock Surface in Bear Creek and Union Valleys, near Oak Ridge, Tennessee. U. S. Geological Survey Water Resources Division Report 86-4165.

Law Engineering, Inc. 1975. Preliminary Safety Analysis Report, Exxon Nuclear Fuel Recovery and Recycling Center. Docket No. 50-564, Exxon Nuclear Corporation.

Law Engineering, Inc. 1983. Results of Groundwater Monitoring Studies. Report Y/SUB/83-47936/1.

McMaster, W. M. 1963. Geological map of the Oak Ridge Reservation, Tennessee. ORNL/TM-713.

Ragan, D. M. 1973. Structural Geology: An Introduction to Geometrical Techniques, 2nd ed. John Wiley & Sons, New York, NY.

INTERNAL DISTRIBUTION

1. S. I. Auerbach
2. J. S. Baldwin
3. W. J. Boegly, Jr.
4. R. B. Clapp
5. A. G. Croff
6. N. H. Cutshall
7. E. C. Davis
8. L. R. Dole
9. R. B. Dreier
10. G. A. Gillis
11-20. C. S. Haase
21. S. E. Herbes
22. S. G. Hildebrand
23. C. G. Jones
24. R. Jordan
25. R. H. Ketelle
26. C. W. Kimbrough
27-36. H. L. King
37. I. L. Larsen
38. S. Y. Lee
39-88. L. L. McCauley
89. L. E. McNeese
90. T. W. Oakes
91-92. D. E. Reichle
93. E. D. Smith
94. D. K. Solomon
95. B. P. Spalding
96. S. H. Stow
97. J. Switek
98. L. E. Toran
99. S. H. Welch
100. G. T. Yeh
101. Central Research Library
102-116. ESD Library
117-118. Laboratory Records Dept.
119. Laboratory Records, ORNL-RC
120. ORNL Patent Section
121. ORNL Y-12 Technical Library

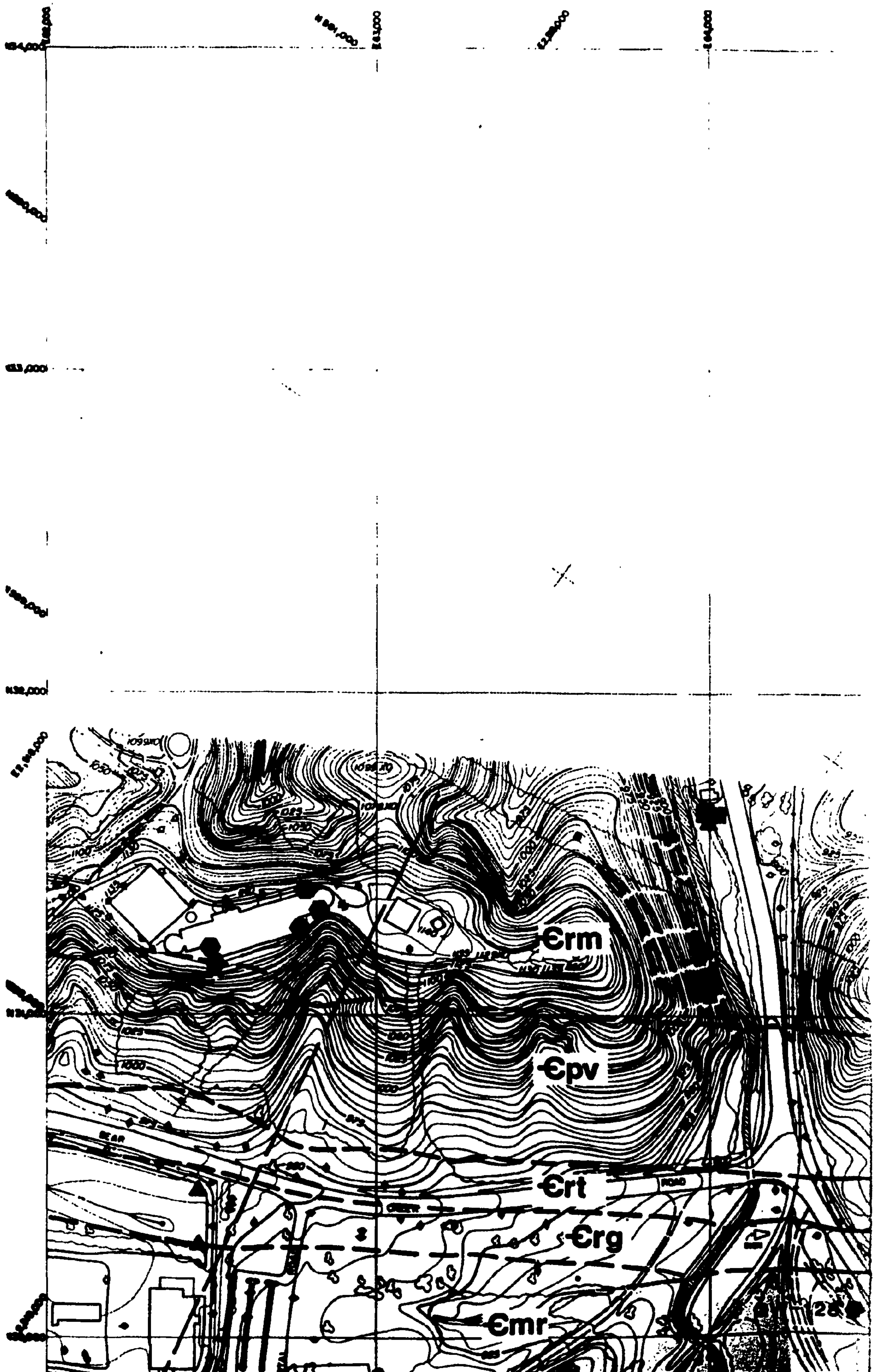
EXTERNAL DISTRIBUTION

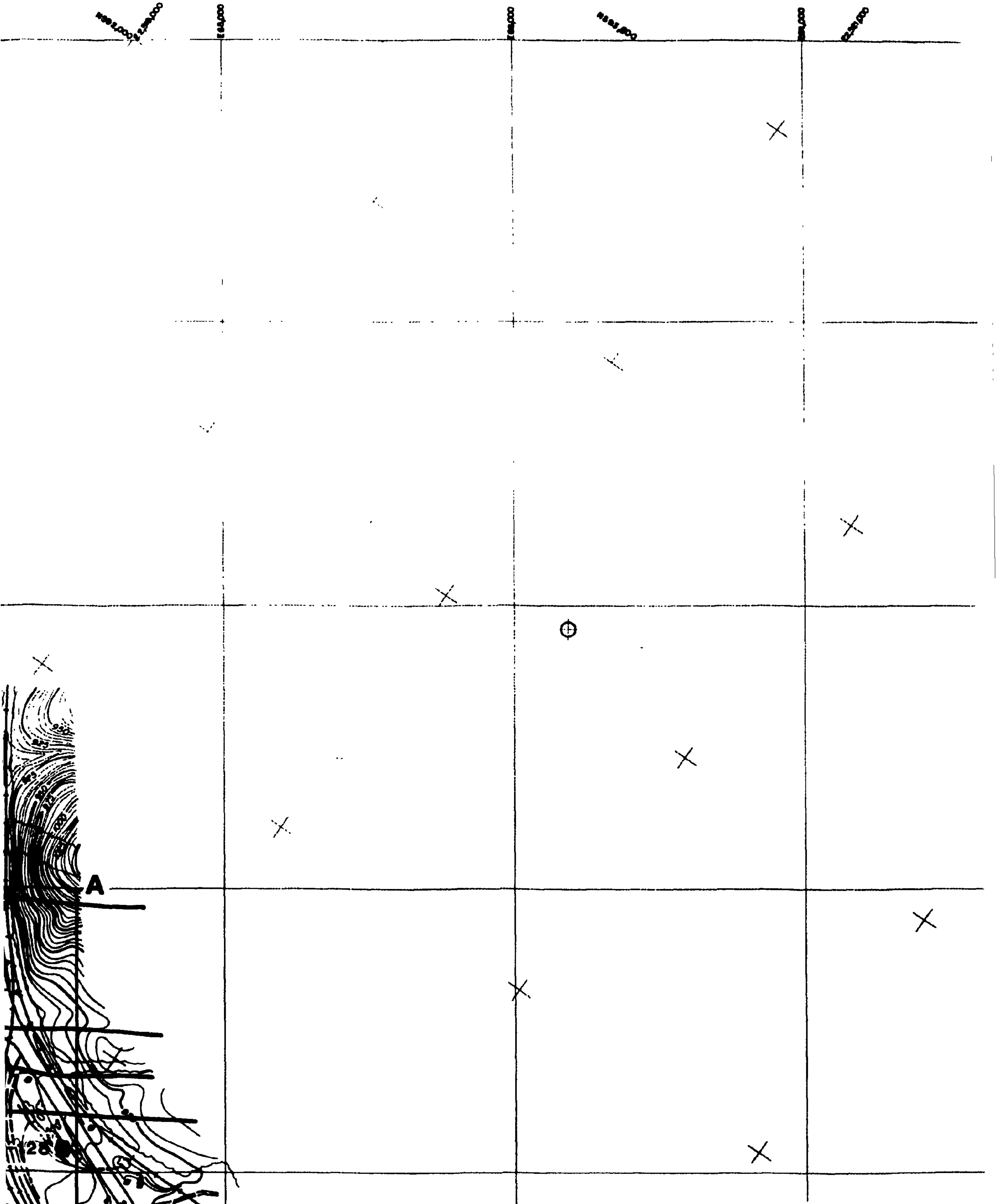
122. G. A. Archer, Geraghty and Miller, Inc., Kentucky-Tennessee Executive Plaza, Bldg. A, Suite 2, 140 E. Division Road, Oak Ridge, TN 37830
123. Z. Bailey, U.S. Geological Survey, A413 Federal Building, U.S. Courthouse, Nashville, TN 37203
124. J. Thomas Callahan, Associate Director, Ecosystem Studies Program, Room 336, 1800 G Street, NW, National Science Foundation, Washington, DC 20550
125. T. K. Cothron, Tennessee Division of Health and Environment, TERRA Bldg., 150 9th Avenue, North, Nashville, TN 37914
126. J. E. Dieckhoner, Acting Director, Operations and Traffic Division, DP-122 (GTN), U.S. Department of Energy, Washington, DC 20545
127. G. J. Foley, Office of Environmental Process and Effects Research, U.S. Environmental Protection Agency, 401 M Street, SW, RD-682, Washington, DC 20460
128. C. R. Goldman, Professor of Limnology, Director of Tahoe Research Group, Division of Environmental Studies, University of California, Davis, CA 95616
129. C. D. Henry, Geraghty and Miller, Inc., Land Mark Plaza, Suite 200, 14310 N. Dale Mabry, Tampa, FL 33618
130. H. W. Hibbitts, U.S. Department of Energy, Oak Ridge Operations, Federal Bldg., Room 3025, Oak Ridge, TN 37830

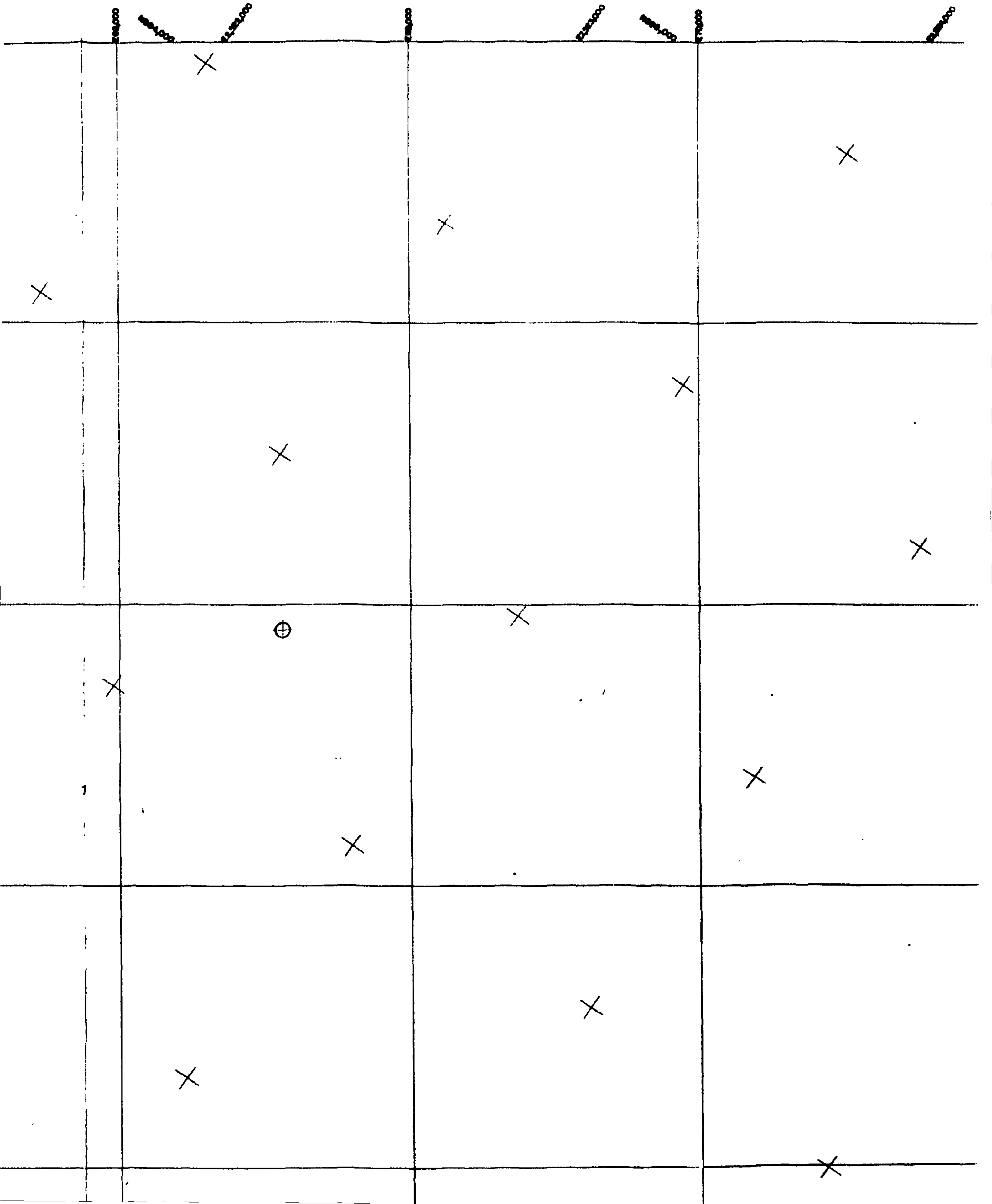
131. J. W. Huckabee, Manager, Ecological Studies Program, Electric Power Research Institute, 3412 Hillview Avenue, P.O. Box 10412, Palo Alto, CA 94303
132. D. R. Hunter, U.S. Environmental Protection Agency, Region IV, Hazardous Waste Section, College Station Road, Athens, Georgia 30613
133. George Y. Jordy, Director, Office of Program Analysis, Office of Energy Research, ER-30, G-226, U.S. Department of Energy, Washington, DC 20545
134. D. B. Leclaire, Director, Office of Defense Waste and Transportation Management, DP-12 (GTN), U.S. Department of Energy, Washington, DC 20545
135. E. C. Leming, Tennessee Division of Health and Environment, Bureau of Environment, 1605 Prosser Road, Knoxville, TN 37914
136. S. L. Lestrange, U.S. Department of Energy, Oak Ridge Operations, Federal Bldg., Room G114, Oak Ridge, TN 37830
137. C. J. Mankin, Director, Oklahoma Geological Survey, The University of Oklahoma, 830 Van Vleet Oval, Room 163, Norman, OK 73019
138. Helen McCammon, Director, Ecological Research Division, Office of Health and Environmental Research, Office of Energy research, MS-E201, ER-75, Room E-233, Department of Energy, Washington, DC 20545
139. Michael McFadden, Waste Management, Albuquerque Operations Office, U.S. Department of Energy, Albuquerque, NM 37115
140. E. W. Morse, Geraghty and Miller, Inc., Kentucky-Tennessee Executive Plaza, Bldg. A, Suite 2, 140 E. Division Road, Oak Ridge, TN 37830
141. E. Phillips, Tennessee Division of Health and Environment, TERRA Bldg., 150 9th Avenue, North, Nashville, TN 37914
142. G. N. Pruitt, Tennessee Division of Health and Environment, TERRA Bldg., 150 9th Avenue, North, Nashville, TN 37914
143. D. R. Rima, Tennessee Division of Health and Environment, TERRA Bldg., 150 9th Avenue, North, Nashville, TN 37914
144. R. J. Stern, Director, Office of Environmental Guidance, EH-23, FORRESTAL, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585
145. J. A. Stone, Savannah River Laboratory, E. I. DuPont de Nemours and Company, Bldg. 773-A, Room E-112, Aiken, SC 29808
146. D. A. Webster, U.S. Geological Survey, 1013 N. Broadway, Knoxville, TN 37917
147. Leonard H. Weinstein, Program Director of Environmental Biology, Cornell University, Boyce Thompson Institute for Plant Research, Ithaca, NY 14853
148. Raymond G. Wilhour, Chief, Air Pollution Effects Branch, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, 200 SW 35th Street, Corvallis, OR 97330
149. Frank J. Wobber, Ecological Research Division, Office of Health and Environmental Research, Office of Energy Research, MS-E201, Department of Energy, Washington, DC 20545

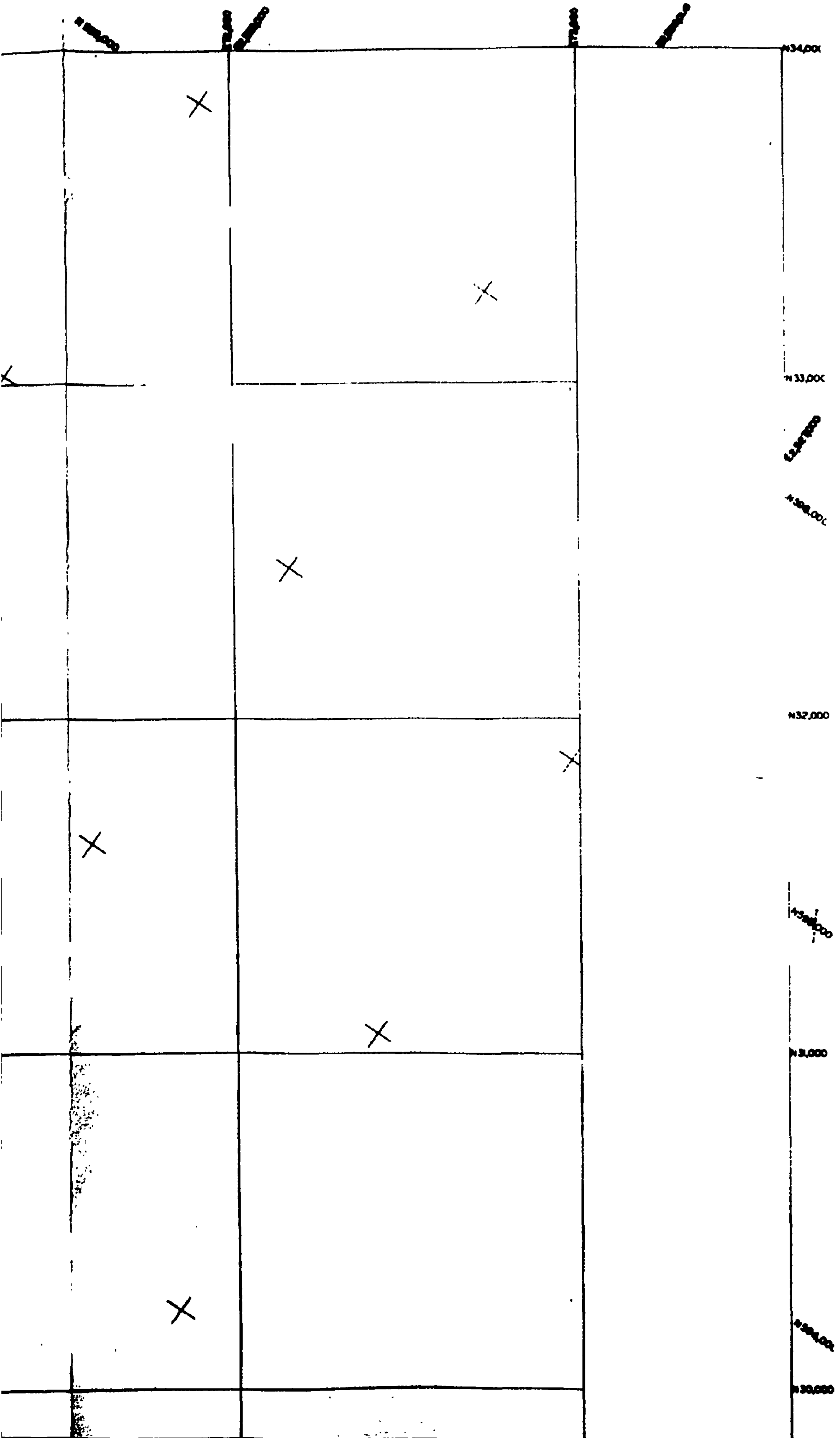
150. M. Gordon Wolman, The Johns Hopkins University, Department of Geography and Environmental Engineering, Baltimore, MD 21218
151. H. H. Zehner, U.S. Geological Survey-Water Resources Division, 1013 N. Broadway, Knoxville, TN 37917
152. Office of Assistant Manager for Energy Research and Development, Oak Ridge Operations, P. O. Box E, U.S. Department of Energy, Oak Ridge, TN 37831
153-182. Technical Information Center, Oak Ridge, TN 37831

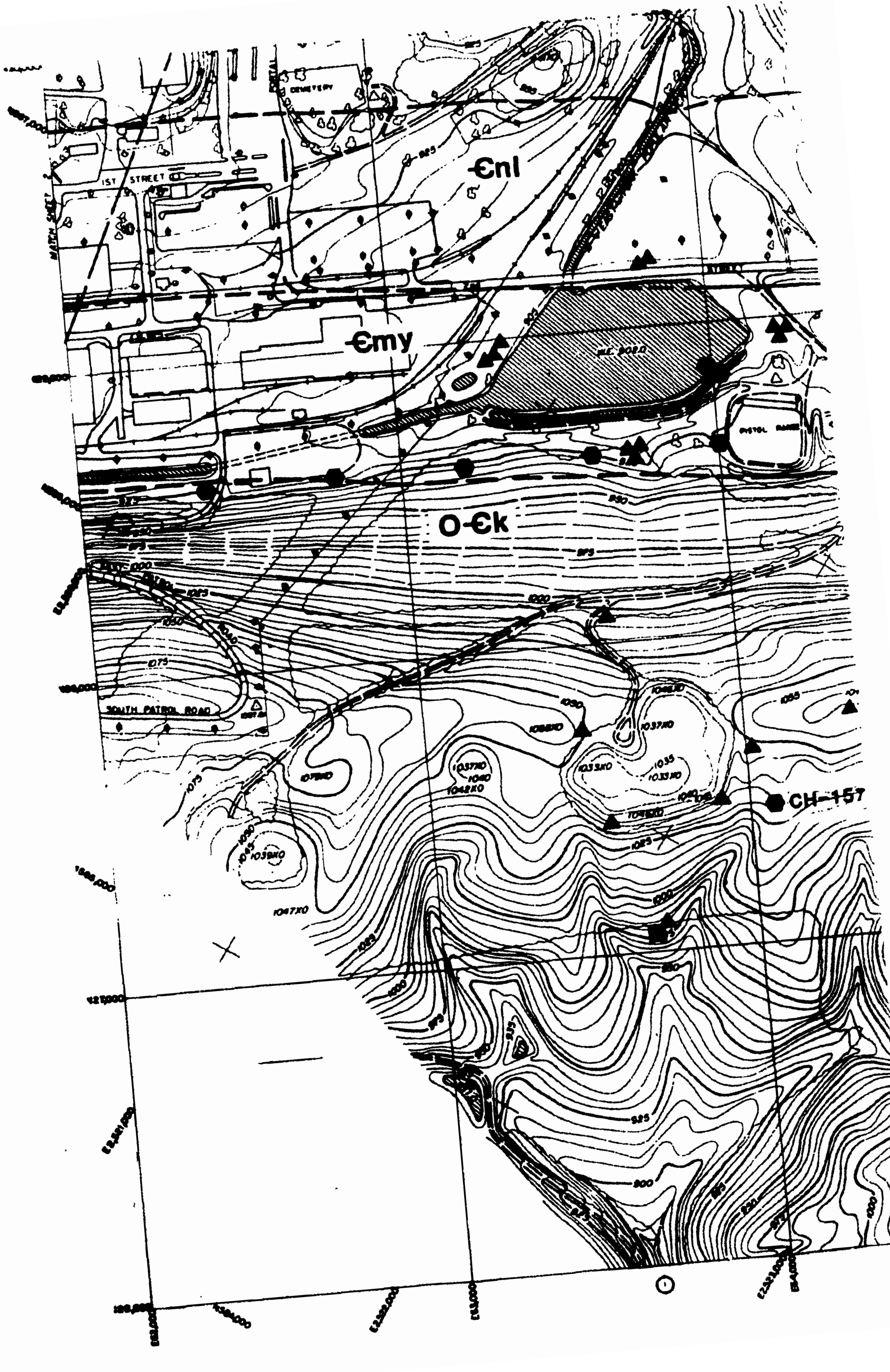
☆ U.S. GOVERNMENT PRINTING OFFICE:1987-750-411


Єrm
Єpv
Єrt
Єrg
Єmr

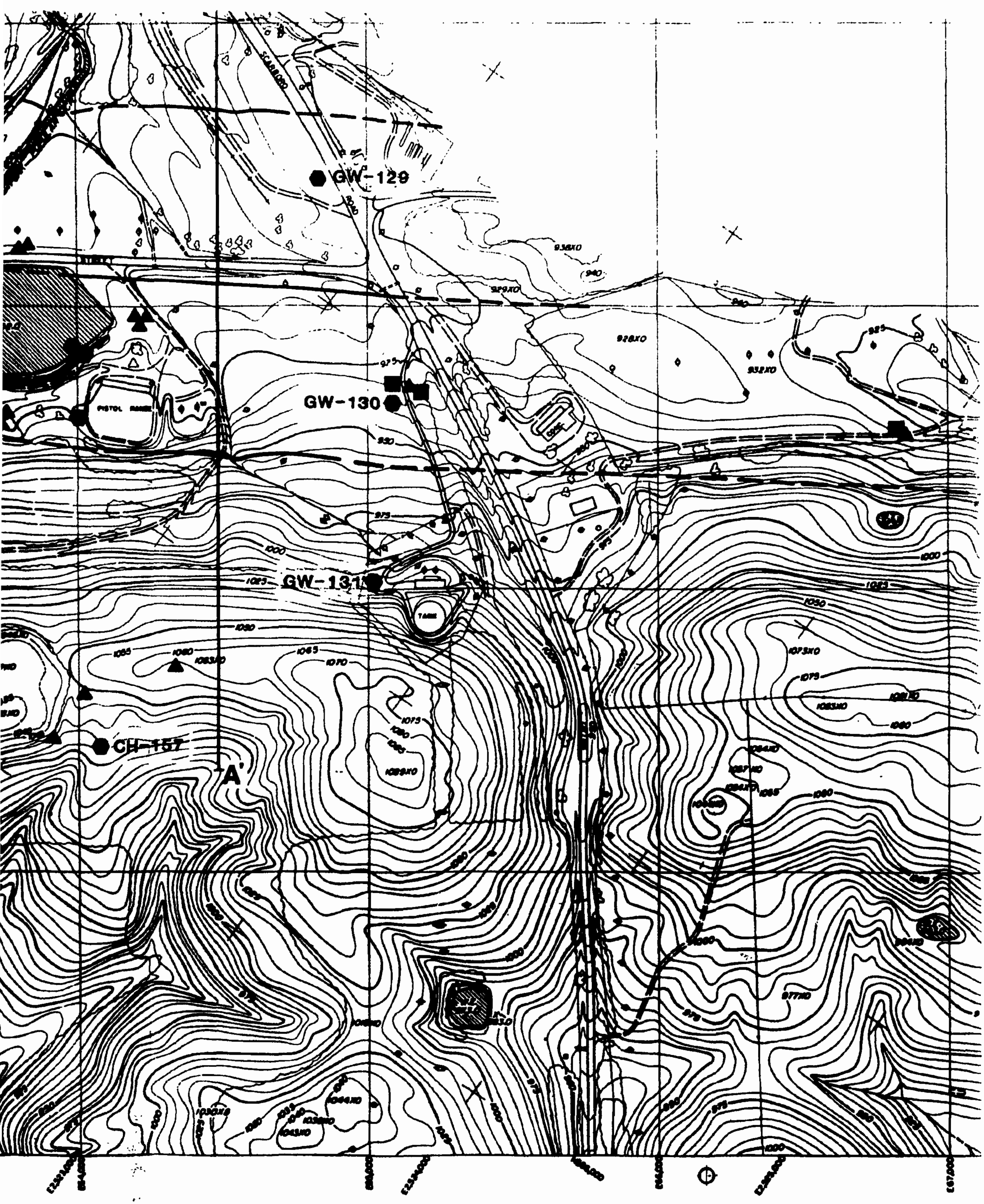

A

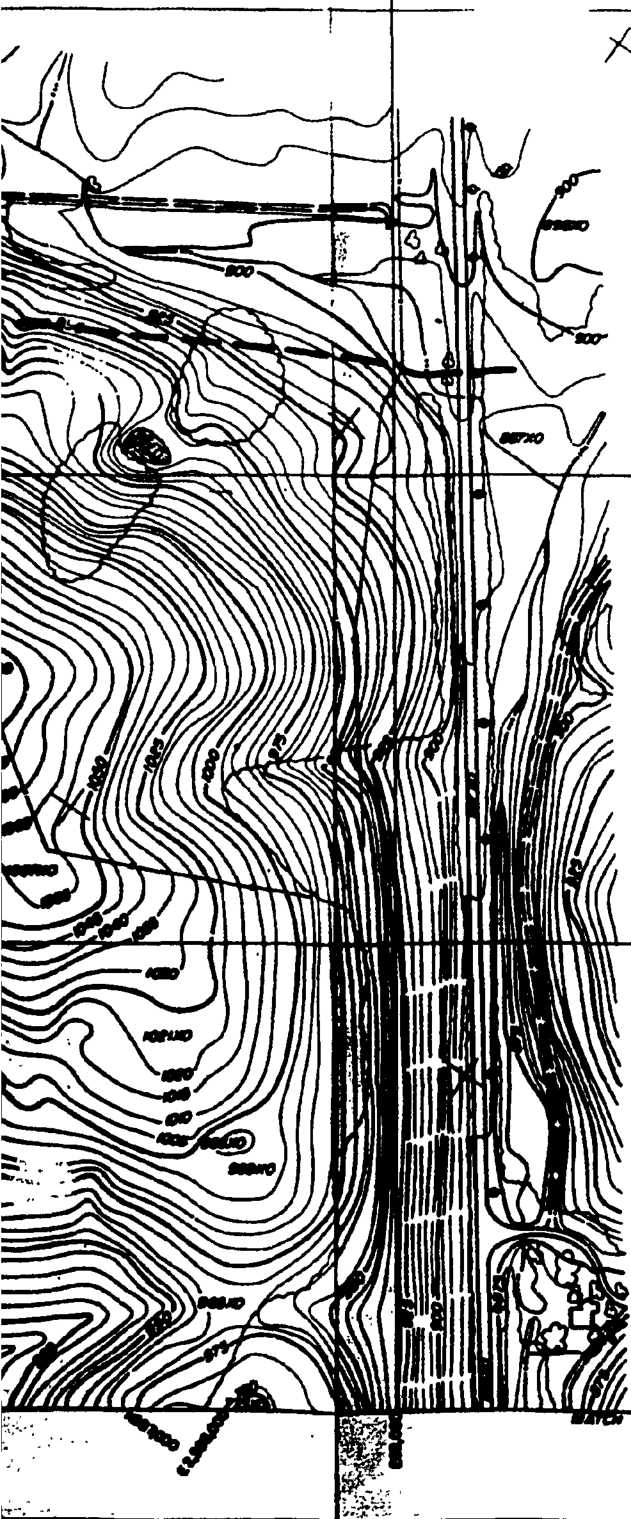



N34,000
N33,000
N32,000
N31,000
N30,000



Єnl
Єmy
O-Єk
CH-157
1ST STREET
SOUTH PATROL ROAD
PISTOL RANGE
CEMETERY
MATCH SHEET


GW-129
GW-130
GW-131
CH-157
A'
PISTOL RANGE
TANK
975
1000
1025
1050
1060
1065
1070
1075



GEOLOGIC MAP

SHEET 2 OF 9 DATE: 6-86

OAK RIDGE NATIONAL LABORATORY TM10112

COMPILED BY: H. L. KING
C. S. HAASE

EXPLANATION

O-Ꞓk	KNOX GROUP	
Ꞓmy	MAYNARDVILLE	CONASAUGA GROUP
Ꞓnl	NOLICHUCKY	CONASAUGA GROUP
Ꞓmr	MARYVILLE	CONASAUGA GROUP
Ꞓrg	ROGERSVILLE	CONASAUGA GROUP
Ꞓrt	RUTLEDGE	CONASAUGA GROUP
Ꞓpv	PUMPKIN VALLEY	CONASAUGA GROUP
Ꞓrm	ROME FORMATION	

BOREHO

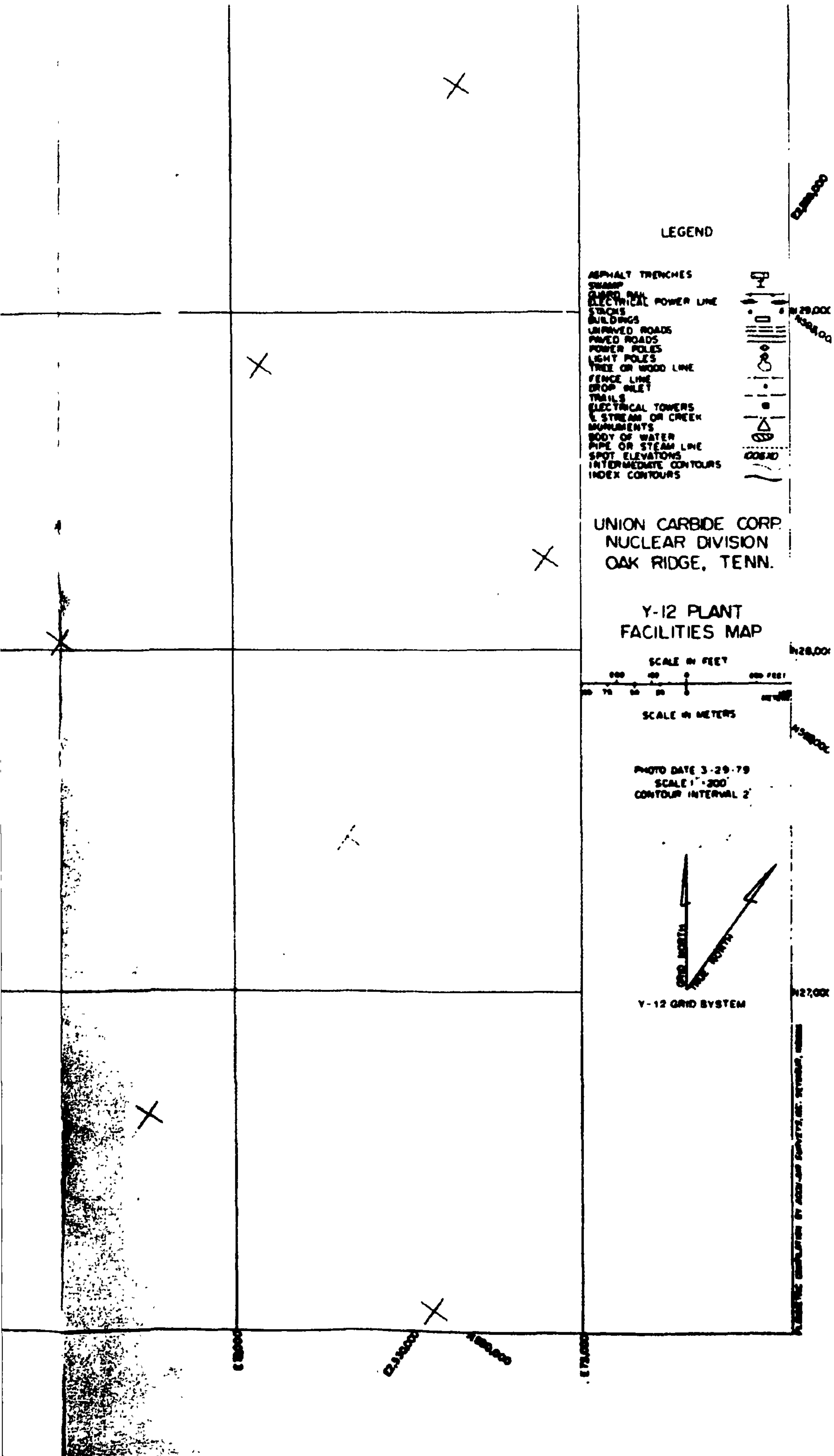
▲ SCRE
■ OREA
● CORE

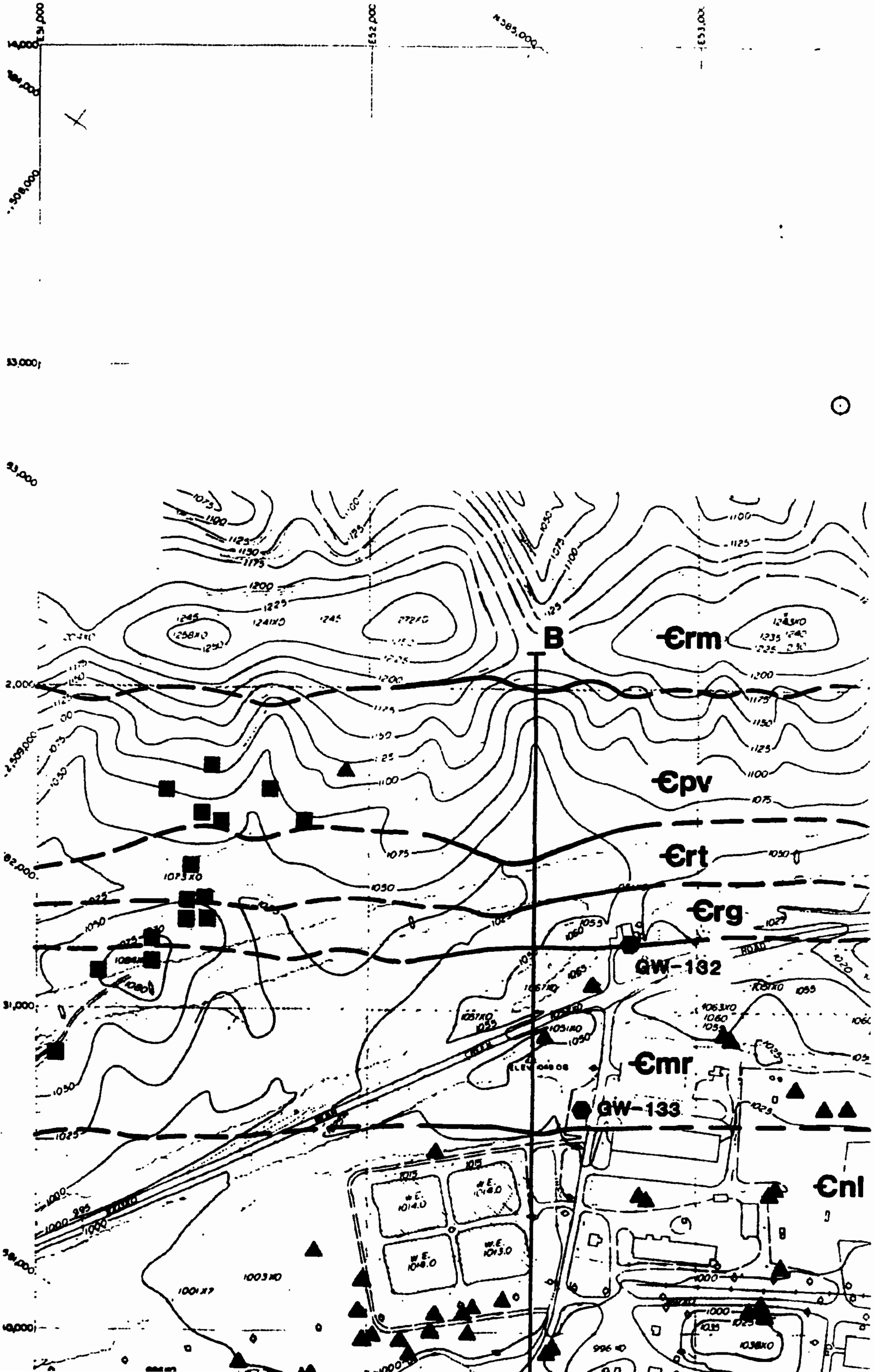
CONTACT
(DASHED WHERE APPROXIMATELY LOCATED)

A
A'

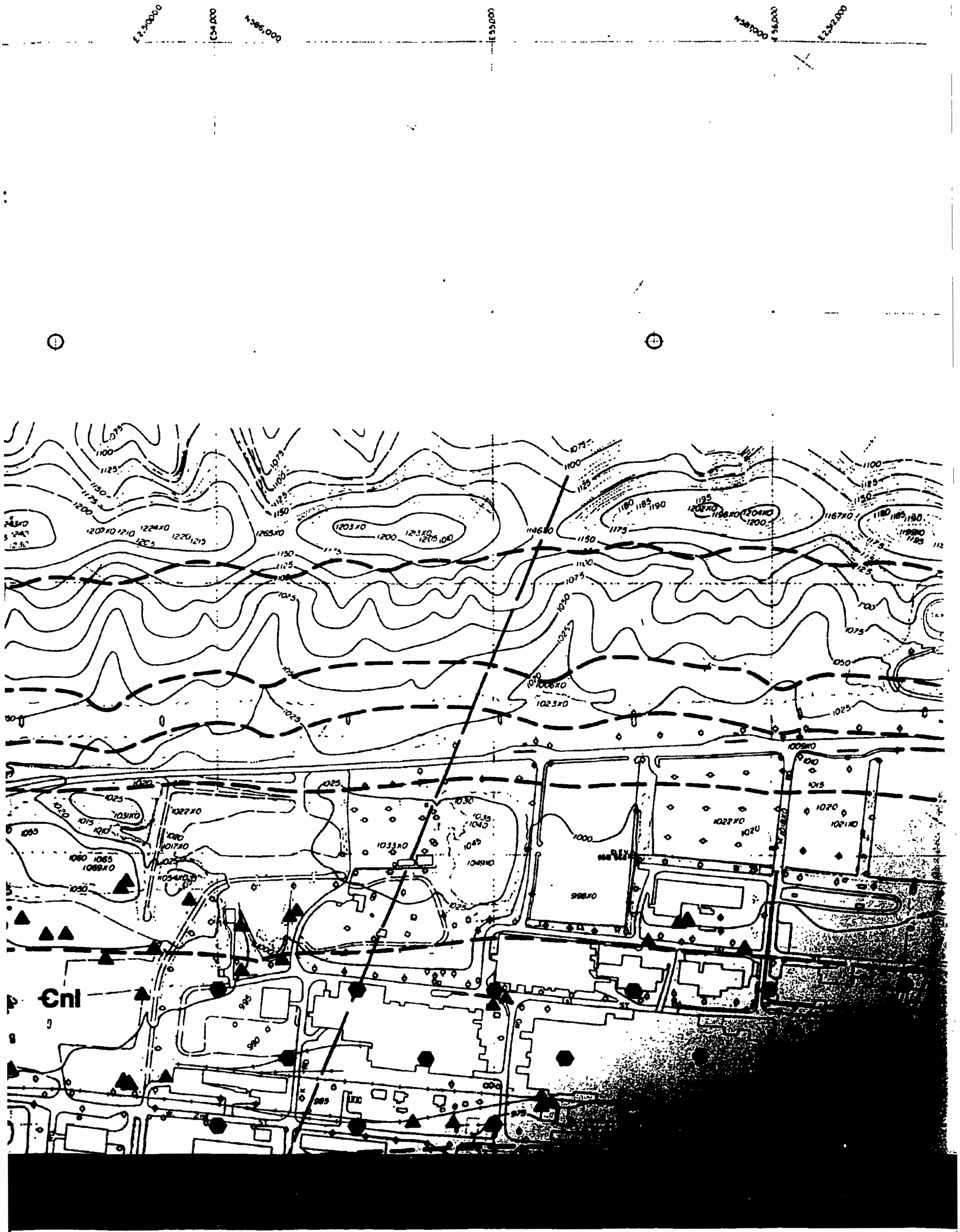
CROSS SECTION

APPROXIMATE LOCATION OF FAULT

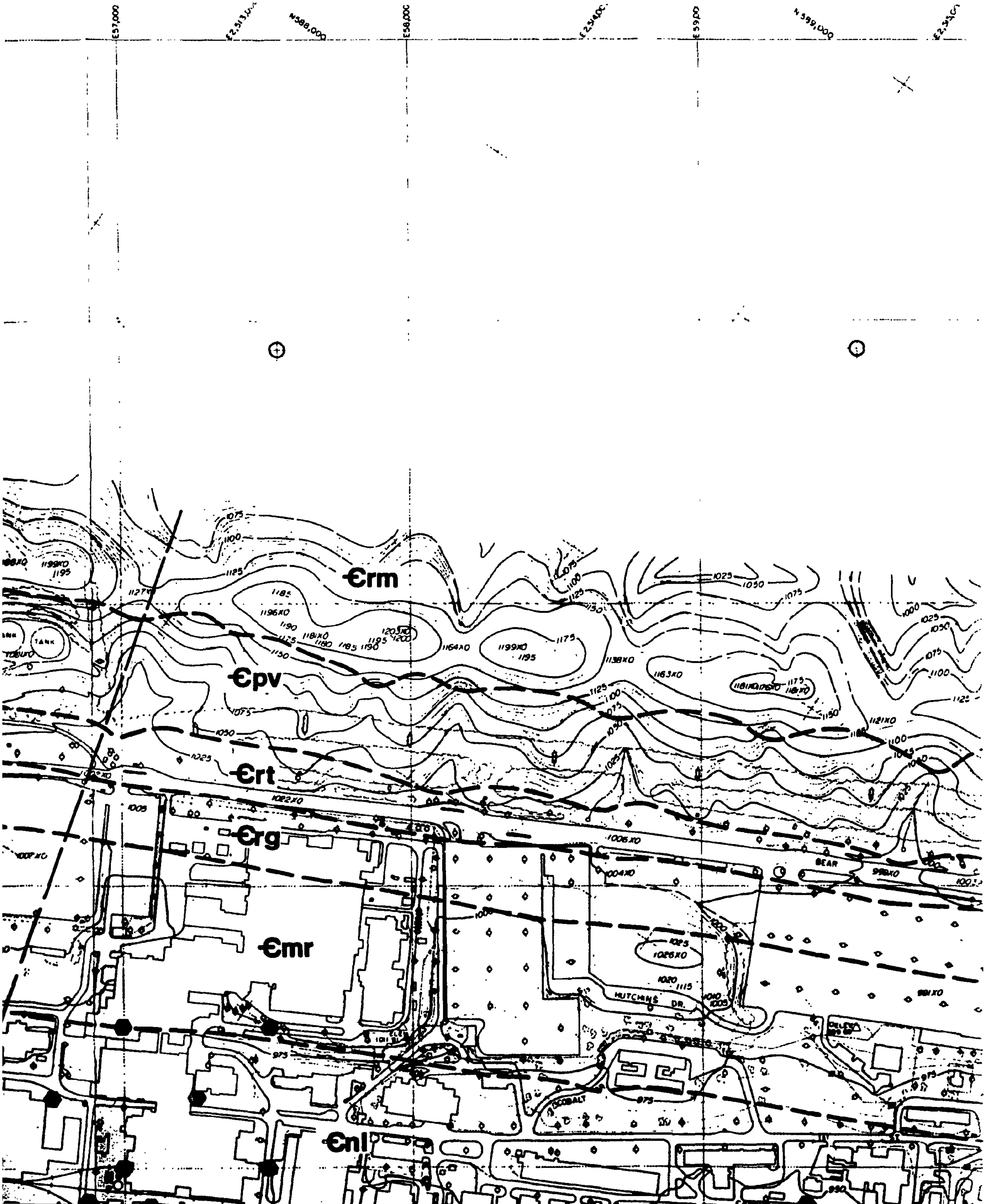

LEGEND
ASPHALT TRENCHES
SWAMP
GUARD RAIL
ELECTRICAL POWER LINE
STACKS
BUILDINGS
UNPAVED ROADS
PAVED ROADS
POWER POLES
LIGHT POLES
TREE OR WOOD LINE
FENCE LINE
DROP INLET
TRAILS
ELECTRICAL TOWERS
℄ STREAM OR CREEK
MONUMENTS
BODY OF WATER
PIPE OR STEAM LINE
SPOT ELEVATIONS
INTERMEDIATE CONTOURS
INDEX CONTOURS
UNION CARBIDE CORP.
NUCLEAR DIVISION
OAK RIDGE, TENN.
Y-12 PLANT
FACILITIES MAP
SCALE IN FEET
SCALE IN METERS
PHOTO DATE 3-29-79
SCALE 1"=200'
CONTOUR INTERVAL 2'
GRID NORTH
TRUE NORTH
Y-12 GRID SYSTEM
N 29,000
N 28,000
N 27,000



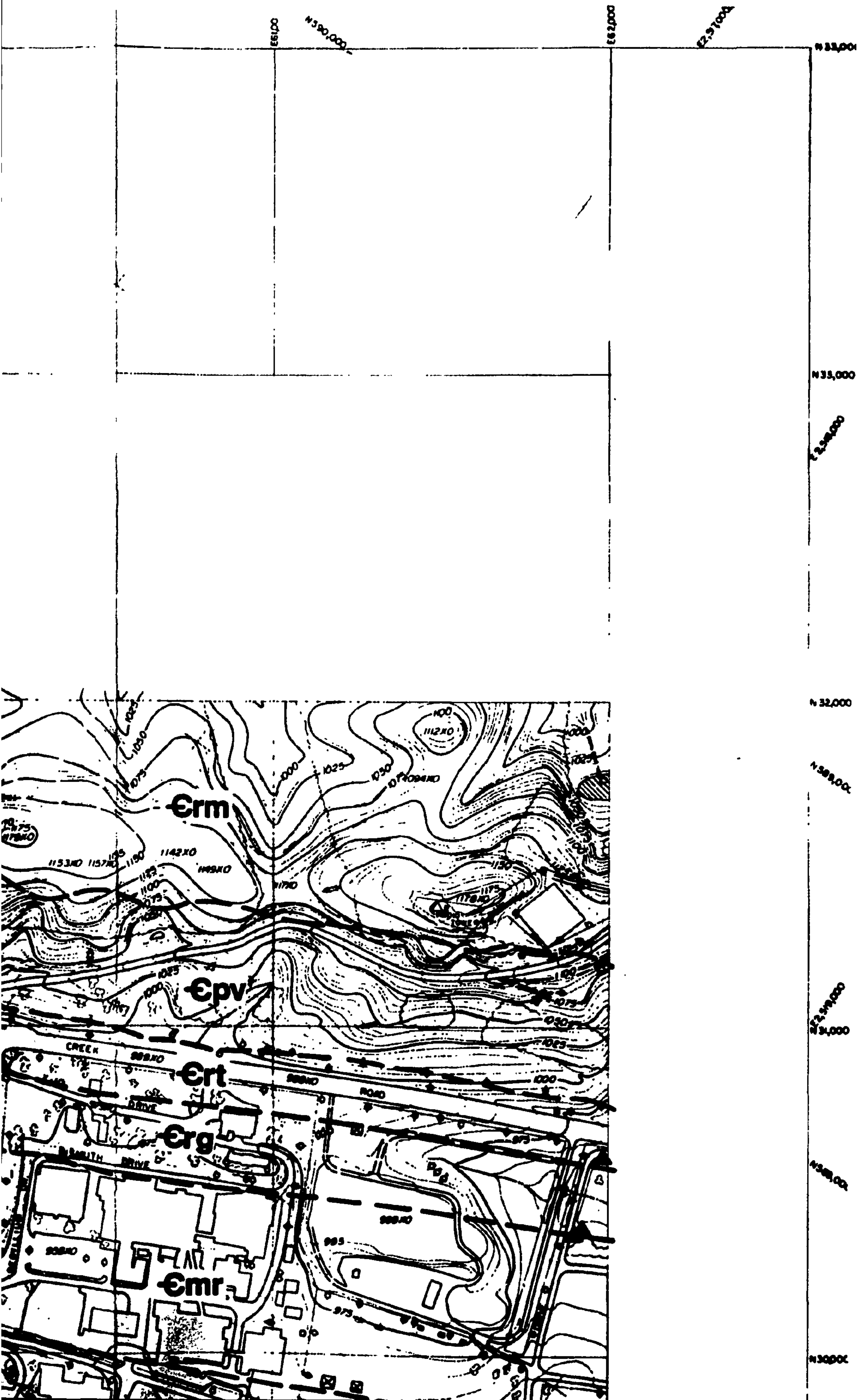
E51,000
E52,000
E53,000
N385,000
B
€rm
€pv
€rt
€rg
GW-132
€mr
GW-133
€nl
ROAD



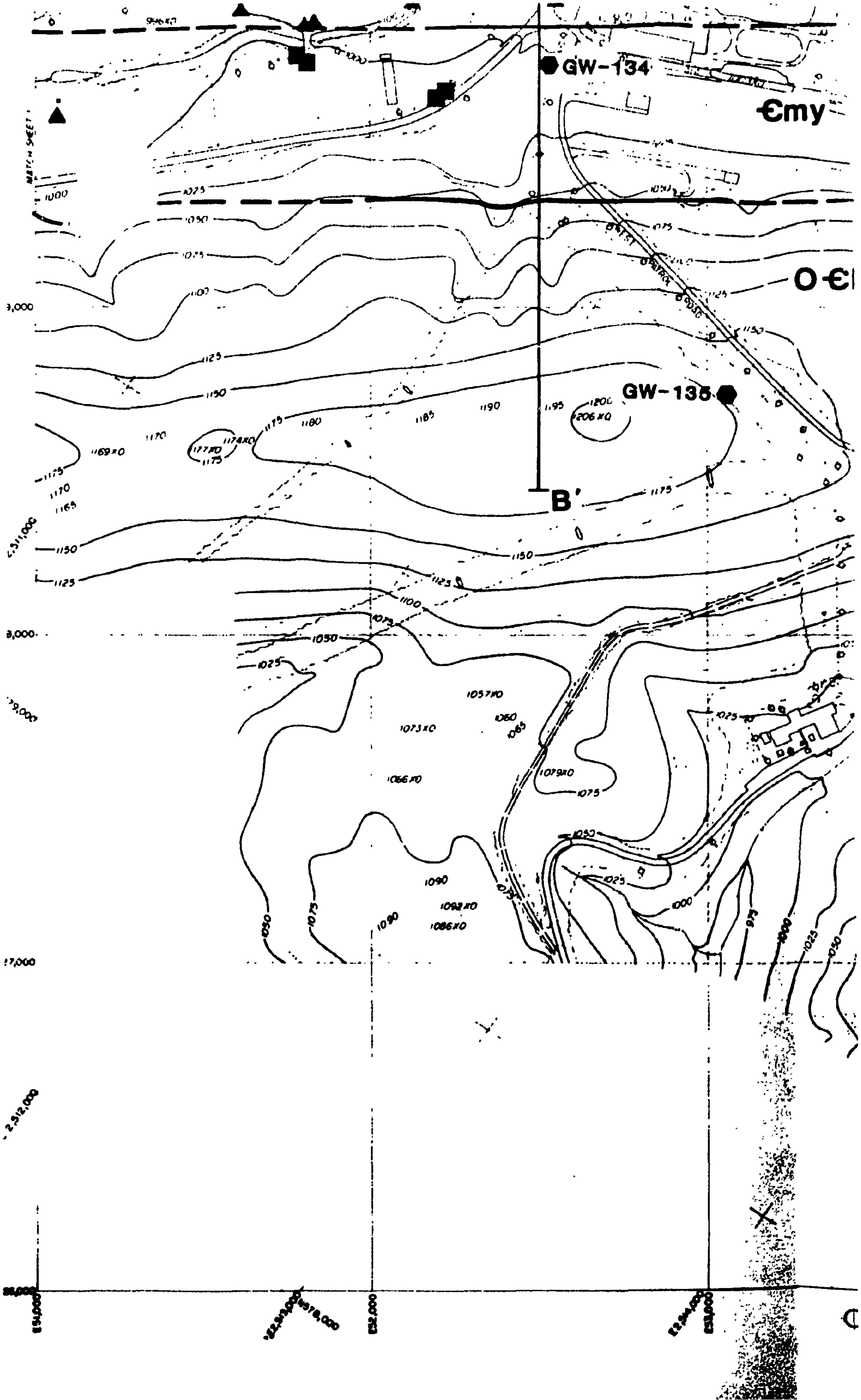
Cnl

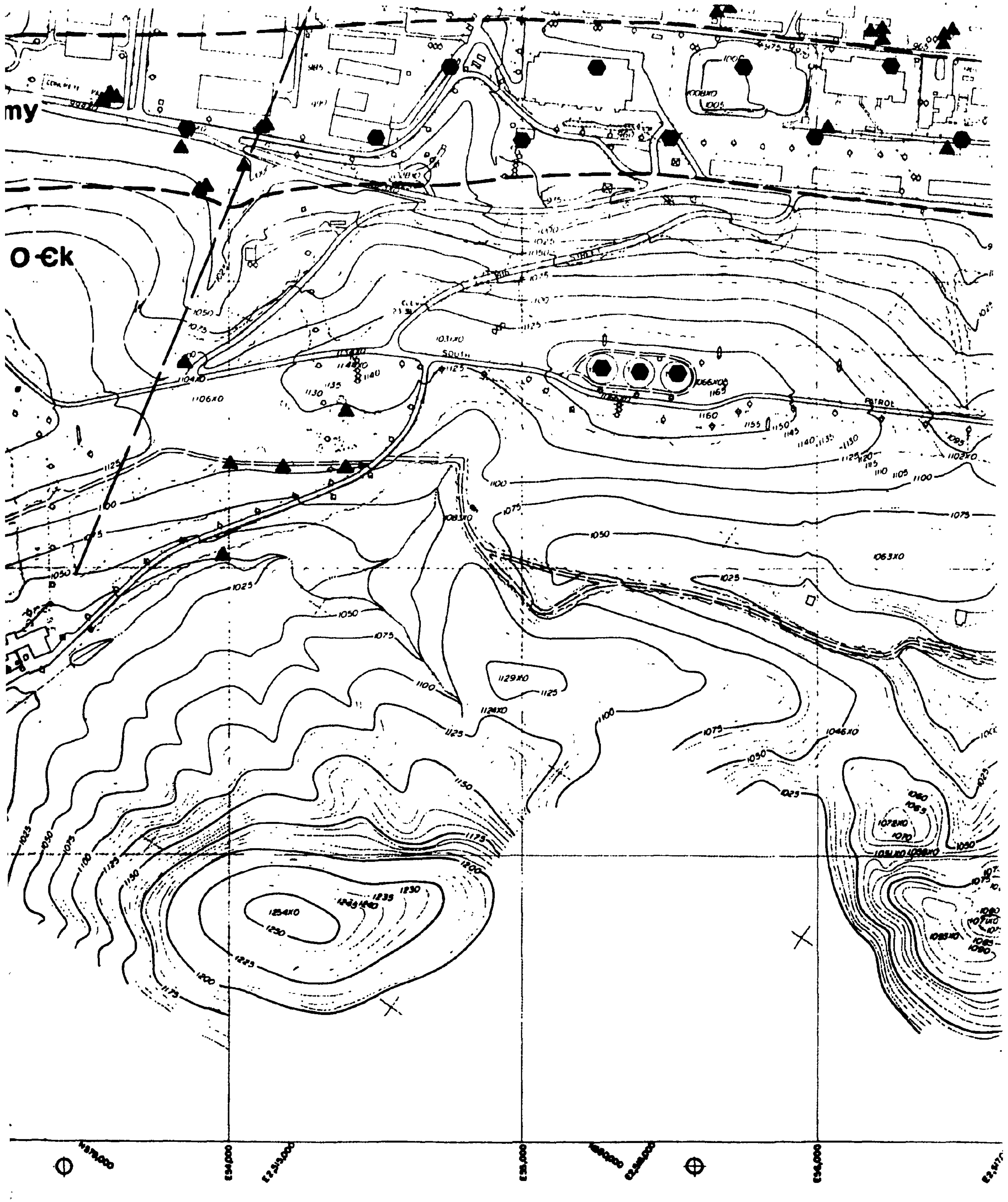


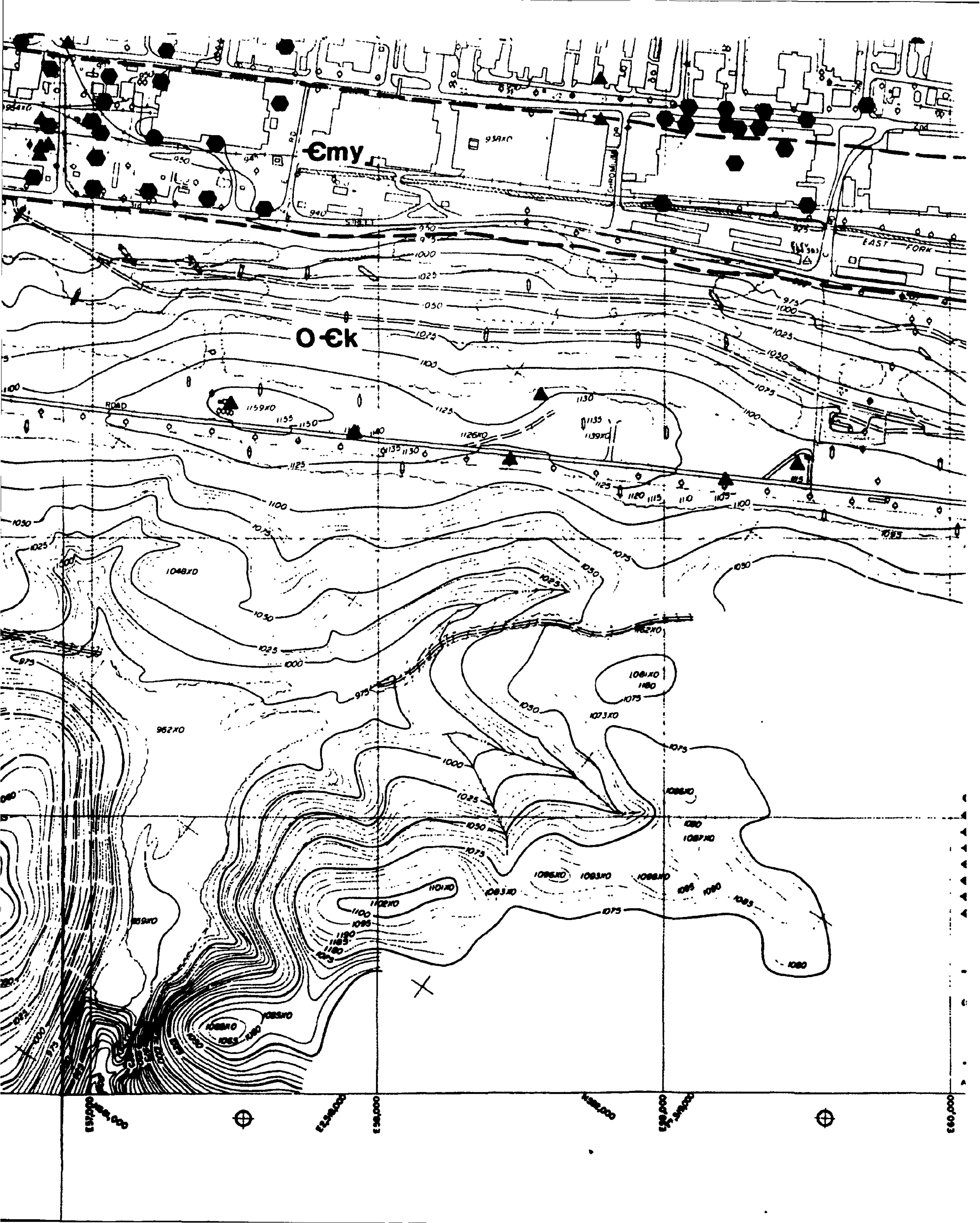
N588,000
N589,000
€rm
€pv
€rt
€rg
€mr
€nl
HUTCHINS DR.
COBALT
BEAR
TANK



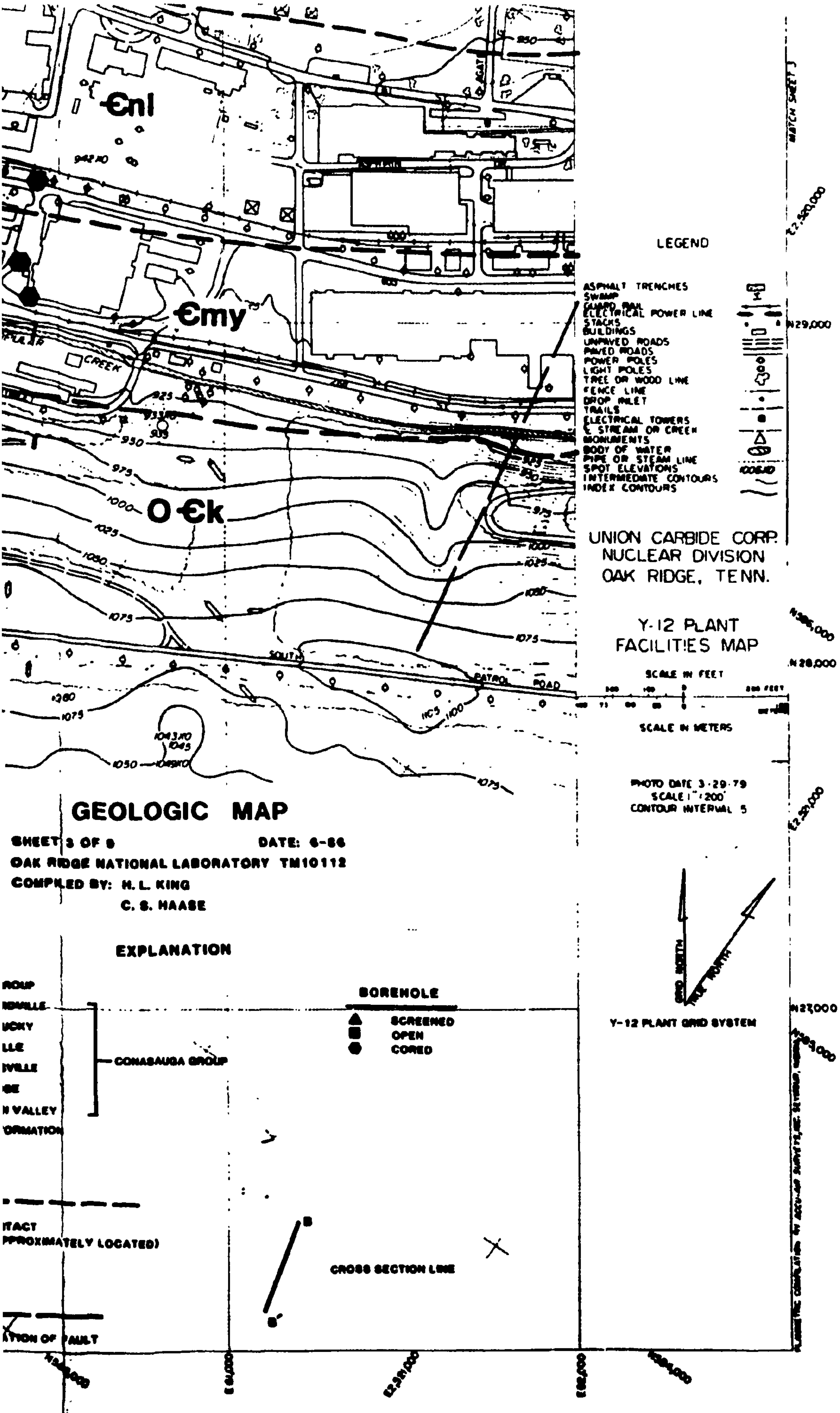
E62,000
N33,000
N32,000
N30,000
€rm
€pv
€rt
€rg
€mr
CREEK
ROAD
DRIVE


GW-134
€my
O-€
GW-135
B'
MATCH SHEET
1000
1025
1050
1075
1100
1125
1150
1175
1180
1185
1190
1195
1200
1206 x0
1170
1169 x0
1174 x0
1177 x0
1165
1057 x0
1060
1065
1073 x0
1066 x0
1079 x0
1090
1092 x0
1086 x0
975
3,000
2,511,000
8,000
79,000
77,000
2,512,000
2,513,000
878,000
2,514,000

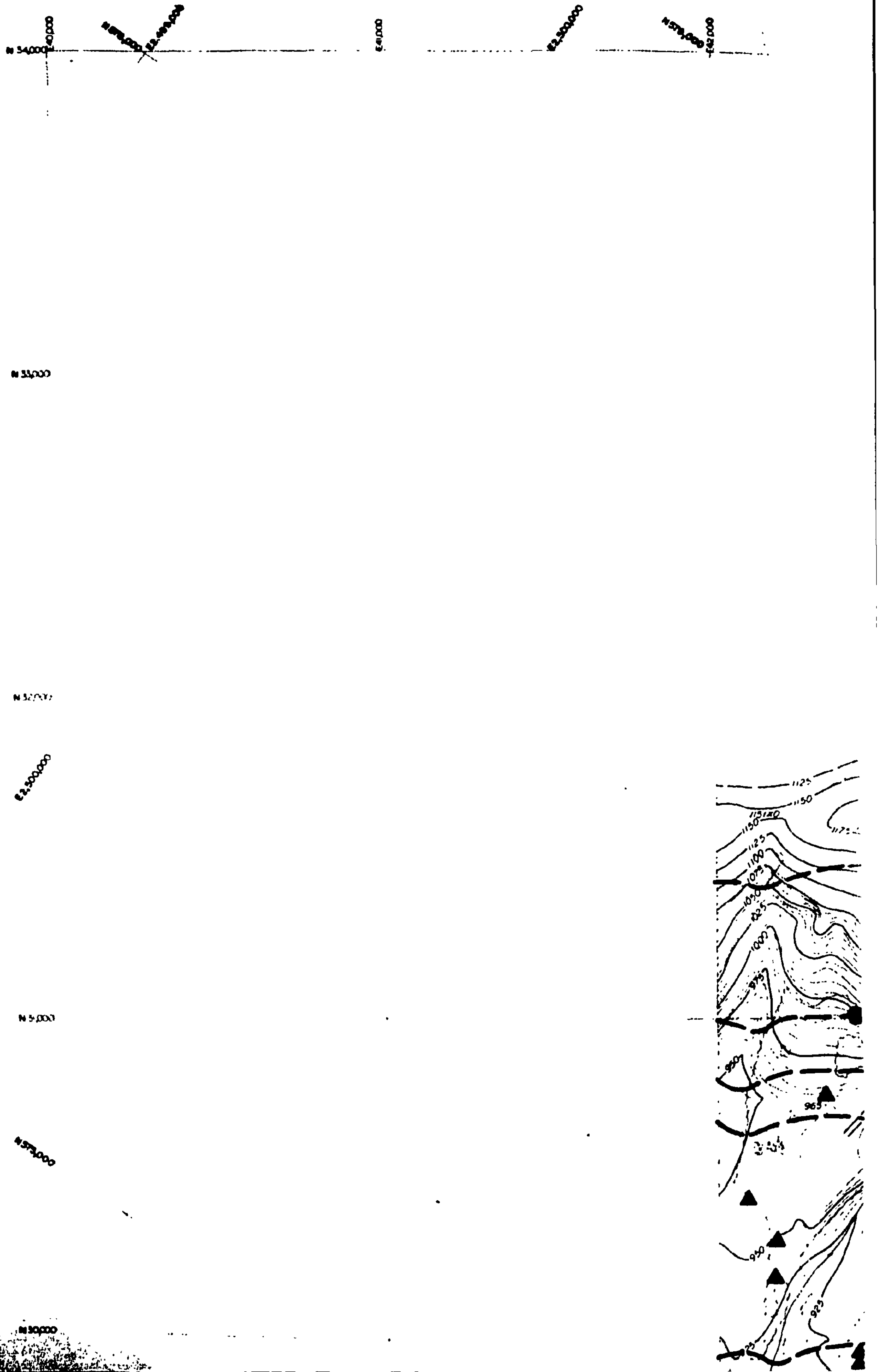

my
O-Ꞓk
SOUTH
PATROL
1254x0
1129x0
1063x0
1066x0
1046x0



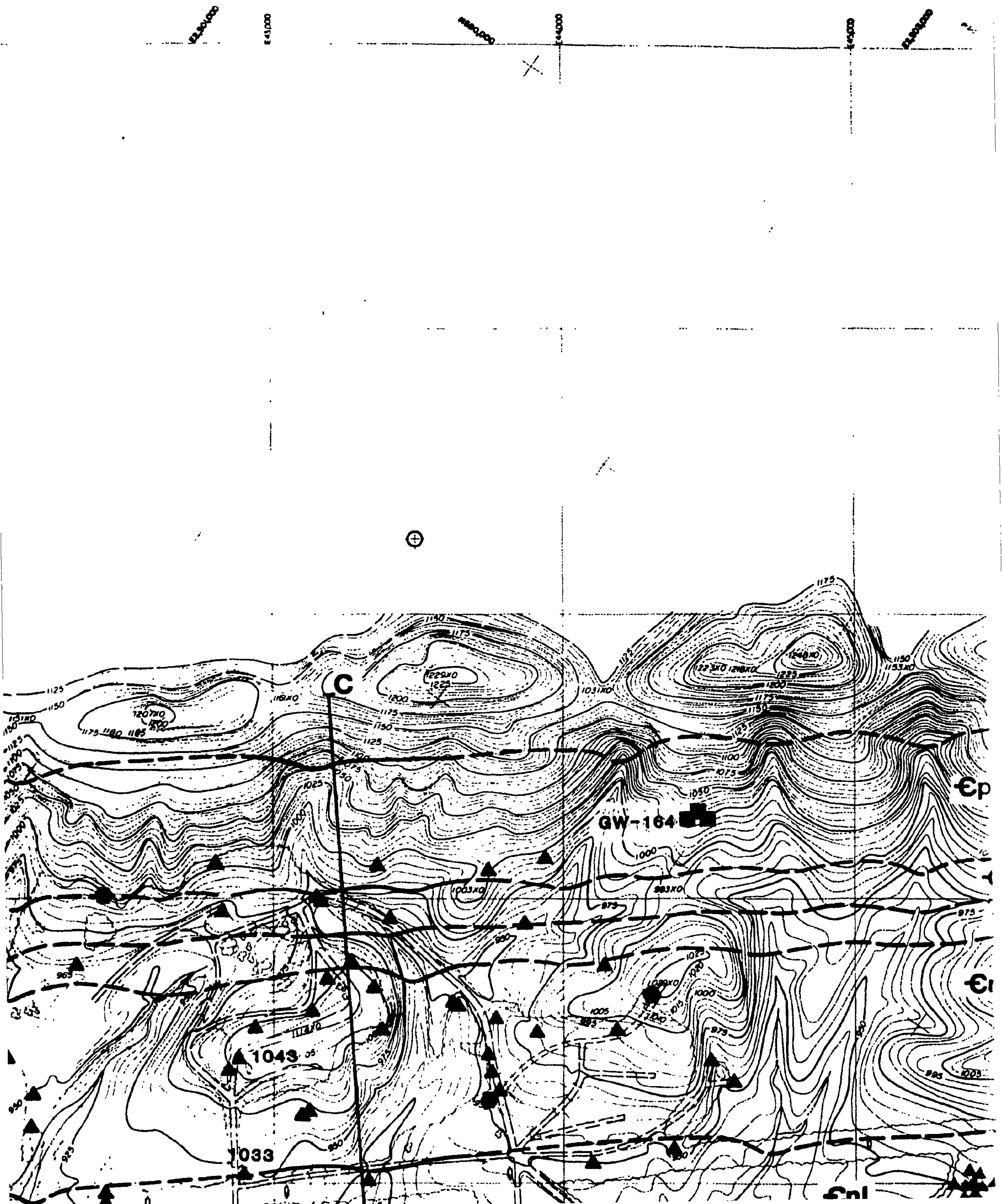
Ꞓmy
O-Ꞓk
ROAD
EAST FORK



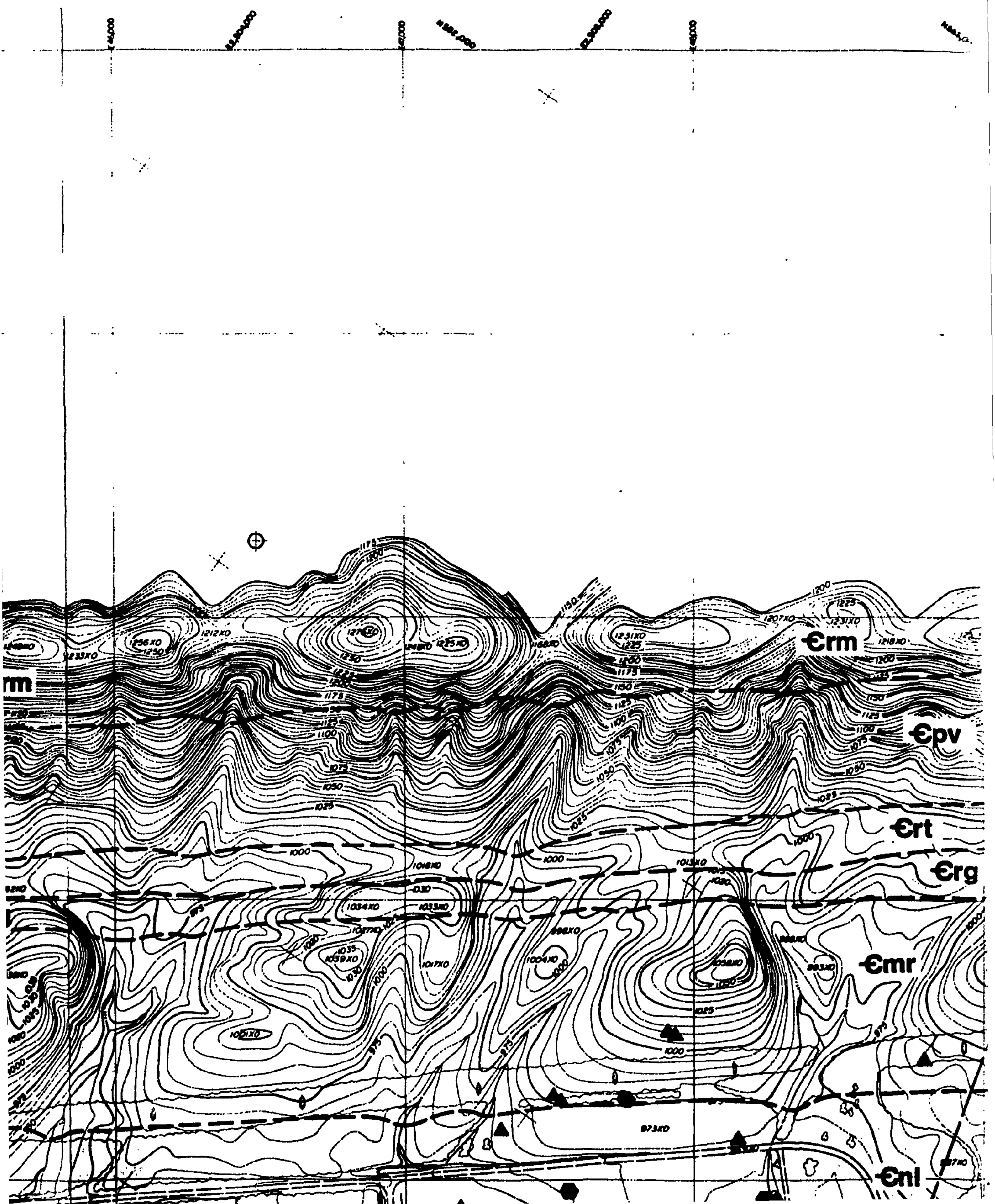
€nl
€my
O€k
CREEK
SOUTH
PATROL
ROAD
LEGEND
ASPHALT TRENCHES
SWAMP
GUARD RAIL
ELECTRICAL POWER LINE
STACKS
BUILDINGS
UNPAVED ROADS
PAVED ROADS
POWER POLES
LIGHT POLES
TREE OR WOOD LINE
FENCE LINE
DROP INLET
TRAILS
ELECTRICAL TOWERS
℄ STREAM OR CREEK
MONUMENTS
BODY OF WATER
PIPE OR STEAM LINE
SPOT ELEVATIONS
INTERMEDIATE CONTOURS
INDEX CONTOURS
UNION CARBIDE CORP.
NUCLEAR DIVISION
OAK RIDGE, TENN.
Y-12 PLANT
FACILITIES MAP
SCALE IN FEET
SCALE IN METERS
PHOTO DATE 3-29-79
SCALE 1"=200'
CONTOUR INTERVAL 5
N29,000
N28,000
N27,000
GRID NORTH
TRUE NORTH
Y-12 PLANT GRID SYSTEM
GEOLOGIC MAP
SHEET 3 OF 9
DATE: 6-86
OAK RIDGE NATIONAL LABORATORY TM10112
COMPILED BY: H. L. KING
C. S. HAASE
EXPLANATION
BOREHOLE
SCREENED
OPEN
CORED
CONASAUGA GROUP
CROSS SECTION LINE
B
B'

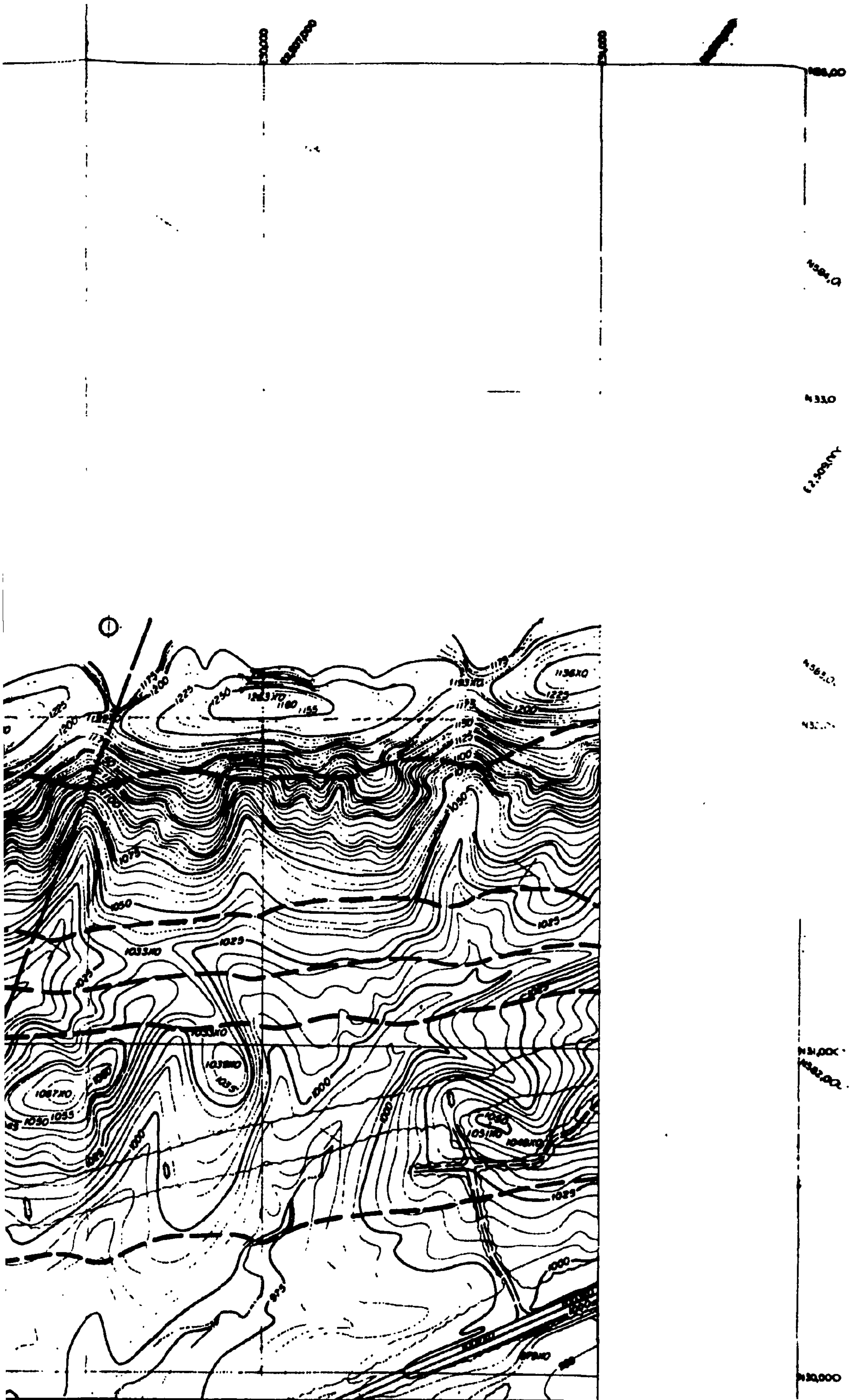


N 34,000
E41,000
E2,500,000
N 578,000
E42,000
N 33,000
E2,500,000
N 577,000
N 30,000
1125
1150
1125
1100
1075
1050
1025
1000
975
950
965
950
925

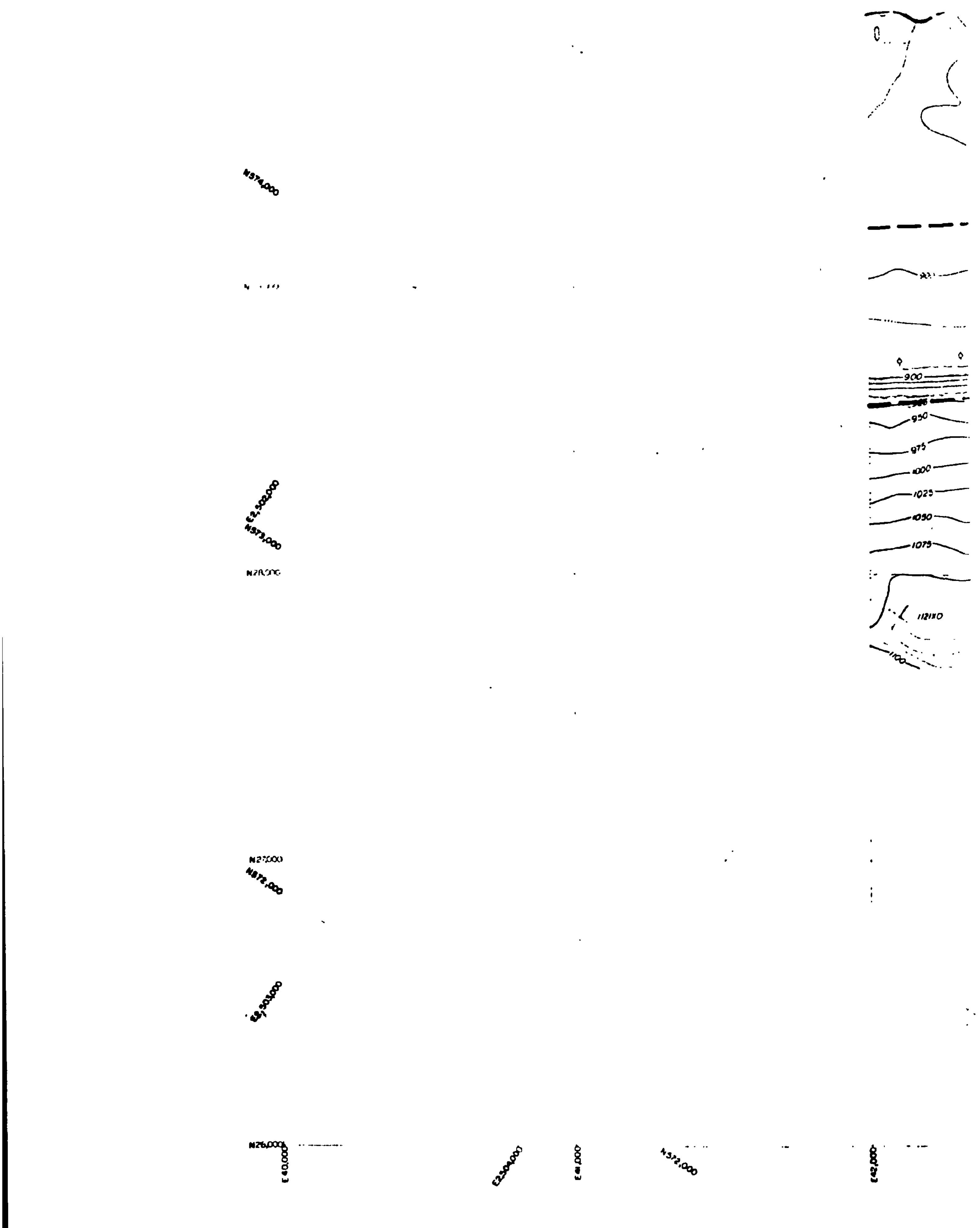


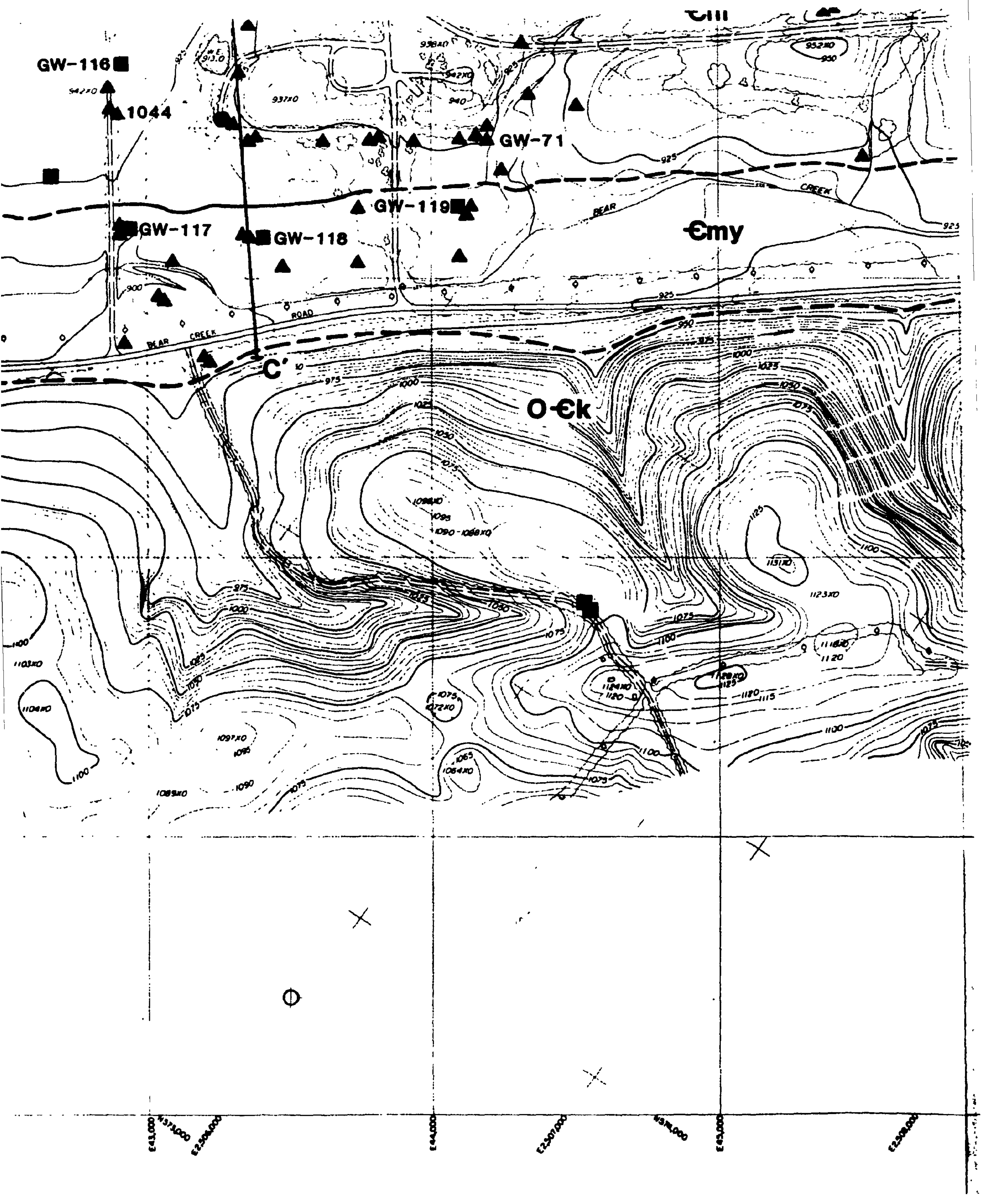
E43,000
E44,000
E45,000
C
GW-164
1043
1033
Ꞓp
Ꞓr
Ꞓnl


Ꞓrm
Ꞓpv
Ꞓrt
Ꞓrg
Ꞓmr
Ꞓnl

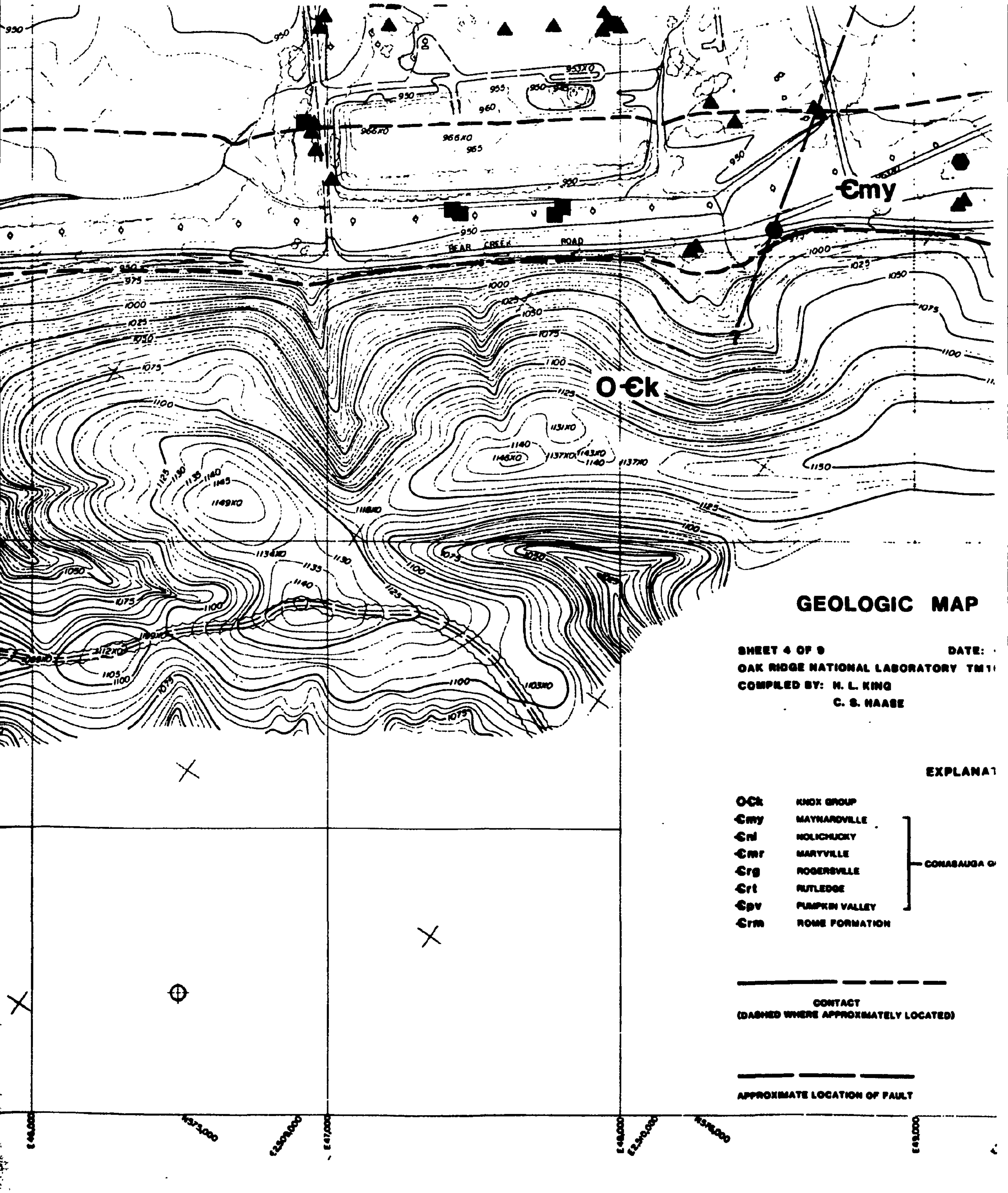


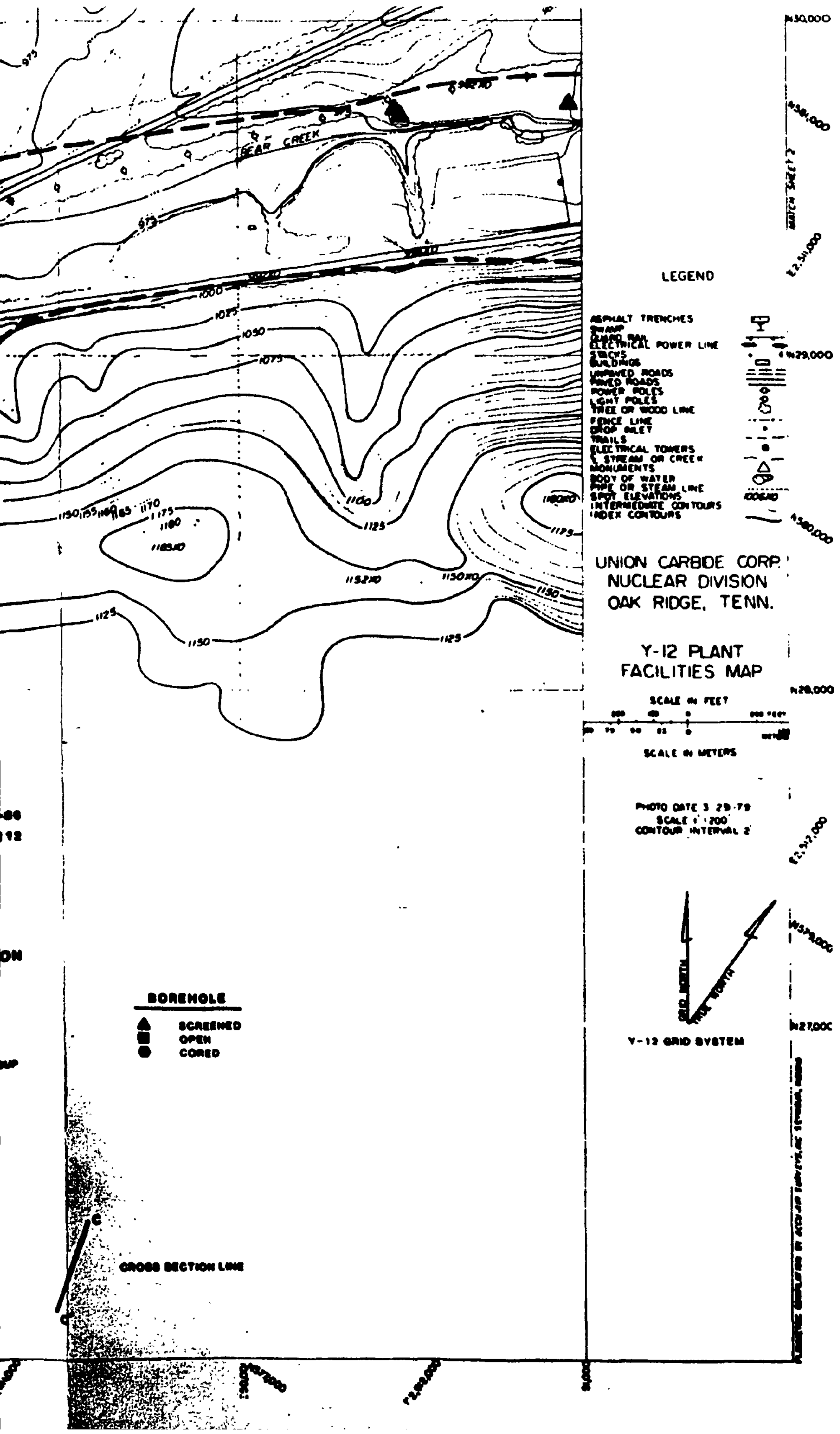
23,000
24,000
N33,0
N31,00C
N30,000
1136XO
1225
1200
1250
1263XO
1160
1155
1175
1150
1125
1100
1075
1050
1025
1033XO
1035
1039XO
1087XO
1030
1055
1000
1031XO
1048XO
975


N374,000
E2,502,000
N373,000
N28,000
N27,000
N372,000
E2,503,000
N26,000
E40,000
E2,504,000
E41,000
N372,000
E42,000
900
950
975
1000
1025
1050
1075
1100



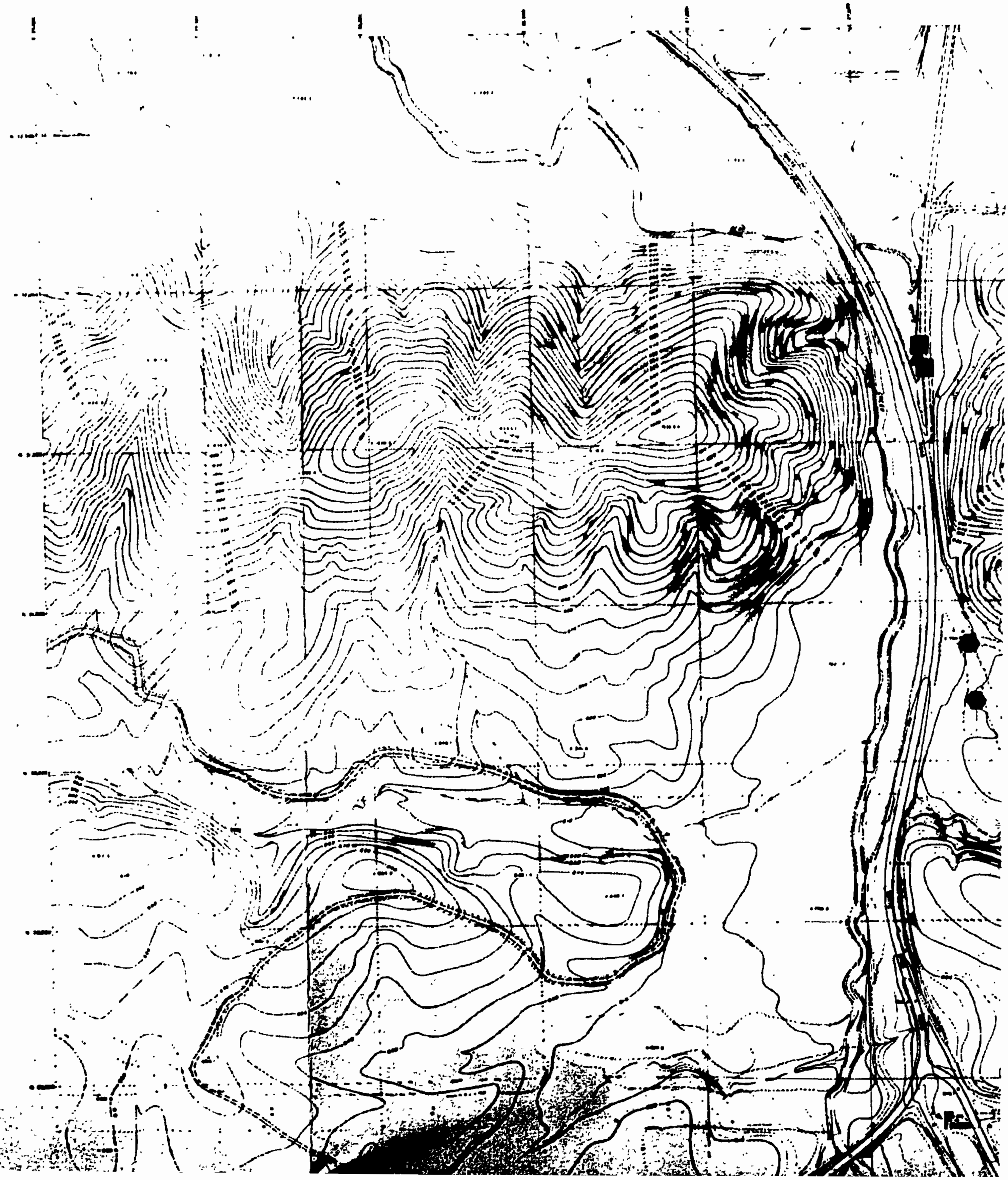
GW-116
1044
GW-71
GW-119
GW-117
GW-118
Єmy
BEAR CREEK
ROAD
C'
O-Єk
Єm
E43,000
E44,000
E45,000

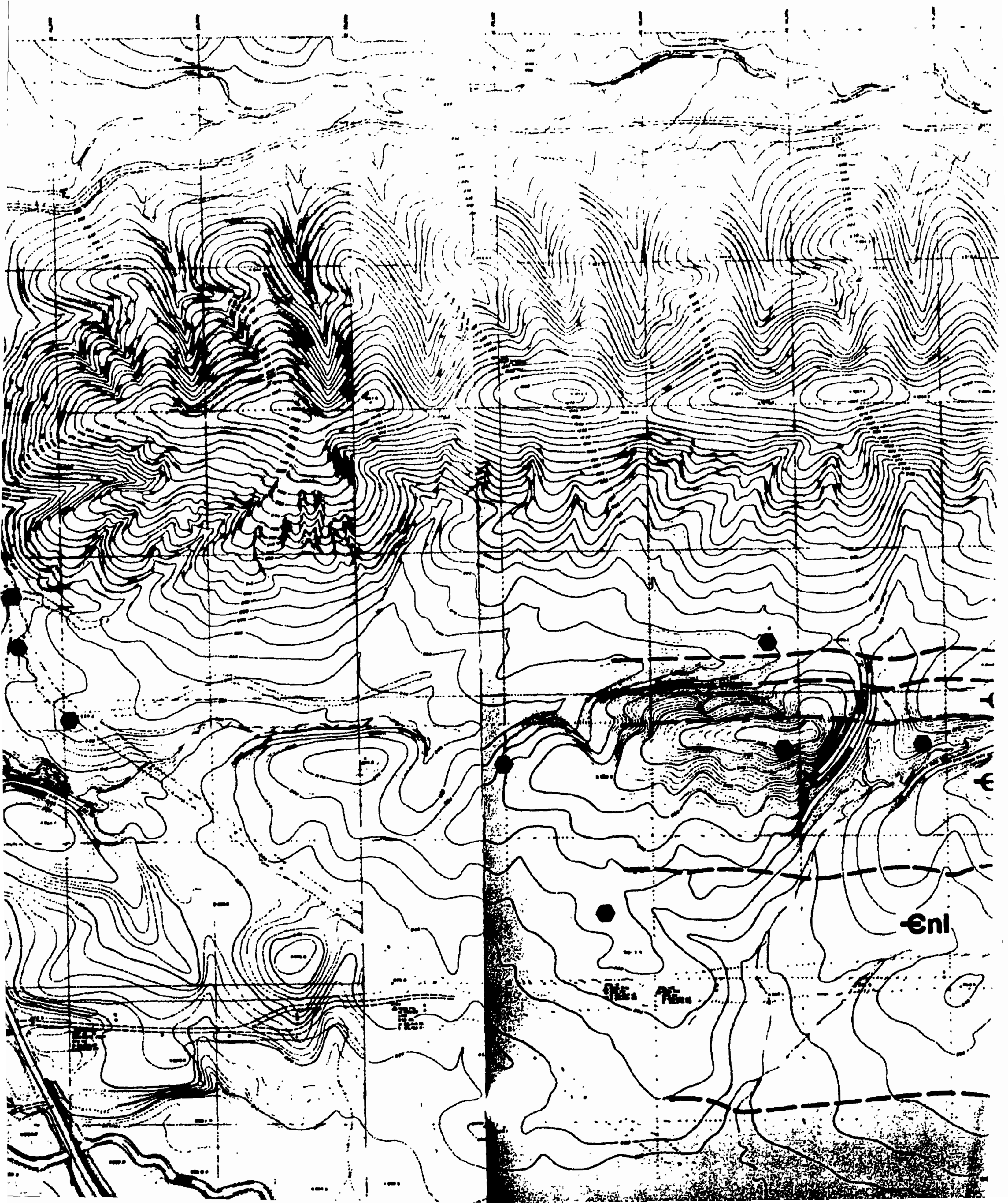

GEOLOGIC MAP
SHEET 4 OF 9
DATE:
OAK RIDGE NATIONAL LABORATORY TM
COMPILED BY: H. L. KING
C. S. HAASE
EXPLANA
O-Єk KNOX GROUP
Єmy MAYNARDVILLE
Єnl NOLICHUCKY
Єmr MARYVILLE
Єrg ROGERSVILLE
Єrt RUTLEDGE
Єpv PUMPKIN VALLEY
Єrm ROME FORMATION
CONASAUGA G
CONTACT
(DASHED WHERE APPROXIMATELY LOCATED)
APPROXIMATE LOCATION OF FAULT
Єmy
O-Єk
BEAR CREEK ROAD



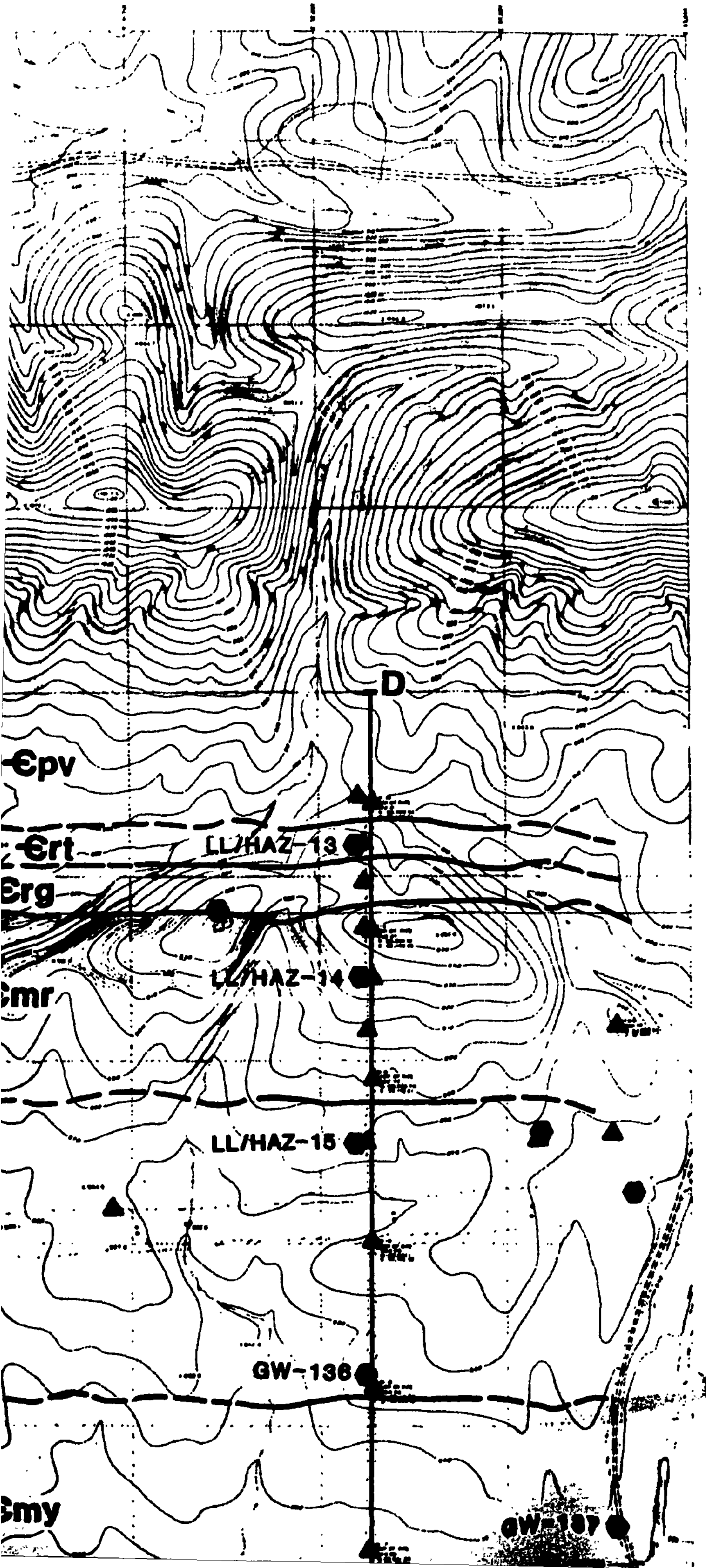
LEGEND
ASPHALT TRENCHES
SWAMP
GUARD RAIL
ELECTRICAL POWER LINE
STACKS
BUILDINGS
UNPAVED ROADS
PAVED ROADS
POWER POLES
LIGHT POLES
TREE OR WOOD LINE
FENCE LINE
DROP INLET
TRAILS
ELECTRICAL TOWERS
STREAM OR CREEK
MONUMENTS
BODY OF WATER
PIPE OR STEAM LINE
SPOT ELEVATIONS
INTERMEDIATE CONTOURS
INDEX CONTOURS
UNION CARBIDE CORP.
NUCLEAR DIVISION
OAK RIDGE, TENN.
Y-12 PLANT
FACILITIES MAP
SCALE IN FEET
SCALE IN METERS
PHOTO DATE 3 29 79
SCALE 1" 200'
CONTOUR INTERVAL 2'
GRID NORTH
TRUE NORTH
Y-12 GRID SYSTEM
BOREHOLE
SCREENED
OPEN
CORED
CROSS SECTION LINE
BEAR CREEK
MATCH SHEET 2
N30,000
N29,000
N28,000
N27,000

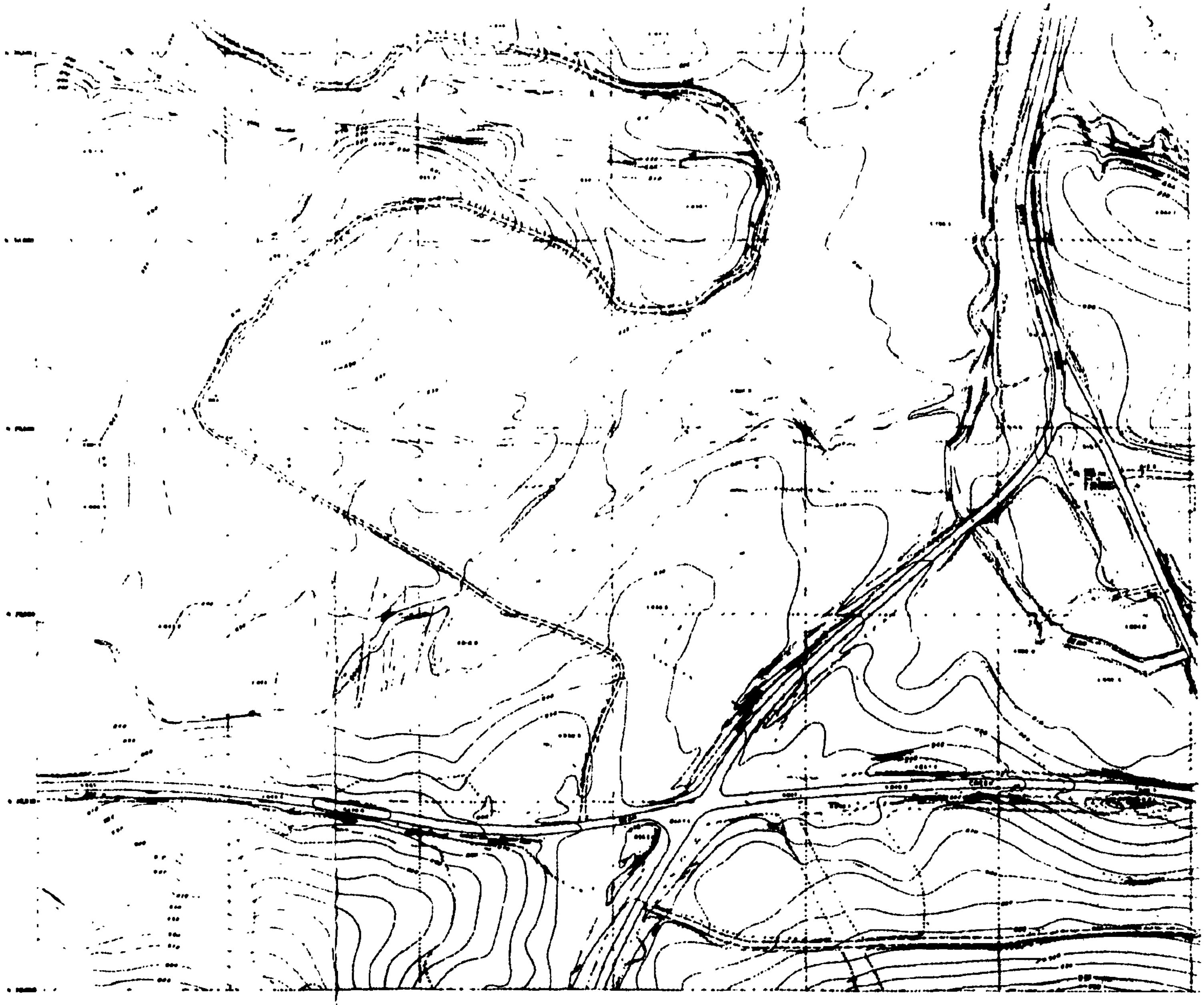
6





-Єnl


D
Ɛpv
Ɛrt
LL/HAZ-13
Ɛrg
LL/HAZ-14
Ɛmr
LL/HAZ-15
GW-136
Ɛmy
GW-137



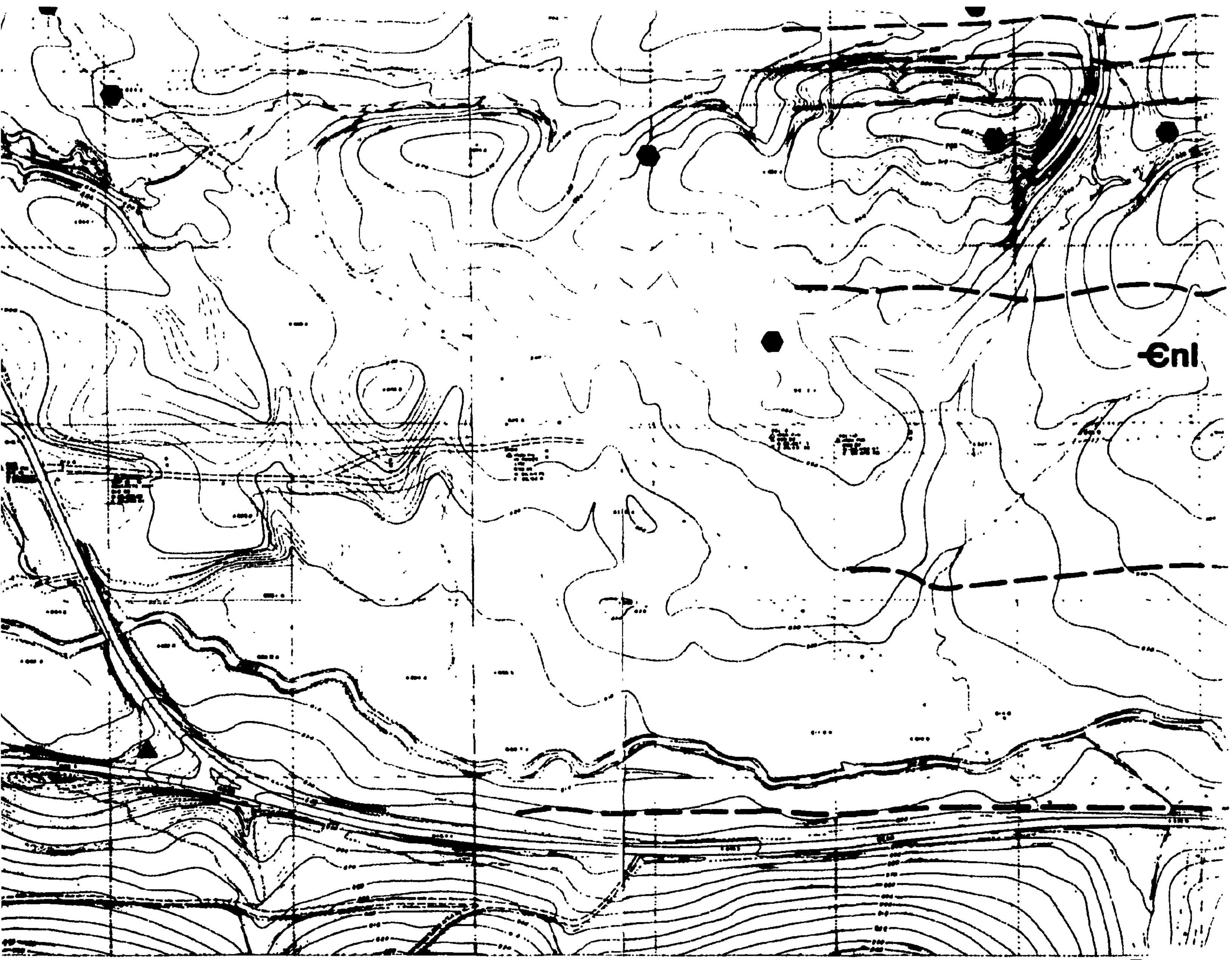
GEOLOGIC MAP

SHEET 7 OF 9 **DATE: 6-86**

OAK RIDGE NATIONAL LABORATORY TM10112

COMPILED BY: H. L. KING

C. S. HAASE



EXPLANATION

OꞒk	KNOX GROUP	
Ꞓmy	MAYNARDVILLE	CONASAUGA GROUP
Ꞓnl	NOLICHUCKY	CONASAUGA GROUP
Ꞓmr	MARYVILLE	CONASAUGA GROUP
Ꞓrg	ROGERSVILLE	CONASAUGA GROUP
Ꞓrt	RUTLEDGE	CONASAUGA GROUP
Ꞓpv	PUMPKIN VALLEY	CONASAUGA GROUP
Ꞓrm	ROME FORMATION	

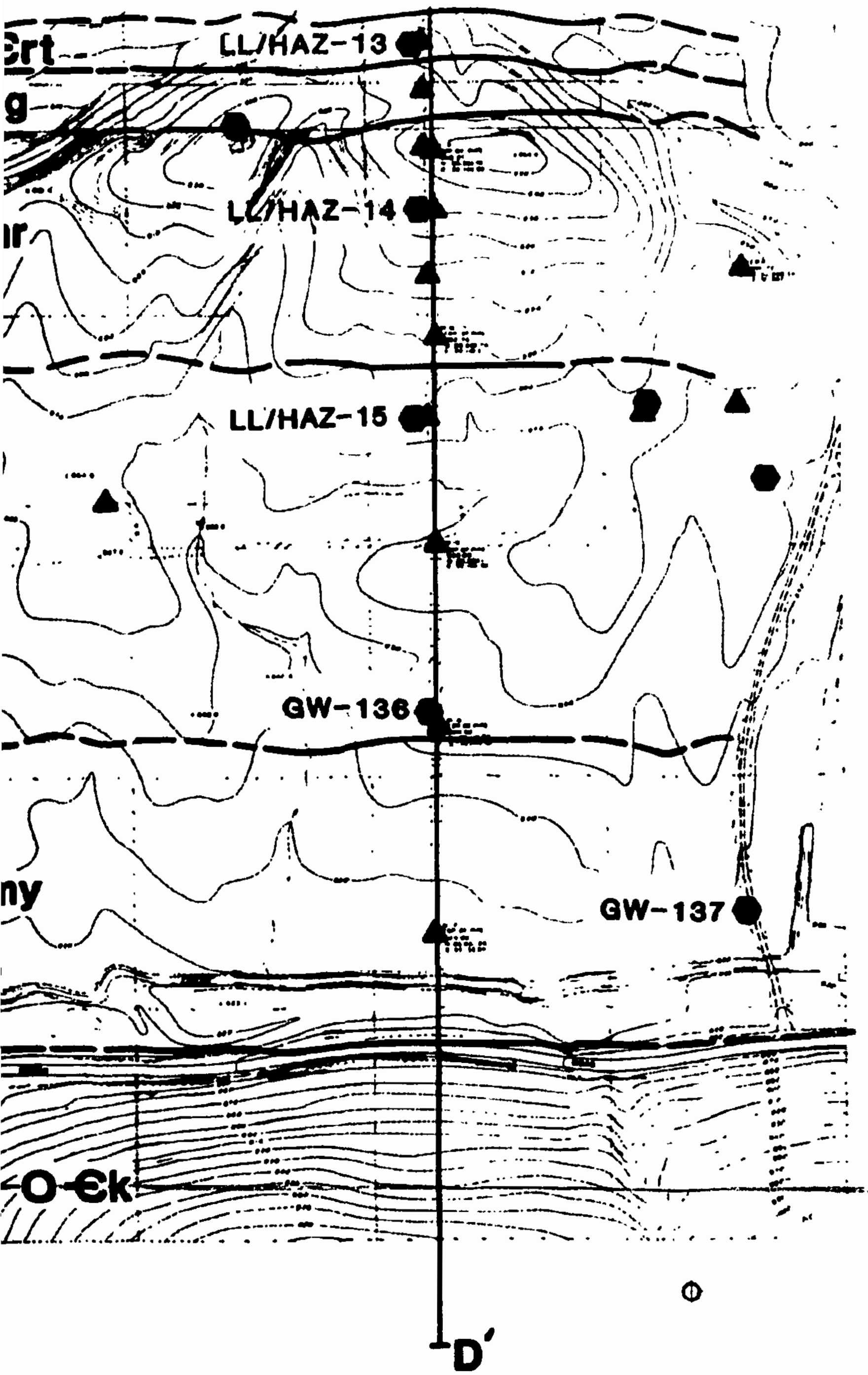
CONTACT
(DASHED WHERE APPROXIMATELY LOCATED)

APPROXIMATE LOCATION OF FAULT

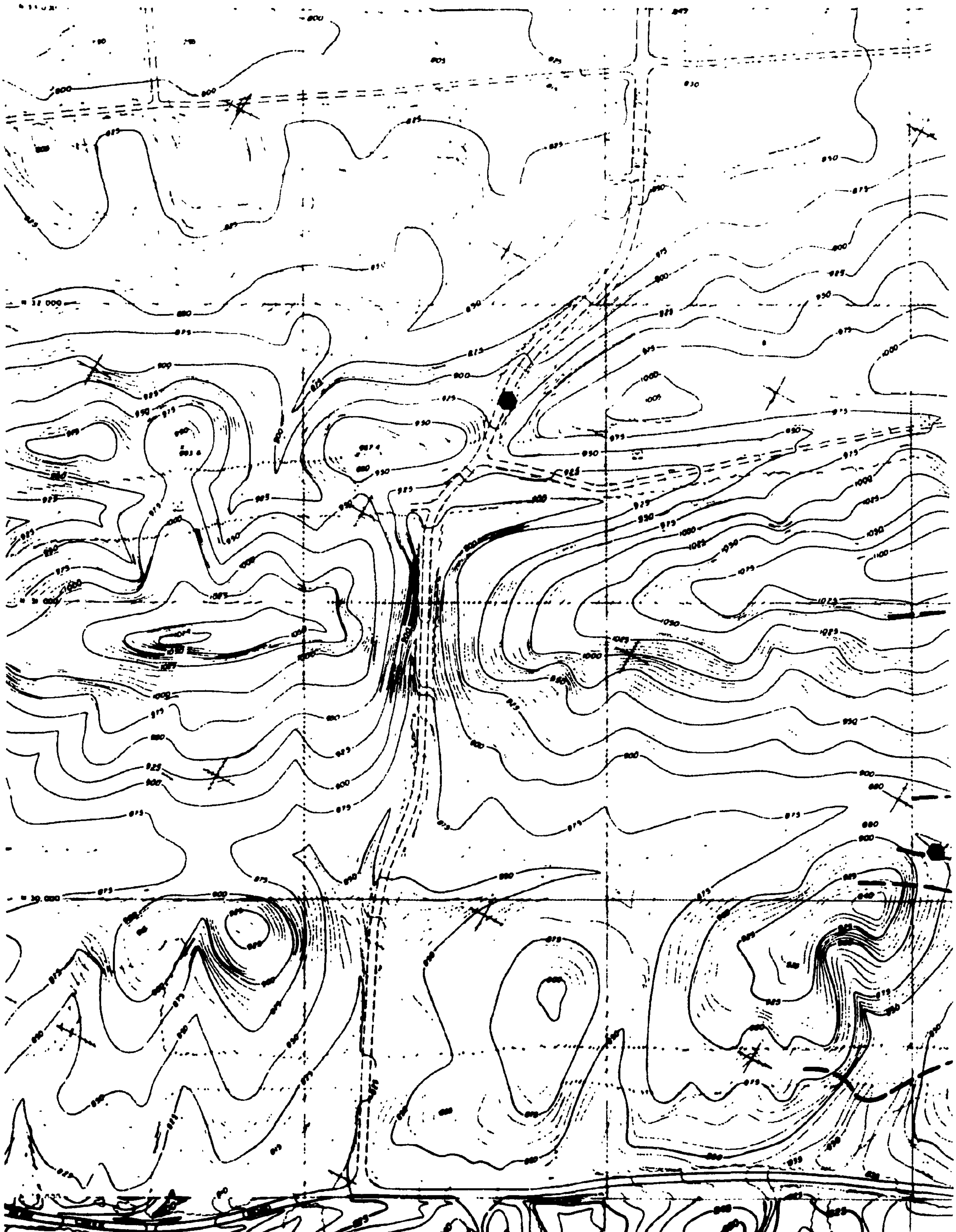
D — D′ CROSS SECTION LINE

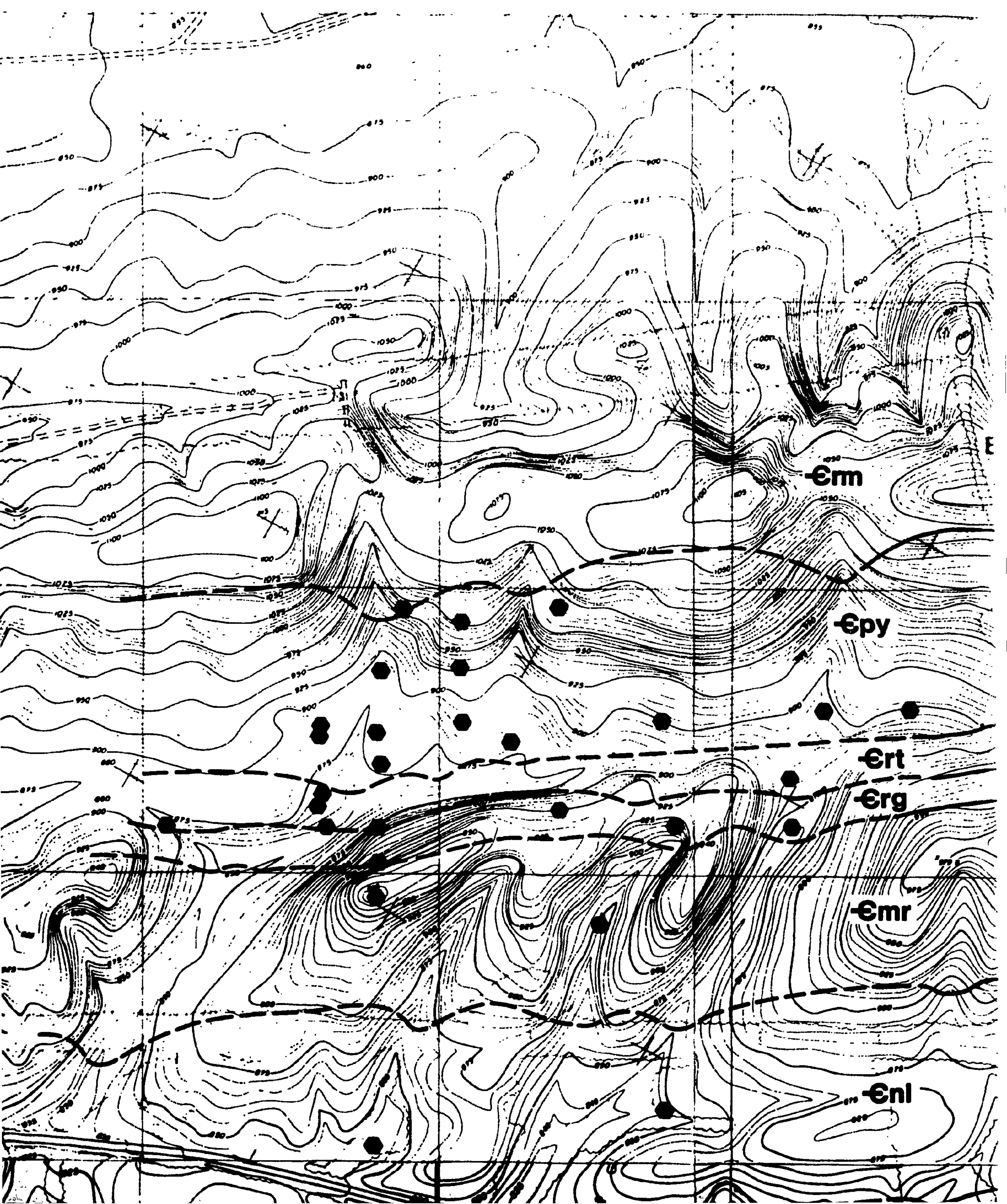
BOREHOLE

- ▲ SCREENED
- ■ OPEN
- ● CORED

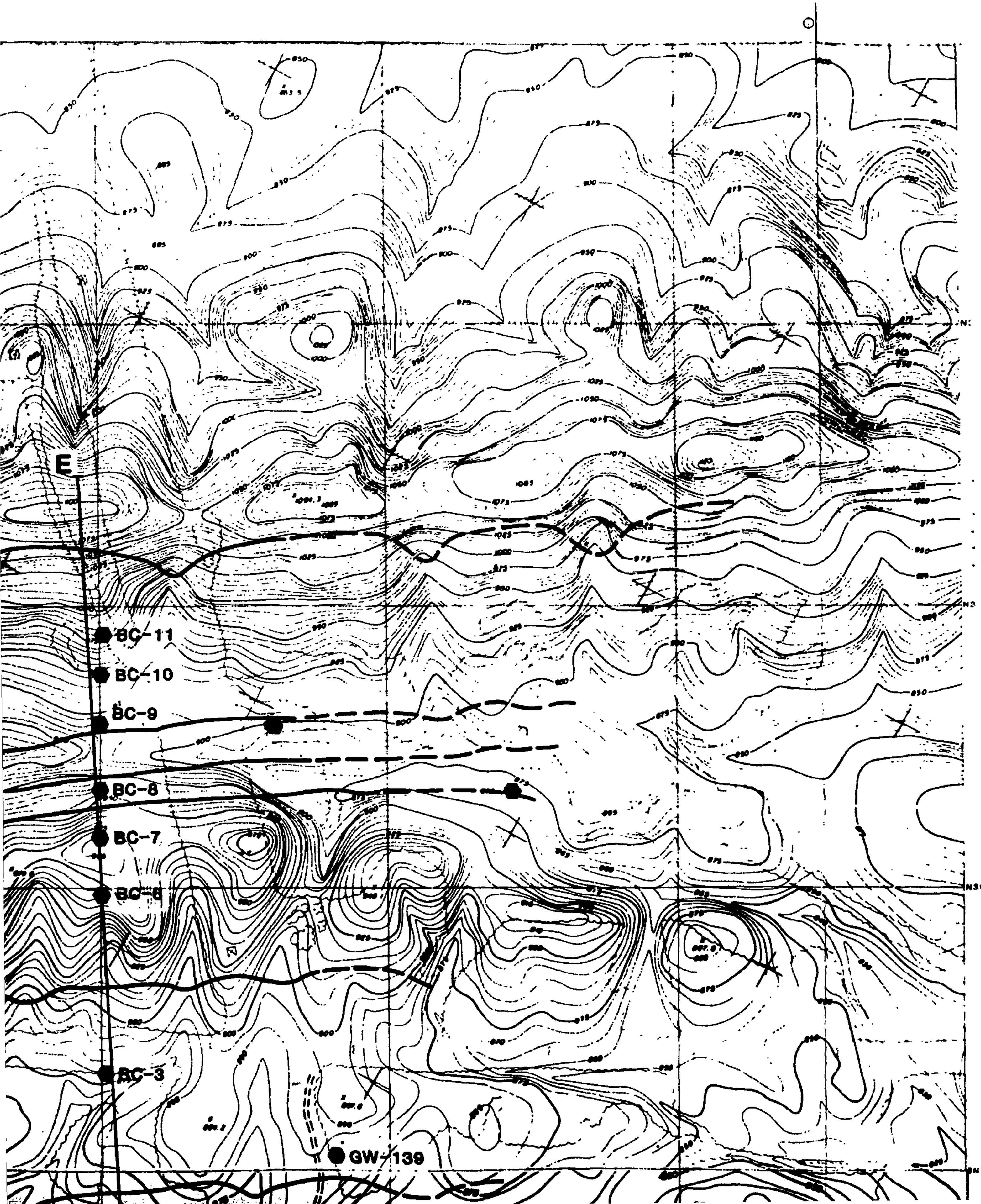


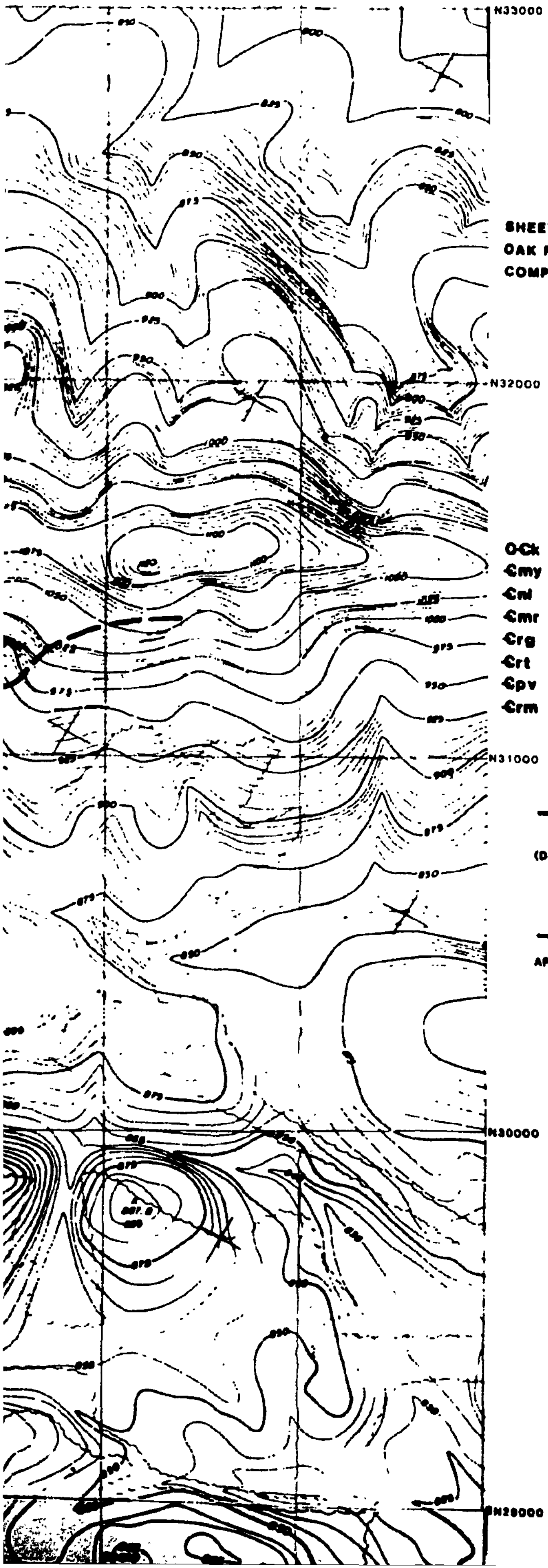
Ꞓrt
LL/HAZ-13
g
LL/HAZ-14
LL/HAZ-15
GW-136
my
GW-137
O-Ꞓk
D′





-Єm
-Єpy
-Єrt
-Єrg
-Єmr
-Єnl


E
BC-11
BC-10
BC-9
BC-8
BC-7
BC-6
BC-3
GW-139



GEOLOGIC MAP

SHEET 8 OF 9 **DATE: 6-86**

OAK RIDGE NATIONAL LABORATORY TM10112

COMPILED BY: H. L. KING
C. S. HAASE

EXPLANATION

OꞒk	KNOX GROUP	
Ꞓmy	MAYNARDVILLE	CONASAUGA GRO
Ꞓnl	NOLICHUCKY	CONASAUGA GRO
Ꞓmr	MARYVILLE	CONASAUGA GRO
Ꞓrg	ROGERSVILLE	CONASAUGA GRO
Ꞓrt	RUTLEDGE	CONASAUGA GRO
Ꞓpv	PUMPKIN VALLEY	CONASAUGA GRO
Ꞓrm	ROME FORMATION	

CONTACT
(DASHED WHERE APPROXIMATELY LOCATED)

APPROXIMATE LOCATION OF FAULT

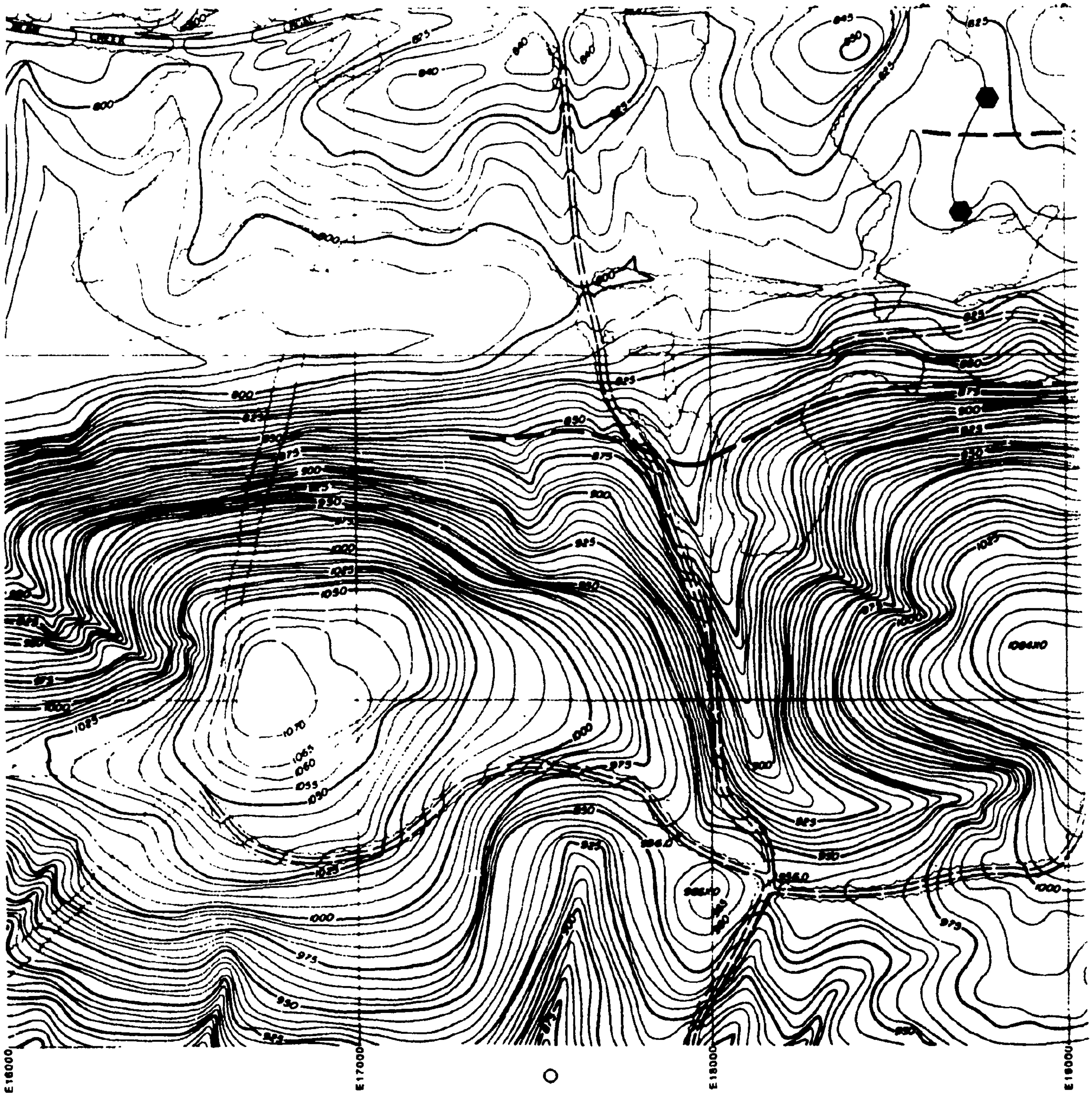
E

CROSS SECTION LINE

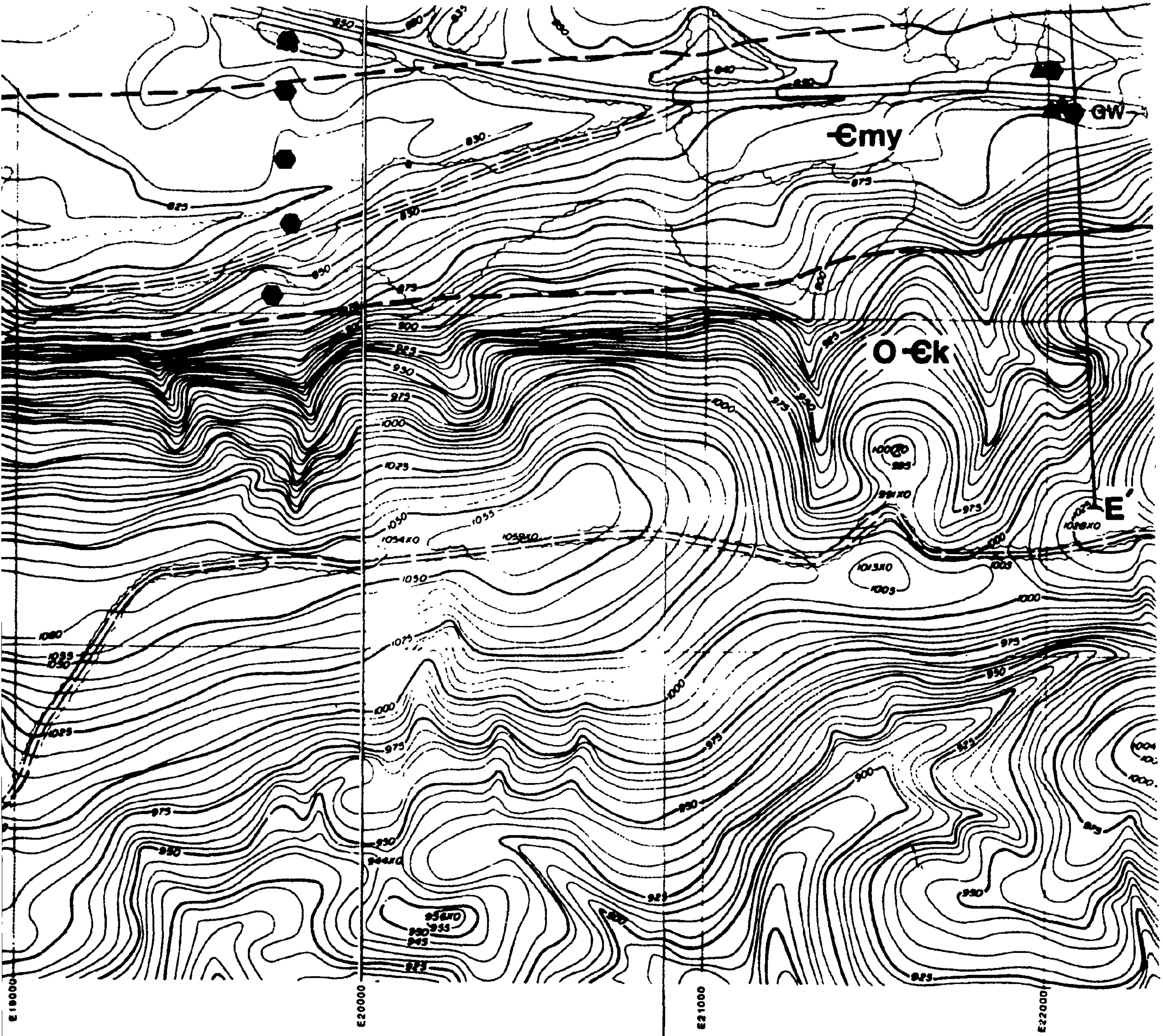
E′

BOREHOLE

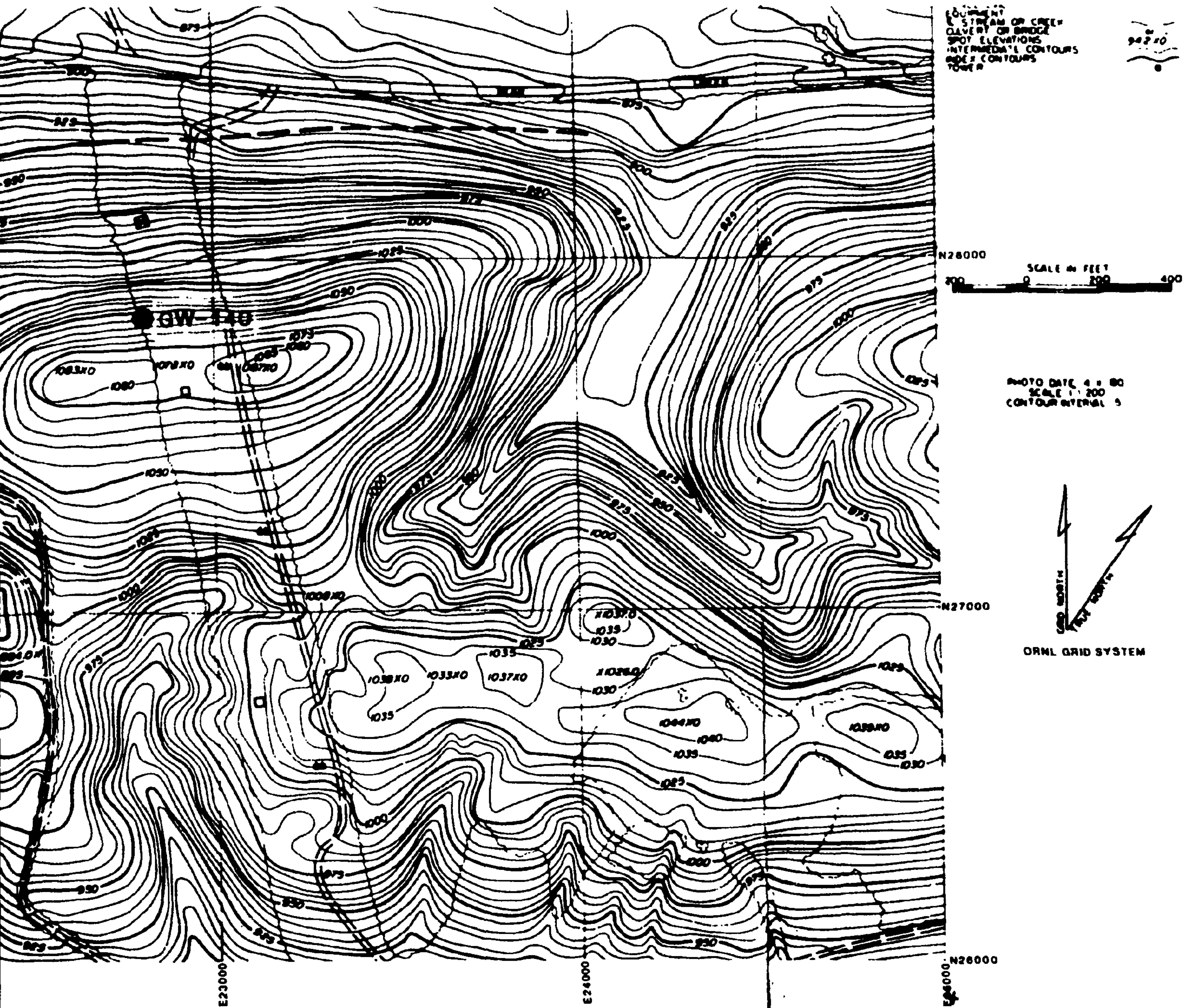
▲ SCREENED
■ OPEN
● CORED

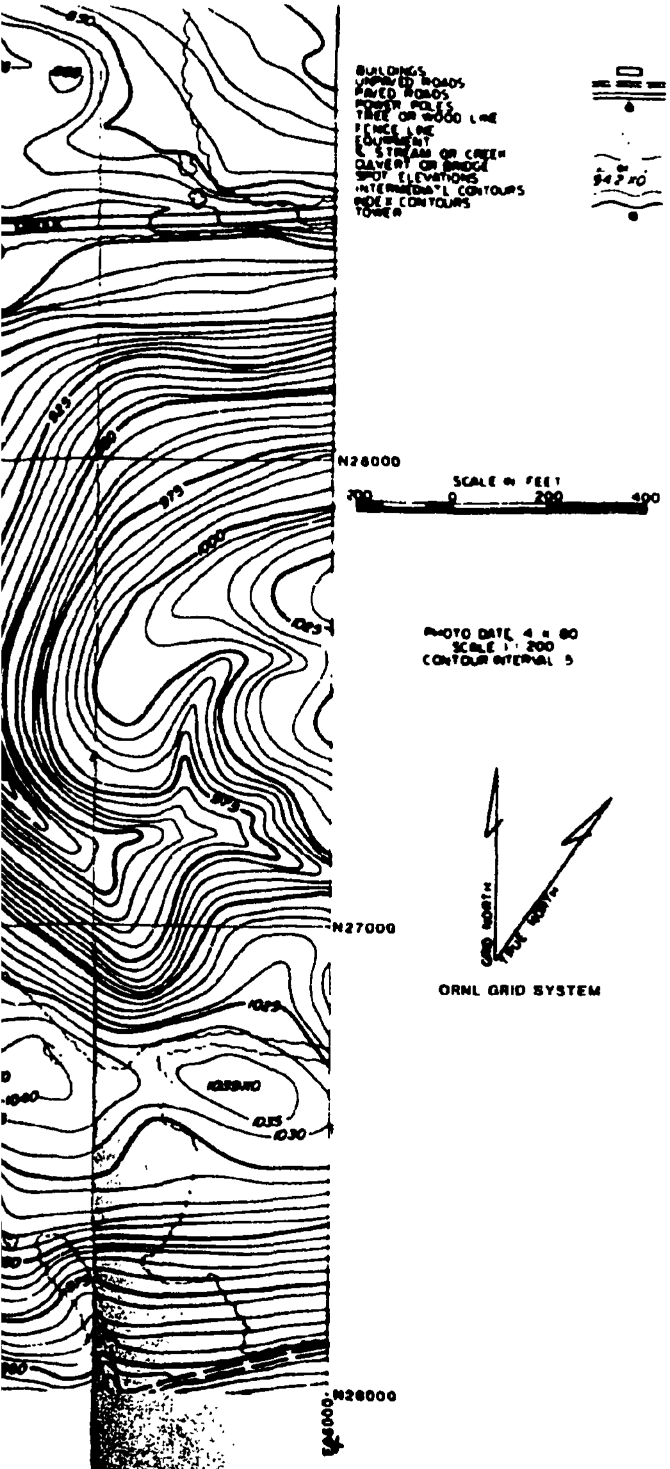


E16000
E17000
E18000
E19000



Єmy
O-Єk
GW
E′
E19000
E20000
E21000
E22000


STREAM OR CREEK
SPOT ELEVATIONS
INTERMEDIATE CONTOURS
TOWER
N28000
SCALE IN FEET
200 0 200 400
PHOTO DATE 4 — 80
CONTOUR INTERVAL 5
N27000
GRID NORTH
TRUE NORTH
ORNL GRID SYSTEM
N26000
E23000
E24000


BUILDINGS
UNPAVED ROADS
PAVED ROADS
POWER POLES
TREE OR WOOD LINE
FENCE LINE
EQUIPMENT
STREAM OR CREEK
CULVERT OR BRIDGE
SPOT ELEVATIONS
INTERMEDIATE CONTOURS
INDEX CONTOURS
TOWER
N28000
SCALE IN FEET
200 0 200 400
PHOTO DATE 4 80
SCALE 1 : 200
CONTOUR INTERVAL 5
GRID NORTH
TRUE NORTH
N27000
ORNL GRID SYSTEM
N26000