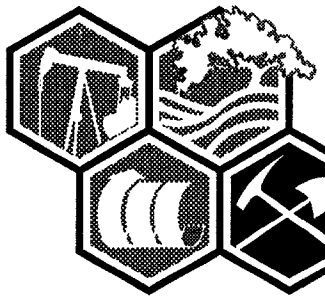
CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

DMG OPEN-FILE REPORT 96-03

UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

1996



DEPARTMENT OF CONSERVATION
Division of Mines and Geology

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JAMES F. DAVIS, *STATE GEOLOGIST*

UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

BY

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DMG OPEN-FILE REPORT 96-03

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ix

PART I - CLASSIFICATION OF AGGREGATE RESOURCES IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION . . . 1
INTRODUCTION 1
REEVALUATION OF MINERAL LAND CLASSIFICATION 6
REEVALUATION OF AGGREGATE RESOURCES IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION 7
Concepts Used in Identifying Available Aggregate Resources 7
Calculation of Available Resources 9
Reserves and Resources 9
Factors Considered in Calculations 9
Resource Sectors 10
Newly Classified Aggregate Resource Areas
Classified MRZ-2 12
Sunol Valley Area 12
Langley Hill Area 13
Aggregate Resources in the South San Francisco Bay Production-Consumption Region 13
Lost Resources 14
Newly Permitted or Newly Classified Aggregate Resources (Reserves) 14
Recycled Aggregate 20
Dredge Sand 20

PART II - AGGREGATE PRODUCTION IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION 22
ACTIVE MINING OPERATIONS 22
A.J. Raisch Company 24
Bauman Landscape, Inc. 24
California Rock and Asphalt, Inc. 24
CalMat Company 24
Dumbarton Quarry Associates 25
East Bay Excavation Company, Inc. 25
F.T.G. Construction Materials, Inc. 25
Kaiser Sand and Gravel Company 25
Kaiser Cement Corporation 26
Michael Dempsey 26
Mission Valley Rock Company 26
Oliver de Silva, Inc. 26
RMC Lonestar 27
Stevens Creek Quarry, Inc. 27
West Coast Aggregates, Inc. 27
INACTIVE/PROPOSED PERMITTED AGGREGATE OPERATIONS 28
CLOSURES OF AGGREGATE OPERATIONS 28

PART III - ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION 30

POPULATION PROJECTION FOR THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION 30
CORRELATION BETWEEN AGGREGATE PRODUCTION AND POPULATION .30
PROJECTED AGGREGATE DEMAND FOR THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION TO THE YEAR 2045 .31
COMPARISON OF THE 50-YEAR AGGREGATE DEPLETION WITH CURRENT RESERVES 32

PART IV - ALTERNATIVE SOURCES OF AGGREGATE 40

PART V - COMPARISON OF PROJECTED AGGREGATE CONSUMPTION TO ACTUAL CONSUMPTION IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION, 1981-1994 41

PART VI - CONCLUSIONS 44

ACKNOWLEDGMENTS 47

REFERENCES 48

APPENDIX 50

FIGURES

Page

Figure 1. Map of the South San Francisco Bay Production-Consumption Region 3

Figure 2. Index map of Plates 2-7; Revised Mineral Land Classification Maps 5

Figure 3. Index map of Plates 8-29; Designated Areas Update, Regionally Significant Aggregate Resources in the South San Francisco Bay Production-Consumption Region 8

Figure 4. Map of the Livermore Valley production district showing land owned or leased by aggregate companies as of January, 1996 18

Figure 5. Map of the Sunol Valley production district showing land owned or leased by aggregate companies as of January, 1996 19

Figure 6. Aggregate Recycling Facilities located in the South San Francisco Bay Production-Consumption Region 21

Figure 7. Locations of aggregate mines or proposed mines in the South San Francisco Bay Production-Consumption Region having current permits as of January, 1996 .23

Figure 8. South San Francisco Bay Production-Consumption Region: population and aggregate consumption records for the years 1953-1994 34

Figure 9. Annual per capita consumption of aggregate in the South San Francisco Bay Production-Consumption Region for the years 1953-1994 35

Figure 10. Projected population of the South San Francisco Bay Production-Consumption Region to the year 2045 .37

Figure 11. Comparison of aggregate consumption in the South San Francisco Bay Production-Consumption Region for the years 1981 to 1994, with the forecast in Special Report 146, Part II, (Stinson and others, 1987) 42

Figure 12. Comparison of population in the South San Francisco Bay Production-Consumption Region for the years 1981-1994, with the forecast in Special Report 146, Part II, (Stinson and others, 1987) . .43

Figure 13. California Mineral Land Classification Diagram: Diagrammatic relationship of mineral resource zone categories to the resource/reserve classification system. Adapted from U.S. Bureau of Mines/U.S. Geological Survey (1980) 51

TABLES

Page

Table 1. Lead agencies located within the South San Francisco Bay Production-Consumption Region 2

Table 2. Data on resource areas and designated sectors of the South San Francisco Bay Production-Consumption Region 15

Table 3. Resources made unavailable due to irreversible land use since designation in October, 1986 17

Table 4. Population, aggregate consumption, and per-capita consumption of aggregate in the South San Francisco Bay Production-Consumption Region during the period 1953-1994 33

Table 5. Projected aggregate consumption for the South San Francisco Bay Production-Consumption Region 1995-2045 36

Table 6. Summary of aggregate resources and projected 50-year consumption for the South San Francisco Bay Production-Consumption Region 38

Table 7. Projected aggregate depletion of reserves for the South San Francisco Bay Production-Consumption Region 1995-2045 39

PLATES

Plate 1. Generalized Mineral Land Classification Map of The South San Francisco Bay Production-Consumption Region.

Revised Mineral Land Classification Maps

Plate 2. Newark Quadrangle
Plate 3. Niles Quadrangle
Plate 4. La Costa Valley Quadrangle
Plate 5. Mountain View Quadrangle
Plate 6. Milpitas Quadrangle
Plate 7. Mindego Hill Quadrangle

Designated Areas Update, Regionally Significant Aggregate Resource Areas in the South San Francisco Bay Production-Consumption Region

Plate 8. San Quentin Quadrangle
Plate 9. Richmond Quadrangle
Plate 10. Clayton Quadrangle
Plate 11. Brentwood Quadrangle
Plate 12. Oakland East Quadrangle
Plate 13. Bryon Hot Springs Quadrangle
Plate 14. San Francisco South Quadrangle
Plate 15. Hayward Quadrangle
Plate 16. Livermore Quadrangle
Plate 17. Altamont Quadrangle
Plate 18. Montara Mountain Quadrangle
Plate 19. Newark Quadrangle
Plate 20. Niles Quadrangle
Plate 21. La Costa Valley Quadrangle
Plate 22. Half Moon Bay Quadrangle
Plate 23. Mountain View Quadrangle
Plate 24. Milpitas Quadrangle
Plate 25. Calaveras Reservoir Quadrangle
Plate 26. Mindego Hill Quadrangle
Plate 27. Cupertino Quadrangle
Plate 28. San Jose East Quadrangle
Plate 29. Los Gatos Quadrangle

EXECUTIVE SUMMARY

This report updates information presented in a classification study on construction aggregate in the South San Francisco Bay Production-Consumption (P-C) Region completed in 1983. Results of that study were published by the Department of Conservation's Division of Mines and Geology (DMG) as Special Report 146 - Mineral Land Classification: Aggregate Materials in the San Francisco-Monterey Bay Area, Part II South San Francisco Bay Production-Consumption Region (Stinson, Manson, and Plappert, 1987). Special Report 146 included the urban and urbanizing parts of Alameda, Contra Costa, San Francisco, San Mateo, and northern Santa Clara counties as a single P-C region.

All sand and gravel as well as stone deposits having material suitable for class III sub-base or above were classified in this study. For the purposes of discussion, aggregate meeting such specifications will be referred to as construction-grade aggregate. Construction-grade aggregate includes four basic types of aggregate which must meet specific standards. These are from highest quality standards to lowest: 1) portland cement concrete (PCC) aggregate, 2) asphaltic aggregate, 3) base, and 4) subbase. Subbase is divided into five classes. The lowest two categories, class IV and V, are considered types of fill and were not considered in the classification process because of their general abundance throughout the South San Francisco Bay P-C Region.

Data contained within this update were current as of January 1996, with the exception of the figures related to annual aggregate production--which are complete only to December 1994. In this case, the 1994 data are the most recent available from the U.S. Geological Survey.

Updated information for this report pertaining to classification is shown on Plate 1, a generalized classification map and Plates 2-7, revised Mineral Land Classification Maps. Plates 8-29 show updated information on areas designated by the State Mining and Geology Board (SMGB).

The only actions required of local lead agencies by this report are that the County of Alameda must incorporate the reclassification information on Plates 3 and 4 (Revised Mineral Land Classification Maps of the Niles, and La Costa Valley quadrangles) into their general plans; the Cities of Newark and Fremont must incorporate the reclassification information on Plates 2, 3, 5, and 6 (Revised Mineral Land Classification Maps of the Newark, Niles, Mountain View, and Milpitas quadrangles) into their general plans; and the classification information on Plate 7 (Revised Mineral Land Classification Map of the Mindego

Hill Quadrangle) must be incorporated into San Mateo County's general plan.

Based on this update study and assuming that the consumption forecast is accurate, the following conclusions were reached:

o The 676 million tons of presently permitted construction-grade aggregate resources (reserves) within the South San Francisco Bay P-C Region are enough to continue to supply the demand of the Region for 30 years - until the year 2024. In 1981, the region had 552 million tons of reserves which were projected to run out in 20 years or the year 2000.

o Since 1980, about 406 million tons of reserves were added to the South San Francisco Bay P-C Region through new mining permits or through new classification of resource areas. Most of the newly permitted reserves are in Alameda County. Permits were granted for mining aggregate in areas which were previously unmined as well as for deeper mining in permitted areas. One area covering about 100 acres in San Mateo County was newly classified for construction-grade aggregate.

o The anticipated consumption of aggregate in the South San Francisco Bay P-C Region for the next 50 years (through the year 2045) is estimated to be 1.76 billion tons, of which 32 percent or 563 million tons must be of PCC quality.

o The projected depletion of aggregate in the South San Francisco Bay P-C Region for the next 50 years is estimated to be 1.23 billion tons. This depletion rate is based on 70 percent of the projected aggregate consumption.

o In 1981, 22 square miles of land containing 6.3 billion tons of construction-grade aggregate resources were available in the South San Francisco Bay P-C Region. In 1986, the SMGB designated 18 square miles of this land as being regionally significant. These designated areas contained 4.1 billion tons of construction-grade aggregate resources. Since 1980, about 253 million tons of aggregate resources underlying designated areas have been lost due to aggregate consumption. About 2 percent of the total resources (75 million tons) underlying designated areas within the South San Francisco Bay P-C Region have been lost due to urbanization or other irreversible land uses since designation in 1986. Also, 32 million tons of aggregate resources have been subtracted from the total due to a change in classification in the Niles Cone area, located in the city of Newark, Alameda County.

o Within designated areas, there are presently 3,700 million tons of construction-grade aggregate resources available.

Aggregate resources in designated and non designated areas total 3,775 million tons.

o As of January 1996, 22 mines and one proposed mine, operated or controlled by 17 different mining companies were producing or permitted to produce construction-grade aggregate in the South San Francisco Bay P-C Region. Two of the 22 mines are currently not active. The proposed mine was permitted in 1984 but no mining has occurred to date. In 1980, there were 32 mines operated by 24 companies. All of the mine closures were crushed stone operations and most were small. This decline in active mines may be attributed in part from increased use of recycled aggregate in the production of class II aggregate base.

o Almost all of the aggregate produced within the South San Francisco Bay P-C Region is also consumed within the region. However, only 83 percent (1994 data) of the aggregate consumed in the P-C region is produced in the region. Imported aggregate comes from deposits of sand and gravel and crushed stone located in San Joaquin, Santa Clara, and San Benito counties.

o The average annual per capita consumption rate from 1953 to the end of 1994 was 5.7 tons. That rate was derived by correlating aggregate consumption and population for those years. Data collected from 1953 to the end of 1980 for Special Report 146, Part II determined that the average annual per capita consumption rate was 6.0 tons. The drop in per capita consumption may be a reflection of California's economic recession beginning in the early 1990's.

o The forecast of aggregate demand of 401 million tons for the South San Francisco Bay P-C Region for the period 1981-1994 was within 17 percent of the aggregate production of 335 million tons measured for that period for this study. This level of forecast accuracy is not unreasonable for the simplistic forecast technique used.

Changes in Mineral Land Classification of the Region Since 1983

DMG has classified the South San Francisco Bay P-C Region according to the presence or absence of significant construction-grade aggregate deposits. The land classification is presented in the form of Mineral Resource Zones (MRZs). MRZ-2 represents areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood exists for their presence. MRZ-3 represents areas containing mineral deposits the significance of which cannot be evaluated from available data. For a more detailed explanation of MRZ's, see Appendix, Mineral Resource Zone Categories, page 48 of this report.

There are five changes in the mineral land classification of the South San Francisco Bay P-C Region from the 1983 report. They are: 1) the reclassification of the Mission Valley Rock property from MRZ-1 to MRZ-2 for construction-grade aggregate (see Plates 3 and 4); 2) the reclassification of Sunol Valley alluvial areas from MRZ-1 to MRZ-4 and MRZ-3 (see Plates 3 and 4); 3) the classification of the Langley Hill site, as MRZ-2 for construction-grade aggregate (see Plate 7); 4) the reclassification of a part of the Niles Cone from MRZ-2 to MRZ-3 (see Plates 2 and 3); and 5) the reclassification of a part of Sector J (also part of the Niles Cone) from MRZ-2 to MRZ-1 (see Plates 2, 3, 5, and 6).

The following table compares population, aggregate demand, reserves, annual per capita consumption, projected depletion of reserves, resources, number of aggregate mines, number of permitted properties, and the price of aggregate in the South San Francisco Bay P-C Region for the data-base year of the original classification (1980) with data current up to the end of 1994.

COMPARISON OF:	1980	1994
POPULATION	4,191,200	4,994,500
CALCULATED ANNUAL AGGREGATE DEMAND	22 MILLION TONS	22 MILLION TONS
TOTAL PERMITTED AGGREGATE RESERVES	552 MILLION TONS	676 MILLION TONS
CALCULATED ANNUAL PER CAPITA CONSUMPTION	6.0 TONS (1953-1980 average)	5.7 TONS (1953-1994 average)
CALCULATED YEARS UNTIL DEPLETION	20 YEARS	* 30 YEARS
AGGREGATE RESOURCES	**6.3 BILLION TONS	3.8 BILLION TONS
PERMITTED PROPERTIES	32	23 (20 active)
NO. OF COMPANIES	24	17 (15 active)
AVERAGE PRICE OF AGGREGATE PER TON	$2.00	$5.00

* Based on 70 percent of the projected aggregate consumption.

** Aggregate resources for all sectorized land prior to designation.

PART I - CLASSIFICATION OF AGGREGATE RESOURCES IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

INTRODUCTION

The Department of Conservation's Division of Mines and Geology (DMG) published a four-part study of aggregate resources for the San Francisco-Monterey Bay Area as Special Report 146, Mineral Land Classification: Aggregate Materials of the San Francisco-Monterey Area, Parts I, II, III, and IV (Stinson and others, 1987). Special Report 146 covers three adjoining P-C Regions--Part II covers the South San Francisco Bay P-C Region, Part III covers the North San Francisco Bay P-C Region and Part IV covers the Monterey Bay P-C Region. Each of these P-C Regions covers a separate aggregate production district and its surrounding market or consumption area. Part I of Special Report 146 is an introduction to the three P-C Regions.

This report is an update of the South San Francisco Bay P-C Region (see Figure 1) which includes Alameda, Contra Costa, San Mateo, San Francisco, and northern Santa Clara counties. In Special Report 146, Part II, urbanizing lands within the South San Francisco Bay P-C Region were classified according to the presence or absence of significant construction-grade aggregate resources. Subsequent to classification and the completion of an Environmental Impact Report (California Department of Conservation, 1985), the State Mining and Geology Board (SMGB) designated areas within the P-C Region as having aggregate resources of regional significance on October 2, 1986 (California Department of Conservation, 1987). Special Report 146, Part II also projected future aggregate demand to the year 2030 (a 50-year projection).

This update report conveys important information on the present aggregate resources in the South San Francisco Bay P-C Region for the benefit of local lead agencies (see Table 1 for list of lead agencies). Information provided for the update reevaluates the availability of aggregate resources in the classified and designated areas within the South San Francisco Bay P-C Region and also projects the demand for construction-grade aggregate within the region to the year 2045.

The original study and this update were conducted as specified by the Surface Mining and Reclamation Act (SMARA) of 1975. Section I, Subsection 7 of the SMGB Guidelines for Classification and Designation of Mineral Lands, adopted in 1978 and published in 1983, requires the State Geologist to review mineral land classification information after a period of no longer than 10 years to determine whether reclassification and/or revision of projected requirements of construction materials is necessary. It was determined that a revision of projected

COUNTIES

*+Alameda
*+Contra Costa
San Francisco
*+San Mateo
*+Santa Clara

INCORPORATED CITIES OR TOWNS

Alameda
Albany
Antioch
Atherton
Belmont
Berkeley
Brentwood
Brisbane
Burlingame
Campbell
Clayton
Colma
Concord
Cupertino
Daly City
Dublin
El Cerrito
Emeryville
Foster City
*+Fremont
Half Moon Bay
Hayward
Hillsborough
Lafayette
+Livermore
Los Altos
Los Altos Hills
Los Gatos
Martinez
Menlo Park
Millbrae
Milpitas
Monte Sereno
+Moraga
+Newark
+Oakland
+Orinda
+Pacifica
Palo Alto
Piedmont
Pinole
Pittsburg
Pleasant Hill
+Pleasanton
Portola Valley
Redwood City
*+Richmond
San Bruno
San Carlos
San Francisco
+San Jose
San Leandro
San Mateo
San Pablo
Saratoga
South San Francisco
Sunnyvale
+Union City
Walnut Creek
Woodside

OTHER

* San Francisco Bay Conservation and Development Commission

\+ East Bay Regional Park District
* State Lands Commission
State of California
U.S. Army
U.S. Department of Defense
U.S. Navy
U.S. Corps of Engineers

+Agencies that have designated land within their jurisdictions.

*Agencies that have active aggregate operations within their jurisdictions.

Table 1. Lead agencies (county, city, and other) located within the South San Francisco Bay Production-Consumption Region.

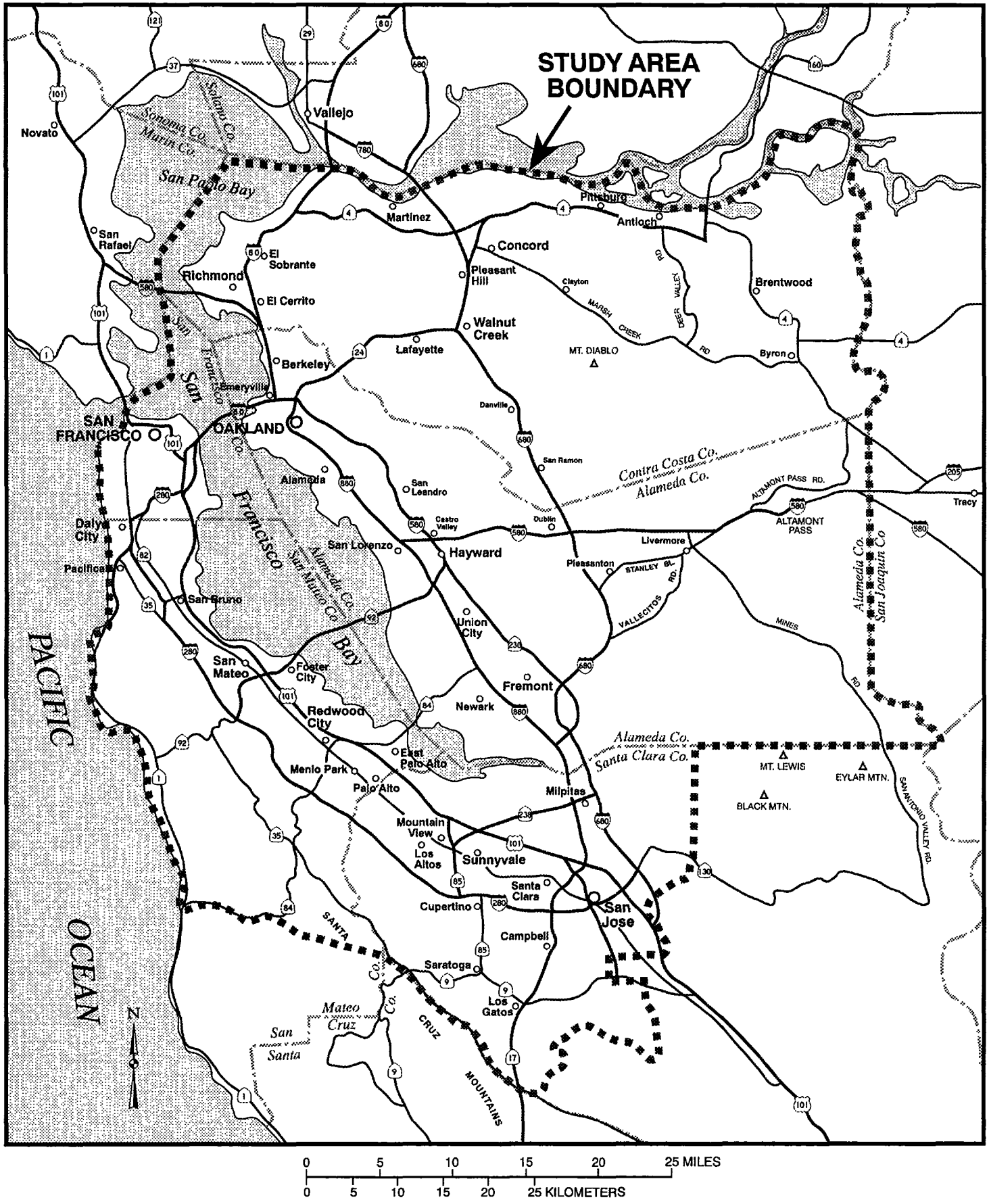

Figure 1. Map of the South San Francisco Bay Production-Consumption Region.

requirements was necessary for the South San Francisco Bay P-C Region.

It should be noted that the 1987 publication date for Special Report 146 does not reflect the report's completion date or the data-base year. Special Report 146 was completed and published in pre-print form in 1983. Consequently, information pertaining to classification is updated herein as of 1983. Data in Special Report 146 regarding land use was updated to conditions present in 1986 as part of the official designation process conducted by the SMGB. Changes in classification since 1983 and changes in available resource areas since designation in 1986 are shown on Plates 2 through 29 (see Figures 2 and 3 for indexes to Plates).

The most recent available data-base year for aggregate production used in Special Report 146 was 1980. Information pertaining to aggregate consumption and aggregate resources is updated as of the end of 1980. The last aggregate consumption data-base year for the following update report is 1994. All aggregate resource data for this report will be current to the end of 1994.

Classification of the South San Francisco Bay P-C Region was done with regard to the suitability of the underlying material for use in construction-grade aggregate. For Special Report 146, and this update, construction-grade aggregate is defined as portland cement concrete (PCC) aggregate, asphaltic aggregate, aggregate base, and aggregate subbase down to class III (class IV and V are considered types of fill and were not classified because of their abundance). This approach to classification is in contrast to the P-C Region studies done in southern California where only deposits meeting specifications for PCC aggregate were classified. In southern California, almost all aggregate production is from deposits which meet PCC specifications but in the South San Francisco Bay P-C Region, large amounts of high quality aggregate are not available. About half of the aggregate produced from the South San Francisco Bay P-C Region comes from crushed rock sources which do not meet PCC specifications. Consequently, the decision was made to classify for all construction-grade aggregate rather than exclusively for PCC.

The generalized land classification within the South San Francisco Bay P-C Region, as presented on Plate 1 at a scale of 1:125,000, has been revised from Special Report 146, Part II. Four areas have been reclassified and one area has been newly classified for this update. These areas are shown on Plates 2-7, Revised Mineral Land Classification Maps (see Index Map of Plates, Figure 2) The classification nomenclature in use at the time of the original report has been kept.

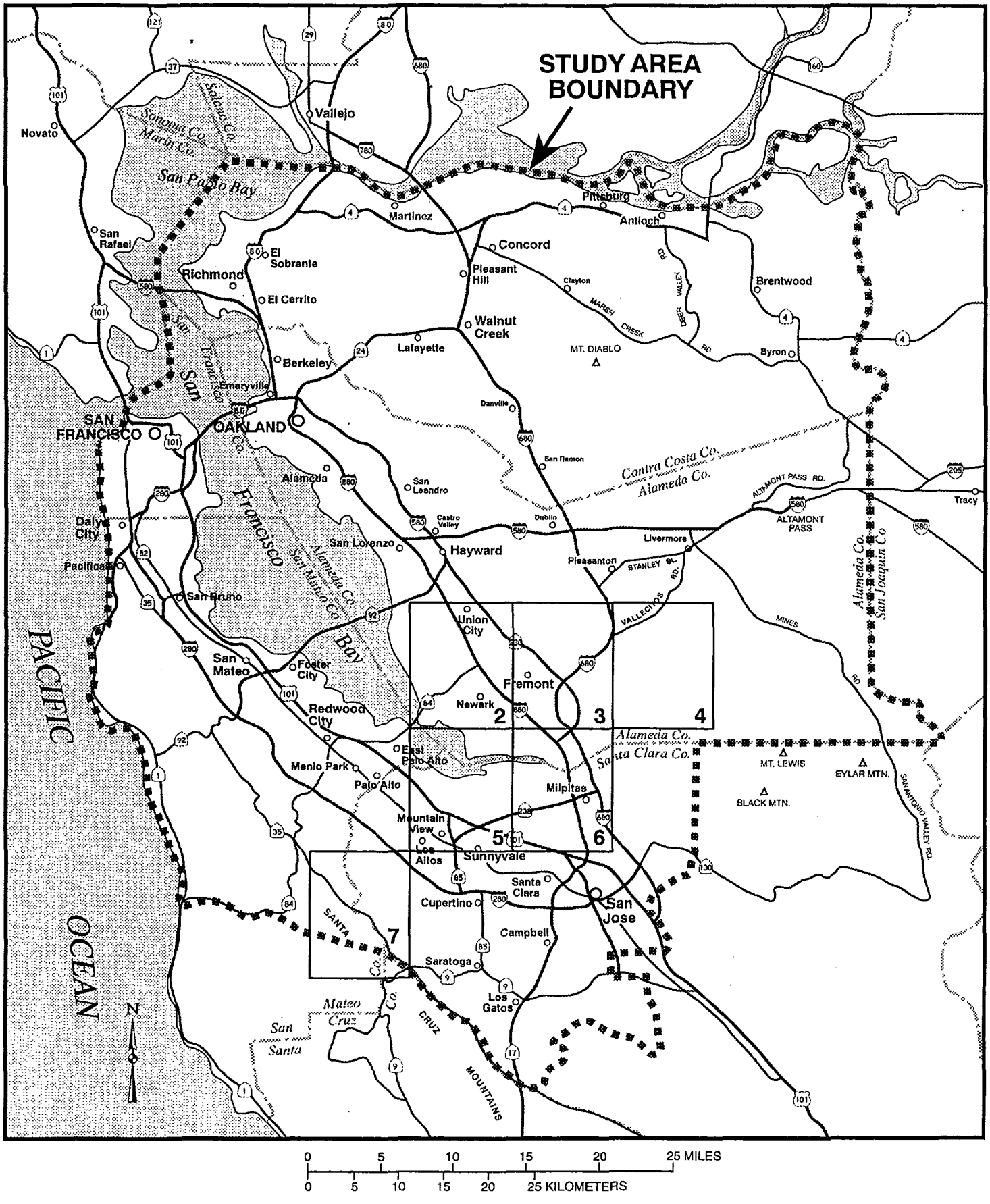

Figure 2. Index map of Plates 2-7; Revised Mineral Land Classification Maps.

REEVALUATION OF MINERAL LAND CLASSIFICATION

A reevaluation of Mineral Land Classification in the South San Francisco Bay P-C Region is presented in this section of the report. Based on new data that has become available since classification was completed in 1983, five changes have been made to the original classification report. These changes are shown on Plates 2-7, Revised Mineral Land Classification Maps. Three of these changes involve the addition or subtraction of aggregate resources. They are as follows:

1) Reclassification of about 160 acres in the Sunol Valley, Alameda County from MRZ-1 to MRZ-2 (see Plates 3 and 4).

2) Classification of about 100 acres in the Langley Hill area located in southern San Mateo County to MRZ-2 (see Plate 7)

3) Reclassification of about 340 acres in the Niles Cone area (Sector J) in western Alameda County, from MRZ-2 to MRZ-1 (see plates 2, 3, 5, and 6)

The reclassification of the Sunol Valley area and the new classification of the Langley Hill area have added resources to the South San Francisco Bay P-C Region. Both of these newly identified resource areas lie in non designated lands. They are discussed in more detail beginning on page 12, "Newly Classified Aggregate Resource Areas, Classified MRZ-2".

The reclassification of the Niles Cone area, Sector J, has resulted in lost resources within the P-C Region (see page 14 "Lost Resource"). This area is part of the Niles Cone, a large subaerial delta formed by Alameda Creek, containing sand and gravel deposits exceeding 100 feet in thickness. Based on geological information, water well data, and past mining in the Niles Cone area, this area was classified MRZ-2 in Special Report 146, Part II. Subsequent to classification, the area was designated by the SMGB in 1986. Since classification and designation, three exploratory holes have been drilled in the area underlying Sector J. The holes indicate that clay, silt and dirty sands underly the area to depths of at least 65-100 feet. Based on this information, the area was reclassified MRZ-1.

The following two remaining changes do not add or subtract from resources in the South San Francisco Bay P-C Region:

4) Reclassification of lands in the Sunol Valley area, Alameda County from MRZ-1 to MRZ-4 and MRZ-3 (see Plates 3 and 4). These changes were made in areas adjacent to or in the vicinity of current aggregate mining operations in the Sunol Valley.

5) Reclassification of land in the Niles Cone area in western Alameda County, from MRZ-2 to MRZ-3.(see Plates 2, 3, 5, and 6). This land is located directly north and west of the reclassified area in Sector J.

REEVALUATION OF AGGREGATE RESOURCES IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

A reevaluation of aggregate resources in South San Francisco Bay P-C Region is presented in this section of the report. The reassessment was conducted on the basis of a quantitative evaluation of available construction-grade aggregate resources classified as MRZ-2 (see Appendix, p 50). Construction aggregate is defined for this report as any aggregate material (sand and gravel and crushed rock) which meets specifications for class III aggregate subbase or higher grades.

Concepts Used in Identifying Available Aggregate Resources

The State Geologist is responsible for calculating aggregate resources in those areas classified as MRZ-2 for aggregate. Recognizing that there are lands within these areas that have already been urbanized and therefore have a limited opportunity for mineral resource conservation and extraction, the State Geologist has limited the calculation of aggregate resource tonnages to areas classified as MRZ-2 that have not been urbanized. These areas were identified as sectors in Special Report 146, Part II (Stinson and others 1987). The majority of the sectors were subsequently designated by the SMGB as being regionally significant. All designated sectors which were identified in SMARA Designation Report No. 7. (California Department of Conservation, 1987) have been re-evaluated during the course of this update. Plates 8-29 (see Figure 3 for index to Plates) show all changes in designated sectors or parts of sectors since designation took place in October, 1986. These maps show areas of urbanization within designated areas and any changes in land owned or controlled by aggregate companies.

For purposes of identification of available aggregate resources, incompatible uses of land are defined as improvements of high cost such as high-density residential developments, intensive industrial developments, commercial developments, and major public facilities. Lands that have compatible uses are defined as those that are nonurbanized or that have very low density residential development (1 unit per 10 acres), lands that do not have high-cost improvements, and lands used for agriculture, silviculture, grazing, or open space.

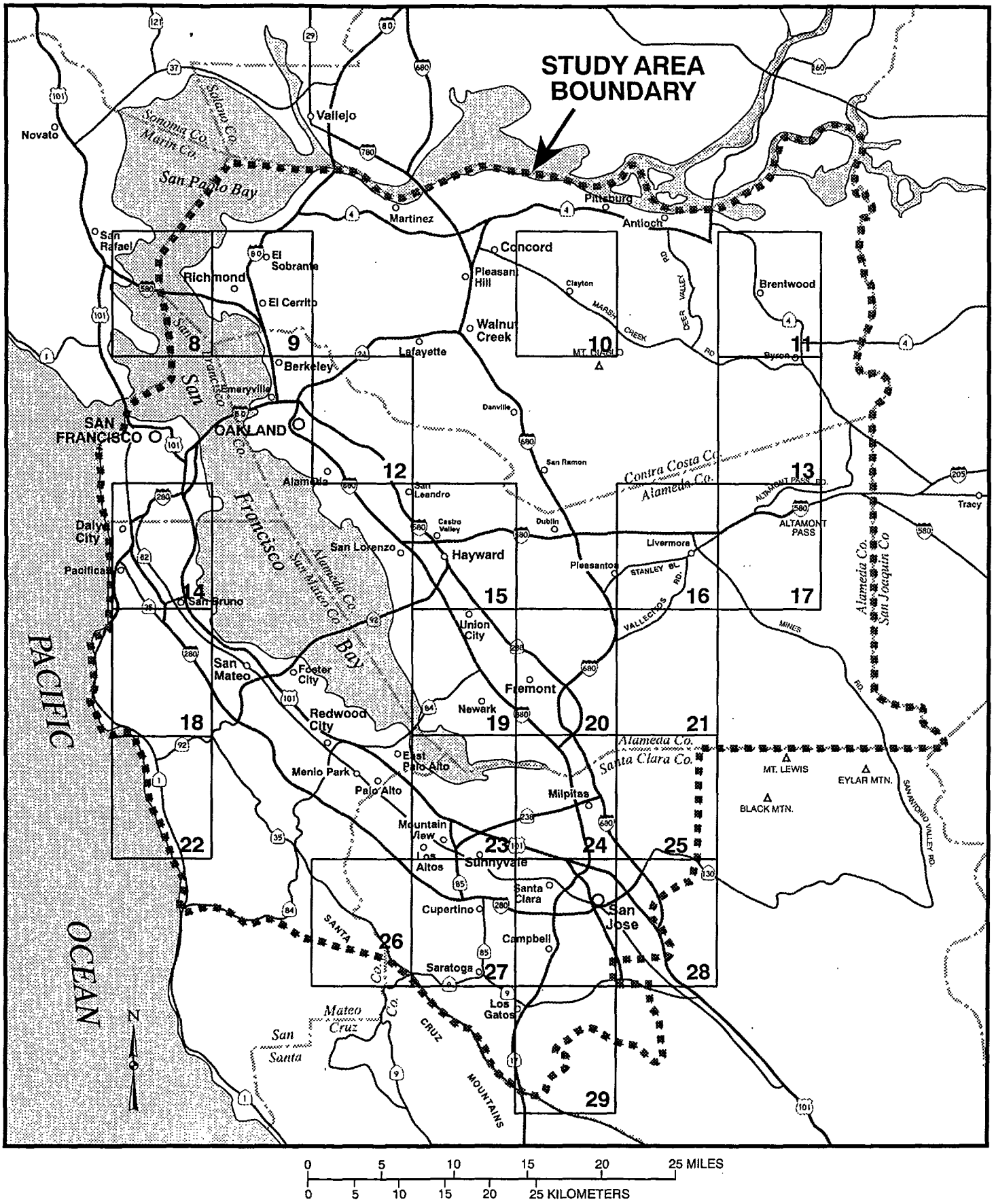

Figure 3. Index map of Plates 8-29; Designated Areas Update, Regionally Significant Aggregate Resources in the South San Francisco Bay Production-Consumption Region.

In this report, land use for aggregate resource areas classified MRZ-2 was based on conditions as of January, 1996. Use of these areas was determined after review of data from lead agencies, reference to aerial photographs and photo-revised topographic maps, and field reconnaissance.

The revised resource calculations of aggregate in the P-C Region are compared with the State Geologist's new forecast of the 50-year needs of that region. The comparison of regional needs with available reserves and resources provides the opportunity to focus attention on the mineral resource issues confronting the region, such as the need to plan carefully for the use of any lands containing mineral resources, and the need to consider the permitting of additional mining operations in the region as currently mined deposits are depleted.

It is highly likely that all available aggregate resources calculated for this report will not ultimately be mined. There may be political constraints and other considerations confronting local government in making aggregate resources available for extraction that are not accounted for. Considering this, it becomes important for local governments to carefully review the estimated resources in order to ensure that adequate resources will be available for future development of the region's economy.

Calculation of Available Resources

Reserves and Resources

In this report, reserves are calculations of tonnages of aggregate that have been determined to be acceptable for commercial use, that exist within properties owned or leased by aggregate producing companies, and for which permits have been granted to allow mining and processing of the material. Permits may be required by agencies other than the county, as is the case in rivers where a permit may also be required by the Army Corps of Engineers. Resources include reserves as well as all potentially usable aggregate materials that may be mined in the future, but for which no permit allowing mining has been granted.

Factors Considered in Calculations

The resource calculations given here are for those aggregate resources in the sectors designated by the SMGB (California Department of Conservation, 1987) with the addition of resources on the reclassified Sunol Valley Mission Valley Rock property and the newly classified Langley Hill property. The changes in the areas available for mining, as identified in this study, are shown on Plates 8-29 (see Figure 3 for index to Plates).

The factors used in this study to determine the areal extent and tonnage of aggregate resources remaining within the sectors were the same as those used in Special Report 146, Part II. (Stinson and others, 1987). They were as follows:

1. Resource tonnage calculations were based on measurements taken from base maps that have a scale of 1:24,000 or maps obtained from aggregate companies with varying scales.

2. Thicknesses of aggregate deposits were determined in the original reports through analysis of water well-log data, examination of active aggregate pits and natural outcrops, and other information provided by persons who have knowledge concerning aggregate deposits in this region.

3. A standard setback of 100 feet from utility and rail lines and urban developments was used in determining the limits of areas available for mining, unless otherwise stipulated on individual mining plans.

4. Side slopes were generally calculated to have a 1:1 gradient, or, if the deposit was permitted for mining, the side slopes of the mining plan.

5. In-place densities of 0.06 tons per cubic foot were assumed in calculating sand and gravel resources and densities of 0.06 to 0.09 tons per cubic foot were assumed in calculating crushed stone resources.

Resource Sectors

All lands in the South San Francisco Bay P-C Region classification report (Stinson and others, 1987) containing extractable aggregate deposits were divided into 42 sectors, covering 23 square miles of land. During the process of public and lead agency comment in response to the EIR, written prior to designation (California Department of Conservation, 1985), it was determined that 12 of these sectors should not be designated. All or parts of the remaining 30 sectors, covering 19 square miles, were designated by the SMGB in 1986 (California Department of Conservation, 1987). They are described below:

Sector A - Aggregate deposits located in the Amador Valley and Livermore Valley areas in the Cities of Pleasanton and Livermore, Alameda County.

Sector B - Alluvial deposits consisting of six parcels along Arroyo del Valle on the southwestern edge of Livermore, Alameda County.

Sector C - Alluvial deposits consisting of six parcels located along Arroyo Mocho on the eastern edge of Livermore, Alameda County.

Sector D - Greenstone deposit located on Apperson Ridge east of Sunol Valley, Alameda County.

Sector E - Alluvial deposit consisting of five parcels in Sunol Valley, Alameda County.

Sector H - Elongated sandstone deposit located on the foothills east of the Cities of Fremont and Union City, Alameda County.

Sector I - Elongated sandstone deposit consisting of four parcels located along the foothills east of the Cities of Fremont and Milpitas, Alameda and Santa Clara counties.

* Sector J - Alluvial deposit near Mowry Landing in the City of Newark, Alameda County.

Sector K - Alluvial deposit located west of Highway 17 on the southern edge of Fremont, Alameda County.

Sector L - Alluvial deposit consisting of five parcels located between the Nimitz Freeway, Alameda Creek, the Coyote Hills, and Jarvis Avenue in the northwestern part of the Fremont, Alameda County.

Sector M - Located at the southern end of the Coyote Hills on the west side of Fremont, Alameda County.

Sector N - Exposures of greenstone located in the Foothills east of the City of Hayward, Alameda County.

Sector O - Greenstone and rhyolitic rocks located in the Berkeley Hills west of Lake Chabot, Alameda County.

Sector P - Rhyolitic rocks located north of the Oak Knoll Naval Hospital in the Berkeley Hills, Alameda County.

Sector S - Diabase located at Mount Zion and a smaller adjacent hill southwest of the community of Clayton in central Contra Costa County.

Sector T - Exposures of basalt and andesite located at the south end of Gudde Ridge in the City of Moraga in southwestern Contra Costa County.

Sector U - Basalt and andesite located at the northern end of Gudde Ridge in the Berkeley Hills of southwestern Contra Costa County.

Sector V - Basalt and andesite exposed on a small ridge southwest of the City of Orinda, Contra Costa County.

Sector W - Sandstone and shale deposit consisting of three parcels located on the west side of the City of Richmond, Contra Costa County.

Sector X - The Guadalupe Quarry property on the north side of San Bruno Mountain, west of the City of Brisbane in San Mateo County.

Sector Y - Limestone and greenstone deposits located west of Pacifica near Rockaway Beach in northern San Mateo County.

Sector Z - Greenstone deposit located in the Los Altos Hills southwest of the City of Los Altos in northwestern Santa Clara County.
Sector BB - Limestone deposit located west of the City of Cupertino on Permanente Creek, Santa Clara County.
Sector CC - Greenstone body located northwest of Stevens Creek Reservoir west of the City of Cupertino, Santa Clara County.
Sector DD - Conglomerate deposit located northwest of Stevens Creek Reservoir on the western edge of the City of Cupertino, Santa Clara County.
Sector EE - Franciscan Complex melange and associated serpentinite and silica-carbonate rocks located west of the intersection of the Capitol Expressway and Monterey Road (Highway 82) in the City of San Jose, Santa Clara County.
Sector GG - Sandstone deposit located about 2.5 miles west of the town of Byron in eastern Contra Costa County.
Sector HH - Granitic rock deposit located northeast of the City of Half Moon Bay in western San Mateo County.
Sector II - Sandstone and siltstone deposit located in Limekiln Canyon east of Lexington Reservoir in southwestern Santa Clara County.
Sector LL - Sandstone deposit located in the foothills east of the City of Fremont, Alameda County.

* Sector J is no longer considered to be underlain by aggregate resources.

Newly Classified Aggregate Resource Areas Classified MRZ-2

Since the original classification and designation of the South San Francisco Bay Area P-C Region, two additional areas have been identified as containing significant aggregate resources. These are: 1) a reclassified area containing sand and gravel resources in the Sunol Valley, Alameda County (see Plates 3 and 4) and 2) a newly classified area containing crushed rock resources situated in the Santa Cruz Mountains along the eastern part of Langley Hill, San Mateo County (see Plate 7).

In classifying these deposits the SMARA guidelines were followed which require that:

1. The deposit be composed of material that is saleable as a marketable commodity (construction-grade aggregate) and
2. The deposit meet a minimum value of $12,150,000, based on the gross selling price of the first marketable product (5,000,000 1978-dollars, when the guidelines were written).

Sunol Valley Area: This reclassified area includes about 160 acres of land underlain by alluvial sand and gravel and

discontinuous layers of clay deposited in the floodplain of Alameda Creek. The aggregate is derived from rocks of the Franciscan Complex. The area reclassified as MRZ-2 is currently leased by Mission Valley Rock Company which has permits (SMP-29 and SMP-32) to mine the property. No mining has taken place to date on any of the reclassified land. Mission Valley Rock is currently mining to a depth of 200 feet on land located adjacent to the reclassified land, directly south of Interstate 680. Information which was available during the original classification (Stinson and others, 1987) indicated that the area was underlain by sand and gravel but had too much overburden and too many clay layers for the aggregate to be mined economically. Data on 15 new drill holes, provided to staff for this update by Mission Valley Rock Company through Spinardi Associates, indicated that this area is underlain by economically recoverable sand and gravel. Based on this new data, the area was reclassified MRZ-2.

Langley Hill Area: Covers about 100 acres in the Santa Cruz Mountains, and is located about 2 miles south of the outer boundary for areas subject to urbanization. This area has been newly classified MRZ-2. The area includes the eastern half of Langley Hill which is underlain by submarine deposited lava flows, pillow lavas, flow breccias, tuff breccia, and agglomerate belonging to the Miocene Mindego Hill Basalt. Overburden is generally less than 10 feet thick throughout the newly classified area. The newly classified area includes the Langley Hill Quarry and surrounding leased area where crushed rock has been mined since the early 1930s. The quarry is currently controlled by the Dempsey family who have operated the property since 1954. Aggregate produced at the quarry is largely used for base and drain rock. In Special Report 146, Part II, this area was discussed as an alternative source of crushed rock which was not classified because of its location outside the urbanizing boundary. With the loss of reserves caused by closures of several crushed rock operations throughout the South San Francisco Bay P-C Region since the original classification and designation, the Langley Hill Quarry site was classified.

Aggregate Resources in the South San Francisco Bay Production-Consumption Region

Aggregate resources of construction-grade aggregate for all designated land in the South San Francisco Bay P-C Region are shown on Table 2. This table also includes reserves and resources for the above mentioned lands reclassified MRZ-2, in the Sunol Valley and the newly classified Langley Hill area. The resources shown on Table 2 are current as of December, 1994.

As shown on Table 2, construction-grade aggregate resources within the South San Francisco Bay P-C Region currently total 3775 million tons, of which 3700 million tons lie in designated lands. This is a decrease of 285 million tons from the 4,060 million tons available at the time of designation in 1986. Permitted resources (reserves) available in the P-C region total 676 million tons, an increase of 124 million tons since 1980.

About 656 million tons (17 percent) of the total 3775 million tons of resources available in the P-C Region are sand and gravel. The remaining 3119 million tons (83 percent) are crushed stone resources. Of the 676 million tons of reserves available in the P-C Region, 308 million tons (46 percent) are sand and gravel and 368 million tons (54 percent) are crushed stone.

Lost Resources

Loss of resources was caused by aggregate consumption since 1980, by urbanization in aggregate resource areas since designation, and by reclassification of land formerly believed to contain construction aggregate resources. Since 1980, roughly 253 million tons of aggregate resources have been lost due to consumption in the South San Francisco Bay P-C Region. Since designation in 1986, about 2 percent of the designated areas have been made unavailable for mining due to urbanization. This amounts to about 75 million tons of lost resources (see Table 3). Most of this land lies within the jurisdiction of the City of Fremont. Also, 32 million tons of aggregate in Sector J has been subtracted from the total resources of the P-C Region (see page 6 "Reevaluation of Mineral Land Classification").

Newly Permitted or Newly Classified Aggregate Resources (Reserves)

Since 1980, about 406 million tons of construction-grade aggregate reserves have been added to the South San Francisco Bay P-C Region through new permits or through newly classified aggregate resources. Permits were granted for mining aggregate in previously unmined areas as well as for mining deeper in areas already permitted. Newly permitted sand and gravel reserves amounted to 179 million tons, most of which are located in the Sunol Valley and Livermore Valley aggregate production districts (see Figures 4 and 5). Crushed stone reserves for the P-C Region were increased by 227 million tons. This includes reserves added through new or expanded permits and also those added through the reclassification of the Langley Hill property. Over half of the new crushed stone reserves are on Apperson Ridge in Alameda County. To date, no mining has taken place on this property which is leased by the Oliver de Silva Company.

RESOURCE AREA	SECTOR	RESOURCES (includes reserves) *Million Short Tons*	RESERVES *Million Short Tons*
Livermore-Amador Valley	A-1	*	*
	A-2	*	*
	A-3	13	0
	Total:	254	*
Livermore Valley	B-1	9	0
	B-2	17	0
	B-3	29	0
	B-4	0	0
	B-5	2	0
	B-6	22	0
	Total:	79	0
Livermore Valley	C-1	30	0
	C-2	27	0
	C-3	9	0
	C-4	2	0
	C-5	20	0
	C-6	11	0
	Total:	99	0
Apperson Ridge	D-1	138	*
	D-2	299	*
	D-3	604	*
	Total	1,041	*
Alameda Creek-Sunol Valley	E-1	54	0
	E-2a	*	*
	E-2b	*	*
	E-3	*	*
	E-4	*	*
	E-5	*	*
	No Sector	*	*
	Total	153	*
Niles Deposit	H	112	0
Scott Creek Deposit	I-1	293	*
	I-2	*	*
	I-3	40	*
	I-4	29	0
	Total:	377	25

Table 2. Data on resource areas and designated sectors of the South San Francisco Bay Production-Consumption Region.

* Cannot be shown individually due to confidentiality; however, amount is included in total at bottom of page.

RESOURCE AREA	SECTOR	RESOURCES (includes reserves) *Million Short Tons*	RESERVES *Million Short Tons*
Alameda Creek	J	0	0
	K-2	21	0
	L-1	16	0
	L-2	19	0
	L-3	0	0
	SubTotal:	35	0
Coyote Hills Deposit	M	*	*
La Vista Deposit	N	*	*
San Leandro Deposit	O	*	0
Gallagher and Burke Quarry	P	*	*
Mount Zion Deposit	S-1	579	*
	S-2	71	*
	SubTotal:	650	*
South Gudde Ridge	T	121	0
North Gudde Ridge	U	94	0
Orinda Deposit	V	29	0
Richmond Deposit	W-1	33	0
	W-2	*	0
	W-3	*	*
	SubTotal:	46	*
San Bruno Mountain	X	*	*
Rockaway Beach	Y	32	0
Neary Quarry	Z	31	0
Permanente Quarry	BB	*	*
Stevens Creek Quarry	CC	177	*
Stevens Creek Quarry	DD	4	*
Hillsdale Deposit	EE-1	77	*
Ridgemoor Quarry	GG	11	*
Pilarcitos Quarry	HH	*	*
Lexington Quarry	II	*	*
Mission Peak Deposit	LL-1	85	0
	LL-2	88	0
	SubTotal:	173	0
Langley Hill	No Sector	*	*
Designated Areas	All Sectors	3700	*
Designated and Non-designated Areas	**Grand Total**	**3775**	**676**

Table 2 (continued)

* Cannot be shown individually due to confidentiality; however, amount is included in total at bottom of page.

Sector	Lost Resources (million tons)	% of Sector Lost	Plate #
B-4	4	100	16
B-1	5	35	16
L-1	10	40	19
L-2	5	20	19
L-3	47	100	19
M	4	19	19
Total	75		

Table 3 Resources made unavailable due to irreversible land use since designation in October, 1986.

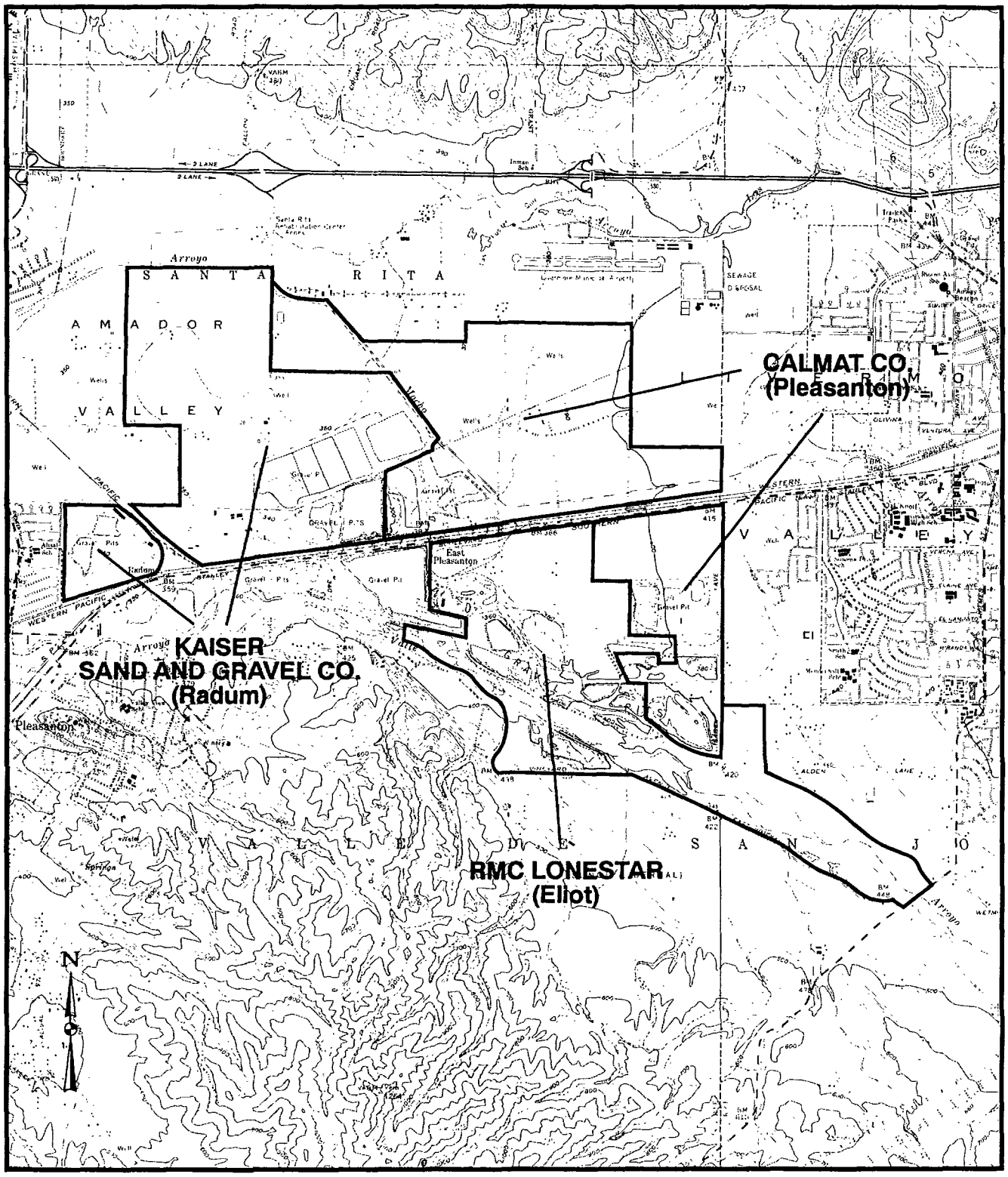

Figure 4. Map of the Livermore Valley production district showing land owned or leased by aggregate companies as of January, 1996.

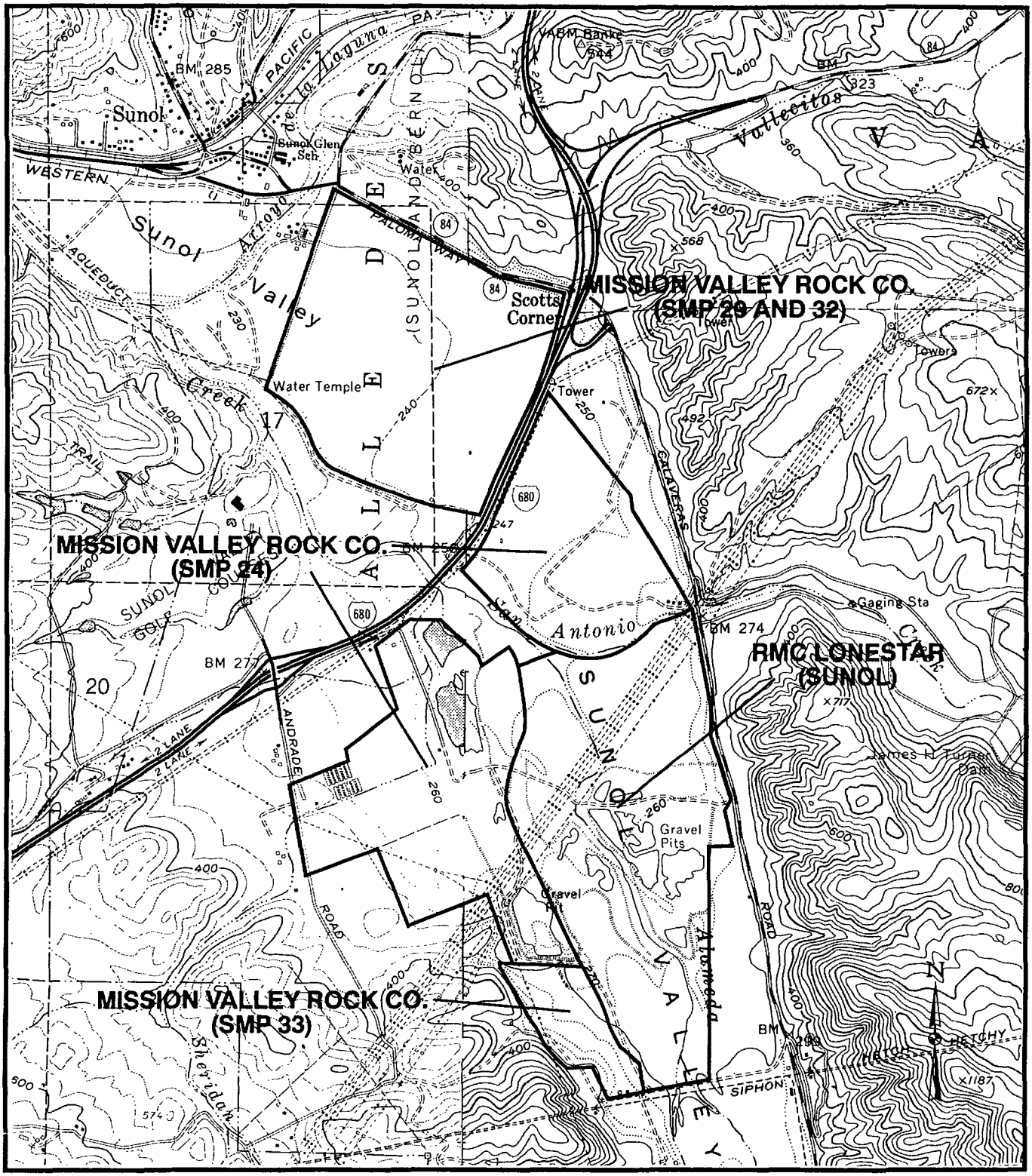

Figure 5. Map of the Sunol Valley production district showing land owned or leased by aggregate companies as of January, 1996.

Recycled Aggregate

Recycled construction and demolition waste material has become widely used in the South San Francisco Bay P-C Region for class II aggregate base. Although recycling of aggregate in the South San Francisco Bay area has been taking place to a limited extent for about the last 10-15 years, significant production of recycled aggregate began about 6 years ago. This increase in production may have been prompted by the Loma Prieta earthquake of 1989 which served to provide millions of tons of demolished concrete and asphalt for recycling. Twenty-seven operations currently produce recycled aggregate throughout the P-C Region (see Figure 6). Ten of these centers are located at active or inactive aggregate mining operations.

Production figures were collected from most of the recycling aggregate companies for as many years as possible since 1980. In most cases, records were incomplete and were largely estimates given by the producing company. Using this limited data, an estimated 2.3 million tons of class II aggregate base was produced from recycled concrete and asphalt in 1994. This amounts to roughly 11 percent of the total aggregate consumed in the P-C Region for that year.

Recycled material cannot now be used to make concrete aggregate or asphalt aggregate. Its use is limited to class II aggregate base and some Recycled Asphalt Pavement (RAP)--old asphalt which is torn up and mixed in small percentages with new asphalt paving at the batch plant. The increased use of recycled material will lead to an extended life of virgin aggregate reserves and resources in the South San Francisco Bay P-C Region.

Dredge Sand

Dredge sand is produced from bay areas in the northern part of the South San Francisco Bay P-C Region in Contra Costa and San Francisco counties. Because these resources are being replenished, they cannot be quantified and are not included in the total aggregate resources tonnage (Table 2). In 1994, a little over 1 million tons of sand dredged from the Suisun Bay, San Francisco Bay, and Carquinez Strait was consumed in the South San Francisco Bay P-C Region. This amounts to a little less than 5 percent of the total aggregate consumed in the P-C Region. Roughly 25 percent of the dredge sand can be used for PCC concrete sand. The remaining sand is largely used for fill. According to the sand dredging companies, sand removed from the bay areas is being replenished at about the same rate that it is being mined.

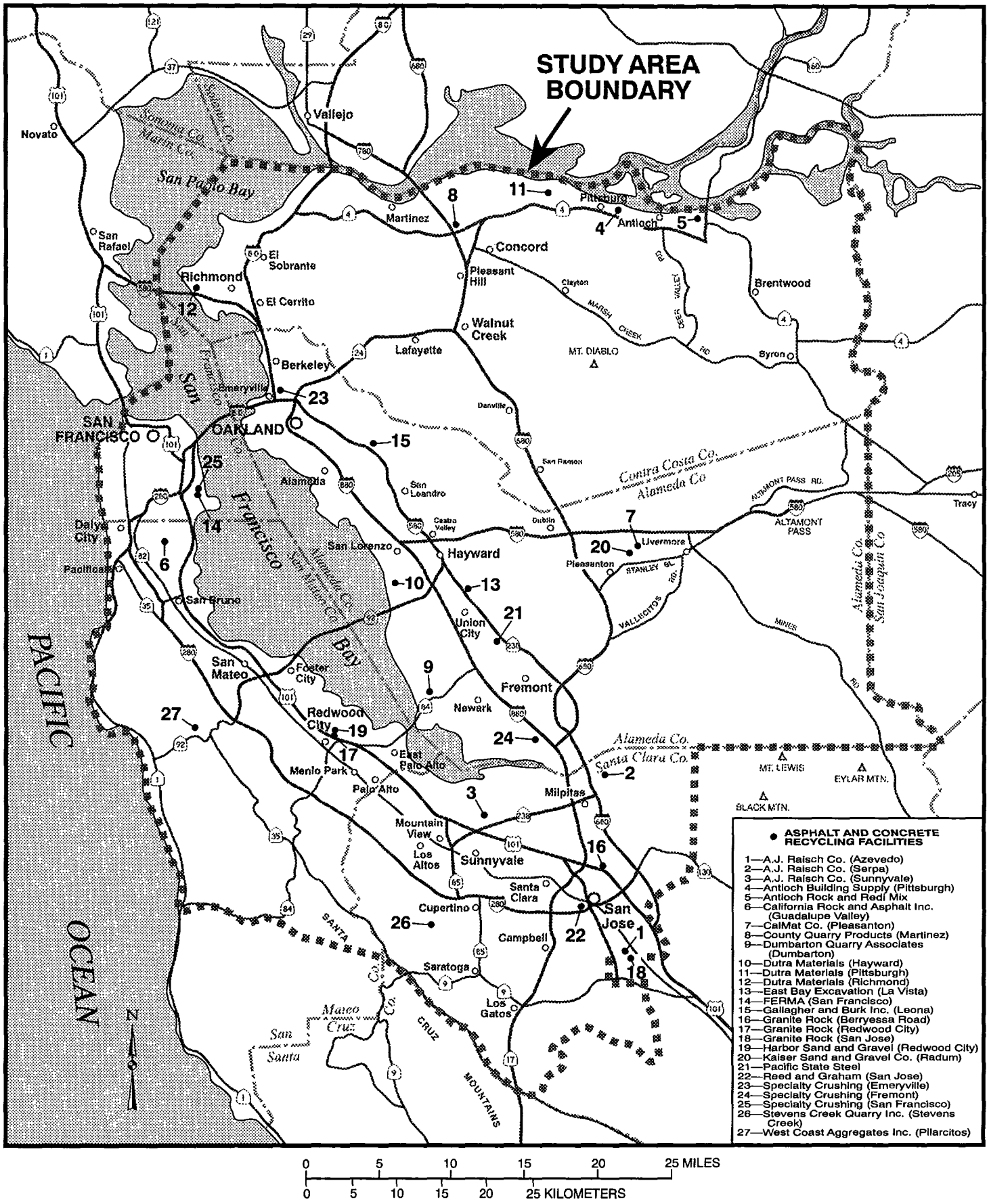

Figure 6. Aggregate Recycling Facilities located in the South San Francisco Bay Production-Consumption Region.

PART II - AGGREGATE PRODUCTION IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

The historical aggregate production data for the South San Francisco Bay P-C Region were obtained from mining records of the U.S. Department of the Interior, Bureau of Mines (this function is now within the U.S. Geological Survey); the California Department of Conservation, Office of Mine Reclamation; and the aggregate companies. The U.S. Bureau of Mines records were compiled from responses to voluntary questionnaires sent annually or biannually to all known mining operators. Each producer was requested to divulge the production from each of his producing properties for the preceding year. The accuracy of these figures depends on the producer's response. DMG staff checked current and past production where possible, and modified the data accordingly.

As of January 1996, 20 active mines, two inactive mines, and one proposed mine had active permits to mine aggregate in the South San Francisco Bay P-C Region. These 23 permitted properties are shown on Plate 1 and Figure 7.

At the time Special Report 146, Part II was completed in 1983, there were 24 companies producing construction aggregate from 32 mines in South San Francisco Bay P-C Region. The total aggregate reserves at that time amounted to 552 million tons.

ACTIVE MINING OPERATIONS

As of January 1996, 15 companies were producing construction -grade aggregate from 20 different mines in the San Francisco Bay P-C Region. A list of the 15 companies and a brief summary of each company and their properties follow:

A.J. Raisch Company
Bauman Landscape, Inc.
California Rock and Asphalt, Inc.
CalMat Company
Dumbarton Quarry Associates
East Bay Excavation Company, Inc.
F.T.G. Construction Materials, Inc.
Kaiser Sand and Gravel Company
Kaiser Cement Corporation
Michael Dempsey
Mission Valley Rock Company
Oliver de Silva, Inc.
RMC Lonestar
Stevens Creek Quarry, Inc.
West Coast Aggregates, Inc.

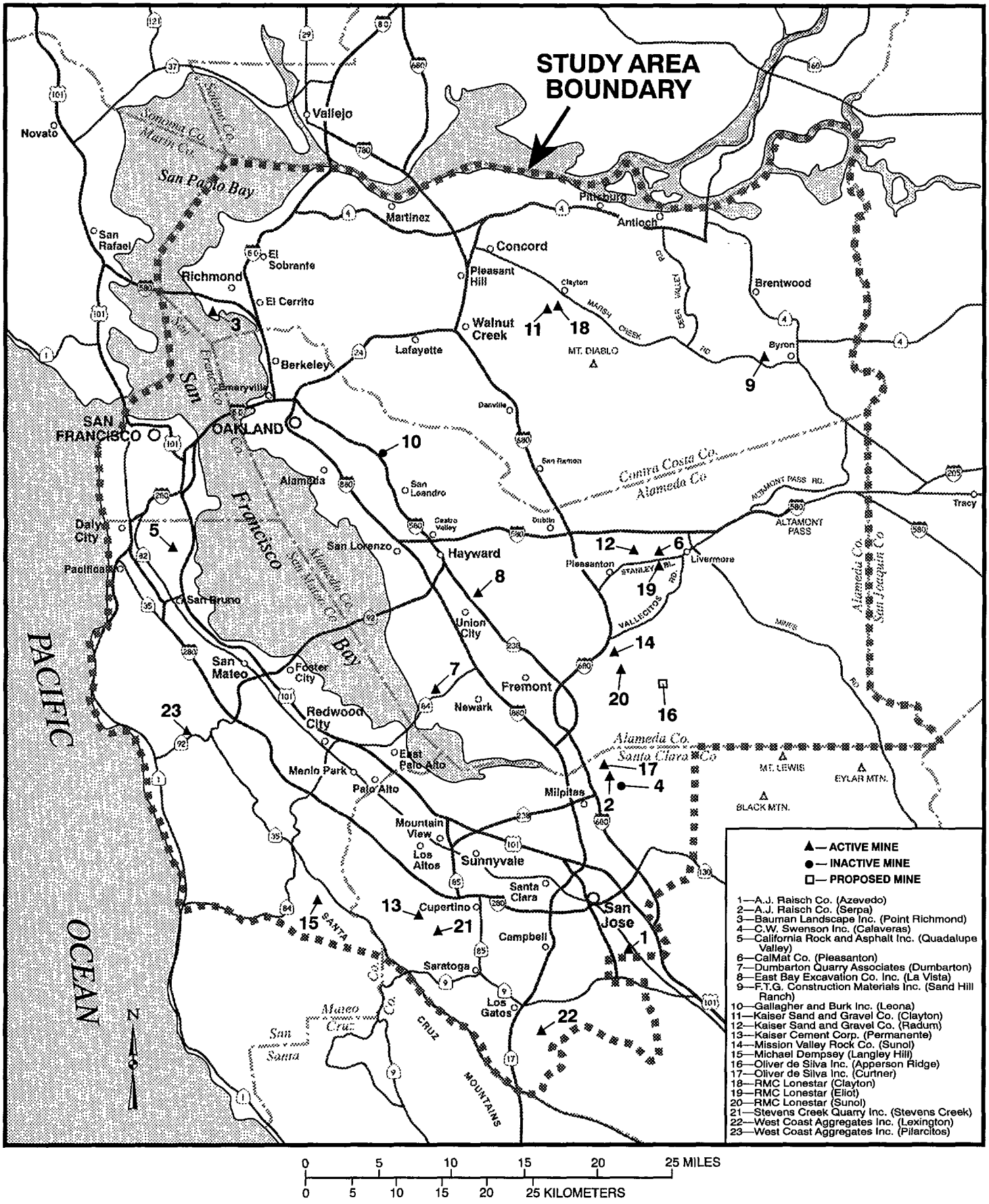

Figure 7. Locations of aggregate mines or proposed mines in the South San Francisco Bay Production-Consumption Region having current permits as of January, 1996.

A.J. Raisch Company operates the Azevedo and the Serpa quarries both located in Santa Clara County. The Azevedo Quarry lies near the eastern edge of a group of low isolated hills that are considered a northward continuation of the Santa Teresa Hills. The quarry has been operated almost continuously since 1971 by the A.J. Raisch Company, the original lessee of the property from M.T.A. Properties. Aggregate produced at the quarry is largely used for road base. Since 1986, the Azevedo Quarry operation has also been producing class II aggregate base from recycled asphalt and concrete. To date, the quarry has produced about 2 million tons of aggregate from recycled material.

Operations at the Serpa Quarry began in early 1958 and continued on a limited basis for about the next 10 years. A.J. Raisch Paving Company purchased the property in 1967. The quarry was mined almost continuously from 1968 until 1977. Little has been mined since then. The quarry chiefly produced aggregate subbase and fill. In May of 1995, a recycling operation was started at the Serpa Quarry site.

Bauman Landscape, Inc. operates the Point Richmond Quarry located on the southern end of San Pablo Peninsula along the eastern flank of Potrero Hills, Contra Costa County. Parts of the property were mined from 1959 to 1975. A conditional use permit was issued to reactivate the quarry in 1980. The permit was scheduled to expire in 1990 but mining has continued under a series of short term extensions. The main products have been base, subbase, and fill. The quarry was operated by Quarry Products, Inc. prior to Bauman Landscape, Inc. leasing the property in 1993.

California Rock and Asphalt, Inc. operates the Guadalupe Valley Quarry (also known as the Brisbane Quarry) located on the northeastern flank of San Bruno Mountain. Originally opened in 1895, the quarry is the oldest active quarry in the South San Francisco Bay P-C Region. Several owners and operators have worked the quarry during its 100 year history. Since 1980, the quarry has changed ownership three times. The last change in ownership occurred in November of 1995 when American Rock and Asphalt, Inc. sold the property to California Rock and Asphalt, Inc. The quarry's current permit has no specified expiration date but does specify a maximum amount of material which can be taken from the site. Aggregate produced from the quarry is largely used for asphaltic concrete.

CalMat Company owns and operates a group of sand and gravel pits in the Livermore Valley, Alameda County, located both north and south of Stanley Boulevard (see Figure 4). Collectively the pits are known as CalMat, Pleasanton. The pits north of Stanley Boulevard were formerly owned by Rhodes and Jamieson, Ltd. who began operations in the early 1950s. Operations have been

continuous at this site since they began. CalMat purchased the mining lease from Rhodes and Jamieson in December, 1992. The group of pits south of Stanley Boulevard has been mined since 1932 when California Rock and Gravel Company began operations. In January 1978, California Rock and Gravel Company was bought by Rhodes and Jamieson. The lease was purchased by CalMat in December of 1993. CalMat currently runs an asphalt batch plant and a drum plant on its property. There is also a concrete batch plant located on the property which is leased to RMC Lonestar. Aggregate produced at the CalMat, Pleasanton operation is largely used for PCC and asphaltic aggregate. In March of 1996, CalMat started crushing recycled concrete and asphalt at the Pleasanton property for use in class II aggregate base and asphaltic aggregate.

Dumbarton Quarry Associates operates the Dumbarton Quarry located in the southern part of the Coyote Hills in the City of Fremont. The quarry was run by Lone Star Industries until 1967 when it was bought by Dumbarton Quarry Associates which has operated the property continuously since then. An asphalt plant was installed on the property in 1982. Aggregate mined from the quarry is used largely for road base and asphalt.

East Bay Excavation Company, Inc. operates the La Vista Quarry situated at the base of the western slope of the Berkeley Hills, Alameda County. Rock was first quarried at this property in the early 1950s. East Bay Excavation Company took over the property in 1964 and mining has taken place continuously since then. The mined rock is used primarily for asphaltic aggregate and other asphalt products, trench backfilling, and drain rock. The property has an asphalt batch plant with a capacity of 250 tons per hour. Some recycling of asphalt and concrete has been taking place at the La Vista site for the last 10-15 years.

F.T.G. Construction Materials, Inc. operates the Sand Hill Ranch Quarry for owner Tom Anderson. The quarry is located in Contra Costa County about 2.5 miles west of the town of Byron. The property was first mined in 1989 by V.E. Santos Enterprises. F.T.G. Construction Materials Inc. was contracted to mine the property in June 1993. The material mined has largely been used for fill.

Kaiser Sand and Gravel Company (owned by Hanson PLC) operates the Radum sand and gravel property in Livermore Valley, Alameda County (see Figure 4), and the Clayton crushed stone quarry on the west side of Mount Zion, Contra Costa County.

Kaiser Sand and Gravel began operations at the Radum site in 1930 and has been operating it continuously since then. The property has an asphalt batch plant and a concrete batch plant. The concrete plant has not been operated in the last 2 years.

Aggregate produced at the Radum property has largely been used for PCC aggregate, asphaltic aggregate, and road base.

Kaiser Sand and Gravel has been mining continuously at the Clayton Quarry since 1954. Most of the rock produced from the quarry is used for road base and asphaltic aggregate.

Kaiser Cement Corporation (owned by Hanson PLC) operates the Kaiser Permanente limestone quarry located on the west side of Santa Clara Valley in the eastern foothills of the Santa Cruz Mountains, Santa Clara County. The quarry largely produces limestone which is used for the manufacturing of cement; but the quarry is included in this aggregate study because roughly 25% of the rock mined at the quarry is used for aggregate. The first mining of the quarry is not known, but in 1930 (Franke, H.A., 1930) the quarry was listed as being idle for some time. In 1938, Kaiser Cement purchased the quarry from the Santa Clara Holding Company. Most of the early mining of the rock at the quarry was used for lime purposes. Aggregate production from the site began in the mid 1950s. The main aggregate use for the crushed limestone is for PCC, asphaltic concrete, and road base.

Michael Dempsey operates the Langley Hill crushed rock quarry and plant situated on the northeastern flank of Langley Hill, San Mateo County. Mining at the site started in the early 1930s. In 1954, Michael Dempsey's father took over the operation and the quarry has been mined continuously since then. Rock produced from the quarry is largely used for road base.

Mission Valley Rock Company leases four sand and gravel properties (SMP-24, SMP-29, SMP-32, and SMP-33) located in Sunol Valley on the western flood plain of Alameda Creek, Alameda County (see Figure 5). For Plate 1 and Figure 7, these four properties are listed together as Mission Valley Rock Company, Sunol. Only SMP-24 is currently being mined; yet all of the properties have active mining permits. Concrete Service Company began mining on the SMP-24 property in 1951. In 1965, Mission Pass Aggregates Company bought the operation and leased the property to Mission Valley Rock. The most southerly property, SMP-33, was purchased by Mission Valley Rock sometime in the late 1980s or early 1990s from Ivaldi Brothers, who was originally granted a permit to mine the site in 1966. Ivaldi Brothers last mined the property in 1987. SMP-29 and 32 are two adjoining unmined properties which were granted permits in 1991 and 1994 respectively. Mission Valley Rock is using 4,000-5,000 tons per year of by-product from glass recycling for select fill and trench backfilling. Mission Valley Rock currently has an on-site asphalt and concrete plant. Mission Valley Rock mainly produces aggregate for use in PCC and asphaltic concrete.

Oliver de Silva, Inc. operates the Curtner Quarry located in Santa Clara County north of Colera Creek and directly south of

the Alameda-Santa Clara County line. Little is known about the quarry's history other than it has been mined since at least 1950. Most of the crushed rock produced at the Curtner Quarry has been used for fill.

RMC Lonestar operates the Eliot sand and gravel property in Livermore Valley, Alameda County (see Figure 4); the Sunol sand and gravel property located in Sunol Valley, Alameda County (see Figure 5); and the Clayton crushed rock quarry situated along the east side of Mount Zion in Contra Costa County.

The Eliot site originally had four processing plants in operation in the late 1920s. In 1928, Rhodes-Jamieson Company, G. and M. Gravel Company, Coast Rock and Gravel Company, and California Rock Company merged with several other firms to form Pacific Coast Aggregates, Inc. In the mid 1960s Pacific Coast Aggregates, Inc. bought a cement plant from Santa Cruz Cement and became Pacific Cement and Aggregate. Soon afterwards, Lonestar Industries purchased Pacific Cement and Aggregate. Lonestar Industries changed its name to RMC Lonestar in the mid 1980s. Aggregate produced at the Eliot property is largely used for PCC, asphaltic concrete, and road base.

The Clayton Quarry was opened in 1947 by the Harrison-Birdwell Company. In 1954, the quarry was purchased by Pacific Coast Aggregates, Inc. and followed the same history of ownership as the Eliot site. The Clayton Quarry has been in operation continuously since its opening in 1947. Aggregate produced at the Clayton Quarry has largely been used for road base and asphaltic concrete.

The Sunol property, owned by the City of San Francisco, was first mined in 1960. In 1961, the lease was sold to Santa Clara Sand and Gravel and has been under continuous operation since then. RMC Lonestar purchased the operation in 1984. The Sunol property is still operated under the name of Santa Clara Sand and Gravel Company which is a subsidiary of the RMC Lonestar Company. Aggregate produced from RMC Lonestar's Sunol property is mostly sold for asphaltic concrete, PCC, and road base.

Stevens Creek Quarry, Inc. operates the Stevens Creek Quarry located on the west side of Santa Clara Valley in the low eastern foothills of the Santa Cruz Mountains, Santa Clara County. The quarry was first opened in the late 1930s by A.J. Voss who later incorporated his business to become Stevens Creek Quarry, Inc. The property has been mined continuously since its opening despite a few periods of low activity. The rock is used primarily for base, drain rock, fill, and some rip rap. A recycling plant was installed on the property in 1995.

West Coast Aggregates, Inc. operates the Pilarcitos Quarry in San Mateo County, about 2.5 miles northeast of Half Moon Bay,

and the Lexington Quarry along the western edge of Santa Clara County about 1.5 miles southeast of the City of Los Gatos.

The Pilarcitos Quarry was opened in 1957. Lonestar Industries, Inc. (now RMC Lonestar Company) owned the property in 1980 and the property was sold to the Piombo Corporation in 1981. In 1993, the property was sold to its current owner. The current operating permit is up for renewal in 1997. Crushed rock produced at the quarry is mainly used for road base, drain rock, and fill sand.

The Lexington Quarry was first worked in the early 1960s. In 1980, the operation was owned by Hillsdale Rock Company. The last recorded production by Hillsdale Rock Company was in 1981. Sometime after this date, the quarry was sold to the Zanker Road Disposal Company. The quarry had little production from 1982 up until 1989 when Zanker Road Disposal sold the quarry to the current operator. Aggregate produced at the quarry is sold for asphaltic concrete, drain rock, railroad ballast, and road base.

INACTIVE/PROPOSED PERMITTED AGGREGATE OPERATIONS

The C.W. Swensen Company's Calaveras crushed stone quarry, Santa Clara County has been inactive since 1986 but still has a valid permit to mine rock. It is not known if or when the quarry plans to re-open.

Gallagher and Burk, Inc. closed the Leona Quarry, Contra Costa County, in early 1995. The mine is currently undergoing reclamation and there are no plans to re-open the quarry. Recycling of aggregate at the Leona site has been taking place since 1992.

A large crushed rock reserve and resource lies beneath Apperson Ridge. A permit was granted for mining the property in 1984 to the Oliver de Silva Company. To date, no mining has taken place. The reserves and resources for the Calaveras Quarry, Leona Quarry, and the Apperson Ridge property have been included in the total reserves for the South San Francisco Bay P-C Region.

CLOSURES OF AGGREGATE OPERATIONS

Since the original mineral land classification report was written, several crushed rock quarries have closed and no longer have valid mining permits. These include the Hillsdale Quarry (Santa Clara County), closed in mid-1990; the Neary Quarry (Santa Clara County), closed in 1989; the Page Mill Quarry, (Santa Clara County), closed in 1981; the Pacifica Quarry (San Mateo County) closed in 1985; the Point Molate Quarry (Contra Costa County), also known as the Richmond Quarry or the Chevron Quarry, closed in the late 1980s; and the San Leandro Quarry (Alameda County)

closed in 1986. Recycled aggregate is currently being produced at the Point Molate Quarry.

PART III - ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

The State Mining and Geology Board (SMGB), as specified in its guidelines for classification and designation of mineral land (California State Mining and Geology Board, 1983, p. 23) requires that mineral land classification reports for regions containing construction materials classified as MRZ-2 include "*An estimate of the total quantity of each such construction material that will be needed to supply the requirements of both the county and the marketing region in which it occurs for the next 50 years. The marketing region is defined as the area within which such material is usually mined and marketed. The amount of each construction material mineral resource needed for the next 50 years shall be projected using past consumption rates adjusted for anticipated changes in market conditions and mining technology.*" The SMGB guidelines also specify that the State Geologist periodically review (every 10 years or less) the information in the reports to determine if a revision is warranted.

POPULATION PROJECTION FOR THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION

The population projection for the South San Francisco Bay P-C Region was estimated from official projections published by the State of California in May 1993 (California Department of Finance, 1993) for Alameda, Contra Costa, San Mateo, San Francisco, and Santa Clara counties. The projections are for the years 2000, 2010, 2020, 2030, and 2040. The interim years were estimated by equally dividing the difference between the decade projections into 10 increments. Population projection for the years 2041 through 2045 were visually extrapolated from the projections made by the California Department of Finance. Subtracted from these population totals were the population estimates for that part of southern Santa Clara County located outside the region which is included in the adjacent Monterey Bay P-C Region.

CORRELATION BETWEEN AGGREGATE PRODUCTION AND POPULATION

Although there are many factors that control, to some degree, the yearly demand for aggregate in any region, the single factor of population was selected to keep the basis for the forecast as simple as possible. Past studies of marketing areas in California have demonstrated a correlation between the amount of aggregate consumed and the population in the market area over an extended period of time (Anderson and others, 1979). Miller (1994) recently completed a correlation study between population and aggregate consumption in Los Angeles County. Linear regression analyses were performed on population and production data from 1960 to 1992 for the populations of the four P-C

regions within the county and their combined production. The correlation coefficient between population and aggregate production in Los Angeles County was calculated to be r = .83. If the correlation between the two were perfect, r would equal 1, and if there were no correlation between them, r would equal 0. It can be roughly estimated what percent of the variation in annual production can be accounted for by the annual population by multiplying r-squared by 100. The result--69 percent--can be interpreted as meaning that about two-thirds of the variation in annual aggregate production can be attributed to change in population, which, for the past 3 decades, has been generally increasing. Miller's study also shows that the economy has had a definite influence on aggregate production but to keep the basis for the aggregate demand projection simple, no attempt was made to account for future economic conditions or other factors, such as public construction projects, which can randomly add large amounts of aggregate to consumption.

PROJECTED AGGREGATE DEMAND FOR THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION TO THE YEAR 2045

A 50-year forecast of construction aggregate demand for the South San Francisco Bay P-C Region was made on the basis of reported aggregate consumption and population data for the years 1953-1994 (see Table 4 and Figure 8). Consumption and population data for 1953-1980 was used from Special Report 146, Part II with some slight modifications made on population data to adjust for the 1980 census data which became available after the completion of the study. To estimate the future consumption of aggregate, an average per-capita consumption figure of 5.7 tons per year was derived using population and consumption records from 1953 to 1994 (see Figure 9 and Table 4).

The simple analysis of the historical aggregate production explained in the preceding section was used to forecast the aggregate demand in South San Francisco Bay P-C Region through the year 2045 (see Table 5 and Figure 10). An annual per-capita consumption rate of 5.7 tons was multiplied times the annual projected population, derived from figures published by the California Department of Finance (1993). The aggregate demand through the year 2045 is based on construction aggregate consumption and population from 1953 through 1994.

The results of these projections show that an estimated 1.76 billion tons of aggregate will be needed to satisfy the future demand of the South San Francisco Bay P-C Region through the year 2045.

According to the U.S. Bureau of Mines aggregate production statistics for the years 1980 to 1994, about 32 percent of the total aggregate consumed in the region was used in PCC aggregate. This estimate is based only on the records that contained

separate figures for PCC aggregate production, 5 of the 15 years. This percentage equates to 563 million tons of PCC aggregate that will be needed within the next 50 years. Table 6 is a summary of present aggregate resources and future aggregate demands for the South San Francisco Bay P-C Region.

The wide variations from year to year in the historic aggregate consumption rate (Figure 8) probably reflect to a large degree, changes in urban growth rates and intermittent large construction projects (for example: freeways, dams, and canals). In part, these variations also result from incompleteness and inaccuracies in the production records supplied by the U.S. Bureau of Mines and the Office Of Mining and Reclamation. Certainly the economic climate is a powerful variable that influences aggregate demand. Very high interest rates, for example, as in California in 1979 and 1980, tended to lower the amount of new construction and consequently lower the demand for aggregate. Also, the economic recession at the beginning of the 1990s caused a sharp drop in aggregate production. High consumption of aggregate occurred in the region in the mid-1960s due to construction of freeways, and in the mid-and late-1980s as the construction industry recovered after the economic recession in the early 1980s. Also, major unforeseen events such as disaster reconstruction in the wake of an earthquake or a major economic recession would cause aggregate demand to change radically.

COMPARISON OF THE 50-YEAR AGGREGATE DEPLETION WITH CURRENT RESERVES

If all aggregate consumed in the South San Francisco Bay P-C Region came from the reserves indicated on Table 2, a comparison of total aggregate reserves with projected aggregate consumption (Table 5) would indicate that the region should run out of aggregate in the year 2016. However, about 30 percent of the aggregate consumption in the region comes from other aggregate sources. These include aggregate imported from areas outside the P-C Region, aggregate from sand dredging, and aggregate produced from recycled concrete and asphalt. In considering the rate of depletion, it is necessary to factor in these other aggregate sources. By subtracting 30 percent of the projected aggregate consumption tonnages on Table 5, estimates of projected aggregate depletion for the South San Francisco Bay P-C Region were made (see Table 7). Table 7 indicates that estimated aggregate reserves of 676 million tons for the South San Francisco Bay P-C Region will be depleted in the year 2024 by supplying the region with 70 percent of its demand.

Table 4. - Population, aggregate consumption, and per-capita consumption of aggregate in the South San Francisco Bay Production-Consumption Region during the period 1953-1994.

YEAR	POPULATION	*AGGREGATE CONSUMPTION	ANNUAL PER-CAPITA CONSUMPTION (TONS)	YEAR	POPULATION	*AGGREGATE CONSUMPTION	ANNUAL PER-CAPITA CONSUMPTION (TONS)
1953	2,588,500	10,684,000	4.1	1974	3,972,500	25,611,000	6.4
1954	2,649,100	10,066,000	3.8	1975	4,005,300	17,684,000	4.4
1955	2,694,000	13,343,000	5.0	1976	4,035,400	19,016,000	4.7
1956	2,779,000	19,296,000	6.9	1977	4,060,600	19,892,000	4.9
1957	2,857,800	14,363,000	5.0	1978	4,088,700	25,223,000	6.2
1958	2,952,500	15,519,000	5.3	1979	4,108,000	30,428,000	7.4
1959	3,035,900	16,066,000	5.3	1980	4,148,300	22,927,000	5.5
1960	3,112,100	15,575,000	5.0	1981	4,196,300	22,163,000	5.3
1961	3,204,200	16,659,000	5.2	1982	4,245,400	21,140,000	5.0
1962	3,286,800	17,800,000	5.4	1983	4,314,100	23,518,000	5.5
1963	3,379,200	22,250,000	6.6	1984	4,367,100	25,482,000	5.8
1964	3,425,800	24,099,000	7.0	1985	4,432,000	27,829,000	6.3
1965	3,526,700	25,603,000	7.3	1986	4,482,000	27,212,000	6.1
1966	3,598,100	23,389,000	6.5	1987	4,529,100	24,990,000	5.5
1967	3,680,200	24,645,000	6.7	1988	4,594,400	25,336,000	5.5
1968	3,740,700	26,914,000	7.2	1989	4,662,000	26,616,000	5.7
1969	3,785,800	30,517,000	8.1	1990	4,719,300	25,833,000	5.5
1970	3,855,200	24,683,000	6.4	1991	4,790,200	22,291,000	4.7
1971	3,903,100	29,615,000	7.6	1992	4,875,500	20,342,000	4.2
1972	3,930,700	23,140,000	5.9	1993	4,941,200	20,604,000	4.2
1973	3,953,000	24,751,000	6.3	1994	4,994,500	21,834,000	4.4

Average annual per-capita aggregate consumption 1953-1994 = 5.7 tons
* rounded to nearest 1,000 tons

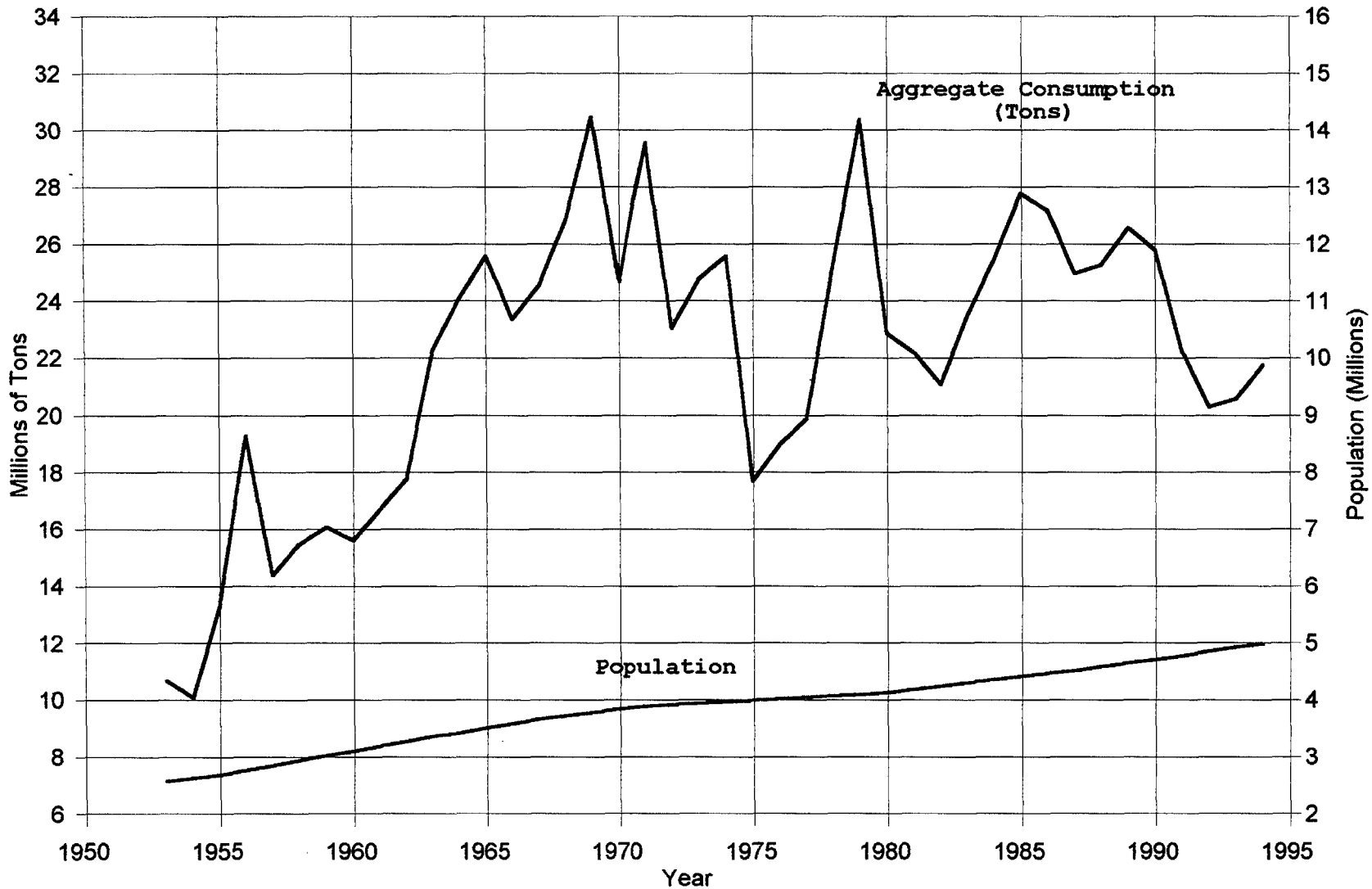

Figure 8. South San Francisco Bay Production-Consumption Region: population and aggregate consumption records for years 1953-1994.

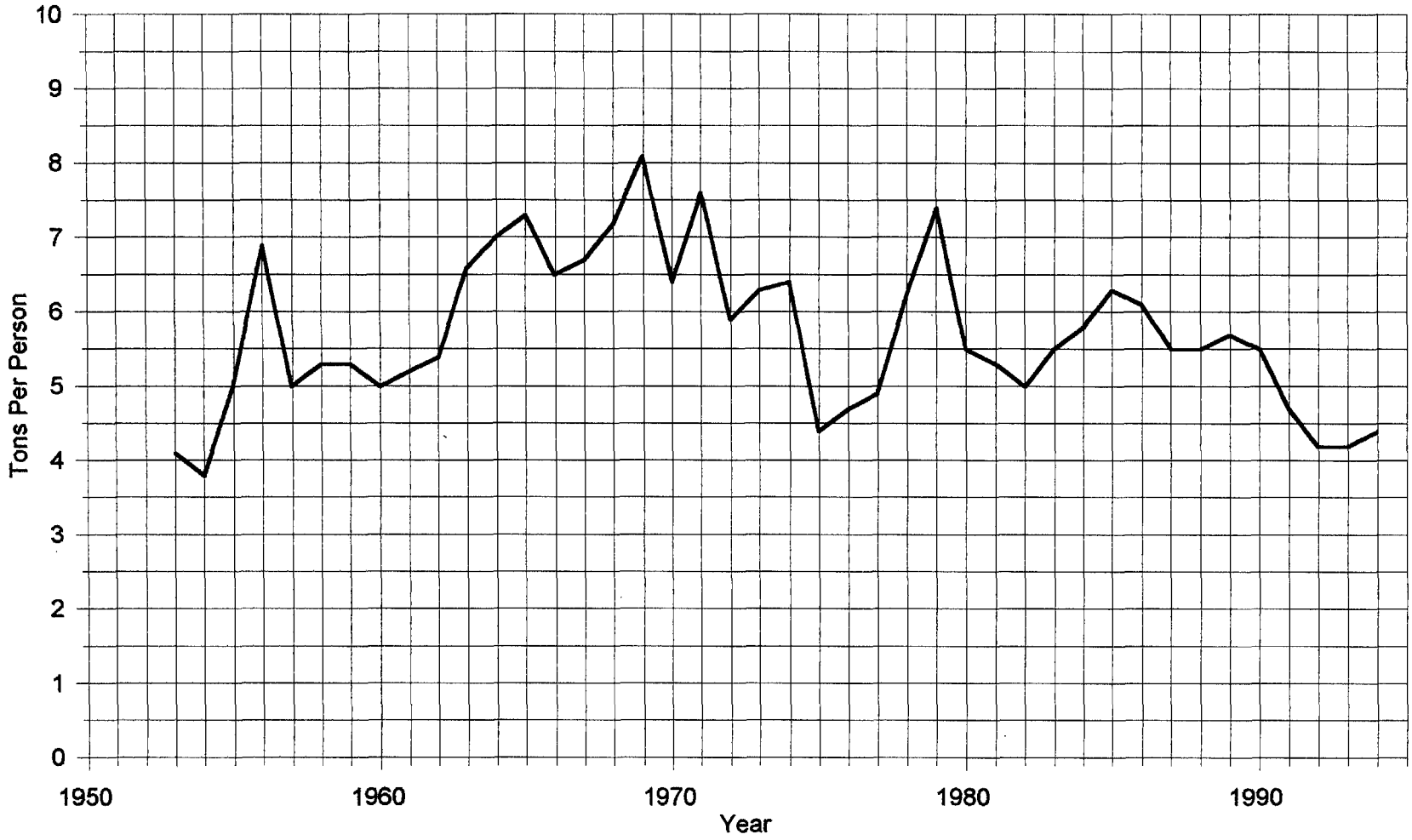

Figure 9. Annual per-capita consumption of aggregate in the South San Francisco Bay Production-Consumption Region for the years 1953-1994.

YEARS	AVERAGE POPULATION	PROJECTED AGGREGATE CONSUMPTION (TONS)	PROJECTED AGGREGATE CONSUMPTION (TONS) RUNNING TOTAL
1995-1999	5,177,620	147,600,000	147,600,000
2000-2004	5,440,164	155,000,000	302,600,000
2005-2009	5,638,710	160,700,000	463,300,000
2010-2014	5,828,181	166,100,000	629,400,000
2015-2019	6,004,040	171,100,000	800,500,000
2020-2024	6,173,070	175,900,000	976,400,000
2025-2029	6,331,858	180,500,000	1,156,900,000
2030-2034	6,469,213	184,400,000	1,341,300,000
2035-2039	6,574,419	187,400,000	1,528,700,000
2040-2044	6,682,525	190,500,000	1,719,200,000
2045	6,750,000	38,500,000	1,757,700,000

Table 5. Projected aggregate consumption for the South San Francisco Bay Production-Consumption Region 1995-2045 (all tonnage figures rounded to nearest 100,000 tons).

Total projected aggregate consumption to the year 2045 = **1,757,700,000 tons**

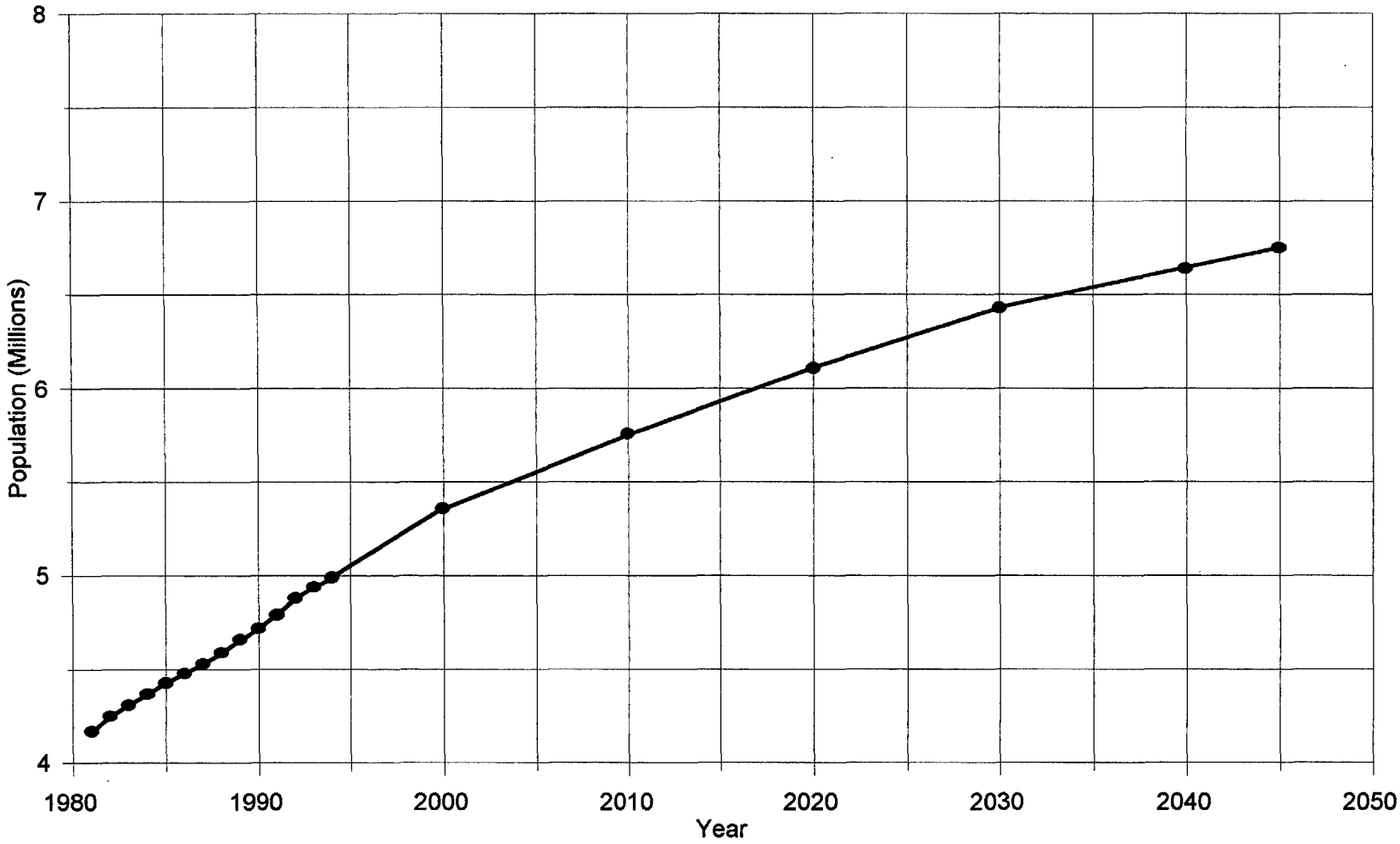

Figure 10. Projected population of the South San Francisco Bay Production-Consumption Region to the year 2045.

Construction-grade aggregate resources (includes aggregate reserves)	3,775 million tons
Construction-grade aggregate reserves	676 million tons
50-year demand, all aggregate	1,758 million tons
50-year demand, PCC aggregate	563 million tons

Table 6. Summary of aggregate resources and projected 50-year consumption for the South San Francisco Bay Production-Consumption Region.

YEARS	AVERAGE POPULATION	* PROJECTED AGGREGATE DEPLETION (TONS)	*PROJECTED AGGREGATE DEPLETION (TONS) RUNNING TOTAL
1995-1999	5,177,620	103,300,000	103,300,000
2000-2004	5,440,164	108,500,000	211,800,000
2005-2009	5,638,710	112,500,000	324,300,000
2010-2014	5,828,181	116,300,000	440,600,000
2015-2019	6,004,040	119,800,000	560,400,000
2020-2024	6,173,070	123,200,000	683,600,000
2025-2029	6,331,858	126,300,000	809,900,000
2030-2034	6,469,213	129,100,000	939,000,000
2035-2039	6,574,419	131,200,000	1,070,200,000
2040-2044	6,682,525	133,300,000	1,203,500,000
2045	6,750,000	27,500,000	1,230,500,000

Table 7. Projected aggregate depletion of reserves for the South San Francisco Bay Production-Consumption Region 1995-2045 (all tonnage figures rounded to nearest 100,000 tons).

Total projected aggregate depletion to the year 2045 = **1,230,500,000 tons.**

*Projected aggregate depletion based on 70 percent of the total projected aggregate consumption shown on Table 5.

PART IV - ALTERNATIVE SOURCES OF AGGREGATE

The potential sources of construction aggregate, in addition to the deposits classified as MRZ-2, which exist within and near the South San Francisco Bay P-C Region were discussed in Special Report 146, Part II. Included were potential resources within the P-C Region that were classified as MRZ-3, marine sand and gravel deposits in the San Francisco Bay area, and aggregate production districts in the neighboring P-C Regions of North San Francisco Bay, Monterey Bay, and Sacramento-Fairfield.

At the time of the original report, the only significant aggregate being imported to the South San Francisco Bay P-C Region came from the neighboring Monterey Bay P-C Region. Since then, sand and gravel has been imported from the Stockton-Lodi P-C Region. Roughly 17 percent of all aggregate consumed in the South San Francisco Bay P-C Region comes from adjacent P-C regions.

Sand dredged from the Suisun and San Francisco bays located in Marin and Solano counties is consumed in the South San Francisco Bay P-C Region. Although consumption data is not available, it is estimated to be less than 500,000 tons per year. About 25 percent of the sand produced from dredging is used for PCC sand.

PART V - COMPARISON OF PROJECTED AGGREGATE CONSUMPTION TO ACTUAL CONSUMPTION IN THE SOUTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION, 1981-1994

The original mineral land classification of aggregate resources in the South San Francisco Bay P-C Region was published as Part II of Special Report 146 - Mineral Land Classification of the San Francisco-Monterey Bay Area (Stinson, and others, 1987). The report's projection for aggregate consumption of the South San Francisco Bay P-C Region to 1994 was based on an annual per-capita consumption of 6.0 tons and a population projection by the California Department of Finance (1977) and DMG staff.

Figure 11 compares the actual yearly aggregate consumption for the years 1981 through 1994 to that projected in the 1983 report for the same years. The projected aggregate consumption for this 14-year period totaled 401 million tons. This is 17 percent more than the 335 million tons that were actually consumed in the P-C Region that period. This level of accuracy is expected in the simplistic forecast technique used. This decrease in aggregate consumption was probably due to the economic recessions in the early 1980s and 1990s, slowing the rate of commercial and residential development in the region. The per-capita consumption rate decreased from an average of 6.0 tons in the period from 1953 to 1980 to 5.7 tons in the years 1981 to 1994. There were 271,000 more people in the P-C Region in 1994 than were predicted in 1980 (Figure 12). This is a 5 percent increase from the projected population.

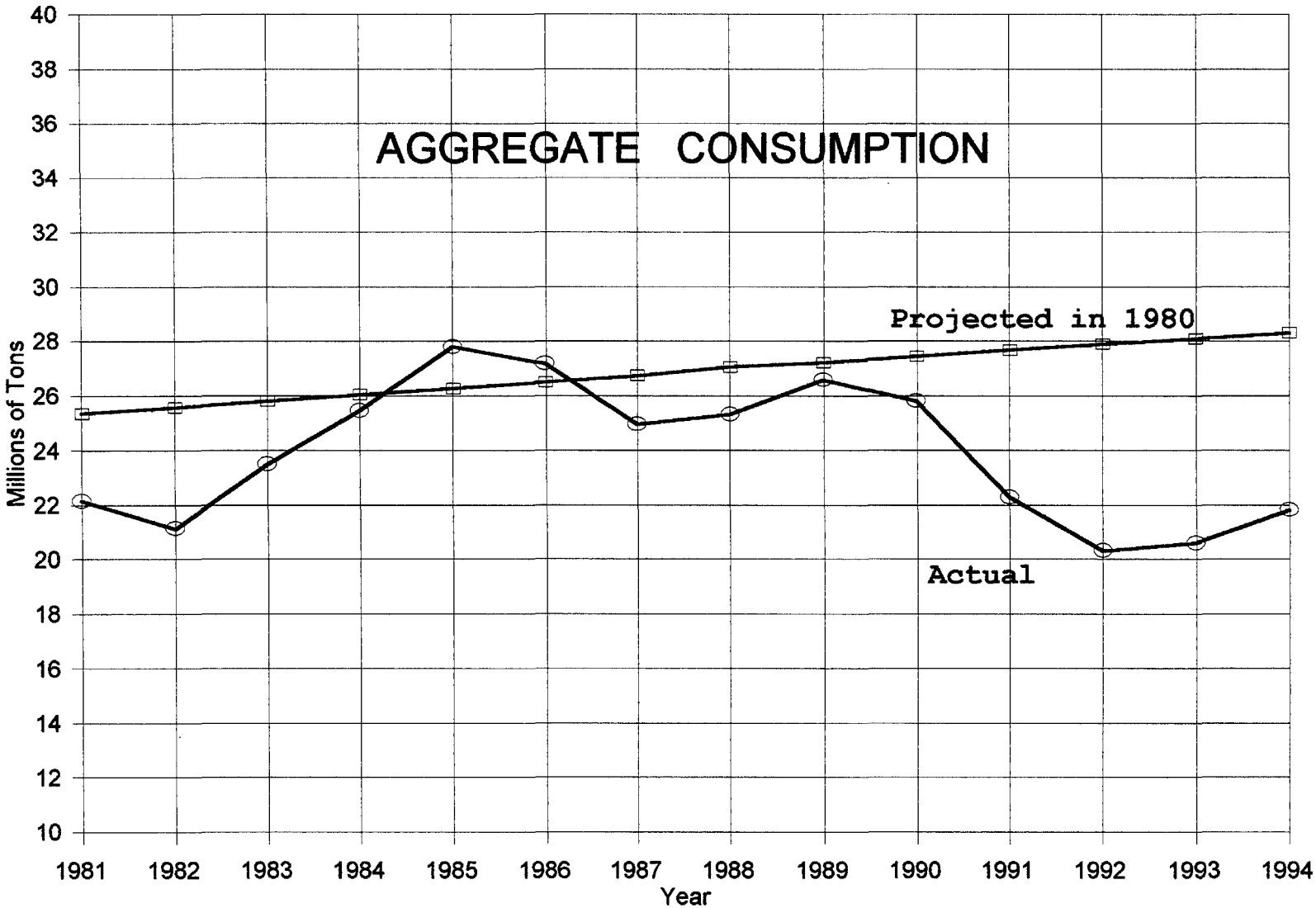

Figure 11. Comparison of aggregate consumption in the South San Francisco Bay Production-Consumption Region for the years 1981 to 1994, with the forecast in Special Report 146, Part II (Stinson and others, 1987).

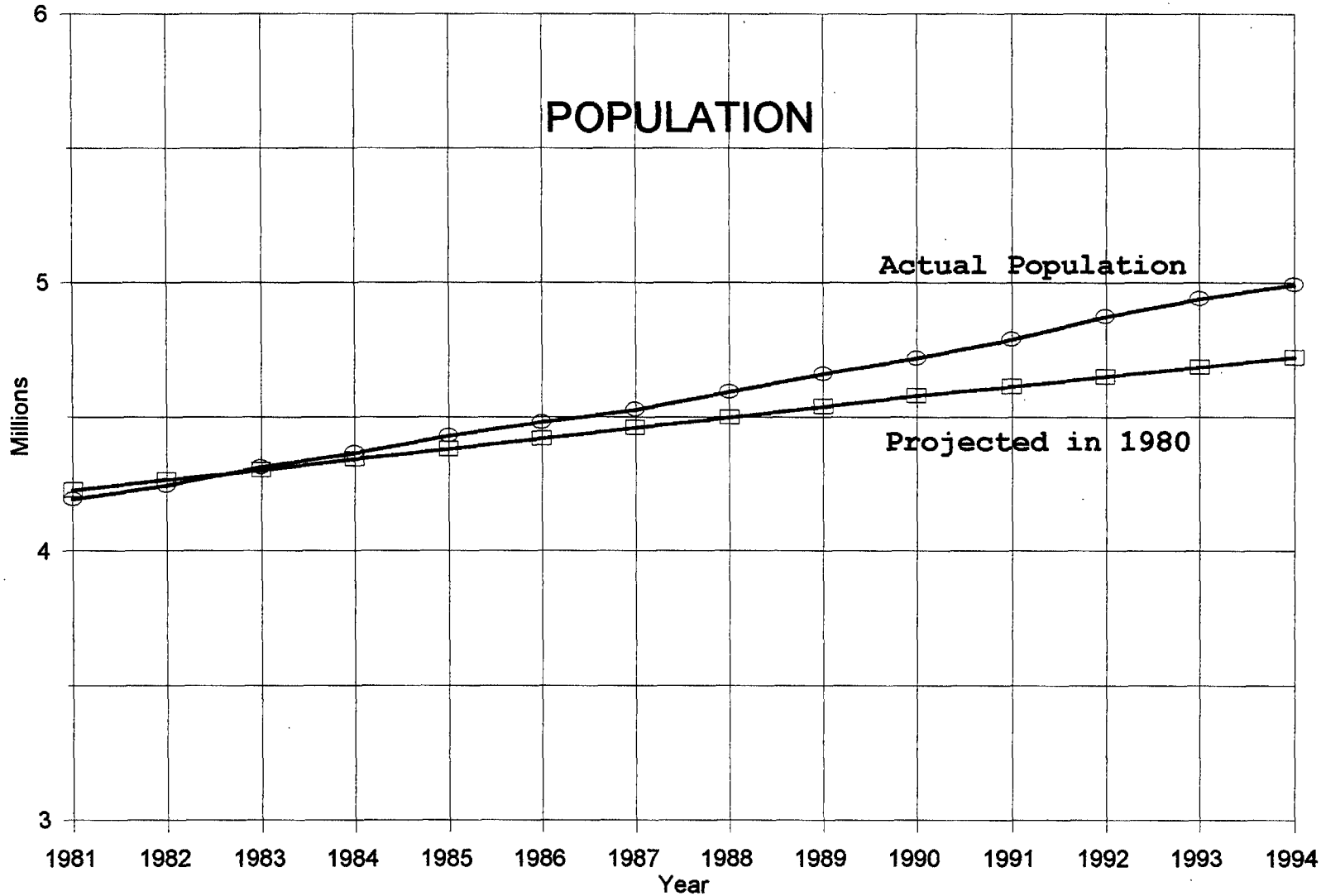

Figure 12. Comparison of population in the South San Francisco Bay Production-Consumption Region for the years 1981 to 1994, with the forecast in Special Report 146, Part II (Stinson and others, 1987).

PART VI - CONCLUSIONS

Within the South San Francisco Bay P-C Region, 42 Aggregate Resource Sectors have previously been classified, one area has been reclassified, and one area has been newly classified as containing significant resources of construction-grade aggregate, Of the 42 Aggregate Resource Sectors that were originally classified, 30 of them were designated by the SMGB as being regionally significant. A reevaluation of construction-grade aggregate resources (both permitted and unpermitted resources) shows that the designated areas and the newly classified areas combined contain an estimated total of 3,775 million tons of geologically and technologically available construction-grade aggregate resources.

The average annual per-capita consumption rate of aggregate materials in the South San Francisco Bay P-C Region from 1953 to 1994 was 5.7 tons. This is a reduction from the 6.0 tons per-capita consumption rate from 1953 to 1980. The population from 1980 to 1994 has increased by 5 percent more than the projection made in 1980.

Based upon available production data and population projections, the South San Francisco Bay P-C Region will need to produce about 1.76 billion tons of aggregate during the next 50 years. Of this projected demand, approximately 32 percent, or 563 million tons, must be suitable for use in PCC.

The use of recycled aggregate, dredge sand, and aggregate imported from outside the South San Francisco Bay P-C Region has reduced the rate of aggregate depletion by about 30 percent.

Unless new resources are permitted for mining, or alternative resources are utilized, existing reserves may be depleted in the year 2024. This is approximately 55 percent of the projected aggregate depletion for the next 50 years. If a major earthquake or similar unforeseen catastrophic event strikes the San Francisco Bay region and necessitates reconstruction, existing reserves will be depleted sooner.

The forecast of aggregate demand of 401 million tons published in the 1983 report for the period 1981 to 1994, was within 17 percent of the actual aggregate consumption of 335 million tons for this same period. This level of accuracy is expected for the simplistic forecast technique used.

Based upon results, designation appears to have been highly effective in preserving significant aggregate resources. Only 2 percent of the designated aggregate resources--75 million tons--were lost due to urbanization since designation in 1986 in spite of an influx of more that 500,000 people to the South San Francisco Bay P-C Region.

In 1980, construction-grade aggregate reserves available within the South San Francisco Bay P-C Region amounted to 552 million tons. Subtracting reserves lost due to consumption, mine closures and other causes, and adding newly permitted or newly classified reserves, the total reserves available in 1994 amount to 676 million tons. This is a total net gain of 124 million tons.

In 1986, the total construction-grade aggregate resources available in designated areas amounted to 4,060 million tons. Since then, aggregate consumption, urbanization and reclassification of land in designated areas have reduced these resources to 3,700 million tons. Updated mineral land classification has identified an additional 75 million tons of aggregate resources in non-designated areas which have been reclassified or newly classified. In adding these 75 million tons to the 3,700 million tons of resources in designated areas, the total 1994 resources for the South San Francisco Bay P-C Region amounts to 3,775 million tons. This is a net loss of 285 million tons.

The following two tables summarize construction-grade aggregate reserves and resources:

RESERVE SUMMARY (all totals in million tons)	
552	1980 Reserves
-29	Reserves lost due to mine closures and other causes
-253	Reserves lost due to consumption
+406	Newly permitted or newly classified reserves
676	1994 Reserves

Total net gain in reserves (1980-1994) = 124 million tons

RESOURCE SUMMARY (all totals in million tons)	
*4,060	Total resources in designated areas 1986
-253	Resources lost due to consumption
-75	Resources lost due to urbanization
-32	Resources lost due to classification change
3,700	Total resources available in designated areas 1994
+75	Resources added in reclassified and newly classified lands
3,775	1994 Resources in designated and non-designated areas

Total net loss in resources (1986-1994) = 285 million tons

* Does not include 2261 million tons of resources in non-designated areas.

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APPENDIX

CALIFORNIA MINERAL LAND CLASSIFICATION SYSTEM

MINERAL RESOURCE ZONE CATEGORIES

DMG has classified the South San Francisco Bay P-C Region according to the presence or absence of significant concrete-grade aggregate deposits. The land classification is presented in the form of Mineral Resource Zones, or MRZ's. Directions for the identification of Mineral Resource Zones are set forth in DMG's Special Publication 51 in the section "Guidelines for Classification and Designation of Mineral Lands" (California State Mining and Geology Board, 1983).

The guidelines for establishing the Mineral Resource Zones are as follows:

MRZ-1: Areas where available geologic information indicates that little likelihood exists for the presence of significant mineral resources.

MRZ-2a: Areas underlain by mineral deposits where geologic data indicate that significant measured or indicated resources are present. As shown on the California Mineral Land Classification Diagram (Figure 13), MRZ-2 is divided on the basis of both degree of knowledge and economic factors. Areas classified MRZ-2a contain discovered mineral deposits that are either measured or indicated reserves as determined by such evidence as drilling records, sample analysis, surface exposure, and mine information. Land included in the MRZ-2a category is of prime importance because it contains known economic mineral deposits.

MRZ-2b: Areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present. For this report, areas classified MRZ-2b contain discovered mineral deposits that are significant inferred resources as determined by their lateral extension from proven deposits or their similarity to proven deposits. Further exploration work could result in upgrading areas classified MRZ-2b to MRZ-2a.

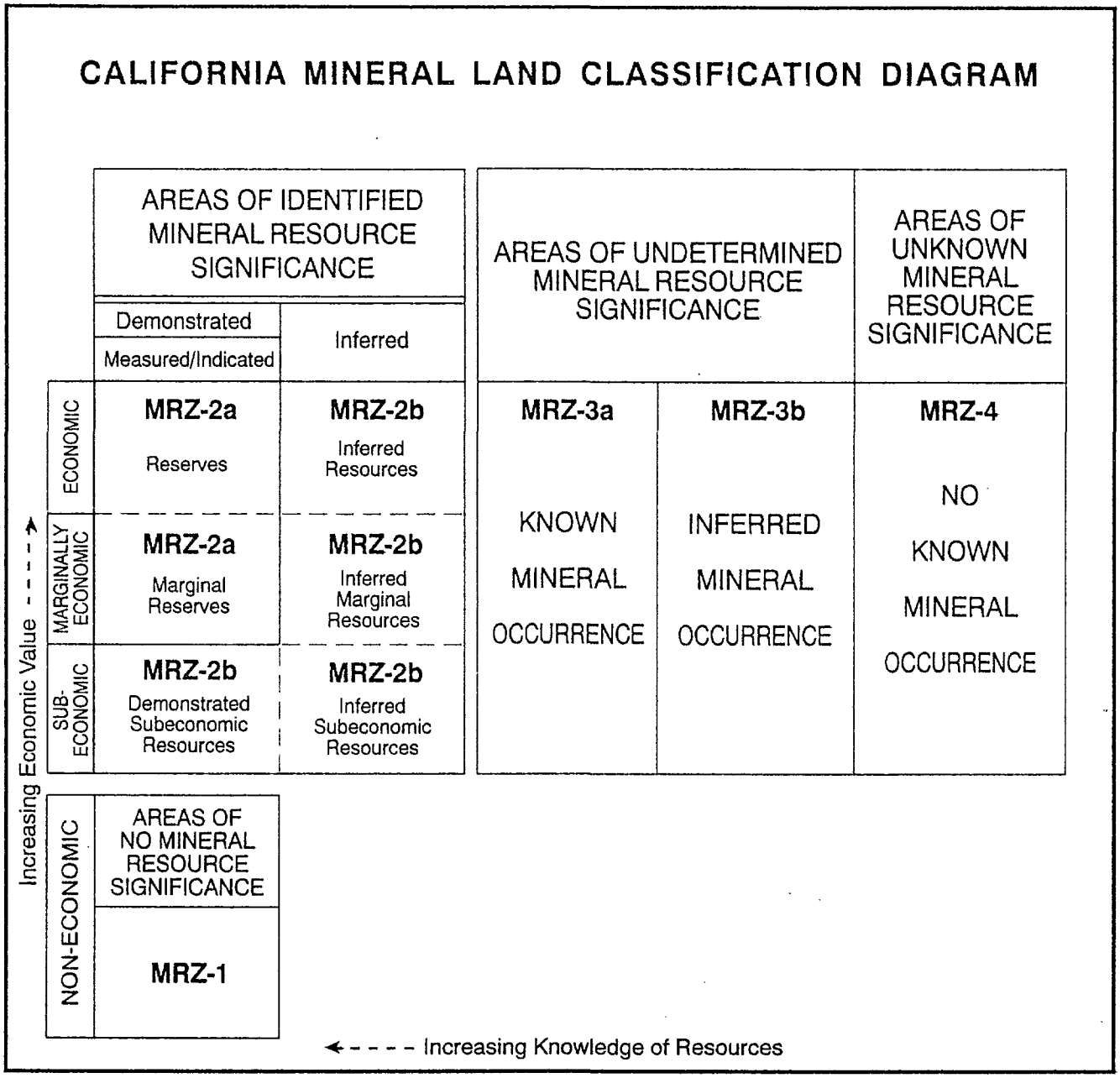

Figure 13. California Mineral Land Classification Diagram: Diagrammatic relationship of mineral resource zone categories to the resource/reserve classification system. Adapted from U.S. Bureau of Mines/U.S. Geological Survey (1980).

MRZ-3a: Areas containing known mineral occurrences of undetermined mineral resource significance. Further exploration work within these areas could result in the reclassification of specific localities into a MRZ-2a or MRZ-2b category. As shown on the California Mineral Land Classification Diagram, MRZ-3 is divided on the basis of knowledge of economic characteristics of the resources.

MRZ-3b: Areas containing inferred mineral occurrences of undetermined mineral resource significance. Land classified MRZ-3b represents areas in geologic settings that appear to be favorable environments for the occurrence of specific mineral deposits. Further exploration work could result in the reclassification of all or part of these areas into the MRZ-2a or MRZ-2b category.

MRZ-4: Areas of no known mineral occurrences where geologic information does not rule out either the presence or absence of significant mineral resources.

The distinction between the MRZ-1 and the MRZ-4 categories is important for land-use considerations. It must be emphasized that MRZ-4 classification does not imply that there is little likelihood for the presence of mineral resources, but rather there is a lack of knowledge regarding mineral occurrence. Further exploration work could well result in the reclassification of land in MRZ-4 areas to a MRZ-3 or MRZ-2 category.

MINERAL RESOURCE/RESERVE CLASSIFICATION NOMENCLATURE

Following are definitions of the nomenclature associated with the California Mineral Land Classification Diagram (Figure 13). It is important to refer to these definitions when studying the different resource categories shown on the California Mineral Land Classification Diagram. Particular attention should be given to the distinction between a mineral deposit and a resource and to how a mineral deposit may relate to resources.

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MINERAL DEPOSIT: A mass of natural occurring mineral material, e.g. metal ores or nonmetallic minerals, usually of economic value, without regard to mode of origin. The mineral material may be of value for its chemical and/or physical characteristics.

MINERAL OCCURRENCE: Any ore or economic mineral in any concentration found in bedrock or as float; especially a valuable mineral in sufficient concentration to suggest further exploration.

ECONOMIC: This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

MINERAL RESOURCE: A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible. The terms resource and mineral resource are synonymous in this report.

RESERVES: That part of the resource base which could be economically extracted or produced at the time of determination. For the purposes of this report, the term reserves has been further restricted to include only those deposits for which a valid mining permit has been granted by the appropriate lead agency.

IDENTIFIED MINERAL RESOURCES: Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified mineral resources include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into demonstrated and inferred.

DEMONSTRATED: A term for the sum of measured plus indicated.

MEASURED: Quantity is computed from dimensions revealed in outcrops, trench workings, or drill holes; grade and/or quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

INDICATED: Quantity and grade and/or quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are

farther apart or otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

INFERRED: Estimates are based on an assumed continuity beyond measured and/or indicated resources, for which there is geologic evidence. Inferred resources may or may not be supported by samples or measurements.

MARGINAL RESERVES: That part of the demonstrated reserve base that, at the time of determination, borders on being economically producible. The essential characteristic of this term is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

MARGINAL RESOURCES: That part of the inferred resource base that, at the time of determination, would be economically producible, given postulated changes in economic or technologic factors.

SUBECONOMIC RESOURCES: The part of identified resources that does not meet the economic criteria of marginal reserves and marginal resources.