DICKENSON PEATMAN & FOGARTY

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# MEMORANDUM

DATE: December 29, 2014

TO: County of Napa

FROM: Thomas Adams

RE: Syar Napa Quarry Reduced Footprint Alternative Infeasibility

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## REDUCED FOOTPRINT/CONSERVATION ALTERNATIVE PREVENTS THE PROJECT FROM ACHIEVING ITS PRIMARY PROJECT OBJECTIVES

The California Environmental Quality Act (CEQA) requires that the alternatives be limited to ones that would avoid or substantially lessen any of the significant effects of the project and could feasibly attain most of the basic objectives of the project. (CEQA Guidelines Section 15126.6(f).) After reviewing the alternatives considered in the Draft Environmental Impact Report (DEIR) it became clear that the Reduced Footprint/Conservation Alternative (Reduced Footprint Alternative) fails to meet the projects basic objectives included in the DEIR, as well as not meeting the supporting project objectives.

Primary Project Objectives:

- To continue and extend operation of the existing Syar Napa Quarry for 35 years, thereby providing a local, reliable, affordable, and consistent source of aggregate and aggregate-related materials to customers in the Napa region;
- To expand the surface mining and reclamation plan for approximately 124-acres to allow for mining access to reliable, affordable, and a consistent source of aggregate and aggregate-related materials to customers in the Napa region;
- To increase the annual permitted saleable quantity of aggregate and aggregate related materials from currently one million tons to two million tons;

The Reduced Footprint Alternative would reduce the proposed project footprint by approximately 35 acres, thereby preventing the project from meeting its objectives by significantly limiting access to high quality basalt material located on both State Blue Pit and the Pasini Parcel. The reasons for this are as follows:

- The high quality basalt material is primarily found on the eastern portion of the quarry. (See DEIR Figure 4.8-7 Geologic Map of Napa Quarry Area.)
- Reducing the footprint of the expansion area limits the feasibility of mining in the remaining areas. By limiting, not only the surface acreage but also the volume due to elevation differentiation. This dramatic reduction of volume is further reduced due to the unknown slope stability constraints in the area. At a minimum slopes must be maintained with 25 foot benches cut every 50 feet with

some slopes requiring slopes graded at a 2 to 1 slope based on stability of the geology encountered. This significantly limits the ability to access tight spaces or irregularly shaped mining areas. (See DEIR pp. 3-7 to 3-9 Project Description and DEIR Appendix H, Napa Quarry Surface Mining and Reclamation Plan, Figure 14a, Final Grading Plan.)

- The geology within the Sonoma Volcanics is variable and therefore, requires flexibility in mining to follow the high quality veins of basalt. In other words not every acre is equal when it comes to rock quality and economically feasibility. Mining requires the ability to access the areas with the highest quality aggregate, such as basalt. (See DEIR p. 4.6-2 Geology and Topography.)
- Higher elevation land forms, such as the hills proposed to be removed from the project contain substantially high volumes of aggregate material compared to lower elevation landforms. Therefore, by removing 35 acres above 800 feet in elevation the reduction in aggregate volume is substantially greater than what is reflected in just the acreage reduction numbers. For example a 900 foot high hill occupying 20 acres contains a much greater volume of material than a 100 foot high hill occupying the same acreage area.

This reduction in the availability of high quality aggregate, such as, basalt significantly limits the ability to provide a local, reliable, affordable, and consistent source of aggregate to customers in the Napa region over the next 35 years by preventing access to the necessary aggregate required for construction and road improvement projects in the Napa region. A 2013 study prepared by the California Geologic Survey on the North San Francisco Bay Production-Consumption Region (which includes Napa) concluded that the currently permitted reserves of all construction aggregate are projected to last only through 2023. (Special Report 205 Update of Mineral Land Classification: Aggregate Materials In the North San Francisco Bay Production-Consumption Region, California Geological Survey 2013.)

Rarely is raw, in-place aggregate material physically or chemically suited for every type of aggregate use. Each potential deposit must be tested to determine how much of its material can meet the specifications for a particular type of use, and what processing is required. Specifications for the various uses have been established by several agencies, such as the California Department of Transportation, to ensure that aggregate is satisfactory. Aggregate materials are essential to the needs of a modern society. Because it is a resource of great importance to the economy of any metropolitan area, it is necessary that lead agencies have knowledge of the significant aggregate resources within their jurisdiction. The areas proposed to be excluded from the mining area in the Reduced Footprint Alternative (Pasini Parcel) have been recently classified MRZ-2 and therefore, should be included in the project so that the project can meet its objectives and the County can maintain a reliable source of local aggregate to support local and regional construction and road improvement projects. (*Ibid*.)

# SYAR INDUSTRIES, INC.

December 10, 2014

Ms. Laura J. Anderson
Deputy County Counsel
1195 Third Street, Suite 301
Napa, California 94559-3035

*Via Email Only*

**Re: Napa Quarry Expansion Project**
**Surface Mining Permit No. P08-00337**

Dear Ms. Anderson:

I am writing this letter to provide the County of Napa with information about the benefits of the Napa Quarry Expansion Project. Syar Industries, Inc. understands the EIR for the project has determined that, if approved, the project would have significant and unavoidable environmental impacts related to the emissions of greenhouse gases, despite the inclusion of avoidance and mitigation measures as conditions of approval for the project. As a result, we are providing this information to assist the County in understanding the benefits of the Napa Quarry project.

**ECOMOMIC**

1. The project will allow the Napa Quarry to continue to maintain a significant level of employment, currently approximately 55 employees at a total annual payroll of $3,439,000. Employment and payroll would increase with additional production at the quarry, including the expanded production allowed under the proposed project. As a result, the project will create a direct economic benefit to the County by preserving these jobs, and indirectly in creating and preserving employment in the County in construction and related industries by ensuring a continuing supply of local aggregate materials.
2. The project will help preserve tax revenues to the County, including Napa County sales taxes revenues on material sales. In the absence of the project, many of these sales would occur in other counties. Through November, 2014 Syar has collected close to $200,000 in sales taxes for Napa County. In 2013, Syar collected over $200,000.
3. The project will ensure the continued availability of a local supply of aggregate materials to local construction and development projects. Without this local source of aggregate materials, each local construction or development project, including critical infrastructure improvement projects, would face increase costs from the need to import materials into the County. The importance of a local supply of aggregate, and the limits on the current local supplies without the project, are discussed in the enclosed documents: California Geologic Survey's Special Report 205 (2013), and letters from the Caltrans Director from 2008 and 2011.

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**ENVIRONMENTAL**

1. Importation of aggregate materials from sources outside the County will require a vastly greater number of truck miles to supply the County's demand than would be required if demand is supplied form local sources, because of the much longer distances that the material would have to be hauled. Having local sources of aggregate materials will reduce the need for importation of this material from outside the County, will greatly reduce the risk of interruptions in supply, and will reduce or eliminate the adverse environmental impacts associated with importation. These adverse environmental impacts include increased traffic, especially from heavy trucks, increased air emissions and green house gases, accelerated deterioration of County roads, and increased use of fossil fuels. Attached is the "Distance Matters" publication of the California Construction and Industrial Materials Association, which provides additional information on these issues.
2. The project will preserve oak woodland habitat and other natural and native habitats.

**PLANNING**

1. The project will promote the goals of the Napa County General Plan, and in particular will support achieving Napa County General Plan Goal CON-7: Identify and conserve areas containing significant mineral deposits for future use and promote a reasonable, safe and orderly operation of mining and extraction and management activities, where environmental, aesthetic, and adjacent land use compatibility impacts can be adequately addressed.
2. The project will promote the goals and policies of the Surface Mining and Reclamation Act, Public Resources Code Section 2710 *et seq.*, which, among other things, declares that the extraction of minerals is essential to the continued economic well-being of the State of California and to the needs of society.

Please let me know if you have any questions concerning this information.

Sincerely,

Michael D. Corrigan
Assistant General Counsel

enclosures

cc: Jennifer Gomez
Thomas Adams

**DEPARTMENT OF TRANSPORTATION**
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*Flex your power!*
*Be energy efficient!*

**CORRECTED COPY**

September 30, 2008

Dear Transportation Partners:

In February 2006, I sent a letter to you stressing the need for permitting new aggregate resources within California. As you are aware, these materials are one of the critical resources required to meet current and expected infrastructure improvement needs for transportation improvements, flood protection, and public and private facilities in the State of California. Toward this effort, I want to again highlight the tremendous need to increase the supply of aggregate resource materials in the State.

Over the past three years, the California Department of Transportation (Caltrans) delivered 754 major projects with a construction value of more than $8.3 billion. I want to continue this success rate with reasonably expected cost effectiveness. This is why it is critical to increase California's permitted aggregate resource reserves.

In the last two years, Caltrans has taken a number of steps to promote aggregate resource needs throughout the State. Caltrans and the Business, Transportation and Housing Agency have provided decision makers with information on the need to increase California's aggregate resource supply and will continue to do so in the future.

To date, Caltrans personnel have made presentations to several local decision-makers in the State, including Nevada, Butte, and Fresno counties, the San Joaquin Valley, and communities in the Bay Area. Caltrans has also coordinated with the construction industry, public decision-makers, and government officials in discussing potential opportunities to increase California's aggregate resource supply. Caltrans' work and partnerships in the *GoCalifornia* Construction Industry Capacity Expansion (ICE) Action Plan has also played a significant role. This work included several workshops and meetings with stakeholders, including the ICE Workshop and Materials Summit held in April. The summit provided a means to communicate with those that are involved with the permit process in order to identify the key issues that arise when attempting to permit a mining facility. Caltrans will continue that collaborative effort. Other collaborative efforts have included developing cooperative partnerships with the California Department of Conservation and the U.S. Department of the Interior, Bureau of Land Management, on mining, reclamation, and permitting issues.

**CORRECTED COPY**

Caltrans also is providing grant funds for the Regional Blueprint Planning Program to promote regional collaboration and integrated planning strategies. This program has enabled regions to plan to accommodate all their future growth while identifying and preserving:

- Mining and material resources.
- Farm and agriculture lands.
- Natural resources.
- Greenbelts and buffer zones.

While all of these efforts have helped to gain approval of new aggregate resources at selected locations in California, we are still well below the amount of reserve required to address expected infrastructure needs over the next 50 years. As we deliver infrastructure improvements with the voter-approved Proposition 1B Bond funds, I want to urge you to continue examining methods to increase the aggregate resources within each of your cities, counties, and regions. Enclosed for your use is an economic assessment of aggregate supply prepared by our Division of Transportation Planning's Office of Transportation Economics.

This provides information on potential economic, social, air quality, and environmental impacts when transporting aggregate materials for infrastructure projects farther than **35** miles each way. *(The original letter incorrectly stated "350 miles each way" instead of "35 miles each way.")* I believe this is a good source of information for you and your local decision-makers to utilize.

Lastly, I want to encourage you to contact representatives from your local Caltrans district office. They are available, upon request, to appear at public meetings and hearings in your areas to speak on the importance of increasing California's aggregate supply. We encourage the development of new sources for aggregate reserves within California, but we also recognize that the permitting of new mining locations must be done in accordance with environmental sensitivity and in accordance with federal, State, and local laws.

Please share this information with your planning commissions, city councils, and county board of supervisors.

Thank you in advance for your assistance in helping to improve mobility across California.

Sincerely,

for WILL KEMPTON
Director

Enclosure

**CORRECTED COPY**

c: Gary Hambly, California Construction and Industrial Materials Association
Charlie Rea, California Construction and Industrial Materials Association
Sam Hassoun, Associated General Contractors of California
Tara McGovern, Engineering and Utilities Contractors Association
Patrick D. Leathers, The Gualco Group, Inc.
RTPAs
MPOs
County Transportation Commissions

# Construction Aggregate Supply Limitations
# Some Estimates of Economic Impact

- Since transportation is a major element in the cost of delivered aggregate, and the cost depends on the distance of the delivery, permitting new aggregate sites that are closer to construction projects would lead to shorter haul distance and minimize transportation/shipping costs. According to the industry, shipping costs for aggregates can outweigh production costs if the material is trucked more than 20 miles.[1]

- A recent University of California, Berkeley, study[2] confirms that the most likely, and dominant effect of opening new sites for the production of construction aggregates would be *a reduction in truck miles of travel for hauling aggregates* (i.e., the new quarry will be located closer to the users to minimize transportation costs), *thus a reduction in emissions from trucks.*

- According to the California Geological Survey (CGS), California has an estimated **74** billion tons of aggregate resources underlying mineral lands classified by the State Geologist. However, only about **5.3** billion tons of aggregate (7.2 percent) have actually been permitted by cities and counties for mining activities. Permitting of mining sites can often take between five and ten years and longer for approval. At the current rate of production of 177 million tons per year, the permitted reserves will be exhausted in about 30 years.

- According to the CGS, the State produced 178.6 million tons of construction sand and gravel in 2006, valued at $1.5 billion. The production of crushed stone in 2006 was estimated at *58.73 million tons*, valued at $481.7 million. According to the same source, California imported from Canada and Mexico about 3.2 million tons of sand and gravel during 2006, a fairly small portion of the total use.

- The total aggregate production (or demand) in 2006, therefore, exceeded **237.3 million tons** (178.6 + 58.73). This production level would *generate about 9.5 million truckloads (at 25 tons per truck), or a total of* **19.0 million truck trips** *a year (including empty trucks returning to the aggregate sites)* related to the transportation of construction aggregate in the state.

- Truck transportation accounts for about 99 percent of shipping aggregates for 40 miles or less.[3] However, according to Teichert Construction and West Coast Aggregates, Inc., the average hauling distance for aggregates in California may be as high as 50 miles one-way. At an average 50-mile distance, the total aggregate-truck vehicles miles traveled would be **950 million miles** per year (19.0 million trucks x 50 miles). This would account for 4 percent of total truck trips, or 6 percent of all truck miles of travel on the State highways.

- Let us assume that permitting additional mining facilities would reduce the average hauling distance from 50 to 35 miles statewide. Using an average hauling distance of 35 miles, the total annual aggregate-truck miles of travel would be **665 million miles** (19.0 million trucks x 35 miles). The 15-mile shorter hauling distance would reduce aggregate-truck miles of travel by **285 million miles per year** (950 - 665), and annual diesel fuel consumption by **44 million gallons** (using California Air Resources Board (CARB) diesel fuel consumption rate of 0.153 gallons per vehicle mile at 55-60 mph speed).

- Based on the CARB emission factors estimates, and assuming an average 55-60 miles per hour speed, a reduction of 285 million miles of truck travel (or 44 million gallons of diesel fuel consumption) would reduce truck emissions (CO, NOx, PM10, SOx, VOC) by about **843.5 tons a year**.

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[1] Therese Dunphy, "Evening the Playing Field," *Aggregates Manager*, August 2006.
[2] Peter Berck, "A Note on the Environmental Costs of Aggregates," *Working Paper No. 994*, Dept. of Agricultural and Resource Economics and Policy, University of California, Berkeley, January 2005.
[3] Tina Grady Barbaccia, "Off-highway Transportation," *Aggregates Manager*, July 2006.

- The total transportation cost of aggregates (at $0.10 per ton per mile) shipped 35 miles average distance throughout California would be $1.67 billion (19.0 million trucks x 25 tons x 35 miles x $0.1), and over $2.38 billion if shipped an average distance of 50 miles. The statewide transportation cost savings of reduced hauling distance would amount to **$710 million a year** (or a 30 percent cost savings).

- The California Department of Transportation (Caltrans) estimates that on average, about $2.55 billion is spent on state and local capital outlay projects each year, and on average, aggregates account for **8-10 percent** of total project costs, or about **$250 million** annually. A 30 percent increase/decrease in shipping cost of aggregates would increase/decrease the total annual project costs by **$75 million per year**.

- The reduction in aggregate-related truck miles of travel would also reduce traffic congestion and traffic accidents on roads, but these impacts would be difficult to estimate. An additional benefit from truck trip reduction would be reduced pavement deterioration. Caltrans expects to spend about $700 million annually on pavement rehabilitation projects. Assuming trucks account for 60 percent of the pavement damage on the state highways, and aggregate-trucks on average account for 5 percent of all truck travel on the State highways, the trucks shipping aggregates would account for about **$20 million** of cost savings in pavement rehabilitation each year.

- Project delays due to lack of aggregate supply in the area would also result in project cost escalation and reduced user benefits (reduced travel time and increased accidents) that would have otherwise been generated. A delay of 10 percent of the projects (or $255 million in capital outlay expenditures) for one year would increase the cost of the State and local capital outlay program by **$13 million a year** (at 5 percent average cost escalation factor).

- Generalizing, and pro rating, the user benefits estimated for the 2006 Interregional Transportation Improvement Program (ITIP) projects, a delay of 10 percent of the capital outlay program for one year would also cost California about **$97 million** in increased roadway congestion and traffic accidents.

In conclusion, permitting and expansion of additional construction aggregate supply sources in California suggests potentially significant benefits and cost savings that would provide a high payoff and worthwhile effort for the State to undertake. Again, those benefits include:

- A reduction in emissions from trucks with a reduction in truck miles of travel for hauling aggregates.
- A shorter hauling distance which would reduce aggregate-truck miles of travel and the cost of the materials.
- A reduction of pavement deterioration from fewer truck miles traveled, which would allow rehabilitation resources to be available for other critical maintenance improvements.
- A reduction in project delays due to lack of aggregate supply in the area, which leads to increased project costs.
- A reduction in aggregate-related truck miles of travel would also reduce traffic congestion and traffic accidents on roads.

Office of Transportation Economics
Division of Transportation Planning
California Department of Transportation
March 2008

# Distance matters

CALCIMA
California Construction and Industrial Materials Association

## The Benefits of Local Supplies

**Distance matters: A community can reduce consumer costs and environmental impacts by using locally produced materials**

Aggregates are a vital natural resource. They are essential to our quality of life in California and needed to build and maintain all roads, bridges, ports, levees, homes, hospitals, schools and public and private construction. Historically, California communities have relied on local supplies of aggregates as the most efficient and effective way to supply materials.

Today, we mainly transport aggregates by truck but, because it is a high bulk, heavy weight commodity, it is very costly to transport long distances and distance adds to environmental impacts. By supporting and obtaining locally produced materials, a community can help reduce consumer costs (fuel and energy costs), and reduce environmental impacts (specifically air quality emissions and greenhouse gases).

### The Trend has been Towards Longer Distances

Since the 1970's, aggregate haul distances have been gradually increasing as local sources of aggregate diminish. These are a few examples:

- Downtown Los Angeles and Ventura County receive aggregate from the Palmdale area, a distance of over 60 miles in congested Southern California traffic.
- The City of Fresno receives material trucked 60-70 miles across county from Coalinga.
- Northern San Diego County receives aggregate from as far away as the San Gabriel Valley, a distance of 90 miles.

### Shorter Distances are Better for the Environment

If truck trip length can be reduced by even 15 miles, then total transport distances could be reduced by 282 million miles per year. It would have these benefits:[1]

- Reduce fuel consumption by 44 million gallons annually.
- Reduce tail pipe emissions by 835 tons a year.
- Remove over 400,000 metric tons of greenhouse gases.

### Shorter Distances Reduce Congestion

- Local aggregates can reduce transport of materials through congested urban areas.

### Shorter Distances Mean More Money to Build Roads

If transportation distances were reduced by an average of 15 miles, Caltrans estimates these benefits:

- 42% savings in material costs.
- Reduce road wear and tear costs by $12-18 million per year.
- Fewer delays in the supply of materials to road and other construction projects, saving about $9 million a year.

### Local Materials Create Local Jobs

- Creating local jobs is a sustainable practice – especially when both jobs and the products produced will benefit the local community.
- Recent studies show that construction materials jobs are desirable, providing some the highest wages and compensation in California.[2]

[1] *Aggregate Availability in California, California Geological Survey, 2007*
[2] *Construction Aggregate Supply Limitations; Estimates of Economic Impact, Caltrans, 2007*

CALCIMA
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02-09

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DRAFT

August 26, 2011

Dear Transportation Partners:

As you are aware, aggregate resources play a vital role in our efforts to build and improve our State's intrastructure. Indeed, our State's mineral resource development is essential to our economic well-being, as well as our intentions to grow more responsibly and provide the safest, fastest, and most efficient transportation options possible. While it is important that we find ways to meet our current needs for construction materials, we must also anticipate future demand and expand our aggregate supply in an environmentally appropriate and culturally circumspect manner. In doing so, we prepare our future generations to navigate the challenges that our State will face as population increases and accessible resources grow scarce.

Throughout the State, attention is being given to what is increasingly seen as an urgent resource issue. The recently enrolled Assembly Bill 566 (Galgiani, 2011) codified several legislative findings, among them that mineral extraction is essential to the needs of society, and that the development of local mineral resources is vital in reducing truck emissions.

These are premises that were acknowledged at the inception of the *GoCalifornia* Construction Industry Capacity Expansion action plan, which sought strategies to increase local aggregate supply as part of a suite of activities intended to meet the demand for services in the construction industry that was booming at the time. The California Department of Transportation (Caltrans) continues the resulting collaborative relationships to this day, coordinating with public decision-makers, the construction industry, and government officials in exploring opportunities to improve the reclamation and permitting processes and increase California's aggregate supply.

While the pressure for resources has eased for the last three years due to a sharp decline in residential construction, the transportation sector continues to build projects and the housing market is showing signs of regaining strength. This is not a time to relax our efforts, but to redouble them in anticipation of full economic recovery.

For example, in the last three years, Caltrans completed 1,398 construction contracts, worth $8 billion, in addition to 825 currently open contracts with a value of over $10 billion. This includes the projects in the $1.9 billion Proposition 1B program. Highway projects are only one part of the story, however, as local and regional agencies continue to maintain and improve the roads in their jurisdictions.

In addition to the outlay of the traditional transportation agencies, the California High Speed Rail Authority expects to break ground on the first 125 mile stretch of its high-speed railway in fall 2012. This section, from Merced to Bakersfield, will require over 50 million tons of crushed stone, sand, and gravel, which is about 40 percent of the total production that the State saw in 2009.

With the passage of Senate Bill (SB) 391 (Liu, 2009) and SB 375 (Steinberg, 2008), Caltrans and local transportation agencies were challenged to conceive of new ways to reduce greenhouse gas (GHG) emissions while providing world class transportation facilities for our constituents. The statewide modal plans and Regional Transportation Plans, which shape California's transportation future, outline extensive improvements to the current system. Yet, between long truck hauls averaging 50 miles and international importing of materials, the GHG impact of aggregate delivery continues to mount. An increased aggregate reserve that is closer to construction sites is key to addressing our dire air quality and climate change concerns.

While we are continuing to work with local and State agencies to help gain approval of new aggregate mining sites throughout the state, there is still much to be done to ensure that these essential resources will be available for development in the far reaches of our long-range plans. I would like to encourage you to explore new strategies to increase aggregate reserves in your region, including education of local stakeholders, early public engagement, and willingness to collaborate in the mitigation of environmental and transportation system impacts from aggregate production and distribution.

The attached Fact Sheet provides information on the potential economic, social, air quality, and environmental factors that are affected by local aggregate supply. This is a good starting point for collaborative discussions that aim to find solutions to issues regarding aggregate availability.

Finally, I would like to invite you to contact representatives from your local Caltrans district office (http://www.dot.ca.gov/localoffice.htm), who are available upon request to speak at public meetings in your area regarding the importance of increasing California's aggregate supply in an environmentally sustainable manner. While the permitting of new mining facilities must be done with attention to all of the possible impacts to surrounding areas, Caltrans encourages the development of new sources for construction aggregate. Our economy and our environment depend on it.

Please share this information with your planning commissions, city councils, and county board of supervisors.

Thank you in advance for helping to improve mobility across California.

Sincerely,

MALCOLM DOUGHERTY
Acting Director

Attachment: Fact Sheet

# Construction Aggregate Supply Limitations
# Some Estimates of Economic Impact – 2011 Update

- Aggregates are low-value, heavy-weight building materials used in construction, including sand, gravel, crushed stone and recycled concrete. Aggregates are mined and either used as raw material (for example, as foundations) or serve as composite materials in the production of concrete and asphalt. The main end markets for aggregates include private residential construction (34 percent), commercial construction (17 percent), and public infrastructure projects (43 percent, including 26 percent for public highways, streets and transit).

- Aggregates are usually shipped from quarries or production sites close to their end market because transportation is a major element in the cost of delivered aggregates and the cost depends on the distance of the delivery. According to the industry, shipping costs for aggregates can outweigh production costs if the material is trucked more than 20 miles.[1] Permitting new aggregate sites would lead to shorter haul distance to minimize transport/shipping cost.

- According to the California Geological Survey (CGS), California has an estimated 74 billion tons of aggregate resources underlying mineral lands classified by the State Geologist. However, only about six to seven percent have actually been permitted by local agencies for mining activities. Permitting of mining sites is difficult and time consuming due to environmental, land development, and zoning laws, and could take between five and ten years. At the current rate of production, available aggregate supply in some areas in the State could be depleted in a decade.

- According to the California Department of Finance, housing construction activity in California more than doubled between 1996-2005, the longest sustained growth period in recent history; but experienced more than 80 percent decline during 2006-2009 (from 209 to 36 thousand units). Despite a 23 percent rebound in housing construction spending in 2010, overall construction industry in California remains depressed. This has contributed to a significant reduction in both production and value of construction aggregate in recent years.

- According to the CGS, California produced 133.5 million tons (valued at $1.4 billion) of construction sand, gravel, and crushed stone in 2009, compared to 237.3 million tons (valued at $1.9 billion) in 2006, an almost 44 percent drop since 2006. The transportation of 133.5 million tons of construction aggregates generates about 5.3 million truckloads (@ 25 tons per truck), or a total of 10.7 million truck trips a year (including empty trucks returning to the aggregate sites) related to the transportation of construction aggregates in the State.

- According to the Teichert Construction and West Coast Aggregates, Inc. the average one-way hauling distance for aggregates in California may be as high as 50 miles. Almost all aggregate used in California is shipped via truck.[2] At an average 50-mile distance, the total aggregate-truck VMT would be 535 million miles per year (10.7 million trucks x 50 miles).

- Let us assume that permitting additional mining facilities would reduce the average hauling distance from 50 to 35 miles statewide. Using an average hauling distance of 35 miles, the total annual aggregate-truck miles of travel would be 375 million miles (10.7 million trucks x 35 miles). The 15-mile shorter hauling distance would reduce aggregate-truck miles of travel by 160 million miles per year (535-375), and annual diesel fuel consumption by 20 million gallons [using California Air Resources Board (CARB) diesel fuel consumption rate of 0.13 gallons per vehicle-mile at 55-60 mph speed].

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[1] Therese Dunphy, "Evening the Playing Field," *Aggregates Manager*, August 2006.
[2] Tina Grady Barbaccia, "Off-highway Transportation," *Aggregates Manager*, July 2006.

- A recent University of California, Berkeley study[3] confirms that the most likely, and dominant, effect of the opening of new sites for the production of construction aggregates would be a reduction in truck miles of travel for hauling aggregates (i.e., new quarry will be located closer to the users to minimize transportation costs), thus a reduction in emissions from trucks.

- Based on the CARB emission factors estimates, and assuming an average 55-60 miles per hour speed, a reduction of 160 million miles of truck travel (or 20 million gallons of diesel fuel consumption) would reduce truck emissions (CO, NOx, PM10, SOx, VOC, and CO2) by about 22,436 tons a year.

- The total transportation cost of aggregates (at $0.10 per ton per mile) shipped 35-miles average distance throughout California would be $936 million (10.7 million trucks x 25 tons x 35 miles x $0.1), and over $1.3 billion if shipped an average distance of 50 miles. The statewide transportation cost savings of reduced hauling distance would amount to $376 million a year (or a 30 percent cost savings).

- The California Department of Transportation (Caltrans) estimates that on average, about $2.5 billion is spent on State and local capital outlay projects each year, and on average, aggregates account for 8-10 percent of total project costs, or about $250 million annually. A 30 percent increase/decrease in shipping cost of aggregates would increase/decrease the total annual project costs by $75 million per year.

- The reduction in aggregate-related truck miles of travel would also reduce traffic congestion and traffic accidents on roads, but these impacts are difficult to quantify. An additional benefit from truck trip reduction would be reduced pavement deterioration. Caltrans expects to spend about $700 million annually on pavement rehabilitation projects. Assuming trucks account for 60 percent of the pavement damage on the State highways, and aggregate-trucks on average account for 5 percent of all heavy truck travel on the State highways, the trucks shipping aggregates would account for about $20 million of cost savings in the pavement rehabilitation each year.

- Project delays due to lack of aggregate supply in the area, would also result in project cost escalation and reduced user benefits (reduced travel time and accidents) that would have otherwise been generated. A delay of 10 percent of the projects (or $250 million in capital outlay expenditures) for one year would increase the cost of the State and local capital outlay program by $13 million a year (at 5 percent average cost escalation factor).

- Generalizing, and pro rating, the user benefits estimated over the 2004 through 2008 Interregional Transportation Improvement Program cycle, a delay of ten percent of the capital outlay program could also cost California on average $100 million annually in increased roadway congestion and traffic accidents.

In conclusion, the overall picture may indicate that the concerns over the limited supply of construction aggregates may have eased for now due to the severe housing decline and economic slowdown. However, over the long run, with the eventual housing and economic rebound, the supply-demand imbalance will continue for many areas. Meanwhile, for some specific localities and construction projects, the challenge of adequate and cost-effective supply of construction aggregates persists.

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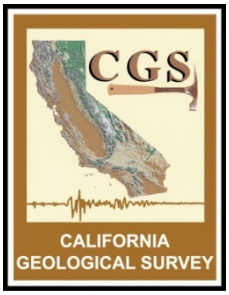
[3] Peter Berck, "A Note on the Environmental Costs of Aggregates," *Working Paper No. 994*, Dept. of Agricultural and Resource Economics and Policy, University of California, Berkeley, January 2005.

SPECIAL REPORT 205

# UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE NORTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION, SONOMA, NAPA, MARIN, AND SOUTHWESTERN SOLANO COUNTIES, CALIFORNIA

**2013**

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# UPDATE OF MINERAL LAND CLASSIFICATION: AGGREGATE MATERIALS IN THE NORTH SAN FRANCISCO BAY PRODUCTION-CONSUMPTION REGION, SONOMA, NAPA, MARIN, AND SOUTHWESTERN SOLANO COUNTIES, CALIFORNIA


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# Table of Contents

EXECUTIVE SUMMARY ..... vii

PART I - INTRODUCTION ..... 1

BACKGROUND ..... 3

OVERVIEW OF CONSTRUCTION AGGREGATE ..... 3

OVERVIEW OF CLASSIFICATION ..... 4

OVERVIEW OF DESIGNATION ..... 5

LEAD AGENCY RESPONSE TO CLASSIFICATION ..... 5

PART II - UPDATE OF MINERAL LAND CLASSIFICATION OF AGGREGATE MATERIALS IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 7

MINERAL RESOURCE ZONES ..... 7

CLASSIFICATION CRITERIA ..... 8

GENERAL GEOLOGY OF THE ROCK UNITS USED FOR AGGREGATE IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 8

REEVALUATION OF MINERAL LAND CLASSIFICATION FOR AGGREGATE MATERIALS IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 10

Areas Newly Classified MRZ-2 for PCC-Grade Aggregate ..... 10

Areas Newly Classified MRZ-3 for PCC-Grade Aggregate ..... 11

Areas Newly Classified MRZ-1 for PCC-Grade Aggregate ..... 12

Areas Newly Classified MRZ-4 for PCC-Grade Aggregate ..... 12

Areas Newly Classified MRZ-2 for AC-Grade Aggregate ..... 12

Areas Newly Classified MRZ-3 for AC-Grade Aggregate ..... 13

Areas Newly Classified MRZ-1 for AC-Grade Aggregate ..... 13

Areas Newly Classified MRZ-4 for AC Aggregate ..... 14

Areas Newly Classified MRZ-2 for Class II Base-Grade Aggregate ..... 14

Areas Newly Classified MRZ-3 for Class II Base-Grade Aggregate ..... 15

Areas Newly Classified MRZ-1 for Class II Base Aggregate ..... 15

Areas Newly Classified MRZ-4 for Class II Base Aggregate ..... 16

PART III - REEVALUATION OF AGGREGATE RESOURCES IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 17

CONCEPTS USED IN IDENTIFYING AGGREGATE RESOURCE SECTORS ..... 17

RECALCULATION OF AVAILABLE AGGREGATE RESOURCES ..... 18

REEVALUATION OF PREVIOUSLY DESIGNATED AGGREGATE RESOURCE SECTORS IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 18

NEWLY IDENTIFIED AGGREGATE RESOURCE SECTORS ..... 23

PART IV - AGGREGATE PRODUCTION IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 25

AGGREGATE PRODUCTION DATA ..... 26

PART V - UPDATED ESTIMATE OF 50-YEAR CONSUMPTION OF AGGREGATE IN THE NORTH SAN FRANCISCO BAY P-C REGION ..... 27

CORRELATION BETWEEN AGGREGATE CONSUMPTION AND POPULATION ..... 27

POPULATION PROJECTION FOR THE NORTH SAN FRANCISCO BAY P-C REGION THROUGH THE YEAR 2060 ..... 27

PROJECTED AGGREGATE DEMAND FOR THE NORTH SAN FRANCISCO BAY P-C REGION THROUGH THE YEAR 2060 ..... 28

COMPARISON OF THE 50-YEAR AGGREGATE DEMAND WITH CURRENT AGGREGATE RESERVES ..... 29

POTENTIAL ALTERNATIVE SOURCES OF AGGREGATE FOR THE NORTH SAN FRANCISCO BAY P-C REGION ..... 31

Alternative Aggregate Sources within the P-C Region ..... 31

Alternative Aggregate Sources outside the P-C Region ..... 32

Recycled Aggregate ..... 33

PART VI - CONCLUSIONS ..... 34

ACKNOWLEDGMENTS ..... 35

REFERENCES CITED ..... 35

APPENDIX A - Summary Table of Designated Sectors and Newly Identified Sectors in the North San Francisco Bay P-C Region ..... 36

APPENDIX B – Active Aggregate Mines in the North San Francisco Bay P-C Region ..... 37

## Figures

Figure 1 General Location Map of the North San Francisco Bay P-C Region……..2

Figure 2 Comparison of Projected Aggregate Demand in the North San Francisco Bay P-C Region with Recorded Aggregate Production from 1981 to 2009....…28

Figure 3 Actual Aggregate Production and Projected Aggregate Demand in the North San Francisco Bay P-C Region (1960 - 2060) …….……..……..….29

## Tables

Table 1 Lead Agencies Located Within the North San Francisco Bay P-C Region…….……6

Table 2 Summary of Construction-Grade Aggregate Resources in the North San Francisco Bay P-C Region in 2011……...……24

Table 3 Population, Aggregate Production (all grades), and Per Capita Consumption in the North San Francisco Bay P-C Region 1960-2010...…….……...26

Table 4 Projected Population and Aggregate Demand in the North San Francisco Bay P-C Region 2011-2060.……...…..…… ……..30

Table 5 Summary of Aggregate Resources, Aggregate Reserves, Projected 50-year Demand, and Depletion Date for the North San Francisco Bay P-C Region…....31

Table 6 Results of this Update Report Compared with Special Report 146, Part III and the Board Designation Report for the North San Francisco Bay P-C Region ……..…….34

# Plates (In Pocket)

| | |
|---|---|
| Plate 1A | Updated Mineral Land Classification Map for Portland Cement Concrete-Grade Aggregate in the North San Francisco Bay Production-Consumption Region, Marin, Napa, Sonoma and Southwestern Solano Counties, California |
| Plate 1B | Updated Mineral Land Classification Map for Asphalt Concrete-Grade Aggregate in the North San Francisco Bay Production-Consumption Region, Marin, Napa, Sonoma and Southwestern Solano Counties, California |
| Plate 1C | Updated Mineral Land Classification Map for Class II Base-Grade Aggregate in the North San Francisco Bay Production-Consumption Region, Marin, Napa, Sonoma and Southwestern Solano Counties, California |
| Plate 2A | Updated Aggregate Resource Sector Map for Aggregate Materials in the North San Francisco Bay Production-Consumption Region, Marin, Napa, Sonoma and Southwestern Solano Counties, California - Northern Part |
| Plate 2B | Updated Aggregate Resource Sector Map for Aggregate Materials in the North San Francisco Bay Production-Consumption Region, Marin, Napa, Sonoma and Southwestern Solano Counties, California - Central Part |
| Plate 2C | Updated Aggregate Resource Sector Map for Aggregate Materials in the North San Francisco Bay Production-Consumption Region, Marin, Napa, Sonoma and Southwestern Solano Counties, California - Northwestern and Southeastern Part |

# EXECUTIVE SUMMARY

This report updates information presented in a classification report on aggregate resources in the North San Francisco Bay Production-Consumption (P-C) Region made available as a preprint in 1985 and formally published in 1987. That report was published by the California Department of Conservation's Division of Mines and Geology (now California Geological Survey) as Special Report 146, Part III (SR 146, Part III) – *Mineral Land Classification: Aggregate Materials in the San Francisco-Monterey Bay Area, Part III, Classification of Aggregate Resource Areas, North San Francisco Bay Production-Consumption Region* (Stinson and others, 1987).

This report presents a reevaluation and update of SR 146, Part III for the benefit of local lead agencies in the North San Francisco Bay P-C Region. This report is intended as an update to and not a replacement for, SR 146, Part III.

SR 146, Part III classified lands for PCC-, AC-, Base-, and subbase-grade aggregates (referred to in that report as "roadbase-grade" aggregate); whereas this report does not classify subbase-grade aggregates.

In this update report, the following conclusions are reached:

- The 115 million tons of currently permitted reserves of all construction aggregate grades are projected to last through the year 2023, 10 years from the present (2013).
- In this update report, an additional 3,069 acres of land containing 853 million tons of construction-grade aggregate resources are identified in the North San Francisco Bay P-C Region.
- The anticipated consumption of construction aggregate in the North San Francisco Bay P-C Region for the next 50 years (through the year 2060) is estimated to be 521 million tons, of which 130 million tons must be PCC quality. This is 9 percent more than the previous 50-year projection of 478 million tons.
- An estimated 2,365 million tons of construction-grade aggregate resources are identified in the North San Francisco Bay P-C Region. Of this, 951 million tons are PCC quality.
- Since the designation of 7,579 acres containing 1,876 million tons of aggregate resources in 1987, about 3% has been lost to urbanization.

The original classification study of the North San Francisco Bay P-C Region assisted the State Mining and Geology Board (Board) in a subsequent process called *designation*. Designation is the formal recognition by the Board of lands containing resources of regional or statewide significance that are needed to meet future demand. In 1987, the Board designated construction aggregate resource areas of regional significance in the North San Francisco Bay P-C Region in SMARA Designation Report No. 7 - *Designation of Regionally Significant Construction Aggregate Resource Areas in the South San Francisco Bay, North San Francisco Bay, Monterey Bay Production-Consumption Regions* (California State Mining and Geology Board, January 1987). **This updated classification report does not change that designation.**

# PART I - INTRODUCTION

This report is an updated Mineral Land Classification of aggregate resources for the North San Francisco Bay P-C Region. The original report titled "*Special Report 146, Part III, Classification of Aggregate Resource Areas, North San Francisco Bay Production-Consumption Region"* (SR 146, Part III) was completed in 1984 by the California Geological Survey (CGS). SR 146, Part III was transmitted by the State Mining and Geology Board (Board) and to lead agencies in February of 1985. CGS formally published the report in 1987. The study area, or P-C Region, for the original and this updated report covers an area of about 3,087 square miles and includes all of Marin, Napa and Sonoma counties and the southwest part of Solano County (Figure 1). Mineral land classification for SR 146, Part III was confined to 445 square miles in the P-C Region delineated by the Office of Planning and Research (OPR) as urbanized or urbanizing. However, active mining operations within the P-C Region, but outside of the OPR area, were also classified.

Unlike SR 146, Part III that confined aggregate classification to OPR boundaries and aggregate mining areas, this updated report classifies **all** lands within the North San Francisco Bay P-C Region. This has added about 2,660 square miles to the area classified—a six fold increase. This additional classification was done in order to identify rock units throughout the P-C Region that may have potential for aggregate development. It should be noted that SR 146, Part III classified lands for PCC-, AC-, Base-, and subbase-grade aggregates (referred to in that report as "roadbase-grade" aggregate); whereas this report does not classify subbase-grade aggregates.

This updated North San Francisco Bay P-C Region report incorporates mineral land classification from Special Report 175 (SR 175), *Mineral Land Classification of Aggregate Materials in Sonoma County, California* (Miller and others, 2005) which classified all of Sonoma County. SR 175 was prepared in response to a petition received by the Board from North Bay Construction, Inc. and was completed in February, 2004.

SR 146, Part III included a 50-year forecast of aggregate needs and a comparison of those needs to the aggregate reserves then available for the North San Francisco Bay Area based on aggregate production and population data through 1980. This update report provides an updated 50-year projection of construction aggregate needs for the North San Francisco Bay P-C Region through the year 2060. Aggregate production data used in this update were current through December 2010; land-use data in this update is current as of May 2012.

Subsequent to Special Report 146, Part III, the Board designated 25 areas totaling 7,579 acres within the North San Francisco Bay P-C Region as having aggregate resources of regional significance. This report also evaluates the land-use changes that have taken place in the designated areas in the 25 years since designation. A detailed discussion of these aggregate resource changes is given in the section titled: *Reevaluation of Designated Aggregate Resource Sectors in the North San Francisco Bay P-C Region***.**


**Figure 1. General Location Map of the North San Francisco Bay P-C Region**

## BACKGROUND

SR 146, Part III and this update report were generated by the State Geologist as specified by the Surface Mining and Reclamation Act (SMARA, PRC 2710 et seq.) of 1975. SMARA was passed by the California State Legislature in response to the loss of significant mineral resources due to urban expansion, the need for current information concerning the location and quantity of essential mineral deposits, and to ensure adequate reclamation of mined lands. To address mineral resource conservation, SMARA mandates a two-phase process known as *Classification-Designation*.

The objective of the Classification-Designation process is to ensure, through appropriate local lead agency policies and procedures, that mineral materials will be available when needed and do not become inaccessible as a result of inadequate information during the land-use decision-making process.

SMARA mandates that the Board develop guidelines for mineral land classification. The Board adopted SMARA guidelines on June 30, 1978 and revised them in 2000. The guidelines are available on the California Department of Conservation website at http:/www.consrv.ca.gov/SMGB/Guidelines/ClassDesig.pdf.

SMARA requires the State Geologist to classify specified areas into Mineral Resource Zones (MRZs). The guidelines also direct the State Geologist to include the following additional information in classification reports for construction aggregate resources: (1) the location and estimated total quantity of construction aggregate in areas with land-uses compatible with potential mining (i.e. Sectors); (2) limits of the market area that these potential resources would supply; and (3) an estimate of the total quantity of aggregate material that will be needed to supply the area for the next 50 years.

## OVERVIEW OF CONSTRUCTION AGGREGATE

Sand, gravel, and crushed rock are “construction materials.” These materials, collectively referred to as aggregate, provide bulk and strength to portland cement concrete (PCC), asphaltic concrete (AC), Class II Base, and other aggregate commodities. Some of these other uses are subbase, drain rock, and fill. Aggregate normally provides 80% to 100% of the volume in these uses. This update report classifies lands for PCC-, AC-, and Class II Base-grade aggregates.

Rarely is raw, in-place aggregate material physically or chemically suited for every type of aggregate use. Each potential deposit must be tested to determine how much of its material can meet the specifications for a particular type of use, and what processing is required. Specifications for the various uses have been established by several agencies, such as the California Department of Transportation, to ensure that aggregate is satisfactory.

Aggregate materials are essential to the needs of a modern society. Because it is a resource of great importance to the economy of any metropolitan area, it is necessary that lead agencies have knowledge of the significant aggregate resources within their jurisdiction.

## OVERVIEW OF CLASSIFICATION

The classification of construction aggregate resources involves the six distinct but interrelated steps that are listed below:

1. Determination of Study Boundary: Study areas may be a county, a part of a county, or a P-C region that may contain part(s) of one or more counties. P-C regions were originally selected such that the majority (95 percent or more) of the construction aggregate produced in the region was consumed in the region.
2. Establishment of Mineral Resource Zones (MRZs): All lands within the P-C region are assigned Mineral Resource Zone classifications (MRZ-1, MRZ-2, MRZ-3, or MRZ-4) based on geologic appraisal. The geologic appraisals include a study of pertinent geologic reports and maps, and field investigations of geologic units exposed in outcrops and at active and inactive mines and quarries.
3. Identification of Sectors: Lands known to contain significant construction-grade aggregate resources (i.e. areas classified as MRZ-2 in Step 2, above) are evaluated to determine if current uses of these lands preclude mining. Areas currently permitted for mining and areas found to have land uses compatible with possible mining are identified as *Sectors*.
4. Calculation of Resource Tonnages within Sectors: Investigation and analysis of on-site conditions, measurement of the areal extent of deposits, drill-hole information, waste-material percentages, and deposit densities are used to calculate total tonnages of aggregate *reserves* and *resources* within each Sector. Reserves are deposits permitted for mining; resources are all aggregate materials identified in Sectors, including the permitted reserves.
5. Forecast of 50-Year Needs and the Life Expectancy of Current Reserves: The total tonnage of aggregate needed to satisfy the demand in the study area over the next 50 years is estimated by multiplying the projected annual populations over that period by the average annual per-capita rate of total aggregate consumption from 1960 to the time of the study. Results of this forecast are also used to estimate the date of depletion of current reserves in the Region.
6. Identification of Alternative Resources: Alternative sources of aggregate are identified and briefly discussed.

When the determination of the study boundary for the North San Francisco Bay P-C Region was originally made in the early 1980s, the region produced nearly 100 percent of the aggregate consumed within the Region. Information provided by the aggregate producers and consumers indicates that recently, imports of aggregate from outside of the Region have been approximately 10 percent of the total aggregate consumed in the region.

Lands within the study area were classified in SR 146, Part III as MRZ-1, MRZ-2, MRZ-3, or MRZ-4 for specific construction aggregate grades. Four aggregate grades were used: (1) PCC, (2) AC, (3) Class II base, and (4) subbase. In this update report, the MRZ classification of 1, 2, 3, and 4 has been retained, but the aggregate grades classified do not include subbase. The classification system is discussed in Part II of this report.

## OVERVIEW OF DESIGNATION

This update report contains the classification step of the Classification-Designation process required by SMARA. The designation phase follows the receipt and acceptance of this classification report by the Board. Designation is the formal recognition by the Board, after consultation with lead agencies and other interested parties, of areas containing mineral deposits of regional or statewide economic significance. Procedures for the designation of lands containing significant mineral deposits are specified in Section II.2 of the Board's Guidelines for Classification and Designation of Mineral Lands (http:/www.consrv.ca.gov/SMGB/Guidelines/ClassDesig.pdf).

The Board previously designated lands in the North San Francisco Bay P-C Region in a report titled "Designation of Regionally Significant Construction Aggregate Resources in the North San Francisco Bay Production-Consumption Region: SMARA Designation Report No. 7 (California Department of Conservation, 1987). At that time, the Board designated 25 areas totaling 7,586 acres within the region as containing aggregate resources of regional significance. This update report reviews the current land uses of the previously designated areas, but does not alter that designation. The Board may revise the designation of the North San Francisco Bay P-C Region based in part on information contained in this update report.

## LEAD AGENCY RESPONSE TO CLASSIFICATION

The Board, upon receipt of the classification report from the State Geologist, transmits the report to the appropriate lead agencies and makes it available to other interested parties. Within 12 months of receipt of the report, each lead agency must develop and adopt mineral resource management policies to be incorporated in its general plan. These policies will:

1. Recognize the mineral land classification information, including the Mineral Land Classification Maps transmitted to the lead agency by the Board.
2. Emphasize the conservation and development of the identified mineral deposits.

Lead agencies that have jurisdiction within the North San Francisco Bay P-C Region are shown in Table 1. The information in this update and the revised projection of aggregate needs in the region should be used by the lead agencies in evaluating the effectiveness of their current mineral resource management policies and in planning for future construction aggregate demands in their jurisdictions. These plans should be updated if necessary.

| County | Incorporated Town or City | Active/Permitted Mining in Jurisdiction | Designated Land in Jurisdiction |
|---|---|---|---|
| Marin County | | yes | yes |
| | City of Belvedere | - | - |
| | Town of Corte Madera | - | - |
| | Town of Fairfax | - | yes |
| | City of Larkspur | - | - |
| | City of Mill Valley | - | - |
| | City of Novato | - | - |
| | Town of Ross | - | - |
| | Town of San Anselmo | - | - |
| | City of San Rafael | - | - |
| | Town of Tiburon | - | - |
| | City of Sausalito | - | - |
| Napa County | | yes | yes |
| | City of American Canyon | - | - |
| | City of Calistoga | - | - |
| | City of Napa | - | - |
| | City of St. Helena | - | - |
| | Town of Yountville | - | - |
| Solano County (southwestern part) | | yes | yes |
| | City of Benicia | - | - |
| | City of Vallejo | yes | yes |
| Sonoma County | | yes | yes |
| | City of Cloverdale | - | yes |
| | City of Cotati | - | - |
| | City of Healdsburg | - | yes |
| | City of Petaluma | - | yes |
| | City of Rohnert Park | - | - |
| | City of Santa Rosa | - | - |
| | City of Sebastopol | - | - |
| | City of Sonoma | - | yes |
| | Town of Windsor | - | - |

**Table 1. Lead Agencies Located Within the North San Francisco Bay P-C Region**.

# PART II - UPDATE OF MINERAL LAND CLASSIFICATION OF AGGREGATE MATERIALS IN THE NORTH SAN FRANCISCO BAY P-C REGION

This section of the report contains information concerning a reevaluation of the location, quality, and quantity of construction-grade aggregate resources in the North San Francisco Bay P-C region. The original report—SR 146, Part III—classified PCC-grade, AC-grade, Base- and subbase-grade aggregate resources. This update report does not include subbase-grade aggregate in the classification. In addition to the urban areas classified in SR 146, Part III, all remaining areas in the P-C Region were also classified in this update. This includes all of Sonoma, Napa, and Marin counties, and the southwestern part of Solano County (Figure 1 and Plate W).

## MINERAL RESOURCE ZONES

As set forth in Section 2761 (b) of SMARA, "… the State Geologist shall classify, on the basis solely of geologic factors, and without regard to existing land use…" Areas subject to mineral land classification are divided by the State Geologist into various Mineral Resource Zone (MRZ) categories that reflect varying degrees of mineral resource potential. When SR 146, Part III was written, the nomenclature for mineral land classification consisted of four categories—MRZ-1, MRZ-2, MRZ-3, and MRZ-4. These original classification categories are retained in this update report. Following is a brief description of these MRZ categories:

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

**MRZ-2:** Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists. This zone shall be applied to known mineral deposits or where well-developed lines of reasoning, based upon economic-geologic principles and adequate data, demonstrate that the likelihood for occurrence of significant mineral deposits is high.

**MRZ-3:** Areas containing mineral occurrences of undetermined mineral resource significance.

**MRZ-4:** Areas where available information is inadequate for assignment to any other MRZ category.

Lands within the North San Francisco Bay P-C Region are classified for three grades of construction aggregate: PCC-grade, AC-grade, and Class II Base-grade. It should be noted that the material in lands classified MRZ-2 for Class II Base should not be considered equivalent to material in lands classified MRZ-2 for PCC- and AC-grade aggregate as those materials must meet more stringent quality specifications.

## CLASSIFICATION CRITERIA

To be considered *significant* for the purpose of mineral land classification, a mineral deposit, or a group of mineral deposits that can be mined as a unit, must meet marketability and threshold value criteria adopted by the Board (http://www.conservation.ca.gov/smgb/pages/index.aspx). Mineral deposits considered significant in this report must meet the specifications for PCC-, AC-, or Class II Base-grade aggregate. Threshold values are intended to indicate in a general way the approximate minimum size of a mineral deposit that will be considered significant for classification and designation. The threshold value criteria vary for different mineral deposits depending on their uniqueness and commodity-type category. The Board determined threshold value of the first marketable product in 1998 dollars to be $1,250,000 for metallic and rare mineral deposits, $2,500,000 for industrial mineral deposits other than construction aggregate, and $12,500,000 for construction aggregate deposits. In order to adjust these threshold values to reflect 2010 dollars, each value was multiplied by an inflation factor of 1.39. This factor was determined by dividing the U.S. Department of Labor's estimated Consumer Price Index (CPI) for California (California Department of Finance website, 2010) for August 2010 (227.4), by the CPI for 1998 (163.7). Threshold values in 2010 dollars (rounded to the nearest thousand) are as follows:

| | |
|---|---|
| Metallic or rare mineral deposits | $ 1,735,000 |
| Industrial minerals other than construction aggregate | $ 3,475,000 |
| Construction aggregate | $ 17,375,000 |

The average price of construction aggregate in the North San Francisco Bay P-C Region is about $12 per ton; therefore, $17,375,000 equates to about 1.45 million tons of aggregate material.

## GENERAL GEOLOGY OF THE ROCK UNITS USED FOR AGGREGATE IN THE NORTH SAN FRANCISCO BAY P-C REGION

The North San Francisco Bay P-C Region lies entirely within the Coast Ranges Geomorphic Province, a region characterized by numerous elongated mountain ranges and narrow valleys that are roughly parallel to the Pacific coastline. The geomorphology of the P-C Region was created over the last 165 million years by complex dynamic interactions between the Farallon, Pacific, and North American plates. The entire region is dissected by numerous fault zones such as the San Andreas, Rodgers Creek, Mayacama, Healdsburg, Tolay, and Tombs Creek. These fault zones and the orogenic processes that formed the study region have profoundly influenced the character of the rock being mined for aggregate.

The North San Francisco Bay P-C Region contains two major rock groups that contain PCC, AC and Class II Base crushed stone aggregate resources. These include older metamorphic rocks of the Franciscan Complex and younger volcanic rocks of the Sonoma Volcanic group. The region also contains Pleistocene alluvial terrace deposits occurring along major streams and rivers and recent alluvial stream channel deposits that are currently being mined for PCC aggregate.

**Franciscan Complex Rocks (age: ~165-45 million years ago)**

The Franciscan Complex can be generally characterized as a complex assortment of tectonically sheared and dislocated blocks of marine greywacke, shale, and greenstone with minor occurrences of chert, blueschist, and serpentinite. Most of active crushed stone quarries in the P-C Region, that produce Class II Base or AC aggregate, mine greywacke or greenstone of the Franciscan Complex. The rocks within the Franciscan Complex accumulated as marine floor sediments and were metamorphosed under high-pressures and low-temperatures. Much of the Franciscan Complex in the P-C Region is mapped as mélange, a chaotic group of dissimilar rock types with very little internal continuity containing a variety of blocks that are juxtaposed along sheared contacts. These blocks contain greenstone, greywacke, chert, shale, serpentinite, and ultramafic rocks. Heavily sheared serpentinite bodies occur at the base of the Franciscan Complex. Numerous faults, fractures, and associated altered zones transect the entire mass of Franciscan Complex rocks.

**Sonoma Volcanics (age: 8-2.3 million years ago)**

Large-scale intermittent volcanic eruptions in the late Miocene and into the Pliocene created the Sonoma Volcanics. These rocks principally consist of interbedded basalt flows, tuffs, breccias, and associated sediments composed of andesite, rhyolite, and volcanic debris. Northward-migrating volcanism associated with this unit reached Clear Lake in Lake County by 2.0 million years ago and created several large lava flows that flowed southwards into Napa and Sonoma counties. These eruptions eventually covered 350 square miles with several thousand vertical feet of accumulated volcanic debris. They blanketed large parts of the Franciscan Complex and Great Valley Sequence rocks in Sonoma and Napa counties. Sonoma Volcanics make up much of the hills between Novato and Healdsburg. In the Alexander Valley, Sonoma volcanics reach a maximum thickness of about 1,000 feet (Department of Water Resources, 1983).

**Recent river channel alluvium and associated Pleistocene terrace deposits (age: ~2 million years ago to present)**

Pleistocene alluvial terrace deposits occur along the major streams and rivers that run through Sonoma County. These deposits consist of unconsolidated cross-bedded gravels, sands, silts, and clays. Thicknesses of these units vary considerably. Generally, deposits located farther from the active channel—terrace deposits—tend to contain less coarse-grained sands and higher percentages of silt and clay. These terrace sediments originally formed as stream channel deposits, alluvial fan deposits, and flood plain deposits, and have subsequently been incised by streams and rivers (Department of Water Resources, 1983). Unconsolidated Recent alluvial river channel deposits, such as those along the Russian and Gualala rivers, and Dry, Sonoma, and Austin creeks, contain hard, durable, high-grade quality alluvial deposits that have been mined for aggregate.

## REEVALUATION OF MINERAL LAND CLASSIFICATION FOR AGGREGATE MATERIALS IN THE NORTH SAN FRANCISCO BAY P-C REGION

The reevaluation of mineral land classification in this update was limited to PCC-, AC-, and Class II Base-grade aggregate resources. SR 146, Part III also included the classification of subbase-grade aggregate resources. Where those subbase-grade resources were designated by the Board in 1987 as being of regional significance, the mineral resource classification was retained.

In this update, there are significant changes to the mineral land classification of the North San Francisco Bay P-C Region from the original report—SR 146, Part III. The most consequential change is the mineral land classification of the remainder of the P-C Region outside the urbanized and urbanizing areas in SR 146, Part III. The updated classification is shown on Plates 1A, 1B, and 1C. The classification of Sonoma County in its entirety, which included the reclassification of the areas originally classified in SR 146, Part III, was published in CGS Special Report 175 (Miller and others, 2005). The reclassification from SR 175 has been modified and is included in this update. It is incorporated, where appropriate, in the "Areas Newly Classified" subsections.

Seven areas were identified as having significant aggregate resources (MRZ-2) in these newly classified parts of the P-C Region. All but one are adjacent to areas previously identified in SR 146, Part III as significant aggregate resource areas (MRZ-2). These new areas are: 1) parts of the Gualala River Valley; 2) areas adjacent to the Mark West quarry; 3) areas adjacent to the Blue Rock quarry; 4) areas adjacent to the Canyon Rock quarry; 5) areas adjacent to the Bohan and Canelis quarry; 6) areas adjacent to the Napa quarry; and 7) a site south of Roblar Road. The Gualala River Valley area and part of the area adjacent to the Bohan and Canelis Quarry are classified MRZ-2 for PCC-grade aggregate; the areas adjacent to the Mark West and Napa quarries are classified as MRZ-2 for AC-grade aggregate; and the areas adjacent to the Blue Rock and Canyon Rock quarries and the Roblar Road site are classified as MRZ-2 for Class II Base-grade aggregate.

In addition to the seven areas listed above, two new areas containing significant PCC-grade aggregate resources (MRZ-2) are identified within the urban and urbanizing areas of the P-C Region previously classified in SR 146, Part III. These new areas are in the middle reach of the Russian River, adjacent to lands previously identified in SR 146, Part III as containing significant PCC-grade aggregate resources (MRZ-2).

### Areas Newly Classified MRZ-2 for PCC-Grade Aggregate

Areas classified as MRZ-2 for PCC-grade aggregate are underlain by alluvial and crushed rock deposits where geologic data indicate that significant PCC-grade aggregate resources are present. Within the North San Francisco Bay P-C Region, areas newly classified MRZ-2 for alluvial sand and gravel are within the active alluvial channel and/or terraces of the Russian River, Austin Creek, and the Gualala River. One crushed rock deposit newly classified MRZ-2 for PCC-grade aggregate is the West Roblar Road area. These areas are described below:

Russian River – Middle Reach

The Middle Reach of the Russian River extends 10 miles south from the Digger Bend area just east of Healdsburg. Large areas of the Middle Reach of the Russian River were previously classified MRZ-2 for PCC-grade aggregate. Two areas that were formerly classified MRZ-3 have been reclassified MRZ-2 in SR 175 and this updated report. Several areas previously classified MRZ-2, where permitted mining has been completed, have been reclassified to MRZ-3. These reclassified lands are shown on Plate 1A.

Austin Creek and adjacent Bohan and Canelis Quarry

Austin Creek flows into the Lower Reach of the Russian River approximately one-mile north of Duncan Mills in western Sonoma County. The Bohan and Canelis Company skims sand and gravel from Austin Creek and quarries material from the adjacent hillside for use as PCC aggregate. The thicknesses of the deposits in the creek vary, but are thin relative to Russian River deposits.

In SR 146, Part III, approximately 27 acres in Austin Creek and the adjacent hillside quarry were classified MRZ-2 for PCC-grade aggregate. In this update report an additional 15 acres in Austin Creek and 27 acres adjacent to the hillside quarry area are classified MRZ-2 for PCC (Plate 1A). The aggregate resource estimate is proprietary.

Gualala River

Aggregate deposits along the Gualala River (Plate 1A) in the far northwest corner of Sonoma County are classified MRZ-2 for PCC-grade aggregate. These deposits consist of hard, durable alluvium that is currently being mined by Bedrock, Inc. in the vicinity of Twin Bridges. The alluvium is unconsolidated cross-bedded gravels, sands, silts, and clays that vary considerably in thickness. This area is classified MRZ-2 for PCC-grade aggregate.

West Roblar Road Site

The West Roblar Road site covers 113 acres about five miles west of Cotati on the south side of Roblar Road in Sonoma County (Plate 1A). This area is classified MRZ-2 for PCC-grade aggregate. The deposit is predominately Sonoma Volcanic agglomerate and andesitic flow rock that is overlain by fine-grained sandstone and siltstone of the Wilson Grove Formation. This site has never been mined, but drilling and testing conducted by North Bay Construction, Inc. indicates that the underlying volcanic rock meet specifications for PCC aggregate. The sedimentary rock of the overlying Wilson Grove Formation is likely only suitable for fill.

**Areas Newly Classified MRZ-3 for PCC-Grade Aggregate**

Large areas within the North San Francisco Bay P-C Region are newly classified MRZ-3 for PCC-grade aggregate (Plate 1A). These areas, outside of the areas previously classified in SR 146, Part III, contain potential PCC-grade aggregate deposits of undermined mineral resource significance. They include: Quaternary sand and gravel deposits including alluvial terrace deposits; Quaternary/Tertiary sandstones and conglomerates including those of the Glenn Ellen

and Huichica Formations; sandstones and conglomerates of the Ohlson Ranch Formation in the Little Sulphur Creek area and East Bay Hills area; sandstone and conglomerate exposed along the Sonoma County coastline; andesitic to basaltic flows of the Sonoma Volcanics; welded tuff of the Sonoma Volcanics; sandstones and conglomerates of the Great Valley Sequence; greenstones of the Franciscan Complex; greywacke of the Franciscan Complex; greywacke, greenstone, chert and eclogite of the Franciscan mélange; Cretaceous diorite exposed at Bodega Head; Mesozoic basalt, diabase and gabbro; high-grade metamorphic rocks of the Franciscan Complex; and chert of the Franciscan Complex.

Several areas previously classified MRZ-2 for PCC are reclassified as MRZ-3. These areas are where mining has removed the significant resources, including sites along the middle reach of the Russian River and the Stony Point-Bodega (Hagemann) quarry north of Highway 1, east of Bodega Bay.

**Areas Newly Classified MRZ-1 for PCC-Grade Aggregate**

Some areas of the North San Francisco Bay P-C Region, outside of the previously classified areas in SR 146, Part III, are newly classified MRZ-1 for PCC aggregate (Plate 1A). These are areas where adequate information indicates that no significant mineral deposits of PCC-grade aggregate are present, or that their presence is unlikely. MRZ-1 areas are underlain by a variety of lithologic units containing rock and sediments that are not suitable for making PCC aggregate. They include Holocene silt and clay; Quaternary agglomerate breccia: Quaternary clay, silt, sand and gravel; Quaternary/Tertiary clayey sediments; tuffaceous member of the Glen Ellen Formation; felsic volcanic rocks of the Clear Lake Volcanics; sandstone and mudstone including parts of the Glen Ellen and Huichica Formation; Petaluma Formation; Sonoma Volcanics tuff; agglomerate of the Sonoma Volcanics; felsic volcanic rocks of the Sonoma Volcanics; silica carbonate rock; mudstone and shale of the Great Valley Sequence; and serpentinite, ultramafic rocks, and silica-carbonate rocks; and the siltstones and fine-grained sandstones of the Wilson Grove Formation.

**Areas Newly Classified MRZ-4 for PCC-Grade Aggregate**

Areas within the North San Francisco Bay P-C Region, outside of the previously classified areas in SR 146, Part III, classified MRZ-4 for PCC-grade aggregate (Plates 2, 3, and 4) are areas where available information is not adequate for assignment to any other category. All areas mapped as landslides are classified MRZ-4 because landslide deposits may vary in composition and thickness and may overlie different types of bedrock. Because of these uncertainties, these deposits have been classified MRZ-4.

**Areas Newly Classified MRZ-2 for AC-Grade Aggregate**

Most of the AC-grade aggregate in the North San Francisco Bay P-C Region has historically been mined from crushed rock sources consisting predominately of greywacke and metavolcanic rock (greenstone) belonging to the Franciscan Complex and basalts and andesites of the Sonoma Volcanics. In general, alluvial sand and gravel and crushed rock that is suitable for PCC aggregate will also meet specifications for AC aggregate, although crushed rock is more

desirable for use in AC. Two new areas classified as MRZ-2 for AC-grade aggregate are adjacent to the Mark West and Napa quarries.

**Note:** All lands classified for PCC-grade aggregate have the equivalent classification for AC-grade aggregate. These areas have been discussed previously in the Mineral Land Classification for PCC-Grade Aggregate section. The following discussion only includes classification of lands containing deposits of aggregates that are suitable for use no higher than AC aggregate.

Area Adjacent to the Mark West Quarry

In SR 146, an area of approximately 61 acres including the Mark West Quarry was classified MRZ-2 for AC-grade aggregate. In this update report, an additional 431 acres adjacent to the quarry, and another 260 acres southeast of the quarry were classified MRZ-2 for AC-grade aggregate (Plate 1B). Here, Franciscan Complex greenstone, greywacke and altered rocks, and Sonoma Volcanic tuffs underlie the area. The only rock mined for AC aggregate is the greenstone. All of the tuffaceous material is overburden and is either waste or can be sold for fill.

Area Adjacent to the Napa Quarry

In SR 146, an area of approximately 1,181 acres, including the Napa Quarry, was classified MRZ-2 for AC-grade aggregate. In this update report an additional 513 acres adjacent to the quarry to the east were classified MRZ-2 for AC-grade aggregate (Plate 1B). The area is underlain by rhyolite, andesite, basalt, perlitic rhyolite, and tuff of the Sonoma Volcanics. Much of the material is suitable for AC aggregate and the remainder can be used for roadbase.

**Areas Newly Classified MRZ-3 for AC-Grade Aggregate**

Areas classified MRZ-3 for AC-grade aggregate are underlain by rock or sediments containing potential AC-grade aggregate deposits of undermined mineral resource significance (Plate 1B). These areas are underlain by: andesitic to basaltic flows of the Sonoma Volcanics, exposed throughout the eastern part of Sonoma County in the area between Santa Rosa Valley and the Howell Mountains; and greenstones of the Franciscan Complex exposed throughout northern Sonoma County. Areas classified MZR-3 for AC-grade aggregate are the same as those areas classified MRZ-3 for PCC-grade aggregate (see "Areas Classified MRZ-3 for PCC-Grade Aggregate" section).

**Areas Newly Classified MRZ-1 for AC-Grade Aggregate**

Areas classified MRZ-1 for AC-grade aggregate (Plate 1B) are areas where adequate information indicates that no significant AC-grade aggregate mineral deposits are present. Areas classified MRZ-1 for AC-grade aggregate are identical to areas classified MRZ-1 for PCC-grade aggregate. These areas are discussed in the section "Areas Newly Classified MRZ-1 for PCC Aggregate."

**Areas Newly Classified MRZ-4 for AC Aggregate**

Areas within the North San Francisco Bay P-C Region, outside of the previously classified areas in SR 146, Part III, classified MRZ-4 for AC-grade aggregate (Plate 1B) are areas where available information is inadequate for assignment to any other category. All of these areas share the equivalent classification for PCC-grade aggregate (see "Areas Newly Classified MRZ-4 for PCC Aggregate" section).

**Areas Newly Classified MRZ-2 for Class II Base-Grade Aggregate**

Much of the Class II Base-grade aggregate in the North San Francisco Bay P-C Region is mined from crushed rock sources predominately consisting of greywacke, and metavolcanic rock (greenstone) belonging to the Franciscan Complex and basalt of the Sonoma Volcanics.

**Note:** All lands classified for PCC- and AC-grade aggregate have the equivalent classification for Class II Base. These areas have been discussed previously in the Mineral Land Classification for PCC-Grade Aggregate and the Mineral Land Classification for AC-Grade Aggregate sections. The following discussion does not repeat information provided above; it includes only the classification of lands containing additional deposits of aggregates that are suitable for uses no higher than Class II Base.

Areas classified MRZ-2 for Class II Base-grade aggregate (Plate 1C) are underlain by mineral deposits where geologic data indicate significant measured or indicated Class II Base-grade aggregate resources are present. There are four newly identified areas classified MRZ-2 for Class II Base-grade aggregate; these are areas where Class II Base is the highest engineering specification achieved. These are areas adjacent to the Blue Rock, Canyon Rock, and Bohan and Canelis quarries, and the Roblar Road East site.

Area Adjacent to the Blue Rock Quarry

This area covers approximately 93 acres south of Highway 116 about one mile west of the town of Forestville (Plate 1C). It is adjacent to the Blue Rock Quarry area. It includes a deposit of massive, hard, gray to bluish-gray greywacke and interbedded shale similar to that currently mined at the adjacent Blue Rock Quarry. The greywacke and shale are the predominant rock types of the Franciscan Complex. The deposit appears to be contiguous with the greywacke that is mined at Canyon Rock Quarry north of Highway 116.

Area Adjacent to the Canyon Rock Quarry

This area covers 114 acres located approximately one mile west of the town of Forestville and north of Highway 116 in Sonoma County (Plate 1C). It is adjacent to the Canyon Rock Quarry. The area is largely underlain by bluish-gray to dark green and black greywacke and shale of the Franciscan Complex.

Area Adjacent to the Bohan and Canelis (Austin Creek) Quarry

This 227-acre area is adjacent to the south and east sides of the active Bohan and Canelis Austin Creek Quarry (Plate 1C). It has been classified MRZ-2 for Class II Base-grade aggregate (highest use). Field investigation by CGS staff indicates that the Franciscan Complex greywacke underlying this area is generally similar in composition and durability to the greywacke that is currently mined at the adjacent Bohan and Canelis Rock Quarry. About 40% of the rock underlying this MRZ-2 area is believed to be suitable for Class II Base with the balance suitable for fill or other low quality uses.

Roblar Road East Site

The Roblar Road East site shown on Plate 1C comprises about 186 acres classified MRZ-2 for Class II Base-grade aggregate (highest use). This site is about five miles west of Cotati on the south side of Roblar Road (Plate 1C). The area is primarily underlain by Sonoma Volcanic agglomerate and andesitic flow rock that is overlain by fine-grained sandstone and siltstone of the Wilson Grove Formation. The Sonoma Volcanics Rocks tested on the adjacent West Roblar Road site meet specifications for PCC-grade aggregate. It is likely, then, that the same units on the Roblar Road East site are hard and durable enough to make Class II Base aggregate. The lack of testing on this site, however, precludes them from being classified MRZ-2 for PCC-grade aggregate. The sedimentary rocks of the overlying Wilson Grove Formation are likely only suitable for fill.

**Areas Newly Classified MRZ-3 for Class II Base-Grade Aggregate**

Large areas within the North San Francisco Bay P-C Region are newly classified MRZ-3 for Class II Base-grade aggregate (Plate 1C). These areas, outside of the previously classified areas in SR 146, Part III, contain known Class II Base-grade aggregate deposits of undermined mineral resource significance. They include all areas newly classified MRZ-3 for PCC- and AC-grade aggregate as well as Class II Base-grade aggregate. They include potential crushed rock resource areas mapped as Mesozoic diorite−exposed at Bodega Head and Point Reyes, chert of the Franciscan Complex, and serpentinite, ultramafic rocks, and silica-carbonate rocks. These units contain rocks that have been used to make Class II Base aggregate but have not been use for making PCC or AC aggregate. Other areas, underlain by: felsic volcanic rocks of the Clear Lake Volcanics; agglomerate of the Sonoma Volcanics, and felsic volcanic rocks of the Sonoma Volcanics contain sediments and rocks that have not been used or tested for, but may have potential for making Class II Base aggregate. See *Appendix C* for a description of these units.

**Areas Newly Classified MRZ-1 for Class II Base Aggregate**

Areas newly classified MRZ-1 for Class II Base-grade aggregate (Plate 1C) are areas, outside of the previously classified areas in SR 146, Part III, where adequate information indicates that no significant aggregate mineral deposits suitable for Class II Base aggregate are present, or that their presence is unlikely. MRZ-1 areas are underlain by a variety of lithologic units containing

rock and sediments that are not suitable for use in Class II Base. They include: Holocene silt and clay; Quaternary agglomerate breccia; Quaternary clay, silt, sand and gravel; Quaternary/Tertiary clayey sediments; tuffaceous member of the Glen Ellen Formation; sandstone and mudstone including parts of the Glen Ellen and Huichica Formation; Petaluma Formation; Sonoma Volcanic tuff; silica carbonate rock; mudstone and shale of the Great Valley Sequence; and the siltstones and fine-grained sandstones of the Wilson Grove Formation.

**Areas Newly Classified MRZ-4 for Class II Base Aggregate**

Areas, outside of the previously classified areas in SR 146, Part III, where available information is inadequate for assignment to any other mineral resource zone are classified MRZ-4. All newly areas classified MRZ-4 for Class II Base are also classified MRZ-4 for PCC- and AC-grade aggregates (Plate 1C). A discussion of these areas is given in "Areas Newly Classified MRZ-4 for PCC-Grade Aggregate."

# PART III - REEVALUATION OF AGGREGATE RESOURCES IN THE NORTH SAN FRANCISCO BAY P-C REGION

A reevaluation of aggregate (PCC-, AC-, and Class II Base-grade) resources in the North San Francisco Bay P-C Region is presented in this section of the report. This reevaluation is based on a quantitative measurement of suitable aggregate resources classified as MRZ-2. This includes the areas designated by the Board in 1987 and newly identified areas reclassified as MRZ-2.

## CONCEPTS USED IN IDENTIFYING AGGREGATE RESOURCE SECTORS

In the mineral land classification process, the identification and creation of mineral resource zones is based on geologic factors alone without regard for current land uses. This results in the identification of resource areas on the maps, but does little to put into context the resource base available to meet the future needs of a region.

The State Geologist is responsible for identifying and calculating the amount of aggregate resources contained in areas classified as MRZ-2. Recognizing that there are lands within these areas that have already been urbanized, and therefore the mineral resources within them have a limited opportunity for conservation, development, and utilization, the State Geologist limits the aggregate resource calculations to areas within "Sectors."

Sectors are areas that have been classified as MRZ-2 by the State Geologist, and that have current land uses deemed compatible with mining based on criteria provided by the Board. Compatible land uses are defined as those that are non-urbanized or that have very low-density residential developments (one dwelling unit per ten acres or less), land without high-cost improvements, and land used for agriculture, grazing, or open space. Urbanization and/or incompatible land uses are defined as improvements of high cost, such as high-density residential developments, intensive industrial developments, commercial developments, and major public facilities.

The delineation of Sectors helps land-use planners and local governments focus on the areas that remain accessible for potential mineral extraction. The State Geologist calculates the available resources of each Sector and identifies the amount of remaining resources that have been permitted for mining (i.e., "reserves"). The calculated amount of reserves and resources within all the Sectors of a P-C region are compared with the State Geologist's forecast of the 50-year needs of that P-C region for the particular mineral resource.

Each Sector, or group of Sectors, meets or exceeds the Board's criteria for threshold value. Each Sector may be considered for designation as an area of regional or statewide significance by the Board pursuant to SMARA. The Board only considers lands within Sectors for designation.

For this update, the determination of land use as accessible for mineral extraction was based on conditions as of May 2012. The land use was determined by reference to satellite imagery, field reconnaissance, and consultation with local planners.

The Board's criteria for identifying Sectors focuses on the apparent suitability of the land for mining and does not take into consideration land commitments (other than approved tracts or Specific Plans) that may have been made that restrict the accessibility of some of the Sectors for mining. It is possible, therefore, that the available resource base as calculated by the State Geologist may be overestimated.

## RECALCULATION OF AVAILABLE AGGREGATE RESOURCES

In 1987 the Board designated 25 areas in the North San Francisco Bay P-C Region as containing aggregate resources of regional significance (California State Mining and Geology Board, January 1987). These 25 areas were identified as Sectors A through Y, with Sectors A, B, C, D, and G further divided into 24 subsectors. Appendix A lists all of the designated Sectors including their acreages and recalculated aggregate resources. Since 1987, the designated aggregate resources have been reduced by 19% (363 million tons) by mining and urbanization (16% and 3%, respectively).

In addition to the 25 designated areas, this report identifies 13 new areas containing significant aggregate resources totaling 853 million tons. These new areas are identified as Sectors AA through MM. Sectors AA through MM may be considered by the Board for designation in the future.

The areas of the Sectors, including the designated Sectors, were calculated for this update using a Geographic Information System (GIS). The total area of the 25 designated Sectors is 7,586 acres, which now contain 1,513 million tons of aggregate resources. The 13 newly identified areas cover 3,069 acres and contain an additional 853 million tons of aggregate resources, not including the Gualala River resources in Sector AA. Aggregate resources in the Gualala River are not included in the North San Francisco Bay P-C Region's resources because they are too far from the urbanized areas of the P-C Region to be economically transported. The combined resources total 2,365 million tons, of which 555 million tons are PCC-grade. This includes 115 million tons of reserves, of which an estimated 27 million tons are PCC-grade. Most factors, such as depth and density, used in this report to calculate aggregate resource totals are the same factors used in SR 146, Part III, and listed in that report.

## REEVALUATION OF PREVIOUSLY DESIGNATED AGGREGATE RESOURCE SECTORS IN THE NORTH SAN FRANCISCO BAY P-C REGION

There are 25 designated Sectors within the P-C Region—Sectors A through Y. Sectors A, B, C, D, and G are subdivided into 24 subsectors; details on the subsectors are provided in Appendix A. Following are descriptions of these designated Sectors with information on changes since the designation in 1987 noted:

**Sector A (PCC-grade)** - Alluvial deposits in the recent river channel of the Russian River in Alexander Valley in Sonoma County. The Sector extends from near the City of Cloverdale to a point 3 miles southeast of the community of Jimtown. Sector A has been subdivided into ten subsectors identified as A-1, A-2a, A-2b, A-2c, A-2d, A-3a, A-3b, A-3c, A-4a, and A-4b (Plate 2A). The combined area of the ten subsectors is 2,330 acres.

*Changes in Sector A Aggregate Resources:* The estimated resources for Sector A are 125.9 million tons of PCC-grade aggregate; this is about 50% of the amount identified in the designation report. Due to the geology of this part of the river valley, the estimated thickness of the aggregate deposits was reduced from 40 feet, as given in SR 146, Part III, to 20 feet. In 2012, there were no reserves (permitted resources).

**Sector B (PCC-grade)** - Alluvial deposits in the middle reach of the Russian River, and a small area of the Dry Creek channel one-half mile west of Healdsburg, in Sonoma County. This Sector extends from the City of Healdsburg to a point near the Wohler Road Bridge. Sector B is subdivided into seven subsectors identified as B-1, B-2a, B-2b, B-2c, B-2d, B-4d, and B-4e (Plate 2A). The combined area of the seven subsectors is 1,964 acres.

*Changes in Sector B Aggregate Resources:* The estimated resources for Sector B are 184.9 million tons of PCC-grade aggregate. This is 56% less than given in the designation report due to depletion by mining and losses from urbanization. Urbanization accounted for less than 10% of the decrease. The total area lost is about 750 acres, of which about 70 acres were urbanized. In 2012, there were no reserves (permitted resources).

**Sector C (PCC-grade)** - Alluvial deposits in two small areas along Sonoma Creek in Sonoma County. Sector C is divided into two subsectors identified as C-2a and C-3. Sector C-2a is about one mile south of Sonoma State Hospital; Sector C-3 is about one mile south of Boyes Hot Springs (Plate 2A). The combined area of the subsectors is 18 acres.

*Changes in Sector C Aggregate Resources:* Both subsectors C-2a and C-3 have been urbanized and the contained aggregate resources are precluded from mining.

**Sector D (PCC-grade) -** Consists of two areas underlain by Novato Conglomerate near Black Point in eastern Marin County (Plate 2B). This Sector is divided into two subsectors identified as D-1 (226 acres) and D-2 (131 acres) for a total of 357 acres.

*Changes in Sector D Aggregate Resources:* The northern 71 acres of subsector D-2 has been urbanized. This has reduced the resources by about 6 million tons. The estimated remaining resources are 23.4 million tons of PCC-grade aggregate.

**Sector E (AC-grade)** - A small basalt deposit on Petaluma Hill, near the southeastern edge of the City of Petaluma in Sonoma County (Plate 2B). The area of the Sector is 51 acres.

*Changes in Sector E Aggregate Resources:* The Sector is being urbanized and the contained aggregate resources are no longer minable.

**Sector F (Class II Base-grade)** - A small hard rock aggregate deposit west of the City of Cotati, in Sonoma County (Plate 2B). This Sector covers 31 acres.

*Changes in Sector F Aggregate Resources:* The Class II Base- and subbase-grade aggregate resources have been reduced by mining. The reserve and resource totals are proprietary.

**Sector G (PCC-grade)** - Three contiguous subsectors underlain by metamorphosed greywacke and greenstone, east of the City of Vallejo on the southern end of Sulfur Springs Mountain in Solano County (Plate 2C). The three subsectors are identified as G-1, G-2, and G-3. The combined area of the subsectors is 643 acres.

*Changes in Sector G Aggregate Resources:* The PCC-grade and all other aggregate resources are estimated at 350 million tons. The aggregate resources and reserves have been reduced by mining; the reserves are proprietary.

**Sector H (PCC-grade)** - An aggregate deposit of Sonoma Volcanics southeast of the City of Napa in Napa County (Plate 2C). It is 1,181 acres in area.

*Changes in Sector H Aggregate Resources:* All aggregate grades including PCC-grade resources are estimated at 626 million tons. The aggregate resources and reserves have been reduced by mining; the reserves are proprietary.

**Sector I (PCC-grade)** - A 145-acre area underlain by metamorphosed sandstone on Point San Pedro in eastern Marin County (Plate 2C).

*Changes in Sector I Aggregate Resources:* All aggregate grades including PCC-grade resources have been reduced by mining. The resource and reserve totals are proprietary.

**Sector J (AC-grade)** - An area underlain by andesite on Burdell Mountain, about two miles north of the City of Novato in Marin County (Plate 2B). The Sector covers 49 acres.

*Changes in Sector J Aggregate Resources:* All of Sector J has been urbanized and the contained aggregate resources are no longer available for mining.

**Sector K (Subbase-grade)** - Two areas underlain by rhyolite east of Dunbar Union School and northeast of the community of Glen Ellen in Sonoma County (Plate 2B). The Sector is 127 acres in area (in two separate parts).

*Changes in Sector K Aggregate Resources:* The aggregate resources have been reduced by mining. The resource total is estimated at 33 million tons.

**Sector L (Subbase-grade) -** A 15-acre area underlain by greenstone and pillow lava, in Millerton Gulch about 3.5 miles north of the community of Point Reyes Station in Marin County (Plate 2B). The resources are proprietary.

**Sector M (Subbase-grade) -** A small area underlain by serpentinite in upper Bowman Canyon on Burdell Mountain, about three miles northwest of Novato in Marin County (Plate 2B). The area of Sector M is 36 acres. The resources are proprietary.

**Sector N (Class II Base-grade)** - A 36-acre area underlain by bluish-gray to dark green and black greywacke and shale, about one mile west of the community of Forestville and south of Highway 116 in Sonoma County (Plate 2A).

*Changes in Sector N Aggregate Resources:* The aggregate resources in this Sector have been reduced by mining. The resources and reserves are proprietary.

**Sector O (Class II Base-grade) -** A 45-acre area underlain by massive, hard, gray to bluish gray greywacke and interbedded shale, about one mile west of the community of Forestville and north of Highway 116 in Sonoma County (Plate 2A).

*Changes in Sector O Aggregate Resources:* The aggregate resources in this Sector have been reduced by mining. The resource and reserve totals are proprietary.

**Sector P (Subbase-grade) -** A small area underlain by siltstone, shale, and indurated mudstone on the west side of Green Valley, about three miles southwest of Forestville in Sonoma County (Plate 2A). The area of the Sector is 78 acres. It has been mined for fill. The resource and reserve totals are proprietary.

**Sector Q (Subbase-grade) -** An area underlain by sandstone in Cheney Gulch, north of Highway 1 about 2.5 miles east of Bodega Bay in western Sonoma County (Plate 2C). The area of the Sector is 55 acres.

*Changes in Sector Q Aggregate Resources:* The aggregate resources in this Sector have been depleted.

**Sector R (Subbase-grade) -** A 112-acre area underlain by Franciscan Complex rocks, about 2.5 miles southeast of the City of Petaluma in Sonoma County (Plate 2B). The estimated resources are 23 million tons of subbase-grade aggregate. The reserve total is proprietary.

**Sector S (Subbase-grade) -** A 54-acre area underlain by basalt, about five miles east of Petaluma on Petaluma Creek Road in Sonoma County (Plate 2B). The resource and reserve totals are proprietary.

**Sector T (PCC-grade) -** This 27-acre area is underlain by both alluvial sand and gravel deposits in Austin Creek and hillside deposits of Franciscan metagreywacke. It is on Austin Creek about 1.5 miles north of Duncan Mills in western Sonoma County (Plate 2A).

*Changes in Sector T Aggregate Resources:* The aggregate resources and reserves in this Sector have been reduced by mining. The resource and reserve totals are proprietary.

**Sector U (PCC-grade) -** A 9-acre area underlain by alluvium at the confluence of the South Fork and the Wheatfield Fork of the Gualala River near Twin Bridges in northwestern Sonoma County (Plate 2C). This Sector is mined for PCC aggregate. The resource and reserve totals are proprietary. This Sector is too far from the major urban areas of the North Bay P-C Region to be considered a part of the available resources or reserves for the P-C Region, but they are important local sources of material for the Gualala area because of its remoteness.

**Sector V (AC-grade) -** An 80-acre area underlain by andesite on Burdell Mountain, about two miles north of the City of Novato in Marin County (Plate 2B).

*Changes in Sector V Aggregate Resources:* Six acres of Sector V have been urbanized reducing the resources by 3 million tons to 28 million tons.

**Sector W (AC-grade) -** A 61-acre area underlain by basalt on Porter Creek Road, about four miles east of the community of Mark West Springs in eastern Sonoma County (Plate 2A).

*Changes in Sector W Aggregate Resources:* The aggregate resources and reserves in this Sector have been reduced by mining. The aggregate resource and reserve totals are proprietary.

**Sector X (Subbase-grade) -** An area underlain by sandstone and andesite along Highway 121, about 2.5 miles north of Sears Point in southeastern Sonoma County (Plate 2B). The area of the Sector is 45 acres.

*Changes in Sector X Aggregate Resources:* All but about 10 acres of this Sector has been urbanized. The remaining resource and reserve totals are proprietary.

**Sector Y (Subbase-grade) -** A 37-acre area underlain by shale, about 2.5 miles west of Healdsburg in Sonoma County (Plate 2A). The resource and reserve totals are proprietary.

## NEWLY IDENTIFIED AGGREGATE RESOURCE SECTORS

There are 13 newly identified areas of aggregate resources in the North San Francisco Bay P-C Region. These areas are identified as Sectors AA through MM. Descriptions of these new Sectors follow:

**Sector AA (PCC-grade)** - Alluvial deposits along the Gualala River in northwestern Sonoma County (Plate 2C). Three subsectors are identified as AA-1 (main branch of the river), AA-2 (Wheatfield Fork of the river), and AA-3 (South Fork of the river). The combined area of the three subsectors is 860 acres; the estimated resources are 8.2 million tons of PCC-grade aggregate. Bedrock, Inc. mines several areas in this Sector. The reserves are proprietary. These resources are too far from the major urban areas of the North Bay P-C Region to be included in the available resource total for the P-C Region, but they are important local sources of material for the Gualala area because of its remoteness.

**Sector BB (PCC-grade) -** A 174-acre area underlain by alluvial deposits along the west side of the middle reach of the Russian River in Sonoma County (Plate 2A). There is an estimated resource of 28.2 million tons of aggregate resources in this Sector.

**Sector CC (PCC-grade) -** A 26-acre area underlain by alluvial deposits along the east side of the middle reach of the Russian River in Sonoma County (Plate 2A). There is an estimated resource of 4.2 million tons of aggregate resources in this Sector.

**Sector DD (AC-grade)** - An area adjacent to the Mark West Quarry in Sonoma County (Plate 2A). This Sector is divided into two subsectors—DD-1 and DD-2. DD-1 is a 431-acre area adjacent to the Mark West Quarry and DD-2 is a 260-acre area southeast of DD-1. The aggregate resource total is proprietary.

**Sector EE (Class II Base-grade) -** An area surrounding the active Blue Rock Quarry on the west, south, and east sides, in Sonoma County (Plate 2A). The Sector covers 93 acres. The Class II Base-grade aggregate reserves and resources are proprietary.

**Sector FF (Class II Base-grade) -** A 114-acre area surrounding the active Canyon Rock Quarry on the west north and east sides, in Sonoma County (Plate 2A). The aggregate reserve and resource totals are proprietary.

**Sector GG (Class II Base-grade) -** An area adjacent to the Bohan and Canelis Quarry (Plate 2A). This Sector is a hillside area adjacent to the quarry on the east and south. It covers 227 acres. The aggregate resource total is proprietary.

**Sector HH (PCC-grade) -** An area near the Bohan and Canelis Quarry in Sonoma County (Plate 2A). This Sector is a 15-acre area of Austin Creek, adjacent to and south (downstream) of Sector T. The aggregate resource total is proprietary.

**Sector II (PCC-grade) -** An area adjacent to the Bohan and Canelis Quarry in Sonoma County (Plate 2A). This Sector is a 27-acre hillside area adjacent to the Quarry. The aggregate resource total is proprietary.

**Sector JJ (Class II Base-grade) -** A 30-acre area adjacent to and west of the Stony Point Rock Quarry (Sector F) in Sonoma County (Plate 2B). The area was classified MRZ-2 in SR 146, Part III, but was not sectorized. It is herein classified MRZ-2 for Class II Base-grade aggregate. The resource total is proprietary.

**Sector KK (PCC-grade) -** A 113-acre area south of Roblar Road, about five miles west of Cotati, in Sonoma County (Plate 2B). The resource totals are proprietary.

**Sector LL (Class II Base-grade) -** A 186-acre area south of Roblar Road, about five miles west of Cotati, in Sonoma County (Plate 2B). The resource totals are proprietary.

**Sector MM (PCC-grade) -** An area adjacent to and east of Sector H in Napa County (Plate 2C). This Sector covers about 513 acres. The estimated aggregate resources total 278 million tons.

**Table 2. Summary of Construction-Grade Aggregate Resources in the North San Francisco Bay P-C Region in 2011.**

| Sector | Resources (includes Reserves) | Sector | Resources (includes Reserves) |
|---|---|---|---|
| **A** | 125.9 | **U** | †P |
| **B** | 184.9 | **V** | 28 |
| **C** | 0 | **W** | P |
| **D** | 23.4 | **X** | P |
| **E** | 0 | **Y** | P |
| **F** | P | **AA*** | †8.2 |
| **G** | P | **BB*** | 28.2 |
| **H** | 626 | **CC*** | 4.2 |
| **I** | P | **DD*** | P |
| **J** | 0 | **EE*** | P |
| **K** | 33 | **FF*** | P |
| **L** | P | **GG*** | P |
| **M** | P | **HH*** | P |
| **N** | P | **II*** | P |
| **O** | P | **JJ*** | P |
| **P** | P | **KK*** | P |
| **Q** | 0 | **LL*** | P |
| **R** | 23 | **MM*** | 278 |
| **S** | P | **Total** | **2,365.3** |
| **T** | P | | |

*** Newly identified Sector.**
**P: Proprietary**
**† Not included in total; see text for explanation.**

# PART IV - AGGREGATE PRODUCTION IN THE NORTH SAN FRANCISCO BAY P-C REGION

As of January 2012, the following seven companies had nine different permitted mining operations producing PCC, AC, and Class II Base aggregate in the North San Francisco Bay P-C Region:

Bedrock, Inc.
BoDean Company, Inc. (2)
Bohan and Canelis Company, Inc.
Canyon Rock Company, Inc.
Dutra Construction Company, Inc.
Stony Point Rock Quarry, Inc.
Syar Industries, Inc. (2)

Following are brief descriptions of these companies operations; more detailed information is provided in *Appendix B*:

Bedrock, Inc. mines PCC and other grades of aggregate from gravel bars along the Gualala River at their Twin Bridges Mine, east of Gualala, in the northwest corner of Sonoma County.

BoDean Company, Inc. operates the Blue Rock and Mark West quarries. The Blue Rock Quarry is about one mile west of Forestville and the Mark West Quarry is about four miles southwest of Calistoga, both in Sonoma County. The Blue Rock Quarry produces Class II Base as the highest grade of aggregate and the Mark West Quarry produces AC as the highest grade of aggregate.

Bohan and Canelis Company, Inc. operates a quarry and instream gravel bar skimming operation along Austin Creek in Sonoma County, about two miles west of Monte Rio. The highest grade of aggregate they produce is PCC.

Canyon Rock Company, Inc. operates a quarry about one mile west of Forestville in Sonoma County. The highest aggregate grade they produce is Class II Base.

Dutra Construction Company, Inc. operates the San Rafael Rock Quarry on the southwest side of San Pablo Bay in Marin County. The highest aggregate grade they produce is AC.

Stony Point Rock Quarry, Inc. operates a quarry in Sonoma County about two miles south of Cotati. Class II Base aggregate is the highest grade produced.

Syar Industries, Inc. operates the Napa Quarry in Napa County and the Lake Herman Quarry in Solano County. Both of the mines produce PCC and other grades of aggregate.

## AGGREGATE PRODUCTION DATA

Aggregate production data for the North San Francisco Bay P-C Region from 1990 through 2010 were derived from annual mine production data collected by the California Department of Conservation's Office of Mine Reclamation. Production figures for 1987 were gathered from producers by CGS in 1987; the production figures for 1988 and 1989 were interpolated from 1987 and 1990 data. Production figures for 1981 through 1986 are from US Bureau of Mines data. Production data from 1960 to 1980 is from SR 146, Part III.

As shown in Table 3, annual aggregate consumption since 1960 in the North San Francisco Bay P-C Region has ranged from 3.5 million tons (1960) to 11.6 million tons (1989). Since 1980 — the last year of data in the original report — about 241 million tons of aggregate have been consumed in the P-C Region. Average per capita consumption of aggregate in the North Bay P-C Region from 1960 through 2010 is 8.9 tons per year.

**Table 3. Population, Aggregate Production (all grades), and Per Capita Consumption in the North San Francisco Bay P-C Region 1960-2010.**

| YEAR | POPULATION | RECORDED AGGREGATE PRODUCTION (in tons) | PER CAPITA CONSUMPTION (in tons) | YEAR | POPULATION | RECORDED AGGREGATE PRODUCTION (in tons) | PER CAPITA CONSUMPTION (in tons) |
|---|---|---|---|---|---|---|---|
| 1960 | 431,000 | 3,450,000 | 8.0 | 1986 | 781,200 | 9,796,000 | 12.5 |
| 1961 | 444,500 | 4,794,000 | 10.8 | 1987 | 796,000 | 9,724,000 | 12.2 |
| 1962 | 460,000 | 4,259,000 | 9.3 | 1988 | 816,000 | 9,827,000 | 12.0 |
| 1963 | 477,200 | 4,284,000 | 9.0 | 1989 | 840,000 | 11,560,000 | 13.8 |
| 1964 | 495,500 | 5,156,000 | 10.4 | 1990 | 855,700 | 9,970,000 | 11.7 |
| 1965 | 514,500 | 5,027,000 | 9.8 | 1991 | 876,800 | 8,492,000 | 9.7 |
| 1966 | 527,200 | 4,512,000 | 8.6 | 1992 | 891,800 | 5,828,000 | 6.5 |
| 1967 | 540,300 | 4,509,000 | 8.3 | 1993 | 903,900 | 6,663,000 | 7.4 |
| 1968 | 553,300 | 4,642,000 | 8.4 | 1994 | 910,200 | 6,331,000 | 7.0 |
| 1969 | 565,900 | 4,746,000 | 8.4 | 1995 | 916,800 | 5,933,000 | 6.5 |
| 1970 | 571,600 | 4,064,000 | 7.1 | 1996 | 922,900 | 7,648,000 | 8.3 |
| 1971 | 588,300 | 4,461,000 | 7.6 | 1997 | 939,200 | 8,899,000 | 9.5 |
| 1972 | 602,800 | 5,130,000 | 8.5 | 1998 | 950,400 | 8,816,000 | 9.3 |
| 1973 | 617,300 | 5,843,000 | 9.5 | 1999 | 965,800 | 9,974,000 | 10.3 |
| 1974 | 628,100 | 5,360,000 | 8.5 | 2000 | 976,400 | 8,270,000 | 8.5 |
| 1975 | 638,600 | 4,164,000 | 6.5 | 2001 | 981,500 | 8,488,000 | 8.6 |
| 1976 | 654,700 | 4,641,000 | 7.1 | 2002 | 986,700 | 8,984,000 | 9.1 |
| 1977 | 764,900 | 5,476,000 | 7.2 | 2003 | 991,800 | 7,461,000 | 7.5 |
| 1978 | 692,700 | 6,702,000 | 9.7 | 2004 | 997,000 | 7,500,000 | 7.5 |
| 1979 | 700,400 | 7,022,000 | 10.0 | 2005 | 1,002,100 | 7,943,000 | 7.9 |
| 1980 | 716,700 | 6,198,000 | 8.6 | 2006 | 1,007,300 | 6,413,000 | 6.4 |
| 1981 | 730,800 | 8,352,000 | 11.4 | 2007 | 1,012,400 | 6,778,000 | 6.7 |
| 1982 | 740,700 | 8,311,000 | 11.2 | 2008 | 1,017,500 | 4,753,000 | 4.7 |
| 1983 | 750,800 | 9,469,000 | 12.6 | 2009 | 1,022,700 | 4,190,000 | 4.1 |
| 1984 | 756,100 | 11,018,000 | 14.6 | 2010 | 1,028,500 | 3,524,000 | 3.4 |
| 1985 | 767,100 | 9,877,000 | 12.9 | AVERAGE | | | 8.9 |

**Population figures are rounded to the nearest 100. Aggregate production figures are rounded to the nearest 1,000 tons.**

# PART V - UPDATED ESTIMATE OF 50-YEAR CONSUMPTION OF AGGREGATE IN THE NORTH SAN FRANCISCO BAY P-C REGION

The Board, in its guidelines for classification and designation of mineral land (California State Mining and Geology Board, 2000), specifies 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, i.e. the production-consumption (P-C) 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." This section contains the revised estimate of aggregate needs for the North San Francisco Bay P-C Region, projected through the year 2060.

## CORRELATION BETWEEN AGGREGATE CONSUMPTION AND POPULATION

Past studies of production-consumption regions in California have shown a correlation between the amount of aggregate consumed and the population of the market area (Anderson and others, 1979). An aggregate report for Los Angeles County (Miller, 1994) includes a statistical analysis of aggregate consumption versus population, suggesting that roughly two-thirds of the variation in aggregate consumption could be attributed to population variance. The fact that large market regions such as Los Angeles County show a correlation between aggregate production and population indicate that population is a major factor in determining aggregate consumption in many areas. Other factors, such as major public construction projects can randomly add large amounts of aggregate to consumption figures. The economy also has a strong influence on aggregate demand; but, the simple factor of population was selected because it most influences aggregate demand over long periods of time.

A comparison of the projected aggregate demand for the North San Francisco Bay P-C Region, from SR 146, Part III, and actual production data for the period of 1981 to 2009 is shown in Figure 2. SR 146, Part III used an annual per capita consumption rate of 8.8 tons to project that the demand for aggregate in the North San Francisco Bay P-C Region from 1981-2009 would be 238 million tons. Recorded aggregate consumption in the North San Francisco Bay P-C Region for that time period was 241 million tons — about 1% more.

## POPULATION PROJECTION FOR THE NORTH SAN FRANCISCO BAY P-C REGION THROUGH THE YEAR 2060

Population data for the North San Francisco Bay P-C Region for 1960 to 1980 were taken from SR 146, Part III. Population data for the Region for the years 1981 to 2010 were obtained from census tract population data from the U.S. Census Bureau (2010) for the 1990, 2000 and 2010 censuses. The population of complete census tracts within the P-C Region was summed with the partial population of partial tracts. The population of partial tracts was assumed to be the same

as the percentage of the included area. Population for each year between the decennial census years was interpolated.

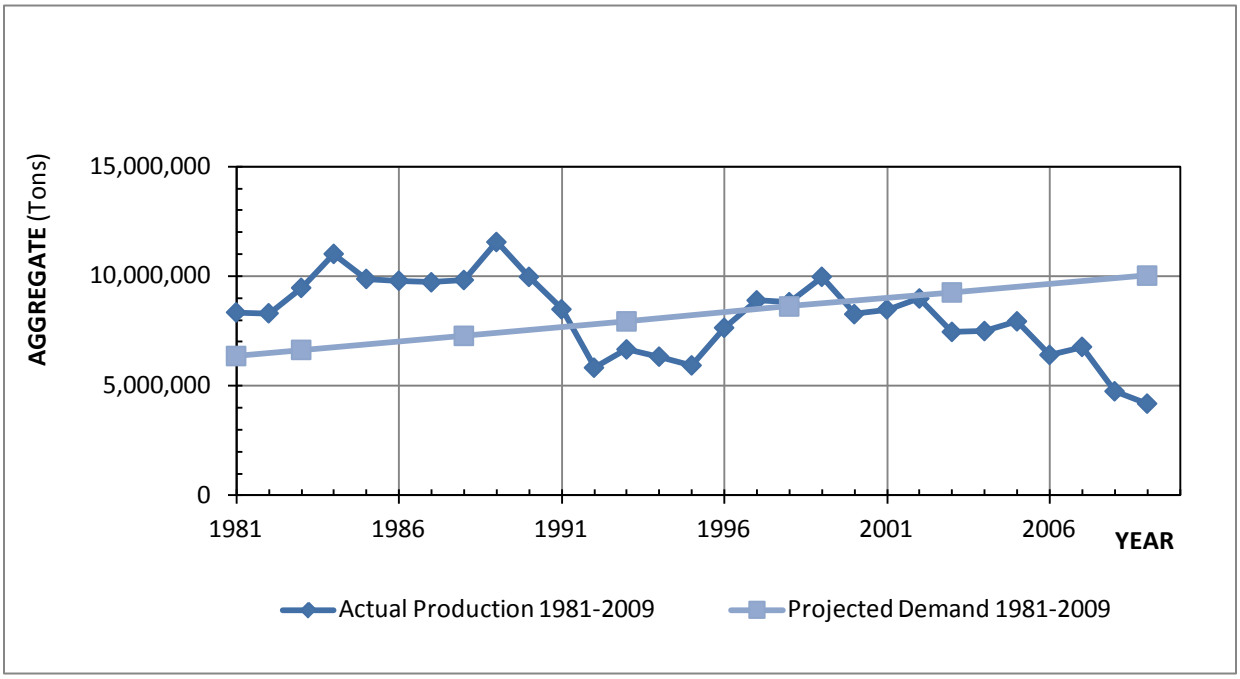


**Figure 2. Comparison of projected aggregate demand in the North San Francisco Bay P-C Region with recorded aggregate production from 1981 to 2009.**

The population projection for the North San Francisco Bay P-C Region (Table 4) was estimated from official projections for counties published by the California Department of Finance's Demographic Research Unit (State of California, Department of Finance, 2010) and the population percentage factor for the P-C Region, cited above. Report 06 P-1 (on the California Department of Finance's website) provides population projections for counties in California forthe years 2010, 2020, 2030, 2040 and 2050. Yearly population estimates were interpolated from the bracketing 10-year projected population numbers and extrapolated for the years 2051 through 2060. The population of the North San Francisco Bay P-C Region is projected to increase from 1,023,000 in 2011 to 1,339,000 in 2060.

## PROJECTED AGGREGATE DEMAND FOR THE NORTH SAN FRANCISCO BAY P-C REGION THROUGH THE YEAR 2060

An analysis using projected population and an annual per capita consumption rate, derived by methods described in preceding sections, was used to forecast the aggregate demand of the North San Francisco Bay P-C Region through the year 2060 (Table 4). The calculated annual per capita consumption rate of 8.9 tons (from Table 3) was multiplied by the projected population for each year through the year 2060 to produce the projected aggregate demand (shown in Figure 3).

This projection indicates that an estimated 521 million tons of aggregate will be needed in the North San Francisco Bay P-C Region through the year 2060. Of this total, it is estimated that approximately 25 percent, or 130 million tons, will be used in PCC, with the remainder being used as other construction aggregates. This updated 50-year demand is 9 percent higher than the 50-year demand of 478 million tons projected in SR 146, Part III (1987).

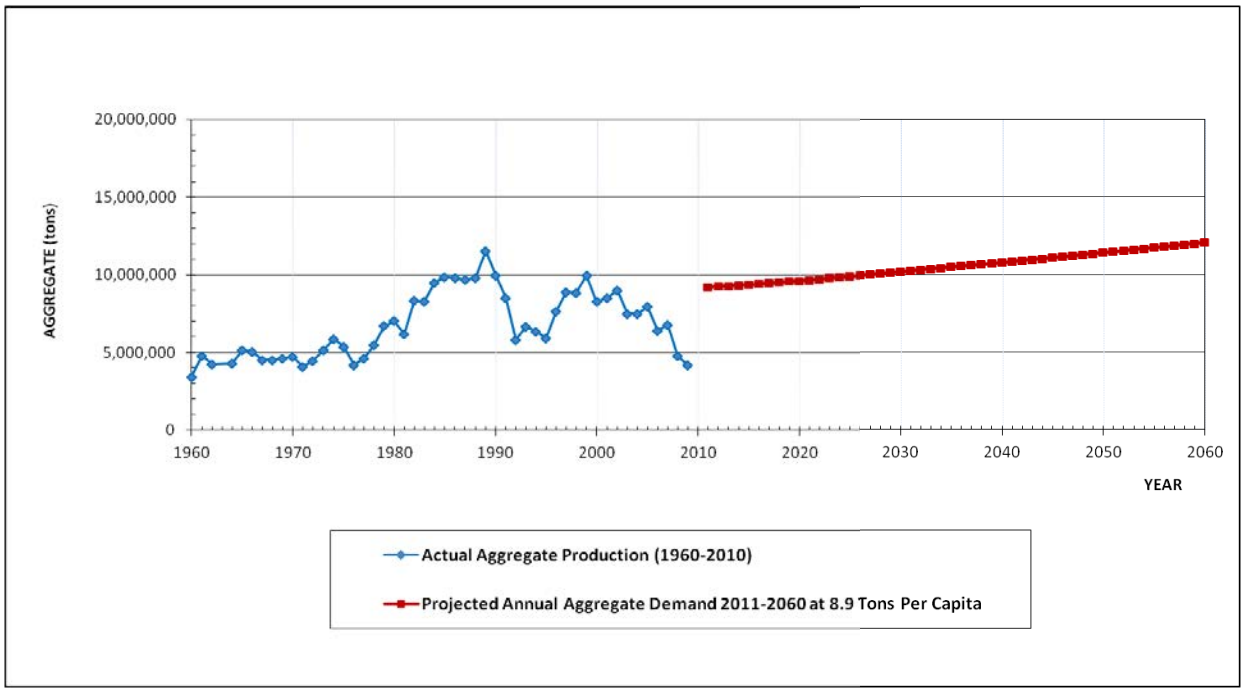


**Figure 3. Actual Aggregate Production and Projected Aggregate Demand (1960 -2060).**

## COMPARISON OF THE 50-YEAR AGGREGATE DEMAND WITH CURRENT AGGREGATE RESERVES

The total aggregate reserves (i.e. permitted resources) of 115 million tons in the North San Francisco Bay P-C Region are projected to last 10 years (into the year 2023). The 27 million tons of PCC-grade reserves will not likely last any longer, even if they are used exclusively for PCC. It is more likely that some of the PCC-grade aggregate reserves will be used for lower grade aggregate products and that the reserves and will be depleted before 2023. Another important consideration is that not all of the aggregate reserves may be minable under the present permits because of operating restrictions or because of expiration dates that may not allow reserves to be completely mined.

**Table 4. Projected Population and Aggregate Demand in the North San Francisco Bay P-C Region 2011-2060.**

| YEAR | PROJECTED POPULATION | PROJECTED AGGREGATE DEMAND (in tons) | PROJECTED PCC AGGREGATE DEMAND (in tons) | YEAR | PROJECTED POPULATION | PROJECTED AGGREGATE DEMAND (in tons) | PROJECTED PCC AGGREGATE DEMAND (in tons) |
|---|---|---|---|---|---|---|---|
| 2011 | 1,023,000 | 9,105,000 | 2,276,000 | 2037 | 1,178,400 | 10,488,000 | 2,622,000 |
| 2012 | 1,027,800 | 9,148,000 | 2,287,000 | 2038 | 1,184,800 | 10,544,000 | 2,636,000 |
| 2013 | 1,032,700 | 9,191,000 | 2,298,000 | 2039 | 1,191,100 | 10,601,000 | 2,650,000 |
| 2014 | 1,037,500 | 9,234,000 | 2,309,000 | 2040 | 1,197,400 | 10,657,000 | 2,664,000 |
| 2015 | 1,042,300 | 9,277,000 | 2,319,000 | 2041 | 1,204,200 | 10,717,000 | 2,679,000 |
| 2016 | 1,047,600 | 9,324,000 | 2,331,000 | 2042 | 1,210,900 | 10,777,000 | 2,694,000 |
| 2017 | 1,052,900 | 9,371,000 | 2,343,000 | 2043 | 1,217,600 | 10,837,000 | 2,709,000 |
| 2018 | 1,058,200 | 9,418,000 | 2,355,000 | 2044 | 1,224,300 | 10,896,000 | 2,724,000 |
| 2019 | 1,063,500 | 9,465,000 | 2,366,000 | 2045 | 1,231,000 | 10,956,000 | 2,739,000 |
| 2020 | 1,068,700 | 9,512,000 | 2,378,000 | 2046 | 1,238,200 | 11,020,000 | 2,755,000 |
| 2021 | 1,074,900 | 9,567,000 | 2,392,000 | 2047 | 1,245,500 | 11,085,000 | 2,771,000 |
| 2022 | 1,081,100 | 9,622,000 | 2,406,000 | 2048 | 1,252,700 | 11,149,000 | 2,787,000 |
| 2023 | 1,087,300 | 9,677,000 | 2,419,000 | 2049 | 1,259,900 | 11,213,000 | 2,803,000 |
| 2024 | 1,093,500 | 9,732,000 | 2,433,000 | 2050 | 1,267,100 | 11,277,000 | 2,819,000 |
| 2025 | 1,099,700 | 9,787,000 | 2,447,000 | 2051 | 1,274,300 | 11,341,000 | 2,835,000 |
| 2026 | 1,106,000 | 9,844,000 | 2,461,000 | 2052 | 1,281,500 | 11,405,000 | 2,851,000 |
| 2027 | 1,112,400 | 9,900,000 | 2,475,000 | 2053 | 1,288,700 | 11,470,000 | 2,868,000 |
| 2028 | 1,118,800 | 9,957,000 | 2,489,000 | 2054 | 1,295,900 | 11,534,000 | 2,884,000 |
| 2029 | 1,125,100 | 10,014,000 | 2,504,000 | 2055 | 1,303,100 | 11,598,000 | 2,900,000 |
| 2030 | 1,131,500 | 10,070,000 | 2,518,000 | 2056 | 1,310,300 | 11,662,000 | 2,916,000 |
| 2031 | 1,138,300 | 10,131,000 | 2,533,000 | 2057 | 1,317,500 | 11,726,000 | 2,932,000 |
| 2032 | 1,145,200 | 10,192,000 | 2,548,000 | 2058 | 1,324,800 | 11,790,000 | 2,948,000 |
| 2033 | 1,152,000 | 10,253,000 | 2,563,000 | 2059 | 1,332,000 | 11,855,000 | 2,964,000 |
| 2034 | 1,158,800 | 10,314,000 | 2,579,000 | 2060 | 1,339,000 | 11,919,000 | 2,980,000 |
| 2035 | 1,165,700 | 10,374,000 | 2,594,000 | 50-YEAR DEMAND | | 521,427,000 | 130,361,000 |
| 2036 | 1,172,000 | 10,431,000 | 2,608,000 | | | | |

**Population figures are rounded to the nearest 100. Aggregate demand figures are rounded to the nearest 1,000 tons.**

Comparing regional needs to available reserves and resources demonstrates the construction aggregate resource issues confronting the P-C Region. This includes the need to plan carefully for the use of lands containing these resources and the need to consider the permitting of additional aggregate resources in the region before currently permitted deposits are depleted. Table 5 summarizes the identified aggregate resources and estimated future aggregate demands for the North San Francisco Bay P-C Region. The projected lifespan of the aggregate reserves assumes that mining of these reserves will continue until the reserves are depleted. Should unforeseen events occur, such as massive urban renewal, infrastructure projects, reconstruction in the wake of a disaster, or major economic recession, the demand for construction aggregate in the North San Francisco Bay P-C Region could change considerably, which could alter the lifespan of the aggregate reserves.

**Table 5. Summary of Aggregate Resources, Aggregate Reserves, Projected 50-year Demand, and Depletion Date for the North San Francisco Bay P-C Region.**

| | |
|---|---|
| **Estimated Construction Aggregate Resources (**all grades**)** | **2,365 Million Tons** |
| **Construction Aggregate Reserves** (Permitted Resources - all grades**)** | **115 Million Tons** |
| **Projected 50-Year Demand for Construction Aggregate (**all grades**)** | **521 Million Tons** |
| **Projected 50-Year Demand for *PCC-Grade* Aggregate** | **130 Million Tons** |
| **Estimated Years Until Depletion of Current Aggregate Reserves** | **10 Years** |
| **Estimated Depletion Date of Aggregate Reserves** | **2023** |

## POTENTIAL ALTERNATIVE SOURCES OF AGGREGATE FOR THE NORTH SAN FRANCISCO BAY P-C REGION

Potential sources of aggregate, in addition to the deposits classified MRZ-2 in this update report, exist within and near the North San Francisco Bay P-C Region. The potential sources within the region are in areas that are classified as MRZ-3 and include areas underlain by the Franciscan Complex and the Sonoma Volcanics. Potential sources outside of the P-C Region include imported aggregate from Canada and dredge sand from nearby bays.

### Alternative Aggregate Sources within the P-C Region

Franciscan Complex

Franciscan Complex greywacke and greenstone are mined at several crushed stone quarries in the North San Francisco Bay Region. These deposits are classified MRZ-2 for PCC, AC, or Class II Base aggregate. Lands within the P-C Region containing potential aggregate resources classified MRZ-3 are underlain by Franciscan greywacke and greenstone that are not currently being mined. These rocks commonly show extensive surface weathering making the near-surface rock unsuitable for higher use aggregate such as PCC, AC, or Class II Base, but they may grade into relatively unweathered, higher quality rock at depth.

Other Franciscan Complex rocks that have been mined for Class II Base (highest use) include serpentinite and ultramafic rock. These bodies of rock can range in size from a few feet to many acres. Bodies of this rock lying within the P-C Region that are large enough to map, are classified MRZ-3 for Class II Base. Franciscan serpentinite and ultramafic rocks commonly contain or are associated with naturally occurring asbestos. In recent years, health issues associated with the mining and use of these rocks throughout California has resulted in restrictions on the end use of aggregate from such deposits that contain asbestos.

Sonoma Volcanic Rocks

The Sonoma Volcanics are a complex series of lava flows and tuffaceous beds that are occasionally interbedded with beds of non-marine sandstone, gravel, and conglomerate. The unit also contains sporadic occurrences of diatomite, pumice, obsidian and perlitic glass. Andesitic and basaltic lava flows make up about 60% of the Sonoma Volcanic sequence. The basaltic rocks occasionally meet quality specifications for AC aggregate, but they usually are not suitable for making aggregate products higher than Class II Base.

Basalt is mined at several quarries in the North San Francisco Bay Region. These deposits are classified MRZ-2 for Class II Base aggregate. Lands within the P-C Region containing potential alternative aggregate resources underlain by basalts are classified MRZ-3. Like the Franciscan Complex rocks, the Sonoma Volcanics commonly show extensive surface weathering making the rock unsuitable for Class II Base, but they may grade into relatively unweathered, higher quality rock at depth. Also, weathering along fracture zones, even at considerable depth, can cause the rock to be friable, making it unsuitable even for use as Class II Base. Operators developing future quarry sites underlain by rocks of the Sonoma Volcanic unit need to consider the same economic concerns discussed in the previous “Franciscan Complex” section. Exploration and testing may identify additional exploitable basalt deposits in the P-C Region.

**Alternative Aggregate Sources outside the P-C Region**

Bay and Marine Sand Resources

Bay and marine sand deposits exist in several places within the San Francisco, San Pablo, and Suisun bays, and offshore from the Golden Gate Channel. In most areas of the bay the sand is too fine or contains too much mud and silt to be economically processed for aggregate. Sand deposits have been extracted both west and east of the Carquinez Strait. Sand deposits within the San Francisco Bay occur in the vicinity of the Point Knox-Alcatraz-Presidio shoals. About 25 percent of the coarse fraction of these sands can be used for making PCC aggregate. The finer 75 percent fraction is used as fill material (Kohler-Antablin, 1996).

Most of the marine sands dredged from San Francisco Bay and San Pablo Bay are consumed in the neighboring South San Francisco Bay P-C Region (Kohler-Antablin, 1996).

Sand and gravel deposits in parts of the Golden Gate Bar area offshore of the Golden Gate Channel—known as the ‘potato patch’—are potential future aggregate sources. However, environmental constraints may limit large-scale extraction of these resources.

Canadian Aggregate Resources

Before 2007, most aggregate shipped from Canada into the San Francisco Bay was used in the South San Francisco Bay P-C Region. In 2007, Polaris Minerals began shipping aggregate from British Columbia to San Francisco Bay where it was loaded onto barges, transported up the Petaluma River, and off loaded at the Shamrock Material Inc. facility in Petaluma. Currently, the amount of aggregate coming into the North San Francisco Bay P-C Region from Canada is less than 10 percent of the total amount of aggregate consumed in the P-C Region, however, it makes up nearly one-third of the PCC aggregate consumed. Canadian aggregate likely will continue to be an important source for the P-C Region.

## Recycled Aggregate

During the past three decades, the recycling of concrete rubble and slab asphalt rubble has steadily increased in California. The most recycled materials in California, by tonnage, are asphalt and concrete. Recycling programs that recover demolition rubble, such as concrete and asphalt, significantly help reduce the waste-stream going into landfills and also extend the life of existing aggregate mines. However, recycled aggregate generally is not suitable for use as PCC aggregate. Many aggregate plants are equipped to collect and make base grade aggregate from this material. Also, a percentage of recycled asphalt pavement (RAP) can be added directly to the hot asphalt mix. California aggregate companies mainly process demolition debris into road base although the use of RAP has been steadily increasing. An estimated 4% to 8% of the total amount of aggregate used in the North San Francisco Bay region is from recycled aggregate. However, aggregate recycling has not significantly reduced consumption of newly mined aggregate in the region.

# PART VI - CONCLUSIONS

As of October 2011, the North San Francisco Bay P-C Region contained approximately 2,365 million tons of identified aggregate resources (PCC-, AC-, and Class II Base-grades). This represents an increase of about 489 million tons from the 1,876 million tons of aggregate resources designated in 1987. This includes a reduction of 237 million tons because of production and urbanization, and a decrease of about 126 million tons resulting from the recalculation of existing aggregate resources. The new resource estimate also includes an additional 853 million tons of aggregate resources identified in this study.

Based on available historic population and production data, and population projections, the North San Francisco Bay P-C Region will need approximately 521 million tons of aggregate during the next 50 years. Of this projected demand, it is estimated that 25 percent, or 130 million tons, must be suitable for use in PCC. The presently permitted aggregate reserves of 115 million tons (all grades) are projected to last until the year 2023 or 11 years from the present. The current PCC-grade reserves of 27 million tons may last until 2023, but are likely to be depleted sooner. If a large scale construction project or catastrophic event requiring rebuilding occurs in the P-C Region, existing reserves may be depleted sooner than projected. A comparison of the results of this update with those of SR 146, Part III and the Designation Report is presented in Table 6.

**Table 6. Results of this Update Report Compared with Special Report 146, Part III and the Board Designation Report for the North San Francisco Bay P-C Region.**

| | **Special Report 146** (or Designation Report †) | **This Update Report** |
|---|---|---|
| **Identified Aggregate Resources*** | **1,876 Million Tons†** (All Grades) | **2,365 Million Tons** (PCC-, AC-, and Class II Base-Grades, only) |
| **Identified PCC-Grade Aggregate Resources** | **~ 854 Million Tons** | **951 Million Tons** |
| **Aggregate Reserves*** | **540 Million Tons** (All Grades) | **115 Million Tons** (PCC-, AC-, and Class II Base -Grade, only) |
| **Projected 50-year Demand For All Construction Aggregate** | **478 Million Tons** | **521 Million Tons** |
| **Estimated Years Until Depletion of Current Aggregate Reserves*** | **58 Years** | **10 Years** |
| **Estimated Depletion Date of Reserves*** | **2044** | **2023** |
| **Calculated Per Capita Annual Aggregate Consumption** | **8.8 Tons** | **8.9 Tons** |

**† California Department of Conservation, 1987.**

*** Reserves are aggregate deposits 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. 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.**

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# APPENDIX A

## Summary Table of Designated Sectors and Newly Identified Sectors in the North San Francisco Bay P-C Region

| Sector | Area (acres) | Resources (includes reserves) (million tons) | Sector | Area (acres) | Resources (includes reserves) (million tons) |
|---|---|---|---|---|---|
| A-1 | 146 | 7.9 | N | 36 | P |
| A-2a | 67 | 3.6 | O | 45 | P |
| A-2b | 281 | 15.2 | P | 78 | P |
| A-2c | 335 | 18.1 | Q | 55 | 0 |
| A-2d | 588 | 31.8 | R | 112 | 23 |
| A-3a | 214 | 11.6 | S | 54 | P |
| A-3b | 236 | 12.8 | T | 27 | P |
| A-3c | 175 | 9.4 | U | 9 | †P |
| A-4a | 94 | 5.1 | V | 80 | 28 |
| A-4b | 194 | 10.5 | W | 61 | P |
| B-1 | 88 | 4.8 | X | 45 | P |
| B-2a | 529 | 61.5 | Y | 37 | P |
| B-2b | 536 | 49.6 | **Subtotal A-Y** | **7,586** | **1,512.5** |
| B-2c | 620 | 50.3 | *AA-1 | 582 | †3.9 |
| B-2d | 151 | 15.5 | *AA-2 | 152 | †2.4 |
| B-4d | 31 | 2.5 | *AA-3 | 126 | †1.9 |
| B-4e | 9 | 0.7 | *BB | 174 | 28.2 |
| C-2a | 9 | 0 | *CC | 26 | 4.2 |
| C-3 | 9 | 0 | *DD-1 | 431 | P |
| D-1 | 226 | 18.5 | *DD-2 | 260 | P |
| D-2 | 131 | 4.9 | *EE | 93 | P |
| E | 51 | 0 | *FF | 114 | P |
| F | 31 | P | *GG | 227 | P |
| G-1 | 182 | P | *HH | 15 | P |
| G-2 | 90 | P | *II | 27 | P |
| G-3 | 371 | P | *JJ | 30 | P |
| H | 1,181 | 626 | *KK | 113 | P |
| I | 145 | P | *LL | 186 | P |
| J | 49 | 0 | *MM | 513 | 278 |
| K | 127 | 33 | **Subtotal AA-MM** | **3,069** | **852.9** |
| L | 15 | P | **Total A-MM** | **10,655** acres | **2,365.4** million tons |
| M | 36 | P | | | |

**P: Proprietary**
***: Newly Identified Sector.**
**†: Not included in total; see text for explanation.**

# APPENDIX B

## Active Aggregate Mines in the North San Francisco Bay P-C Region (In alphabetical order by mine operator)

### Bedrock, Inc. - Twin Bridges

CA Mine ID#: 91-49-0052

Products: PCC and AC aggregate.

This operation is permitted to skim gravel bars in an area of about 7 miles along the main branch of the Gualala River northwest of the Wheatfield Fork and the Gualala River South Fork confluence, along 4.5 miles of the Wheatfield Fork, and along 4.5 miles of the Gualala River South Fork, in northwestern Sonoma County. Annual monitoring of the amount of aggregate excavated is designed to maintain the Gualala River in an aggrading condition. Skimming is done with paddle wheel scrappers. An estimated 90% of the material mined is trucked about 7 miles north to a cement ready-mix batch plant located in Gualala, Mendocino County. The remaining 10% is sold at the plant site for local use. The site is within designated Sector U and new Sector AA.

### BoDean Company, Inc. - Blue Rock Quarry

CA Mine ID#: 91-49-0043

Products: Class II Base, subbase, drain rock, engineered fill,

The 56-acre mine site located about one mile west of the unincorporated town of Forestville. The original 14-acre site was permitted in 1957. A 17-acre expansion in 1981 and a 24-acre expansion in 2007 have increased the site to 56 acres. The latest expansion increases the life of the mine by 20+ years. The current operator purchased the property in 1997. Rock is mined by blasting and ripping. Rock is crushed and screened at the on-site plant. The site is within designated Sector N and new Sector EE.

### BoDean Company, Inc. - Mark West Quarry

CA Mine ID#: 91-49-0032

Products: AC aggregate, Class II Base, subbase, drain rock, riprap, engineered fill, and ornamental/landscape rock.

Aggregate is mined from a rock quarry on 34 acres, located about 4 miles southwest of Calistoga. There have been intermittent mining operations at this site since 1910. The current operator has been mining at the site since 1989. This quarry has been developed into steep, high, south-facing slopes that extend to the top of a dominant ridgeline that trends east-west. Overburden averages about 40 feet in thickness and is sold for fill. The company is also

planning to put in a wash plant to make manufactured sand for asphalt and PCC sand from rock at the quarry. The site is within designated Sector W and new Sector DD.

**Bohan & Canelis Company, Inc. - Skimming Site and Quarry**

CA Mine ID#: 91-49-0034

Products: PCC aggregate, Class II Base, subbase, fill sand, and decorative rock.

Mining operations consist of in-stream gravel bar skimming in Austin Creek and an adjacent 38.5-acre quarry. The site has been mined since 1946. Blasting and dozer ripping is used to mine the adjacent Franciscan Complex greywacke and shale in the quarry. Crushed rock and manufactured sand from the greywacke have been tested and meets standard specifications for PCC aggregate. In 1987, the operator obtained a permit to skim up to 50,000 tons of alluvial aggregate from Austin Creek; the amount skimmed per year is dependent on aggregate recharge. The site is within designated Sector T.

**Canyon Rock Company, Inc. - Canyon Rock Quarry**

CA Mine ID#: 91-49-0004

Products: Class II Base, drain rock, and fill. Some PCC aggregate is produced for company use.

Franciscan greywacke and minor shale are mined from a quarry of 107-acres, located north of highway 16 and about a mile west of the town of Forestville in Sonoma County. Quarry operations have been ongoing for approximately 60 years. Mining occasionally requires blasting. Processing includes rock crushing with both jaw and cone type crushers. Demolition concrete is imported to this plant for processing into Class II Base aggregate. The Quarry site has a concrete batch plant for processing sand and gravel from off-site alluvial sources. The operator was granted a permit expansion in December 2006 to mine an additional 32 acres of land containing 15 million tons of construction aggregate to be mined over a period of 20 years. The site is within designated Sector O and new Sector FF.

**Dutra Construction Company - San Rafael Rock Quarry**

CA Mine ID#: 91-21-0008

Products: AC aggregate, rip rap, Class II Base, sub-base, drain rock, and fill.

Franciscan greywacke is quarried on a 286-acre site, located on a prominent point along the southwest side of San Pablo Bay in Marin County. The 100-year-old quarry has been operated by the Dutra Construction Company, since 1986. The quarry was formerly owned and operated by McNear Company, Inc. and Basalt Rock Company. The main mine products are AC aggregate and rip rap. The quarry location on San Pablo Bay allows for easy transport of rock via barge for river and delta construction projects. Riprap as large as 4 feet in diameter is excavated and transported by barge. The site is within designated Sector I.

**Stony Point Rock Quarry, Inc. - Cotati**

CA Mine ID#: 91-49-0006

Products: Class II Base, drain rock, fill, and rip rap.

Hard rock is quarried from a 70-acre area, located about 2 miles south of Cotati. The quarry has been worked since the 1920s. Demolition asphalt and concrete are trucked to this site for processing into Class II Base. This site is in designated Sector F.

**Syar Industries, Inc. - Lake Herman Quarry**

CA Mine ID#: 91-48-0002

Products: PCC and AC aggregate, Class II Base, subbase, and rip rap.

Aggregate has been mined from this site and nearby sites on Sulphur Springs Mountain since the 1870s. The mine on east side of Sulphur Springs Mountain was called the Hastings Mine, and an old mine on the west side of Sulphur Springs Mountain was called the Brownlie Mine. Mining from the Brownlie Mine continued until 1930. Mining at the Lake Herman Quarry started in the early 1940s and continued at a small scale until 1965, when Syar Industries, Inc. acquired this site and expanded production. This mine site is in designated Sector G.

**Syar Industries, Inc. - Napa Quarry**

CA Mine ID#:91-28-0004

Products: PCC and AC aggregate, base, and subbase.

Mining operations at this site started in the early 1900s. Basalt Rock, a Division of Dillingham Heavy Construction, Inc. acquired 673 acres of this site in 1924. In 1961, a 128 acre parcel on the north boundary of this site was leased for mining (the area for mining was later reduced in the early 1970s to 101 acres). Basalt, rhyolite and volcanic cinders are mined from the Sonoma Volcanics. This site has two asphalt batch plants; one with a 10,000 pound capacity, and a smaller one with 6,000 pound capacity. This mine site is in designated Sector H.