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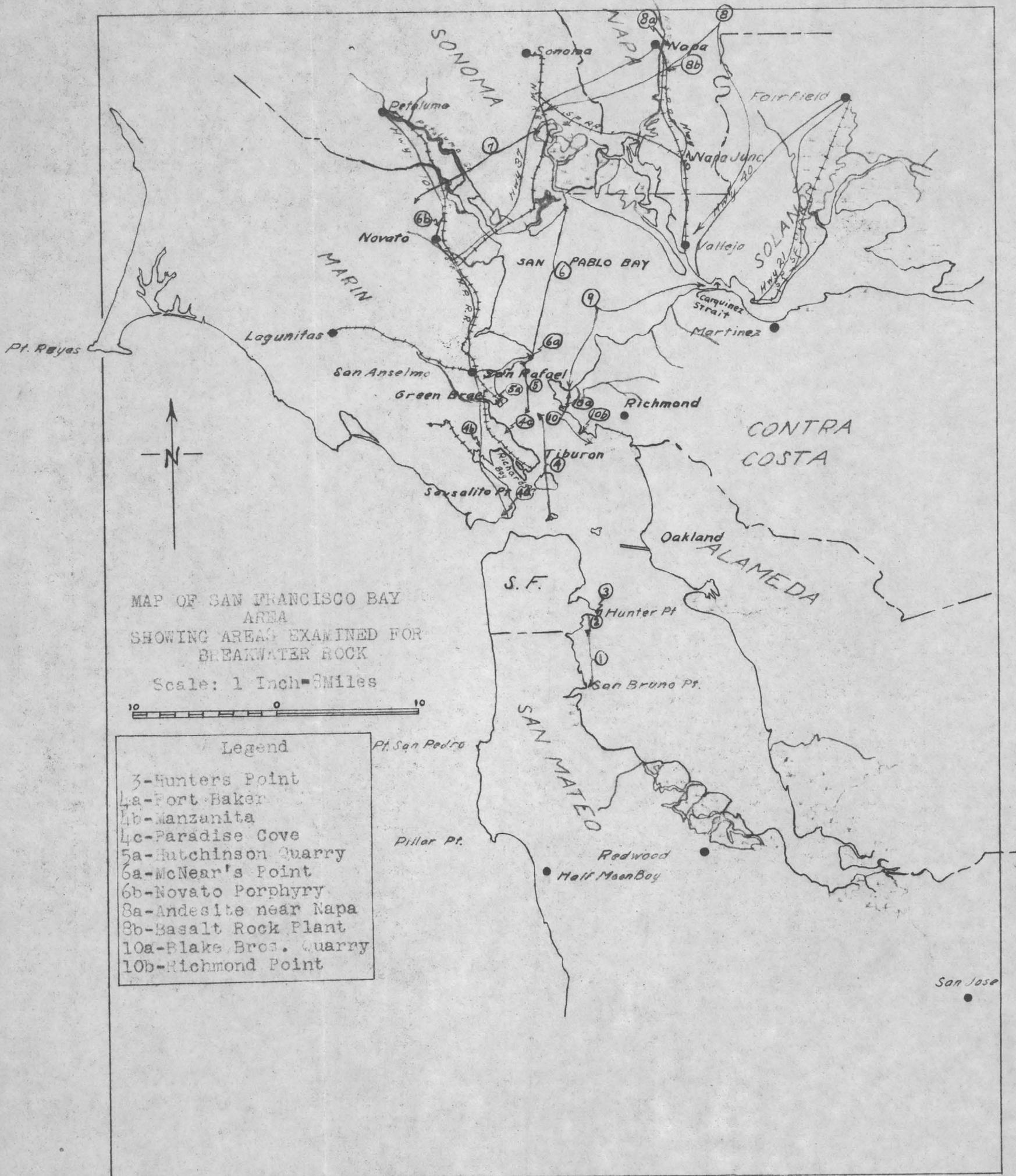
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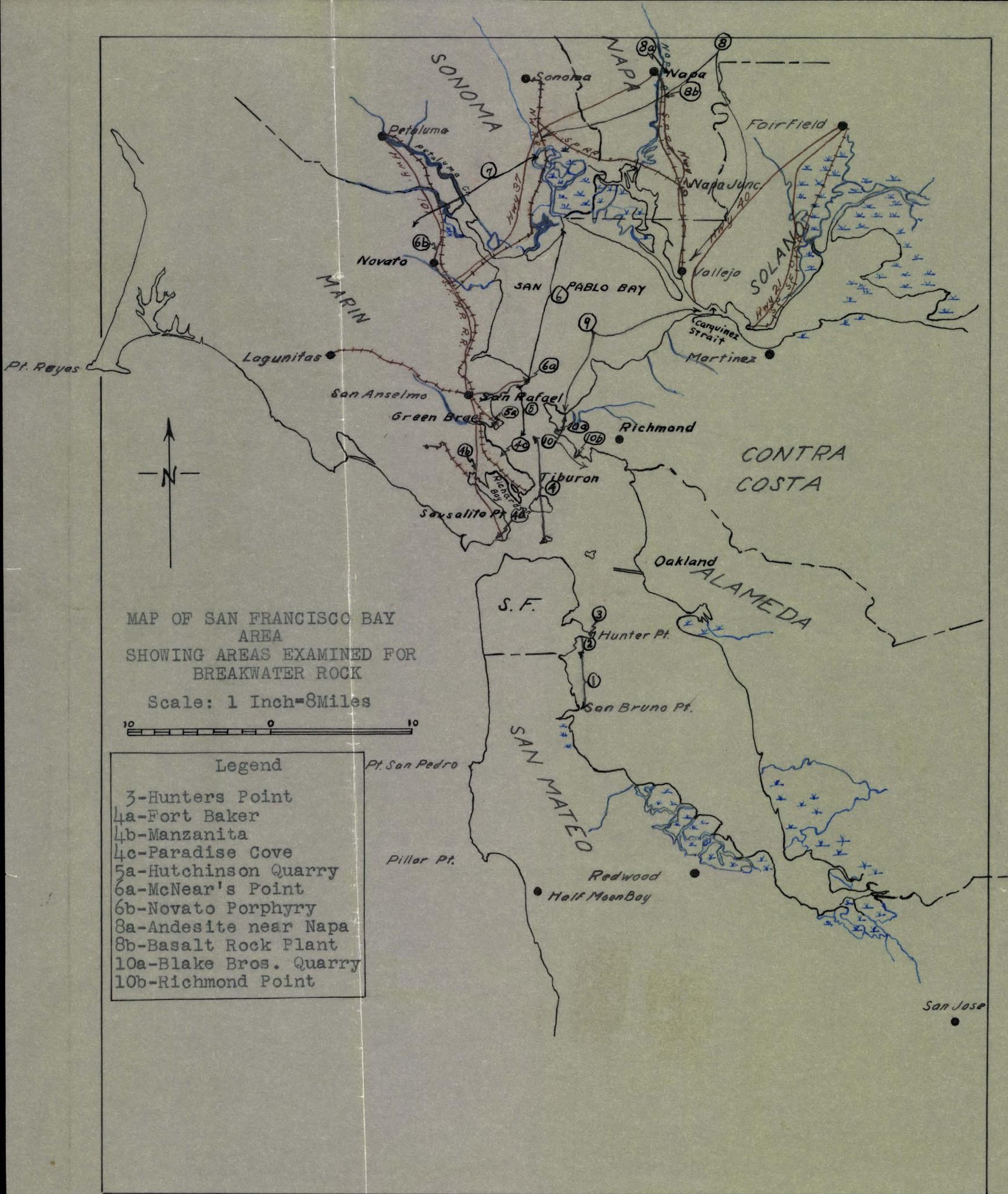
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Winston
CHIEF STAMP ROOM
WINSTON BROS. COMPANY
CONSTRUCTORS AND ENGINEERS

ESTABLISHED 1875—INCORPORATED 1902
GENERAL OFFICE—MINNEAPOLIS, MINN.

411 West Fifth Street
Los Angeles, California

ADDRESS REPLY TO ABOVE OFFICE

July 18, 1941.

Mr. Edward Wisser
Mining Geologist
533 Call Building
San Francisco, California

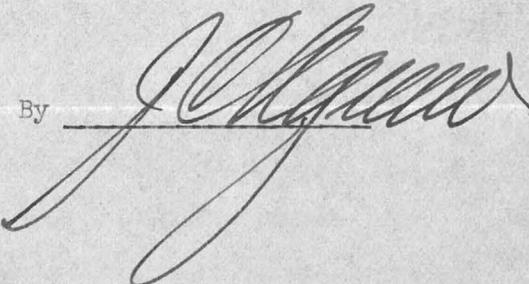
Dear Mr. Wisser:

We acknowledge receipt of and thank you very much for your report of July fourteenth. The invoice enclosed therewith has been passed for payment and will be taken care of about the tenth of next month.

We would like to consider this matter further and after doing so we will communicate with you again.

Yours very truly,

WINSTON BROS. COMPANY

By 

JCA-RC



WINSTON BROS. COMPANY

CONSTRUCTORS AND ENGINEERS

ESTABLISHED 1875—INCORPORATED 1902

GENERAL OFFICE—MINNEAPOLIS, MINN.

411 West Fifth Street
Los Angeles, California

ADDRESS REPLY TO ABOVE OFFICE

June 12, 1941

Mr. Daniel G. Longtin
66 Ritch Street
San Francisco, California

Granite Deposit - Point Reyes
Marin County, Cal. - Possible
use of rock for breakwaters,
jetties and Rip Rap

Dear Mr. Longtin:

We have your letter of June eleventh and are pleased to have your reaction to the situation that exists at Point Reyes.

The next and most important thing to develop is whether there is inclined to be a demand for rock of this quality in and about the San Francisco area, and in sufficient quantities to justify further development of this quarry site.

Apparently in the past the requirements of this area have been filled by the use of serpentine or basalt, and the question arises as to whether past practice will not be followed in the future. I think you will agree that either of these materials can be delivered more cheaply in the area in question than granite from Point Reyes.

We have been unofficially advised that considerable rock will be required at the following locations:

Pillar Point
Mare Island
Hunters Point
Treasure Island
Army Supply Base
Alameda Airport
City of San Francisco

We would appreciate it if you would quietly ascertain what you can about the possibilities at the points above mentioned; and, in particular, ascertain if you can what type of rock the Army and the Navy are thinking of for these purposes.



Specifications Number 10376, issued by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for "Quay Wall at the Naval Dry Docks, Hunters Point, San Francisco, California" are out, and we quote you from Page 11 of these specifications:

"The Rip Rap shall be of sound hard rock, one-man size and larger, and of suitable shape. The stones may be dumped in place, but sufficient care shall be exercised to obtain as nearly as practicable, a compact structure with stones fixed firmly in position."

On drawing number 155,095 accompanying these specifications, the following appears:

"Note:

Decomposed Serpentine Rock Assumed S.G. = 2.6
40% voids.

Wt. in air $2.6 \times 62.5 \times .60 = 97\#$ per cu. ft.

Wt. submerged $97 - (64 \times .60) = 59\#$ per cu. ft.

Rip Rap - assumed S.G. = 2.8 35% voids.

Wt. in air $2.8 \times 62.5 \times .65 = 114\#$ per cu. ft.

Wt. submerged $114 - (64 \times .65) = 72\#$ per cu. ft.

The important thing to determine now is where in the Bay area rock meeting these specifications can be obtained and if the deposit is sufficiently large to provide a supply adequate to the need. If it be found that there is a site, or sites, located more favorably from a transportation standpoint than Point Reyes, it seems to us that, regardless of the quality of the rock that may be found at Point Reyes, it would be unwise to consider opening a quarry at that point, at this time.

There is one other angle to the situation which should not be overlooked, and that is the difference between the requirements for rock in and around the Bay area, and the requirements that might be placed upon rock to be placed out in the ocean, in the form of breakwaters or jetties.

We do not know if any jetty or breakwater work has been done within a reasonable distance from Point Reyes, and would appreciate it if you would ascertain whether any such work has been done in the past, and what rock was used.

In making this investigation, we would prefer that you do not disclose the party whom you represent.

Yours very truly,

WINSTON BROS. COMPANY

By 

JCA-RC

July 14th, 1941.

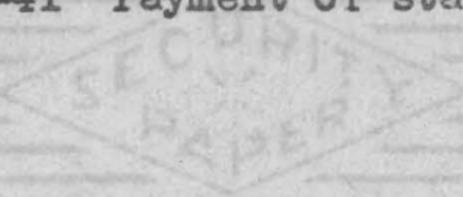
Mr. J.C. Agnew,
924 Title Guarantee Building,
Los Angeles, Calif.

To Edward Wisser, Dr.

To professional services, breakwater rock investigation in San Francisco Bay region, 6 field days @ \$50.00.....	\$300.00
4 office days @ \$25.00.....	100.00
Auto mileage, 495 mi. @ \$0.05.....	24.75
Bridge and Ferry fares.....	7.90
Photos, white prints.....	3.45
Supplies, drafting etc.....	5.50
Meals in field.....	7.33
Typing and assembling report.....	5.00
	<u>\$453.93</u>

8-9-41 Payment of statement dated July 14th, 1941.

453.93





TELEGRAPH AVENUE BRANCH 90-1279

NO. 327

AMERICAN TRUST COMPANY

TELEGRAPH AVENUE NEAR BANCROFT WAY

BERKELEY, CALIFORNIA

Aug 18 1941

PAY TO THE ORDER OF

Albert L. Pepicka

\$ 196 ⁸⁵/₁₀₀

One hundred ninety-six & 85/100

DOLLARS

Edward Wisser



Breakwater Rock Examination

A. J. Ferguson
Albert J. Ferguson

POST OFFICE
AUG 22 1941

EDWARD WISSER
MINING GEOLOGIST

SAN FRANCISCO OFFICE
533 CALL BUILDING
TELEPHONE GARFIELD 4676

BRYAN, WISSER AND PAYNE
CONSULTING ENGINEERS
432 REGINA BUILDING
MANILA, P. I.

July 14th, 1941.

Mr. J.C. Agnew,
924 Title Guarantee Building,
Los Angeles, Calif.

Dear Sir:

Pursuant to your request to me contained in your wire to Daniel Longtin of June 24th last, I have made a survey of the possible sources of breakwater, rip rap and jetty rock in the San Francisco Bay region, exclusive of Point Reyes. The results of this survey are embodied in the accompanying report.

Yours very truly,
Edward Wisser
Edward Wisser

REPORT ON POSSIBLE SOURCES OF BREAKWATER ROCK
NEAR SAN FRANCISCO BAY.

SUMMARY STATEMENT.

A survey of possible sources of breakwater rock is the logical first step for an organization considering entry into the heavy stone industry of San Francisco Bay. The business is highly competitive, and if no stone can be found capable of cheap quarrying and transport, had best be left alone. Inquiries having suggested to the writer a possible demand in the near future for heavy harbor stone in connection with the present military and industrial expansion, as well as the thought that the present dominating factor in the business, the Basalt Rock Co. of Napa, might be underbid if a suitably located quarry could be secured, a preliminary survey of possible quarries and quarry sites was made in the Bay region.

Two promising localities for breakwater rock were found, and few if any other possibilities in the entire region. The preferable locality, because next to deep water, is McNear's Point. A second locality, offering a possibility for more tonnage than McNear's Point, but some two miles from tidewater, and separated from it by a U.S. Highway, is a hill of andesite porphyry north of Novato, Marin Co. McNear's Point is preferable, not only because of location, but because large quarries have opened up the rock for inspection, while at Novato no solid rock is exposed.

It is recommended that McNear's Point be investigated in detail, and if it prove satisfactory, that its areas of massive rock be acquired under lease, if possible. Failing that, it is suggested that an attempt be made to secure control of the Novato porphyry and its possibilities be tested by excavations. Neither of these proposed steps should be taken without more thorough investigation of the future demand for heavy

harbor stone in the San Francisco region, and an analysis of the business angles of the industry. The writer has shown that one and possibly two sources of rock, not now being utilized, exist around the Bay, and he thinks that at least McNear's Point might be acquired. If the Company is in agreement that the two localities just mentioned are promising rock sources, the next step is to make the business investigation outlined above.

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REPORT ON POSSIBLE SOURCES OF BREAKWATER ROCK

NEAR SAN FRANCISCO BAY.

INTRODUCTION.

The object of the investigation summed up in this report was to determine what, if any, available sources of breakwater, jetty and rip rap rock exist in the area tributary to San Francisco Bay. From the standpoint of an organization contemplating entry into the highly competitive harbor improvement business here, this preliminary survey is a logical first step, for if no available source of rock may be found, it is useless to go any farther. Business conditions may be altered, but not the geological distribution of quarry stone.

Before a decision may be made, however, two ^{other} vital questions must be answered affirmatively:

1. Is there, now or in the near future, an important demand for such rock in the Bay area?

2. If so, how keen is the competition, how narrow the profit margin, and what are the chances for an outside organization to compete successfully for future business?

This report deals almost entirely with the possible sources of quarry stone; the questions of demand and competition have been investigated only enough to justify this preliminary search for stone.

Demand for Breakwater Rock.- The chief possible source of demand is of course the U.S. Government, the Army and Navy. In interviewing civilian officials of the Army Corps of Engineers (South Pacific Division, Balfour Building, San Francisco) I found them completely non-committal. "No information." It did not seem worthwhile to interview the Navy at this stage.

I have found no hint that the Government has been freer with information toward any other private individual on this subject. Nevertheless, there is a decided "hunch" among people interested that further demand for heavy harbor construction will arise, strengthened by interviews like the following (San Francisco Examiner, July 12th, 1941):

"Defense Director William S. Knudsen flew into San Francisco last night...with the revelation that a gigantic new shipbuilding program...will bring new shipyards to the Bay area. The new yards here will build both naval vessels and merchant ships as part of the \$1,698,000,000 program by President Roosevelt for ship construction.

"Of course, the San Francisco area will be called upon to take part in this program' the OPM chief said... 'New yards and expanded facilities will be called for.'

"Knudsen withheld comment on reports that work would start immediately on a new Navy yard, or private yard to build Navy vessels in the East Bay. However, informed sources said Knudsen undoubtedly would inspect an East Bay site already chosen to build ships with the \$400,000,000 just set aside by President Roosevelt as the Navy's part of the mammoth ship program."

The emphasis on the East Bay will be noted; there is a logical reason. San Francisco Bay is large, but much of it is too shallow to serve as a harbor. The portion suitable for ocean-going vessels to dock in is, roughly, limited on the north by a line through Richmond west to Marin County, and on the south, by an east-west line through San Bruno Point. (See map accompanying this report). South of this area the Bay is extremely shallow; it is shallow north of it, also, except for the channel to Vallejo (Mare Island) and through Carquinez Strait.

Around the deeper area, San Francisco has crowded its waterfront to the limit; Marin County (just north of the Golden Gate) has almost

no space between its steep mountains and the water. There remains the East Bay, from Martinez to south of Alameda. The Martinez-Richmond area is heavily industrialized now; the Mare Island ship channel passes close to shore, and there seems little opportunity to make new land here, or to find much existent land for shipyards, harbors etc. From Richmond south, however, the East Bay coastal shelf, between the steep Berkeley Hills on the east, and the Bay on the west slopes gradually down into the Bay at such a gradient that new land for industrial sites, shipyards etc. may be made at reasonable cost by building breakwaters and pumping the silt that forms the bottom of the Bay behind them by suction dredges (Treasure Island). At the same time, ship channels between jetties may be kept dredged out within this new land. A good deal of this kind of work has been done around the Oakland Estuary.

There seems, therefore, general reason to believe that a demand for breakwater rock will come forth so long as the present war boom lasts, and that the East Bay will be the site for much of the new construction.

The Heavy Stone Industry in the San Francisco Region.- No breakwater rock is at present being quarried; but extensive breakwaters have been built within the past few years (Treasure Island, Alameda Naval Air Base, etc.). The dominant factor in the industry, a factor ready to dominate it again, once it revives, is the Basalt Rock Co., plant 2.5 miles south of Napa (point Bb on accompanying map) and San Francisco office at 6th and Channel Sts. The operations of this company will be described in the body of this report; it suffices here to say that they mine excellent (basalt and andesite) rip rap from their quarry east of their Napa crushing plant, loading it by truck on barges on the Napa River. This company supplied all the rip rap for the Alameda Naval Base, and combined with its only competitor, the Daniel Construction Co., lessees of quarries at McNear's Point (see 6a, map), supplied the

stone for the Treasure Island breakwater.

Mr. Striblo, head of the Basalt Rock Co., is energetic and bold. He never hesitates to invest heavily in plant, if necessary, in order to insure low-cost operations. As a result, he has, I am told, consistently been low bidder on harbor stone jobs in recent years, and his efficient operation has, according to hearsay, brought him splendid profits in this business; this makes it certain that he will enter the game again when it revives. In spite of this, it seems to me he might be underbid by an organization having a quarry with direct access to tidewater, because the Basalt Rock Co., taking heavy stone from its quarry SE of Napa, on a high mountain, is forced to truck the pieces at least 2.5 miles by truck road to the barge landing on the Napa River. The bigger stones are said just to fill one of their trucks.

The Daniel Construction Co. (sign at plant; "Contracting" Co. in telephone book) has under lease the quarries near the McNear Brack Co. plant at McNear's point. These are described below. I am told that the Daniel Co. is lacking in drive, and has been outsmarted time after time by the Basalt Rock Co. It is, as I have said, that company's sole important competitor.

There are a number of other large quarries around the Bay; all the active ones are busy making crushed rock, and only very occasionally enter the heavy stone field.

Thus the Basalt Rock Co. appears the only outfit to be reckoned with, and in my opinion might with the proper quarry, be given a good run for its money.

Type of Stone Needed.- An exhibit accompanying this report is a copy of specifications for a 13,350' breakwater, and repairs to a 12,500' breakwater at Los Angeles and Long Beach Harbors. I quote from

this on stone requirements:

General: "All stone furnished shall be sound and durable against disintegrating under the conditions to be met in handling and placing, and shall be hard and tenacious and otherwise of a suitable quality to insure permanency in the structure. All determinations as to the quality, durability and/or suitability of the stone to be used in the construction will be made by the contracting officer. All stone shall be angular, each piece having its greatest dimension not greater than 3 times its least diameter."

Class B stone (core of rock breakwater; lower rock layer of composite, sand-core type): to meet above general requirements; average weight 135 lbs. per solid cubic foot, provided not more than 5% weighs less than 130 lbs. per cubic foot.

Class A stone (top and facing of rock breakwater and of composite breakwater): weight not less than 160 lbs. per cubic foot.

The 13,350' breakwater is of the composite type: sand core, topped by clay and covered with Class B stone to a depth of 10 and 20 feet below mean lower low water; the entire top portion of the breakwater above this plane to be Class A stone. These are the requirements for the Class B stone for this breakwater: Quarry run, not over 25% by weight to be in pieces of less than 20%, and not less than 40% by weight to be in pieces of 1 ton or more each. Spalls smaller than 1 lb. and earthy matter aggregating in total not more than 5% of any scow or carload will be accepted, but such material will be considered a part of the 25% by weight of material which will be accepted in pieces weighing less than 20 lbs. each.

Class A stone: Selected stone from the quarry. No piece used shall weigh less than 1 ton, and at least 50% by weight shall be in pieces weighing 10 tons or more each.

The 12,500' breakwater is of the enrockment type: Class B stone to a height 10' below mean lower low water; rest of breakwater above this to be Class A stone. The requirements for stone are the same, except that with the Class A stone, 75% by weight instead of 50% must be in pieces weighing 10 tons or more each.

These specifications represent extreme quality requirements; they would not prevail for breakwaters within San Francisco Bay. To determine what these latter requirements might be, the Alameda Naval Air Base was inspected. Refer to Standard Oil Road Map of California, 1940, large scale map of San Francisco and Vicinity, for location of this base. The base lies on the south side of the Oakland Estuary at the Bay. Breakwaters, each 400-500' long, extend along the Bay and Estuary sides, to provide a harbor for landing seaplanes. The breakwaters rose 6' above water level at time of inspection. The flat part of the top was 8-10' wide. The breakwaters are formed of blocks of stone 2' to 7' in maximum dimension. All are angular, but of variable shape, from roughly cubic to elongated. The stones on top are fitted; the flanks are well sloped but not fitted; evidently this rock was dumped, and considerable open spaces exist between the rock blocks.

The stone, furnished by the Basalt Rock Co., is an andesite with flow-banding, hard and tough. Mixed with this however (about 5%) are small, soft, crumbly tuffaceous stones.

In this connection the following table is useful:

Rock	WEIGHT OF COMMON ROCKS.		DIMENSIONS.	
	Lbs. per cu. ft.		1 Ton piece.	10 ton piece.
Andesite	181		2.25'x2.25'x2.25'	4.8'x4.8'x4.8'
Basalt	181			
Granite	168			
Limestone	168			
Rhyolite	150			
Sandstone	150			

Note: The Franciscan sandstone of the Bay area is heavier than nor-

mal sandstone, because when fresh its composition is almost identical with that of andesite; it probably weighs over 160 lbs. per cubic foot.

Taking the Alameda Naval Air Base breakwaters as representative of requirements for San Francisco Bay construction, it is evident from the above table that specifications for weight ^{per cu.ft.} are about the same as for ocean breakwaters of the Los Angeles Harbor type just described, but that requirements for size of blocks are relaxed. (Class A stone only visible at Alameda, of course). Average size is less; many blocks weigh slightly less than a ton, very few reach 10 tons; probably a greater variation in size is permitted.

On the other hand, the Oakland Estuary and parts of Alameda Island are rippaged by very large blocks of hard, fresh quartz diorite from an unknown source, possibly Rocklin in Placer Co., so that some specifications may call for the finest of breakwater rock. A first-class quarry, would therefore be very desirable, rather than one that would merely fulfill what seem to be average requirements for Bay construction as exemplified at the Alameda Naval Air Base.

In summary, the following general requirements probably prevail for Class B stone: for specific gravity, any common rock will do, since only 135 lbs. per cu.ft. is required (Los Angeles ocean breakwater). 40% of the stone furnished (judging by Los Angeles example) must weigh 1 ton or more, i.e. must break say 2.5' x 2.5' x 2.5'. For Class A stone, heavier rock is needed (basalt, andesite, granite or probably Franciscan sandstone) and more of it must break large, although requirements here are probably less stringent than at Los Angeles Harbor.

POSSIBLE SOURCES OF BREAKWATER ROCK.

The following information is based on a week's field study of quarry stone in the Bay region, conducted by the writer and Mr. A.G.Repecka, Curator of the Geological Museum, University of California. The San Francisco Folio, No.193 of the Geologic Atlas of the U.S., was used as a guide for this work.

General.

Rocks of many ages and structural types surround San Francisco Bay. In age they range from the Mesozoic or older to the Tertiary; in type, from hard, tough massive basalt, granite, sandstone and serpentine, to loosely consolidated, soft sands and shale. From the standpoint of quarry stone, the chief formations of interest are the Franciscan, part of the Tertiary, part of the Cretaceous and the "Montara granite" of unknown age.

Franciscan Series.- (Upper Jurassic). The Franciscan series consists of sandstone, often in massive beds; thin bedded chert; layers of basalt and diabase; layers and irregular masses of serpentine. The sandstone where massive and fresh makes excellent quarry stone, for it is made up of grains of heavy igneous rock, well cemented together. Due to the age of the Franciscan however, and the deformation it has suffered, much of this sandstone is badly weathered, fissured and jointed, quite unsuited for large quarry blocks. The thin-bedded chert is of course useless; and the basalt and diabase, being old, have usually weathered into a coarse red sand. The serpentine varies, often suddenly in a given area, in its structural properties. Locally it is hard and massive, but more commonly soft, sheared. It is difficult to predict, at a given quarry face, how far into the hill a massive exposure of serpentine will persist; it may turn to the soft, sheared, useless variety within a few feet.

Thus the Franciscan offers quarry sites; the larger quarries work fresh exposures of the massive sandstone members (Hutchinson Quarry, Point 5a on Map; McNear Point Quarries, 6a and Photos 2,3,4,6; Blake Bros.Quarry,10a and Photo 9). Many small quarries, now abandoned in the main, have worked the serpentine where this is massive (Paradise Cove Quarry,Tiburon, 4c and Photo 1). While suitable Franciscan quarry sites are few,most suitable sites are exposures of Franciscan rock.

Tertiary.- Most Tertiary rocks around the Bay consist of loose sandstones and shales; but in the northern part of the area, near Napa and Sonoma, is found a series of Pliocene (i.e. young) lava flows, andesite and basalt. These rocks are commonly fresh and undeformed. They are heavy, tough, hard and little jointed,and make ideal breakwater rock. They form, in the quarry of the Basalt Rock Co. (Point 5b on map)the chief recent source of such material. Photo 8 shows a typical flow near Napa.

Cretaceous.- The basal horizons of the Chico (middle Cretaceous) formation offer in places possible sources of breakwater rock. Sandstone from these horizons was used to build Stanford University; the rock was taken from a quarry in the hills west of the campus. This sandstone is massive,breaking large; but it is unlike the Franciscan sandstone, being lighter in weight,probably too light for requirements of Class A stone. The Stanford locality is also far from water transport. The same geologic series is found in the Berkeley Hills and near Vallejo, but in these localities the rock is unsuitable for quarrying.

"Montara Granite."- (Quartz diorite). Large masses of this rock are found between Point Reyes and Bodega head,north of the Golden Gate, and between San Pedro Point and Pillar Point (near Halfmoon Bay) south of the Gate. The Halfmoon Bay granite was examined by the writer many years ago,and as I remember it, is soft and badly weathered. It would stand investigation, however, if harbor improvements at Halfmoon Bay

(Pillar Point) are contemplated.

The Point Reyes granite crops out in several areas between Point Reyes and Bodega Head, but is soft and useless except at the south tip of Point Reyes Peninsula. There it forms a narrow east-west ridge about 1.5 miles long, and rising in a shear cliff from the Pacific to a height of 200-500'. On the landward side of the ridge the granite passes under Miocene conglomerate. The granite is rather badly jointed in places, and large quarrying operations would produce a large percentage of blocks falling below Class A stone requirements for size, although the specific gravity of the granite is satisfactory.

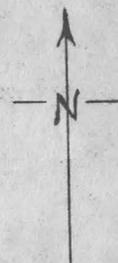
Both the Point Reyes and the Halfmoon Bay granite masses are open to the objection of difficult and dangerous lightering. Beside the need of loading in dangerous open roadsteads, ocean barging would be needed for 30 miles, from Point Reyes to the Golden Gate, and for 25 miles, Halfmoon Bay to the Gate.

There follows the description of localities examined. These are limited to Franciscan sandstone and serpentine, and to Tertiary lava flows. It is understood that a report is already on hand on the Point Reyes granite, and the Cretaceous sandstone is considered unuitable, both as to weight and localities.

Localities Examined.

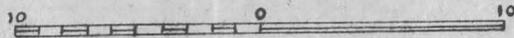
The Bay area was examined systematically, starting along the west shore south of San Francisco and working north to Marin County, thence east to the Napa River and south again along the East Bay. The various areas are given numbers on the map, as 5, 6 etc., and localities within an area are given the area number, as 6, followed by a letter, as 6a. Assuming that breakwater rock will not stand long hauls, and that quarries next to tidewater are desirable, no localities

Pt. Reyes



MAP OF SAN FRANCISCO BAY
AREA
SHOWING AREAS EXAMINED FOR
BREAKWATER ROCK

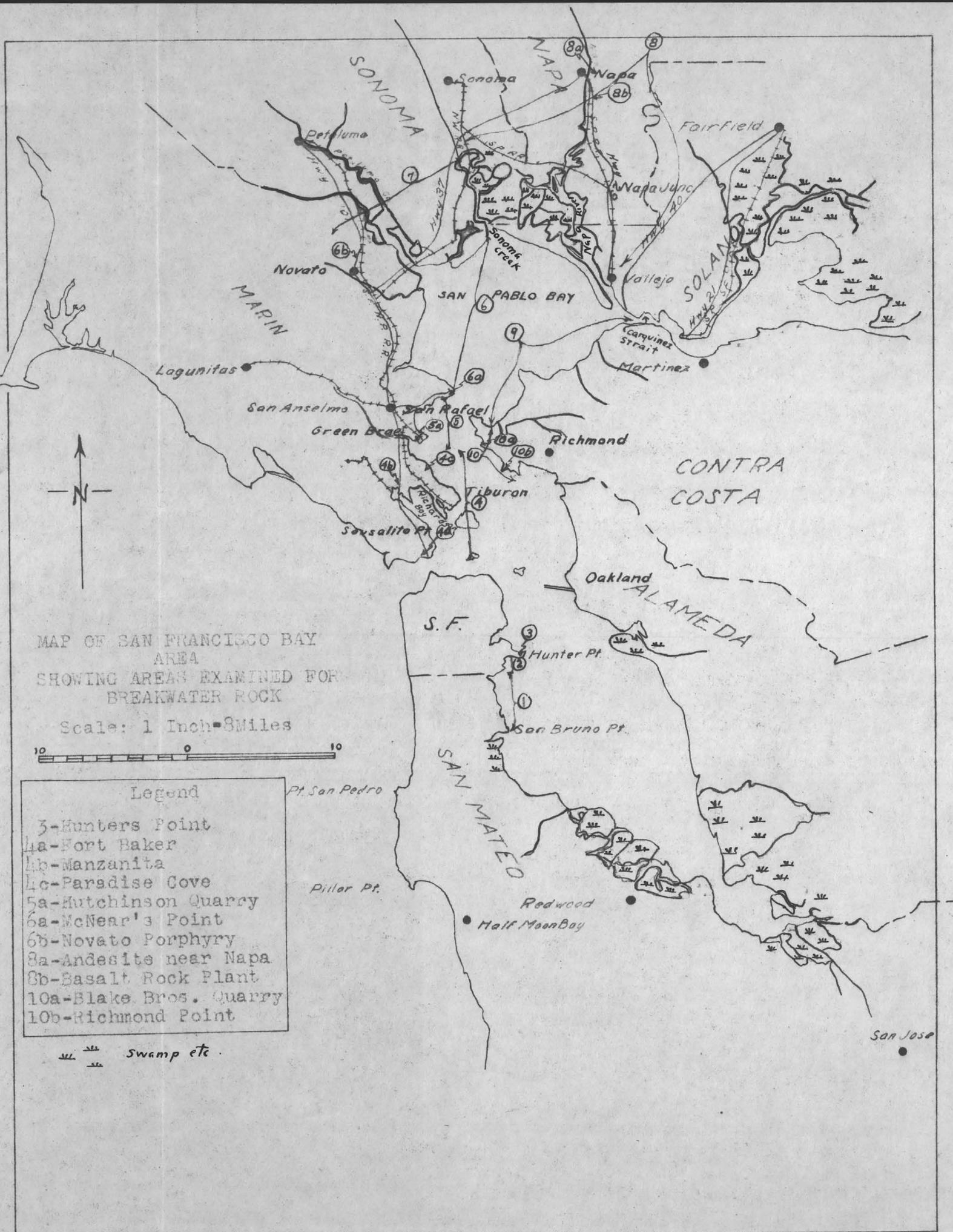
Scale: 1 Inch=8 Miles



Legend

- 3-Hunters Point
- 4a-Fort Baker
- 4b-Manzanita
- 4c-Paradise Cove
- 5a-Mitchinson Quarry
- 6a-McNear's Point
- 6b-Novato Porphyry
- 8a-Andesite near Napa
- 8b-Basalt Rock Plant
- 10a-Blake Bros. Quarry
- 10b-Richmond Point

 Swamp etc.



were examined farther than a mile or so from bodies of water navigable by barges.

Area 1.

West Bay Shore South of San Francisco. San Bruno Point North to San Francisco County line.

Here the west shore consists of cliffs with deep water next them, as shown by the wharves of packing and other companies. The country south of San Bruno Point has no such cliffs and may be eliminated, since the entire shore to the south end of the Bay consists of very shallow sloughs, alluvial silt etc., with hard rock exposures lying from 2.5 to 6 miles inland from even the shallowest water.

The rock from San Bruno Point to the San Francisco County line consists of Franciscan sandstone with some interbedded shales. The sandstone is highly weathered and jointed, and commonly breaks to fragments an inch or so in size. There are no quarries, and this area may be dismissed.

Area 2.

San Francisco County Line to Hunter's Point.

The rock is thin-bedded chert and highly jointed sandstone, with layers of old basalt weathered to red earth. No value.

Area 3.

Hunter's Point.

On the point south of Avisadero Point (the extreme east tip of Hunter's Point) is a mass of basalt 1800' x 1000', and 150' high. The basalt is of the "pillow" variety: it consists of a solid aggregate of pillow-shaped basalt masses, like lumpy oatmeal. The pillows range from 1-3' in length, averaging 1.5'. The pillows themselves are intensely jointed, a slight blow from the pick breaking them to 1" fragments. This mass has never been quarried, and fresh exposures might be less jointed and break bigger. But the basalt would break with the pillows

as unit blocks, and since these are rounded, the rock would be unsuitable.

On the north side of Hunter's Point are some small lenses of massive sandstone mixed with large bodies of serpentine, most of it sheared and soft, but with large blocks of hard serpentine locally obtainable. This serpentine area is covered by Mexican shacks. There is deep water off the Point.

Area 4.

Marin County. Fort Baker to Tiburon.

Fort Baker U.S. Military Reservation, Sausalito etc. face deep water. North of Sausalito Richardson's Bay forms a northwest indentation that becomes progressively shallower toward Mill Valley, which lies just northwest of Richardson's Bay. Barges could utilize this small bay about to where Highway 101 crosses it. The Tiburon Peninsula is surrounded by deep water. This whole area suffers from the disadvantage of dense commuter population and the presence of the Military Reservation and the northern approach to the Golden Gate bridge.

The rocks are Franciscan, mainly sandstone, highly weathered and jointed; there is minor chert and Franciscan basalt, crumbly, red.

Locality 4a.- Fort Baker. Massive Franciscan, better than elsewhere, but weathered, breaking into 18 blocks. While there is a suggestion that deep cuts exposing fresher rock would exhibit it breaking bigger, availability of this source is very doubtful because it lies within the Military Reservation.

Locality 4b.- Cut along Highway 101, 3/8 mile north of crossing of Richardson's Bay at Manzanita. Quarry for highway. Franciscan sandstone with serpentine. The sandstone is fresh, green and massive mainly, but some is brown, weathered and highly jointed. The fresh portion of the sandstone is a bed about 35' x 35' as exposed; it strikes into the hill. The serpentine is soft and sheared. Exposure is too small to be of

interest, but is described as being typical of so many others.

Locality 4c. - Old Quarry near Paradise Cove, Tiburon. Photo 1.

The quarry lies next a public road to Paradise Cove, and about 300 yards inland from the Cove. Both quarry and Cove are within an extensive residential subdivision project owned or controlled by Frank Howard Allen, Drake Boulevard and Bank St., San Anselmo. There is no wharve at the Cove, and the beach is exceptionally flat, necessitating a long loading pier.

The quarry is cut on the south side of a gentle hill, part of a larger ridge. The quarry cut is 175' long and 90' high at the maximum. It exposes Franciscan shales flanked on either side by serpentized gabbro and diabase. These serpentine belts, 30' and 20' thick respectively are fairly hard and massive, but irregular. The photo shows how difficult it would be to quarry either massive belt without taking the rotten material as well; the massive material itself is rather badly jointed. The quarry might be suitable for a limited and local supply of breakwater material.

North of the quarry the same ridge shows surface exposures of massive serpentine, schist and thin-bedded chert, for a distance of half a mile from the quarry. The ridge rises slightly in this direction. Two-fifths of the exposures are serpentine, two-fifths schist, and one-fifth chert. The schist borders the serpentine; the latter is mainly hard and massive. The schist is massive also, but owing to its nature would be tough to drill and break; the serpentine could hardly be quarried without taking the schist as well. Nevertheless the ridge offers a possibly somewhat important source for local breakwater stone.

Area 5.

Between Tiburon and McNear's Point.

In this area two sloughs, separated by San Quentin Point, affording

opportunity for barge transport, penetrate the Marin County hills. (Hutchinson's quarry, locality 5a, utilizes the southern slough).

The rocks are mainly extremely weathered and jointed Franciscan sandstone. These rocks, with interbedded shale, continue west to San Anselmo. There are basalt areas, too, but these are old and badly weathered.

Locality 5a. - Hutchinson Quarry, Greenbrae. At one point only is the Franciscan sandstone fresh enough to quarry. This is at the extensive crushed rock plant of the Hutchinson Co., Contractors, main office 329 17th St., Oakland. Here there are two large cuts in massive Franciscan sandstone; one cut has too much shale for breakwater operations. The other looks more suitable. The cut is about 500' x 400', with a face 120' high. The massive bed is perhaps 400' thick, and strikes northwest out of the company property toward and beyond Highway 101. (See below). Present operations produce only crushed rock "by barge, rail and truck". There is a large crushing and sizing plant. A belt conveyor transports crushed rock from the plant to the barge landing. I am told that in spite of the massive appearance of this sandstone, it lacks strength for rip rap.

The massive bed, as stated, continues beyond Highway 101, where it is well exposed in a deep road cut. On the far side of the highway the Bret Harte residential subdivision sits on this formation.

The only possibility for operations here would be by arrangement with the Hutchinson company, provided tests showed the sandstone did stand up to strength requirements. According to the Marin County surveyor, the San Rafael waterfront rip rap came from this quarry; but that waterfront is subjected to almost no wave action.

Area 6.

McNear's Point to Sonoma Creek. (West shore, San Pablo Bay).

McNear's Point is described in detail. North of that point, the immediate shore of San Pablo Bay is without interest, mainly sloughs and soft volcanic tuff. However, Petaluma Creek is navigable for barges as far as Petaluma, which fact extends our interest in this area inland. The rock in the hilly portions of Area 6 is mainly Franciscan, but some of this is hard, massive sandstone, of great interest (Locality 6a) and there is one area of Tertiary porphyry (6b) of almost equal interest.

Photos 2-6.

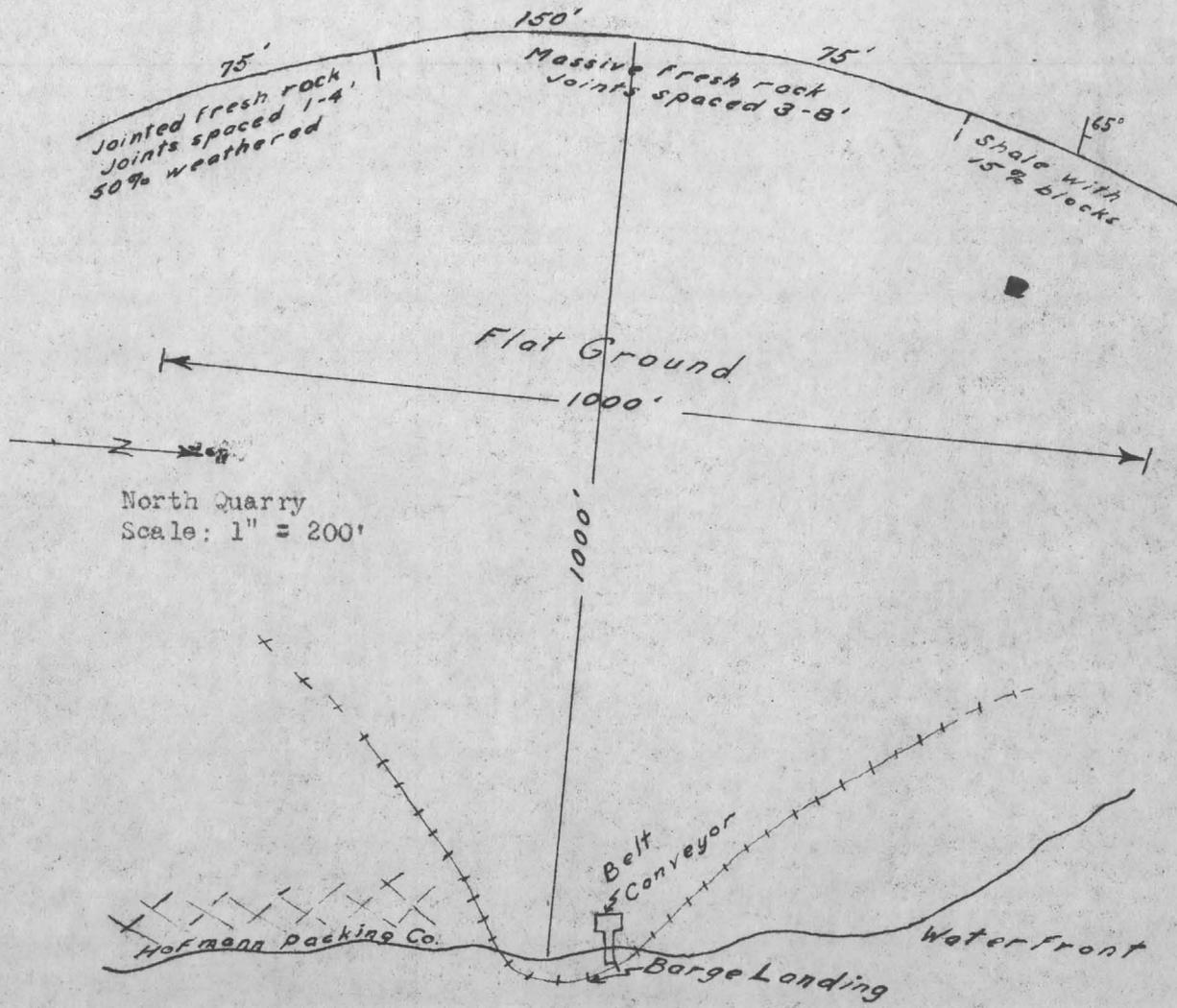
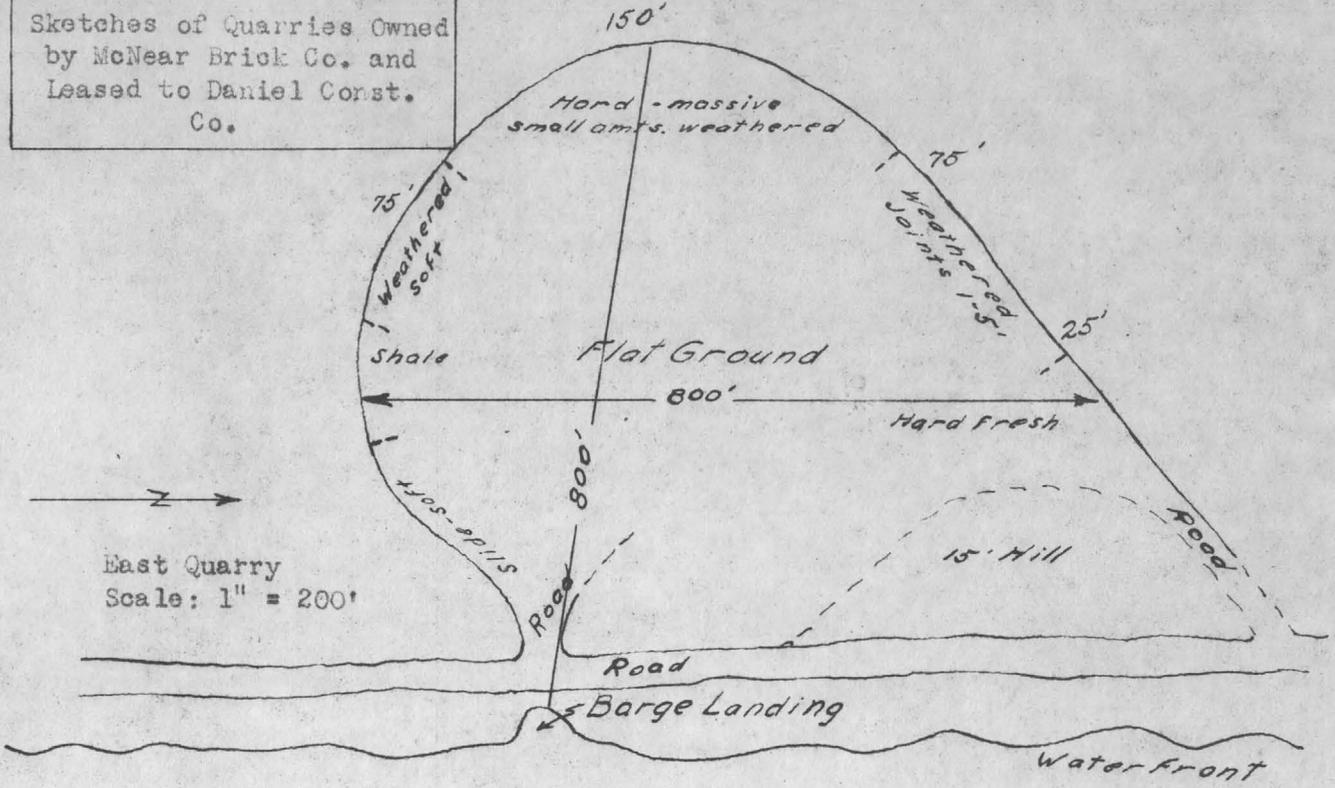
Locality 6a. McNear's Point. [^]This point, one of steep slopes, approaches within 1000' or less deep water (see sketches on following page) and forms one side of San Pablo Strait, a deep channel separating San Pablo Bay from the main Bay.

The rock making up the point is mainly hard, massive Franciscan sandstone. Joints in it are spaced from 1' to 8' apart. With this good material is some weathered, more highly jointed, softer sandstone, and very minor shale.

There are two quarries, both under lease to the Daniel Construction Co., San Francisco office, 503 Market St. The ground is owned by the McNear Brick Co., San Francisco office, 427 Rialto Bldg., Mr. Wm. H. Thomas, manager. The McNear Co. has a brick quarry near the stone quarries mentioned, where they manufacture Haydite, a light-weight aggregate utilizing burnt clay and cement.

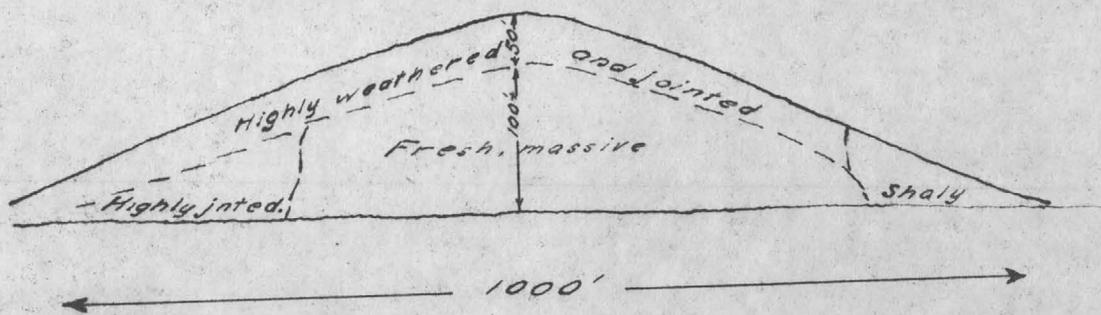
Of the stone quarries, the East quarry faces SE toward the Bay. It is 800' long at the mouth (see sketch), with maximum height of cut 150' plus. From the quarry face to the water the distance is 800'. About 400' of the cut exposed hard, dark blue massive sandstone. While this massive bed is flanked on either side by rotten sandstone or shale,

McNEAR'S PT. MARIN COUNTY
 Sketches of Quarries Owned
 by McNear Brick Co. and
 Leased to Daniel Const.
 Co.



MCNEAR'S POINT, MARIN COUNTY

Sketch of Face of North Quarry
Owned by McNear Brick Co., and Leased to Daniel Construction Co.



Scale: 1" = 200'

it strikes into the hill, which rises, back of the quarry face, about 50' in 300', then drops off gradually to the west. Extension of this massive bed is therefore indicated.

The East quarry is out of use, and its floor overgrown with brush; no rails, cars or machinery. The dock for barges is only 50' long, indicating deep water close to shore. The dock is in poor shape but might be repaired. Several old barges are rotting alongside.

About 1500' around the shore from the East quarry, and north of that quarry, is the North quarry. Not working on the day of inspection, this quarry has been worked very recently by the Daniel company, for crushed rock. Small gauge tracks, conveyor belts etc. are in evidence. The width of the quarry cut is 1000', and the distance from the face to water is 1000'. Maximum height of cut, 150'. At the south end of the cut is fresh but jointed sandstone (4' between joints), with about 50% more highly jointed and weathered. The central part (nearly 600' of the quarry face) is very massive, fresh, blue Franciscan sandstone, with joints spaced 3-8' apart. It breaks in large blocks. The north end of the face shows shales, with about 15% of large blocks.

The upper 50-75' of the quarry face (see sketch) is highly weathered and jointed, reducing the usable quarry height to 100' and less.

There is a barge landing at the North quarry, consisting of a trestle with track paralleling the shore. Flat cars are pulled out on this, and the material dumped into barges lying alongside.

I have been told by an official of the McNair Brick Co., as well as by Mr. Miller of the Calif. State Division of Highways, Dist. No. 4, 2001 Van Ness Ave., San Francisco, that the rock from these quarries stands up under all requirements for breakwaters, as well as under the sodium sulphate test for resistance to disintegration in sea water.

This is in my mind the best possibly available source of break-water rock around the Bay. I say "possibly available" because the Daniel Construction Co. only leases it, and is not at present working it.

Location 6b.- Undeveloped porphyry mass 2.5 miles north of Novato, Marin County. Photo 7. Forms a hill west of Highway 101, separated from the latter by a flat field about 600' wide. On the east side of the highway is the Wright & Owen Grain and Feed plant. The porphyry hill is grass and oak country, unused. I understand it is controlled by Wm. Q. Wright Jr., Novato, Marin County, telephone Novato 138.

The rock apparently making up the hill is a porphyry, probably andesite or latite, Pliocene in age and related to the lava flows near Napa and Sonoma. None of this rock is exposed in place on the Novato hill. It lies strewn over the grassy surface as boulders. (They are larger than they look in Photo 7, reaching 3'x2'x2'). The rock as represented by the boulders is fresh, tough and hard. Such basic rocks characteristically weather into boulders, and the weathering starts along joints. No joints are seen in the boulders, hence the joint spacing (average) is larger than the average size of the boulders; it may be considerably larger, for the rounded form of the boulders is due to spheroidal weathering between the sets of joints.

There is an old quarry on the hill (dumps shown in Photo 7) with its floor only 35' below the crest of the hill. No solid porphyry is exposed, but with depth the boulders average larger and are closely packed. Piles of trimming suggest that the larger boulders were selected and trimmed for paving blocks or rip rap.

Porphyry boulders are scattered on the surface of the hill for a distance of 2500' in a direction N60°W, and over a width perpendicular to this direction of perhaps 1000'. This area probably outlines the

porphyry mass beneath the surface; I judge this mass to be a flow, and would guess from the shape of the flattish hill that the supposed flow extends downward at least to the level of the flat field and Highway 101, or some 100' below the crest of the hill. Allowing say 50' for rubble, this might make a solid porphyry mass 2500' long and 1000' wide, with a height of 50'.

Petaluma Creek lies some two miles east of this porphyry mass, on the opposite side of Highway 101. Provided an agreement could be made with the Division of Highways embodying some method of crossing the highway, breakwater rock could be trucked from this quarry site (if the porphyry proves up) to tidewater more cheaply than the Basalt Rock Co. south of Napa trucks its similar rock across Highway 29 to the barge landing on the Napa River (page 4).

Failing a source of breakwater rock closer to tidewater, this porphyry hill is worth cutting into; the work could be cheaply done with bulldozers and similar equipment.

Area 7.

Petaluma Creek to Sonoma Creek.

Some of the Pliocene lavas that make good rock near Napa border this stretch of the west shore of San Pablo Bay; but here they are badly weathered and without interest.

Area 8.

Lower Napa and Sonoma Valleys.

The Napa River is navigable by barges as far as Napa, and the northern extension of San Pablo is in general marked by a complex of tidal estuaries in places adapted to barge transportation. Pliocene volcanic flows form many of the hills; the Basalt Rock Co. quarries this material with marked success. Between Sonoma Creek and the Napa River the flows are badly weathered and of no interest, but east of the Napa River they are in places fresh and make cliffs. North of Napa these

eastern flows are porous, thin-bedded rhyolite, of no interest; but from Napa south toward Napa Junction they are andesite and basalt, good material.

Locality 8a.- Lava bluff on outskirts of Napa. Photo 8. A hill rising 507' above sealevel (shown on U.S. Geological Survey, Napa Quadrangle Map, scale 2 miles to the inch) is capped by a bluff-making series of andesites, apparently about 100' thick. Some rhyolite gneat was seen, and there is some andesite breccia. The andesite is hard and tough, with few joints, and is identical in appearance with the break-water rock supplied the Alameda Naval Air Base by the Basalt Rock Co. This Napa mass has not been quarried, one reason possibly being that it is too close to town. A new residential subdivision extends practically to the hill; one of the houses is shown in Photo 8. There might be a possibility of opening a quarry on the northwest side of the hill (outside the left margin of Photo 8) but here too country residences would seem to make the chance slim. On the southeast end of the hill is a park and cemetery, which would seem to cut off transportation of material from the hill to the Navigable Napa River 3/4 mile away.

Locality 8b.- Basalt Rock Co. The crushing and sizing plant, together with the plant for the manufacture of Basalite, another lightweight aggregate competing sharply with the Haydite of McNear Brick Co. and consisting of fragments of crushed basalt set in cement, lies 2.5 miles south of Napa, on the east side of Highway 29. The quarry was not visited, but lies on top of the ridge, about a mile airline east of the plant, and probably 2 miles by road. An aerial tram carries quarry rock (apparently after some primary crushing) to the crushing and sizing plant, and a similar tram carries the crushed rock from the plant to the barge landing on the Napa River, about 1.6 miles west of the plant.

No breakwater rock is at present being quarried by the Basalt Rock Co., but I am told they have to truck it from the quarry to the barge landing, a distance of 2.5- 3 miles.

There may be available quarry sites in the high hills near the Basalt Rock Co. quarry, since the Geologic Map of California shows a large area here of Pliocene lavas. Farther south however, say south of a line running due west from Fairfield, the lavas give out, being replaced by loose Eocene and Cretaceous sandstones and shales. This condition prevails to Napa Junction. From Napa Junction to Vallejo, the eastern side of the Napa Valley shows mixed Cretaceous and Franciscan, the latter consisting of serpentine and silica-carbonate rock. Neither are here suitable for quarry stone.

Area 9.

Carquinez Strait to Richmond.

Here are only Tertiary tuffs and loose sediments.

Area 10.

Vicinity of Richmond, Contra Costa Co.

Just west of the city of Richmond, the low alluvial plain rises to form a ridge bordering the Bay, and made up of Franciscan sandstone and shale. Deep water lies next the ridge.

Locality 10a.- Blake Bros. Quarry. Photo 10. Head office, Balboa Bldg., San Francisco. This is the only important quarry producing rock in this area. About 500' long, maximum height 100'. The rock is mainly massive Franciscan sandstone, dipping steeply (dip shown in photo). Next to this thick sandstone bed lie mixed sandstone and shale (outside of photo, to left and right). Quarrying operations are mainly confined to the massive sandstone. The great size of some of the blocks produced is well shown in the photo; since the company produces crushed rock in a large crushing plant, loading it on barges next to the plant, they

probably could break it bigger and engage in the breakwater business if they wished; I have not heard however of their ever doing this.

Locality 10b.- Massive sandstone at Point Richmond (SE of Blake Bros. quarry). Bed of massive sandstone 40' thick, very close to public road and railroad spur to plant of Richmond Pressed Brick Co. Too small and close to railroad and road to be of interest, but the photo is given to show another characteristic exposure of Franciscan sandstone and shale.

South of area 10, the cities of Oakland and Berkeley completely cut off any possible quarry sites in the Berkeley Hills from transportation.

CONCLUSIONS.

Of the many possible quarry sites examined, only Localities 6a and 6b (McNear's Point and Novato respectively) seem of present interest. A possible 3rd site might be the andesite bluff NE of Napa, but I am practically certain this lies too close to the town to make possible its working. The serpentine ridge on Tiburon Peninsula (Locality 4c) is a faint fourth chance.

Possible Tonnage, McNear's Point.- East Quarry: Assume 400' x 400' by 100' height: $\frac{16,000,000 \text{ cu.ft.}}{12.5 \text{ cu.ft./ton}} = 1,280,000 \text{ tons.}$ (of rock as quarried). Extension to the west, with gradually lowering quarry height, may easily bring this to 2,000,000 tons.

North Quarry: Assume 500' extension west into quarry face.
600' x 500' x 80' height: $\frac{24,000,000 \text{ cu.ft.}}{12.5 \text{ cu.ft./ton}} = 2,000,000 \text{ tons approx.}$
Farther extensions and possibly other nearby localities should bring the total tonnage as quarried well over 5,000,000. What proportion of this would be suitable for Class A and Class B stone I cannot say, but I should think well over 50%. A detailed survey of the Point, with geologic mapping of the massive sandstone beds, is needed to give the pos-

sible tonnage with any accuracy; test drilling and blasting would disclose the breaking habits of the rock.

Possible Tonnage, Novato Porphyry.- Assume that the boulders turn to solid rock at an elevation to give 50' quarry face, and that such solid rock underlies the entire area showing scattered boulders on the surface. 2500' x 1000' x 50': $\frac{125,000,000 \text{ cu.ft.}}{11.1 \text{ cu.ft./ton}} = 11,200,000 \text{ tons.}$

This is extremely speculative: the hill may be all round boulders; and even if not, the area may be much less than supposed. But the possibilities are plain.

Because of business considerations outside of the scope of this report, I consider the McNear's Point quarries the most attractive source of breakwater rock in the Bay area. If, first, certain knowledge may be obtained of demand for such rock, and second, if careful investigation of the industry shows a reasonable chance for an outside organization to enter the game, I recommend careful investigation of McNear's Point, from both the business and engineering standpoint.

For an organization desirous of entering the breakwater business and unable to secure the McNear's Point source of rock, I recommend an attempt to secure control of the Novato porphyry, if a way for stone to cross Highway 101 may be devised, and preliminary excavation on this hill to see whether solid rock in quantity underlies the porphyry boulders covering the hill.

San Francisco,
July 12th, 1941.

Edward Wisser
Edward Wisser
Mining Geologist.

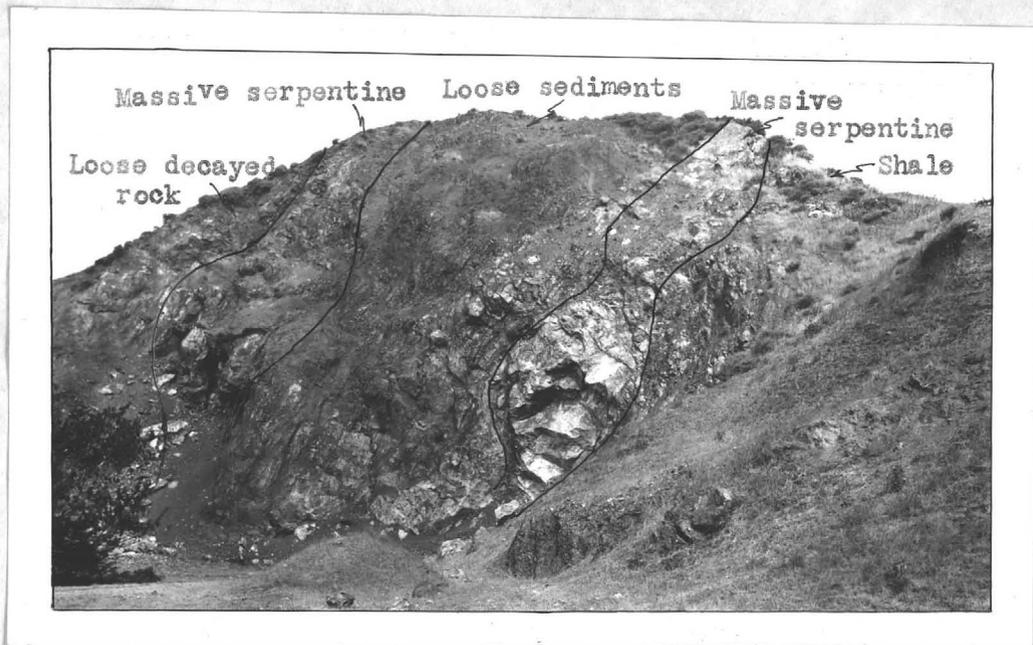


Photo 1. Location 4c. Quarry at Paradise Cove, Tiburon Peninsula, Marin County



Photo 2. Location 6a. McNear's Point
East Quarry Extreme Right Portion
Marin County



Photo 3. Location 6a. McNear's Point
East Quarry Central Portion
Marin County



Photo 4. Location 6a. McNear's Point
East Quarry. Nearly Extreme left.
Marin County

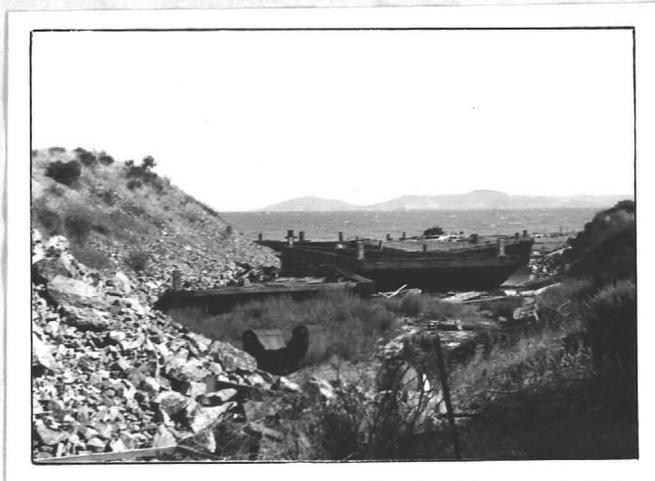


Photo 5. Location 6a. McNear's Point
Barge Landing at East Quarry
Marin County



Photo 6. Location 6a. McNear's Point
North Quarry. Looking North
Marin County



Photo 7. Location 6b. Porphyry Hill North of Novato
Marin County



Photo 8. Location 8a. Lava Bluff North of Napa
Napa County

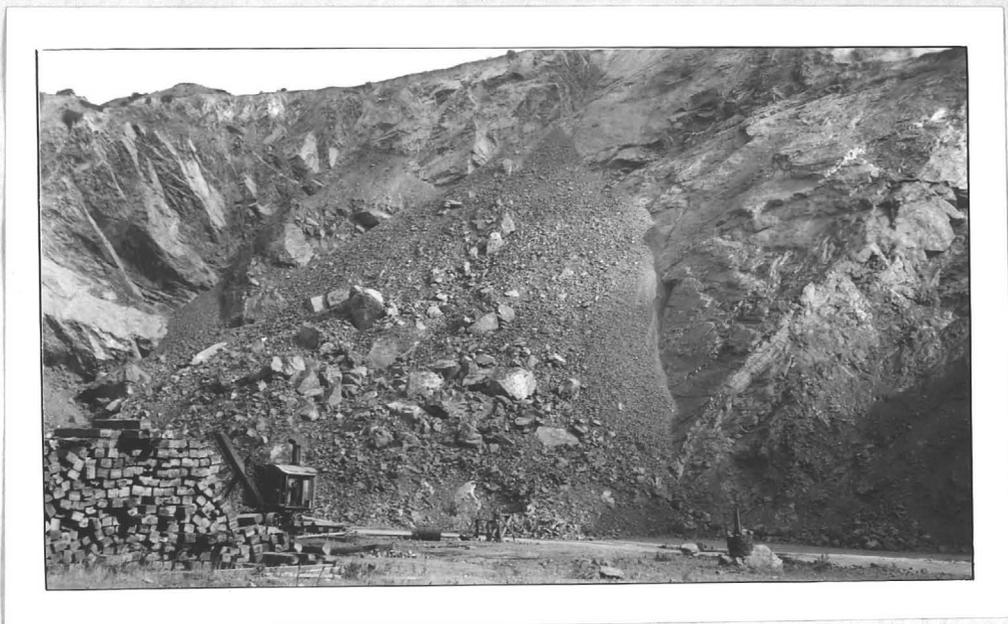


Photo 9. Locality 10a. North Face Blake Bros. Quarry
Contra Costa County

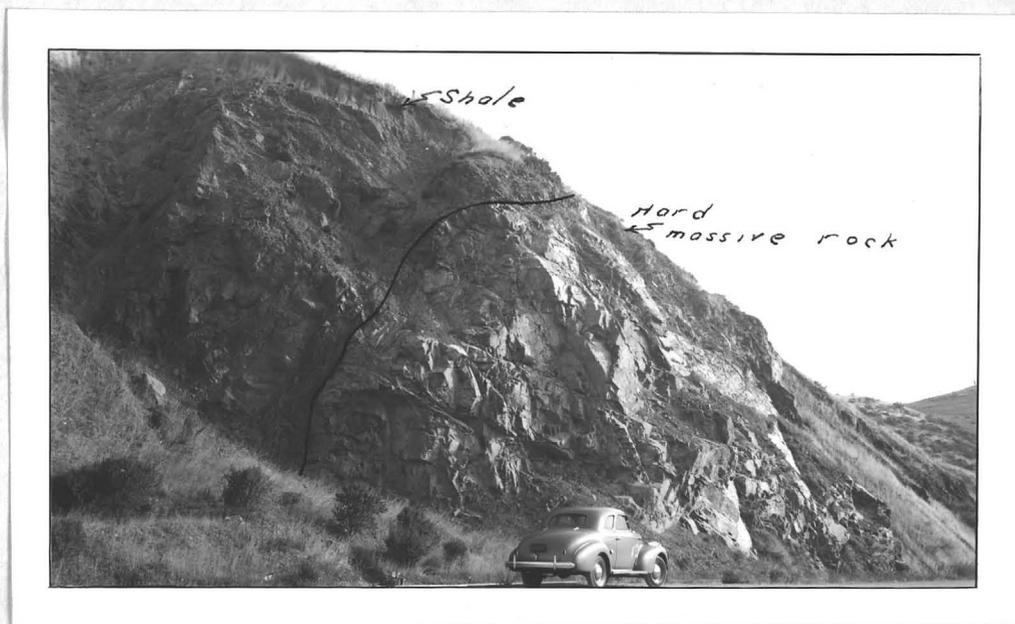


Photo 10. Locality 10b. Hard Massive Sandstone at
Richmond Point, Contra Costa County