Alto Tunnel
Scoping Study

Volume I – Background Information

Prepared For:

Marin County
Department of Public Works

Prepared By:

QUINCY ENGINEERING, INC.

August 31, 2001

Table of Contents

1.0 GENERAL

In April 2001, the Marin County Department of Public Works requested that Quincy Engineering, Inc., Jacobs Associates, and Parikh Consultants conduct a feasibility study to evaluate the existing Alto Tunnel for possible conversion to a pedestrian and bicycle facility.

On June 5th a field reconnaissance of the existing tunnel was conducted by County, Jacobs, Parikh, and Quincy personnel. The entrance to the southern end of the tunnel, located in Mill Valley, collapsed many years ago, so access to the tunnel was only available from the north portal in Corte Madera. Upon entering the tunnel, it was confirmed that a plug had been installed (in 1975) and was impassable to the team. A meeting of the various team personnel was conducted immediately at the conclusion of the field reconnaissance to develop an approach for the next steps of the study. It was decided to break down the Feasibility Study into three stages, the first two of which are scoping in nature, and the third stage being the Feasibility Study itself. Each stage will result in a stand-alone component of the study, as follows:

Volume I – Background Information

Volume II – Engineering Summary and Proposed Supplemental Investigation

Volume III – Feasibility Assessment

Quincy Engineering was assigned the task of developing Volume I, with Jacobs Associates responsible for Volumes II and III. Parikh Consultants was to provide support as appropriate to Quincy and Jacobs.

Volume 1 – Background Information

All existing available information, consisting of plans, reports, and various correspondences is assembled to provide a brief summary of the tunnel to date. This volume of the study is a summary of many documents created by others over the life of the tunnel. All of its contents are taken directly from these documents or are paraphrased from them. The intent is not to claim credit for the authenticity of the information, but rather simply to organize this information for the County.

Volume 2 – Engineering Summary and Proposed Supplemental Investigation

Because the tunnel is plugged, the June 5th inspection provided insufficient information about the condition of the tunnel. In order to complete an assessment of the existing conditions, additional investigations of the tunnel are required. This segment presents the findings of the limited investigation of June 5th, and provides a proposal to gain access to the remaining portions of the tunnel.

Volume 3 – Feasibility Assessment

Upon completion of the proposed supplemental field investigations, this segment of the report will document completely the condition of the tunnel. It will then provide the County with options for rehabilitating the tunnel, including anticipated costs, to allow the County to determine the feasibility of restoring the tunnel for pedestrian and bicycle use.

2.0 History

The Alto Tunnel is a 16-foot wide by 20-foot high, 2,172-foot long railroad tunnel that was constructed in 1884 and maintained until 1971 when it was abandoned. The south portal is 250 feet south of Underhill Road in Mill Valley and the north portal is between Tunnel Lane and Montecito Drive in Corte Madera. The tunnel was built by the Northwestern Pacific Railroad Company and originally conveyed a single narrow-gauge track. At the time of the abandonment heavy bulkheads were built at each end of the tunnel to prevent further access. In 1975, a lean concrete plug approximately 125-feet length was also installed near the North Portal.

The tunnel, which was originally built and operated by the Northwestern Pacific Railroad Company, has changed hands over time. In most cases, ownership has changed as a result of the railroad that owned the tunnel being acquired by another railroad. The Northwestern Pacific Railroad appears to have been acquired by the Southern Pacific Railroad, who in turn was recently acquired by the Union Pacific Railroad. Within this report, these companies are mentioned interchangeably as the owner of the tunnel.

The original tunnel support (bracing) system consisted of redwood timber (10 inches x 14inches) sets in a 7-segment configuration spaced 1½ to 5 feet apart. Lagging consisting of split redwood approximately 2 inches thick and 5 to 8 inches wide that spans between the sets along both sides and the crown of the tunnel. Over time, some of the original 7-segment configurations were replaced with 5-segment timber sets. There were also various locations where portions of lagging and timber sets were replaced, repaired or added.

The concrete plug at the north end and the timber bulkhead at the south end have virtually cut off air circulation in the tunnel. The lack of air circulation coupled with the water that seeps into the tunnel create a highly humid atmosphere that has resulted in the rapid deterioration of the timber support system.

In February 1977 a private party offered to purchase the tunnel with the intent of filling in a portion of the tunnel and then placing a proper concrete lining over the remaining portions. This properly supported section of tunnel could be used as a constant temperature record storage for fireproof and vandal proof vaults. However this proposal was abandoned because the Railroad could not deliver fee title to the premises and the applicant allegedly feared a future claim on profits from heirs of the original grantor.

During a rainstorm in late December 1981 portions of the timber support system near the South Portal gave way causing a portion of the tunnel to collapse. The collapse extended approximately forty feet above the crown of the tunnel to the surface above, near Underhill Road. This large depression caused adjacent areas to move laterally into the cave-in. As a result, one of the properties adjacent to the tunnel alignment was damaged and utilities and access to Underhill Road were affected.

On April 13, 1983 the County of Marin and the Northwestern Pacific Railroad Company entered into a 15-month option wherein the County would purchase a one-mile portion of the railroad right-of-way. This option agreement was set up into two separate releases to provide some relief to the county from possible liabilities related to the tunnel due to

collapses and potential collapses that began to occur in 1981. The "1st Release" included the old railroad right-of-way south of and up to the South Portal, north from the North Portal, and a segment of the tunnel. This tunnel segment extended from approximately 720 feet north of the South Portal up to approximately 490 feet south of the North Portal. The "2nd Release" was comprised of a 445-foot section of tunnel beginning approximately 275-feet north from the South Portal up to southerly tunnel limit of the "1st Release". The Railroad would thus retain approximately 275-feet at the south end and 490-feet at the north end, and thereby maintain liability for the portions where there exist the most questions regarding the tunnel's structural integrity.

In July of 2000 Safe Routes of Marin once again sparked interest into evaluating the possibility of utilizing the Alto Tunnel as part of the bike master plan. They initiated correspondence with Supervisor Annette Rose asking for a formal engineering study for the bike tunnel, emphasizing the Union Pacific Railroad Company's willingness to donate the remaining portions of the tunnel currently owned by the Railroad. In August of 2000, the Marin Department of Public Works researched and verified both the County's and the Railroads current right-of-way. The portions of the tunnel yet to be donated include the portion outlined in the "2nd Release", the 275-foot portion from the South Portal north, and the 490-foot section from the North Portal south.

GEOLOGIC/GEOTECHNICAL INFORMATION

Based on evaluations (by others) of the typical regional geology, the tunnel is located in the Franciscan formation with short sections at the northern end passing through raidolarian chert and intrusive basalt and diabase. The Franciscan group consists of sandstones, conglomerates and shales that are well bedded and thus reasonably competent. However, the rock has undergone widespread structural changes caused by regional deformation and is generally fractured and jointed. The surface of the Franciscan rock is often weathered to soil of gravel, sand, silt, and clay sizes. The degree of weathering decreases with depth. The interface between the Franciscan rock and the chert and/or basalt may be weathered to a clay of low shear strength when saturated. The age of the Franciscan crop is generally considered Jurassic or Cretaceous.

Beginning at the South Portal, the tunnel penetrates approximately 300 feet of sandstone (greywacke), 500 feet of shale and chert and 1,370 feet of sandstone (greywacke). The more susceptible zones where caving might reach the surface include the weathered rock zones near the tunnel portals and the altered chert and shale zones. The records show that this rock was very blocky and seamy under little to moderate side pressure. As such, this type of rock will tend to spall and form an arch if the crown is unsupported. The rule of thumb is that the height of the arch is approximately one-half the width of the tunnel. As noted by others, if a section of the timber sets should fail, it is reasonable to expect spalling or cave-in of the crown to reach a height of 8 to10 feet. The adjustment of the stresses that would occur in the rock could extend on the order of 20-30-feet above the arched section. This means that areas where the cover over the tunnel is less than 40 feet and that are within 50 feet of the tunnel alignment should be considered vulnerable to caving. It follows then that those areas where the height above the tunnel is greater than 50 feet are less likely to collapse because the arching action and resulting adjustment of stresses would not reach the surface.

Other possible susceptible zones include a section 700 feet from the South Portal and a 200-foot section approximately 1,500 feet in from the South Portal where more closely spaced timbers were required. Based on old inspection reports combined with documented conversations with representatives of the Northwestern Pacific Railway Company it appears there was a fairly large cave-in and one small cave-in since the tunnel was abandoned in 1971, which coincided with the regions of the closely spaced timbers.

4.0 SUMMARY OF INSPECTIONS

The following is a summary of two documented inspections of the tunnel, both of which occurred after the tunnel was no longer in service. They provide insight into the condition of the tunnel at the time that they occurred, and more importantly, how the condition of the tunnel has changed over time.

May 18, 1972 by F.T. Matthias, Kaiser Engineers

In 1972, the Golden Gate Bridge Highway and Transportation District (GGBHTD) along with Marin County Transit District proposed to acquire the tunnel. In preparation for the proposed acquisition of the tunnel (and other portions of the Northwestern Pacific Railroad right-of-way) Kaiser Engineers and a group from GGBHTD performed a cursory inspection of the tunnel and observed the following:

- In the south half of the tunnel the timber sets were generally closer spaced than in the north end.
- The south half also appeared to be taking in a little more water than the north half.
- At the mid-point of tunnel some bottom struts had been installed across the tunnel invert to brace the timber sets.
- Throughout the tunnel the timber posts were generally set at about ground level although some were on timber sills held above the general water level. Where posts were wet there was evidence of substantial deterioration of the wood.
- In the middle third of tunnel there were openings to the rock between the sets, meaning that the lagging was omitted, probably because sound rock material was reached and lagging was not required.
- There is evidence of spalling of rock in the crowns and rock that could accelerate into a progressive failure mode if the support system should deteriorate materially.
- The most apparent weakness in the support system is the deterioration of the bottom of the wall timbers at the base where most are wet intermittently or continuously.

In the end the inspectors recommended that the bulkheads at the tunnel entrances be changed to an open bar type to allow air circulation. This was suggested to slow down the deterioration rate of the timber supports in order to reduce the risk of collapse. This lack of air circulation had contributed to the rapidly increasing deterioration rate. This recommendation was not implemented.

1981 by Copple Foreaker Associates

Again, in preparation of the proposed acquisition of the tunnel and portions of the Northwestern Pacific Railroad right-of-way by the County of Marin a formal study report was completed that included an inspection. Because of the collapses that had occurred since the abandonment in 1971 the field investigation was limited to the approximate

tunnel surface alignment above ground and 450-feet from the South Portal inside the tunnel. The following was observed:

- The bottoms of the wall timbers, which were generally wet, and arch segments and lagging that were next to these wet spots, exhibited almost complete deterioration.
- It was reasonable to assume the timber support system was in a very advanced state of deterioration, and would only offer a fraction of its intended support for few more years after which they would be totally destroyed by decay.

Coincidentally, only four months after this inspection, the tunnel collapsed in the very location of this inspection. Copple Foreaker Associates was called in to assess the collapse as well as the emergency repair methods utilized by Southern Pacific. They then made revised recommendations as to the structural integrity and possible repair methods for the tunnel, documented in their report of March 8, 1982.

5.0 SUMMARY OF REPAIRS

There are various forms of documentation on some of the many different repairs that have been made to the tunnel. However, this list is in no way complete nor can it be considered totally accurate. Some of the design drawings that are included as resources may have in fact only been "Standard Type" Railroad Details and might not have actually been used at the Alto Tunnel site.

One of the first major documented repairs occurred in 1958 when the North Portal was re-constructed and approximately 31 feet of concrete lining was installed. The next documented repair was in 1962 when 139 feet of gunite lining was installed adjacent to the concrete lining that was constructed in 1958. The gunite is reinforced with 8 inch steel sets and reinforcing steel. This section obviously had reached an advanced state of deterioration, which prompting the repair.

Other repairs that were mentioned but whose exact details are not known include the arch segment and strut replacement in the middle third of the tunnel and the southern 300 feet of tunnel where the entire support system was replaced with 5 segment timber sets. These are in addition to the various smaller scale repairs and replacements that likely occurred throughout the use of the tunnel.

In 1975, after the tunnel was no longer in use, it was proposed to place a 124-foot long low strength concrete (1 sack mix) plug near the North Portal inside the tunnel starting at the end of the gunited section. Documents describe this as a precautionary measure that was taken to protect the structures on top of the tunnel. It is unclear if this was ever done.

Following the collapse near the South Portal in December 1981, the Southern Pacific Railroad Company undertook emergency repairs. First, rock was dumped into the cave-in to stabilize the immediate area. Then six holes were drilled into the tunnel from above, two north of the collapse and four to the south. According to records, two of the holes south of the collapse were filled with pea gravel and then pumped full of grout to stabilize the fill. The remaining two holes south of the cave-in and the two holes north were only filled with pea gravel and a very small amount of grout and as such may contain some voids.

6.0 CURRENT STATUS

The current condition of the 2,172-foot long tunnel, from the south end to its north portal is believed to consist of the following:

- Dirt plug blocking the South Portal
- 310 feet of pea-gravel and pea-gravel grout slurry mix plug
- 1,568 feet of tunnel with sporadic reported locations of collapses and other likely locations of structurally sound support locations
- 124 feet of lean concrete plug section
- 139 feet of gunited wall with steel reinforcing
- 31 feet of concrete lining leading up to the North portal entrance

As mentioned earlier Marin County currently owns a 963-foot segment within the middle portion of the tunnel. Union Pacific Railroad officials appear to be interested in releasing the remaining portions of the tunnel, which include the 720 feet of the tunnel at the south end and the remaining 490 feet at the north end.

APPENDIX A – REPORTS / LETTERS

1. Letter dated June 8, 1972, from Mr. F.T. Matthais, Vice President; Transportation Projects of Kaiser Engineers addressed to Mr. Robert E. Shields, Golden Gate Bridge Highway and Transportation District. "Inspection of Northwestern Pacific Tunnel Between Corte Madera and Mill Valley"
2. Report of Copple Foreaker Associates Consulting Engineers to Robert Middagh Department of Public Works dated July 15, 1981. Subject: Investigation of Railroad Tunnel between Core Madera and Mill Valley.
3. Report of Copple Foreaker Associates Consulting Engineers to Robert Middagh Department of Public Works dated March 8, 1982. Subject: Evaluation of Tunnel Cave-in and Subsequent Repairs near the South Portal of the Railroad Tunnel between Core Madera and Mill Valley.
4. Letter dated March 5, 1982 from K.B. Dern to Robert Copple, Copple Foreaker Associates, regarding the materials placed during the emergency repair operations following the December '81 cave-in.
5. Report of Harding-Lawson Associates, Engineers, Geologists and Geophysicists, Novato, California, dated May 1, 1981. Subject: Geologic Evaluation, Abandoned Railway Tunnel, Marin County, California.
6. Letter dated June 29, 1981 from John A. Traitina, Consulting Engineering Geologist, to Robert Copple, Copple and Foreacker Associates regarding Structural Evaluation Northwestern Pacific Railway Company Tunnel, Marin County.
7. Letter dated March 17, 1981 from S.A. Sulftin, General Manager, Real Estate, Southern Pacific Land Company to Robert A Middagh Chief Real Property Agent County of Marin Department of Public Works.
8. Letter dated September 9, 1982 from S.A. Sulftin, General Manager, Real Estate, Southern Pacific Land Company to Robert A Middagh Chief Real Property Agent County of Marin Department of Public Works.
9. Letter dated October 6, 1982 Robert A Middagh Chief Real Property Agent County of Marin Department of Public Works to Board of Supervisors County of Marin regarding the Northwestern Pacific Railroad Right-of-Way Option.
10. Report by Brady and Associates, Inc. Planners and Landscape Architects dated November 1994. Subject: Marin County North-South Bikeway Feasibility Study.
11. Inter-Office Memo dated August 1, 2000 from Terry Toner Chief Real Property Agent Marin County Department of Public Works to Supervisor Kress regarding the Alto Tunnel Ownership Research.
12. Letter dated July 11, 2000 from Safe Routes Marin to Supervisor Annette Rose regarding the possible trail project.

APPENDIX B - PLANS

1. Northwestern Pacific Railway Company's chart showing construction data for the tunnel, which is designated as No. 1 – M.P. 11-69.
2. Northwestern Pacific Railway Tunnel No. 1 Typical "as-built" section.
3. Northwestern Pacific Railroad Company Mainline Layout and Profile from Mill Valley to Larkspur Plan Sheet, drawn June 30, 1916 revised December 31, 1919.
4. Typical Southern Pacific Company's details showing Steel and Gunite work for Tunnel Portal Construction and Repairs designated as CE Drawing 32783 sheets 1 of 2 and 2 of 2 dated 12-22-69.
5. Corte Madera-Mill Valley Railroad Tunnel Profile and Recommended Repairs, prepared by Copple Foreaker Associates dated July 1981
6. Corte Madera-Mill Valley Railroad Tunnel Profile and Plan View depicting the proposed releases of Railroad Right-of-Way to Marin County.
7. Northwestern Pacific Railroad Company Corte Madera-Sausalito Bridge Plan & Profile of Tunnel No. 1 revised February 23, 1982 following filling operations after December 1981 cave-in.
8. City of Mill Valley Topographic Map dated 1968 showing portion of Tunnel Alignment from South Portal.
9. Rails to Trails II Exhibit showing proposed Route from South Portal of Tunnel to Tamal Vista Blvd. And Doherty Drive.
10. County of Marin, Department of Public Works Survey Section, Aerial Photograph with Tunnel alignment.

Appendix A

Reports / Letters

Appendix A - Reports / Letters

KAISER ENGINEERS
DIVISION OF KAISER INDUSTRIES CORPORATION

KAISER CENTER · 300 LAKESIDE DRIVE, OAKLAND, CALIFORNIA 94604 · CABLE KAISENGS

June 8, 1972

Mr. Robert E. Shields, Chief Engineer
Golden Gate Bridge Highway and
Transportation District
Box 9000, Presidio Station
San Francisco, California 94129

Dear Mr. Shields:

Inspection of Northwestern Pacific Tunnel
Between Corte Madera and Mill Valley
18 May 1972

The Golden Gate Bridge Highway and Transportation District, together with the Marin County Transit District is planning the acquisition of certain right-of-way of the Northwestern Pacific railroad in Marin County, including a railroad tunnel with its south portal in Mill Valley and its north portal in Corte Madera. The Golden Gate Bridge Highway and Transportation District requested Kaiser Engineers to make a cursory visual inspection of the condition of the tunnel. An inspection trip was made on Thursday, May 18, 1972, by F. T. Matthias, Kaiser Engineers; Robert Shields, Chief Engineer, and Glenn Wallace of the Golden Gate Bridge Highway and Transportation District; James B. Robertson, Acting General Manager, Marin County Transit District; and Art Lawson, City Engineer, Corte Madera. Others in the inspection party were R. Lawson and S. Haymond of Golden Gate Bridge Highway and Transportation District; and Doug Morgan, John Bogliolo, and Frank Fontes of Morgan Rail Car Company.

The north portal of the tunnel was entered through a bulkhead faced solidly with timbers (about 8" x 16", spiked and bolted in place) after removal of a section of the timber facing. The party proceeded through the tunnel to the south portal and returned through the north portal bulkhead. Illumination was by hand carried flashlights. Inspection of the tunnel support systems and the rock wall in the few places that were exposed was limited to what could be seen and reached while standing on the invert of the tunnel. After leaving the north portal, Messrs. Shields and Matthias inspected the south portal from the outside.

General Description of Tunnel

A right-of-way drawing at the Golden Gate Bridge Highway and Transportation District office showed the tunnel length as 2,172.2 feet. All other

dimensions given below are estimated. Sketches of an elevation view and a short centerline longitudinal section including the north portal are attached. The longitudinal section shows the position of the house above the portal and generally on the center line of the tunnel.

The significance of the numbers cast in the concrete of the north portal were stated to be:

Tunnel constructed in 1884

Tunnel repaired and north portal constructed in 1958

It was stated that the railroad stopped service through the tunnel about November, 1971, and that heavy timber bulkheads were built closing both ends of the tunnel about that time. The bulkhead was solidly faced with timber beams about 8" x 16" at both portals limiting air movement through the tunnel to the amount that could go through the small cracks between the facing timbers and at the ends of the facing timbers. At the north portal the bulkhead was approximately vertical within the concrete portal structure. At the south portal the bulkhead was sloped downward and outward about 1 to 1 from the crown of the tunnel and appeared to be built on timber cribbing that formed the portal structure.

The single track railroad through the tunnel appeared to be well ballasted, in good alignment and with ties in fair condition.

The original tunnel support system appeared to have been built with redwood timbers in a 7 segment configuration spaced from about 3 ft to 8 ft and fully lagged, both sides and around the crown, with split redwoods about 2 inches thick and from about 5 to 8 inches wide. It appeared that a spark screen about 3 or 4 feet wide of one to two inch thick boards had been nailed to the underside of the center segment of the timber sets.

The typical regional geology indicates that the tunnel is located in the Franciscan formation with short sections at the northern end passing through radiolarian chert and intrusive basalt and diabase. The Franciscan group consists of sandstones, coaglomerates and shales. The surface of the Franciscan rock is often weathered to soil of gravel, sand, silt, and clay sizes. The degree of weathering decreases with depth. The rock is generally fractured and jointed. The interface between the Franciscan rock and the chert and/or basalt may be weathered to a clay of low shear strength when saturated. The age of the Franciscan group is generally considered Jurassic or Cretaceous.

Observations

From the north portal structure, a distance of approximately 300 feet the entire tunnel had been gunited with concrete. Inspection of weep holes, apparently drilled through the gunite, indicated a 6 to 12 inch thickness. While it could not be ascertained by inspection, there were indications that a wire mesh of about one-eighth inch strands had been placed over the existing timber and lagged support system and the gunite applied. Drilling through the gunite would have to be done to determine whether or not the timber and lagging was left in place. In either case, the gunite appeared to be sound except for shrinkage cracks that should not affect the competence of the gunited section to support the tunnel. The indication of wire mesh showed in one of the weep holes inspected. It is likely that this work was done when the north concrete portal was built, presumably in 1958.

Southward from the south end of the gunited section, the support system appeared to be that originally installed to about the mid point of the tunnel. Spacing of sets was from about 3 to about 8 feet with probably half or more at about 5 feet. A few bottom struts had been installed across the tunnel invert, some singly, others in groups of 2 or 3 bracing consecutive timber sets. A few of the timber arch segments had been reinforced by bolting scabs to the original timbers. The struts and arch segment repair appeared to be more recent than 1958. In the north half of the tunnel, the lagging appeared to be of the original split boards with only a few isolated places where they had broken out. A few posts, generally along the west wall of this section, were bowed away from the wall a few inches and a few groups of 2 or 3 adjacent posts were an inch or so closer to the tunnel centerline than the general alignment.

At one point about in the middle third of the tunnel, lagging, spark screen boards and a few rocks had fallen out of the center of the arch. At other points in the south half of the tunnel, there were open spaces in the crown between timber sets where there was no lagging. Most of these showed timber blocking above the sets. This blocking appeared similar in appearance to original large timbers and probably was placed to fill overbreak spaces that developed during driving.

In the south half of the tunnel the timber sets were generally closer spaced than in the north end. This half also appeared to be making a little more water than the north half. Although there were no places observed where water was flowing into the tunnel in any but small trickles, occasional dripping from the crown was observed in the section from the inside end of the gunited section to the south portal.

In the south third of the tunnel, it appeared that a few jump timber sets had been placed since the original construction. About 300 feet or so

from the south end there was some rock exposed near the crown that appeared to be different in character than the rock exposed on each side. This possibly was a narrow dike intrusion with weaknesses on both sides. From just north of this point to the portal, the entire support structure appeared to have been replaced with 5 segment timber sets. Some of the lagging appeared to be split redwood, other pieces sawed boards. The spacing of these sets was much closer than the rest of the tunnel, varying between about 18 inches to about 4 feet, with most at about 2 feet.

Throughout the tunnel the timber posts were generally set at about ground level although some were on timber sills held above the general water level. Where the posts were in the wet, there was evidence of substantial deterioration of the wood. The vertical timber and lagging along the walls did not show substantial deterioration. The timber set material in the crown could not be examined at close range but the fact that some had been reinforced indicated that some previous inspection had disclosed weaknesses that called for repair.

In a number of places, generally in the middle third of the tunnel, there were openings to the rock. In most of these, the rock disclosed appeared to be hard live rock that protruded inside the outside line of the timber sets. This may indicate that some of the "high" points of sound rock were left "high" during the original driving and lagging omitted rather than trimming the rock.

In the tunnel, as it is now, no evidence was observed of progressive development of pressures exerted on the support system other than that developed by spalls falling out of the crown and sidewalls and building up some loading on the timber sets and lagging. If rock mass pressures had developed it would be expected to cause massive failure of the lagging long before the stress on the timber sets approached anything near a critical level.

The heavy gunite application in the north end and construction of the concrete north portal would indicate that this section of the tunnel must have showed a much greater degree of deterioration prior to its repair than the rest of the tunnel. In its present condition this section can be expected to be more competent in resisting destructive forces than the rest of the tunnel.

It was noted that the practically solid bulkhead walls at each end of the tunnel virtually cut out air circulation in the tunnel. This lack of air circulation, coupled with the water that oozes and drips into the tunnel would maintain a highly humid atmosphere in the tunnel which would contribute to deterioration of the support system (exclusive of the gunited section).

Conclusions

It is understood that there are no current plans to use the tunnel as a transportation route or for any use that would call for use of the tunnel by people. If there is no ultimate use contemplated, it would appear that the tunnel should be filled full of a well graded material, probably gravel, that would prevent deterioration of the support system or the natural material surrounding the tunnel from causing settlement of the ground above the tunnel.

If it is desired to maintain the tunnel opening for a possible future use, certain precautions should be taken to maintain the opening and prevent settlement or other adverse actions that would affect the property above the tunnel.

Except as noted above, the party observed no indication of ground movements or structural failure of the walls, crown, and invert outside the support system (except for the conditions presumed to have been observed and that led to the extensive gunite repair at the north end of the tunnel). This original excavation was apparently done about 88 years ago and a reasonable equilibrium between structural rock competence and the support system apparently has been achieved. There is evidence of spalling of rock in crowns and rock and this could accelerate into a progressive failure mode if the support system should deteriorate materially. It is not likely that such deterioration would be sudden or that the structural competence of the rock would decrease suddenly but it would be prudent to initiate periodic inspections, perhaps every two months, to observe any change in the support system or in the rock conditions. As a safety precaution for inspectors and others that may go through the tunnel the spark screen at the crown should be removed as it is nailed to the old timber sets from the bottom and may continue to fall out from its own weight helped by rock fragments that may fall out of the arch.

The most apparent weakness in the support system is the deterioration of the bottom of the wall timbers at the base where most are wet intermittently or continuously. A concrete curb along both sides of the tunnel against the walls that would surround the vertical timbers and slope slightly downward towards the tunnel centerline would both reinforce the bottom of the timbers and slow down the deterioration.

Natural air circulation through the tunnel would be conducive to longer life of the timber and lagging support system. This could be done by removing the solid timber bulkheads and substituting an open steel grillwork that would let air through. Reinforcing steel, perhaps 1" in diameter, welded to form about 6" x 6" openings should be secure against vandalism. At one or both portals a locked gate should be installed to give access for inspection.

Fire in the tunnel that would destroy parts of the timber support system would be a hazard in that the heat and the removal of the restraint imposed by the support system could result in accelerated spalling that could weaken the rock structure and result in settlement or, at worst, develop openings that might progress upward to the surface. A trade off study of the cost of sprinkler system or other fire protection as compared to the cost of liability insurance would appear to be advisable.

Very truly yours,

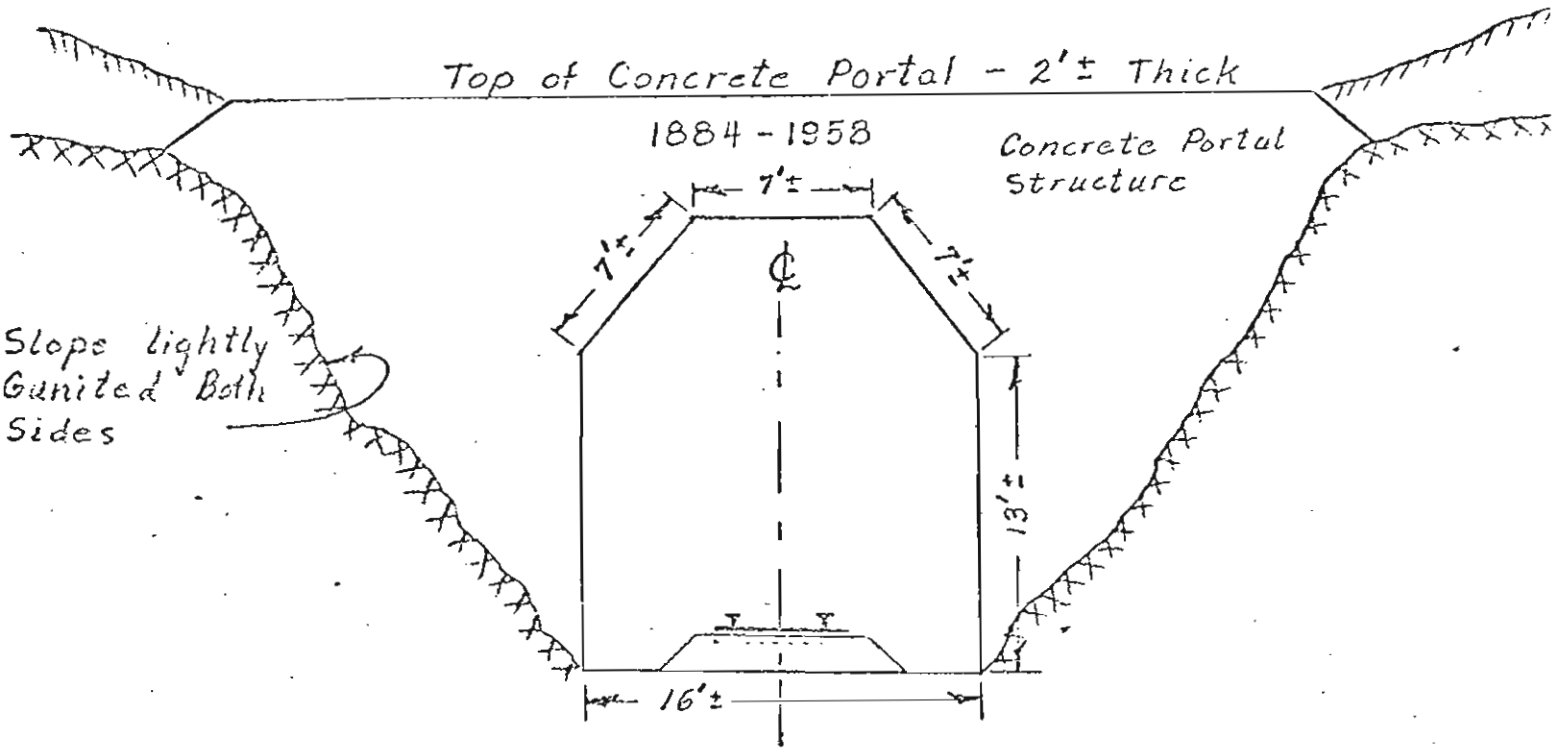
KAISER ENGINEERS
Division of Kaiser Industries Corporation

F. T. Matthias
Vice President, Transportation Projects

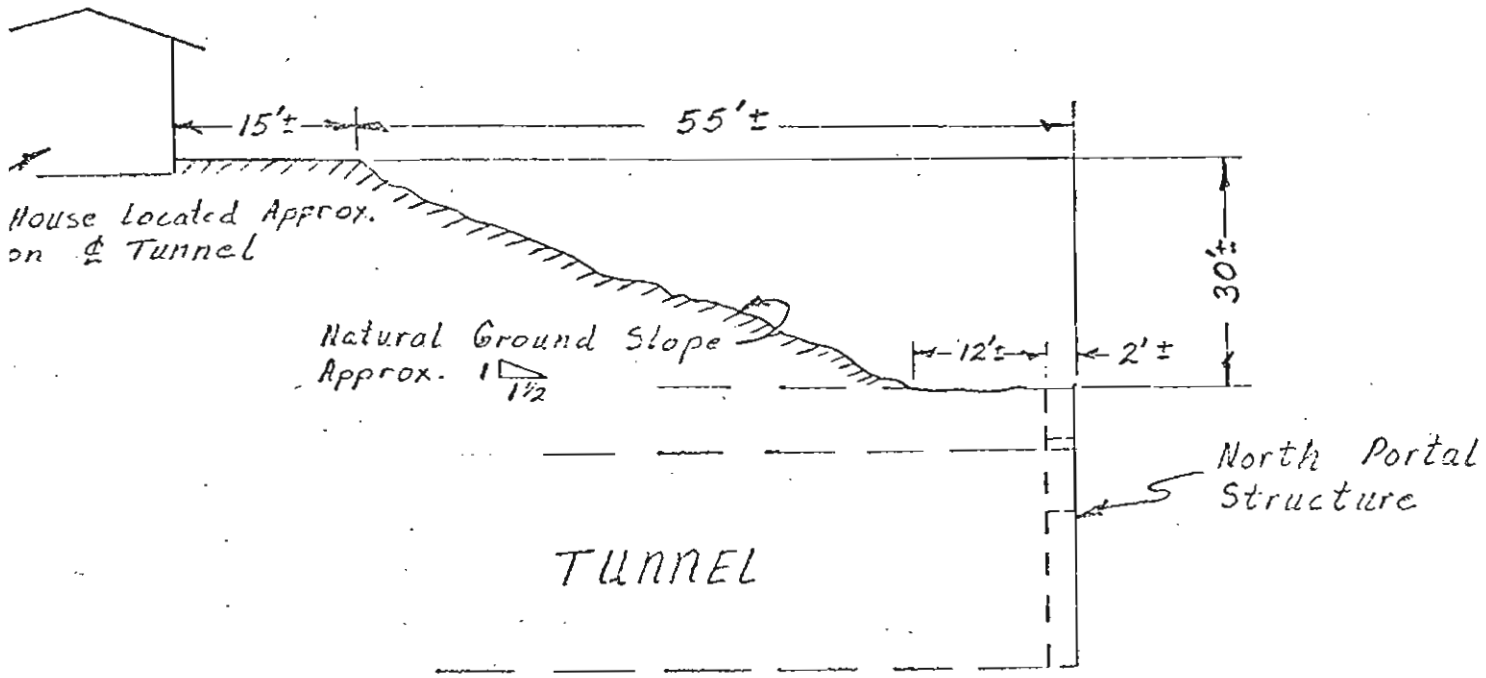
FTM/le

Northwestern Pacific R.R. Tunnel

Between Corte Madera and Mill Valley



Elevation - looking South at North Portal



Longitudinal Section Along ℄ Tunnel

All Demensions Estimated - Not to Scale

DEPARTMENT OF PUBLIC WORKS
MARIN COUNTY, CALIFORNIA

P.O. Box 4186 Civic Center San Rafael 94913
Telephone 499-6578

Ray Thomson, Director
Mario Balestrieri, Chief Deputy Director

May 13, 1981

Mr. Robert W. Copple
Civil & Structural Engineer
Copple Foreaker Associates
1203 Third Street
San Rafael, CA 94901

Re: Structural Engineering Study and Investigation of the Railroad Tunnel Between Corte Madera and Mill Valley

Dear Bob:

Enclosed for your review is a copy of a study prepared by Mr. F. T. Matthias, Vice President, Transportation Projects, Division of Kaiser Industries Corporation, dated June 8, 1972. It appears that this information will be of assistance to you in your tunnel study. Please incorporate this information in your evaluation of the tunnel as you see fit.

Very truly yours,

Robert A. Middagh
Chief Real Property Agent

RAM:ab

Enclosure

COPPLE FOREAKER ASSOCIATES
CONSULTING ENGINEERS
1203 THIRD STREET
SAN RAFAEL, CALIFORNIA 94901

ROBERT W. COPPLE
CIVIL & STRUCTURAL ENGINEER

RAY W. FOREAKER, JR.
CIVIL & MECHANICAL ENGINEER

JOHN C. BETONTE, JR.
CIVIL ENGINEER

TELEPHONE 457-4030
AREA CODE (415)

July 15, 1981

Robert A. Middagh
Department of Public Works
Chief Real Property Agent
P.O. Box 4186
San Rafael, CA 94913

Subject: Investigation of Railroad Tunnel between Corte Madera and Mill Valley.

Dear Bob,

This is to report on our investigation of the Northwestern Pacific Railroad Tunnel between Corte Madera and Mill Valley. The purpose of our investigation was: to determine the present condition of the tunnel, to make an appraisal of existing and future potential problems resulting from defects or deterioration, and to study the feasibility of various ways to correct defects and make the tunnel safe.

For this investigation we consulted with Harding-Lawson Associates, Engineers and Geologists,who have previously made soil engineering studies in the area, and with John A. Trantina, Engineering Geologist, who has extensive experience with tunnel construction. Our field investigation consisted of surface reconnaissance along the tunnel alignment and the inspection of approximately 450 feet of tunnel from the south portal.

We obtained useful information from the Southern Pacific Co. in the form of drawings, records, and personal discussions. A letter dated June 8, 1972 from F.T. Matthais of Kaiser Engineers to Robert E. Shields of the Golden Gate Bridge

Highway and Transportation District regarding a tunnel inspection on May 18, 1972 was informative.

Description of the Tunnel: The Tunnel was constructed in 1884. The excavated rock section is 16 feet wide by 20 feet high and 2172 feet long. The south portal is 250 feet south of Underhill Road in Mill Valley. The north portal is between Tunnel Lane and Montecito drive in Corte Madera. The tunnel was used until the railroad line was abandoned in 1971. At that time bulkheads were built to close both ends of the tunnel. The original tunnel support system consisted of redwood timber sets of 10" X 14" timbers in a 7 segment configuration spaced between 1 1/2 feet to 5 feet apart. The tunnel was fully lagged with two inch thick split redwood. In the southern 300 feet or so of tunnel the entire support system has been replaced with 5 segment timber sets. Elsewhere timber sets have been repaired or added as required during the period the tunnel was in use. In 1958 the north portal was rebuilt and 31 feet of concrete lining was constructed. Beyond the concrete lining, there is 139 feet of Gunite lining. The Gunite is reinforced with 8 inch steel sets and reinforcing steel. In 1975 the 124 feet beyond the gunited section was filled with low strength concrete, reportedly after some caving had occured.

The bulkhead at the south end and the concrete plug at the north end have virtually cut off air circulation in the tunnel. The tunnel collects ground water from the surrounding rock which drips into the tunnel. The lack of air circulation plus the moisture result in an atmosphere where wood deteriorates rapidly. Since 1971 when the tunnel was closed, the timber support system has been almost totally destroyed from decay at points of intermittent moisture. The bottoms of the wall timbers which are generally wet and Arch segments and lagging which are next to wet spots are points of almost complete deteroriation. Based on the foregoing, it is reasonable to assume the timber support system is in a very advanced state of deteroriation, and will only offer a fraction of its intended support for a few more years and then will be totally destroyed by decay. So far there have been several small failures and one large cave-in reportedly 900 feet from the south portal. The condition of the timber is such that repairs would not be feasible. If the tunnel is to be maintained, a completely new support system is necessary. The section of tunnel that has been gunited and the concrete filled section are considered secure and cave-ins should not occur.

According to published geologic maps, reports prepared by others, and surface reconnaissance of the area, the tunnel was excavated in the Franciscan formation. The formation is composed of interbedded sandstones, shales and local units of

conglomerate, chert, and serpentine, all exhibiting complex structures. Based on information we have developed and from the references noted heretofore particularly on information contained in the inspection report prepared by Kaiser Engineers in 1972, it is reasonable to conclude that, beginning at the south portal, the tunnel penetrated approximately 300 ft. of sandstone (graywacke), 500 ft. of shale and chert, and 1370 ft. of sandstone (graywacke).

In general the sedimentary series of rocks in the Franciscan formation are well bedded and reasonably competent; however, the rock has undergone widespread structural changes caused by regional deformation. Therefore it is assumed that the rock excavated from the 700 ft. section of tunnel from the south portal was very blocky and seamy under little to moderate side pressure. Records show that this section and the 200 ft. section approximately 1500 ft. from the south portal required closely spaced timber supports. According to the inspection report and conversation with representatives of the Southern Pacific Railway Company, one fairly large cave-in and one small one occurred in areas where the timber sets were closely spaced. The cave-ins occurred since the line was abandoned in 1971.

Very blocky and seamy rocks will tend to spall and form an arch if the crown is unsupported. The rule of thumb is that the height of the arch is approximately one-half the width of the tunnel. In this case if a section of the timber sets

should fail, it is reasonable to expect spalling or cave-in of the crown to reach a height of 8-10 ft. The adjustment of stresses that would occur in the rock above the arched section could be in the order of 20-30 feet. Therefor any section of tunnel whose present cover is less than approximately 40 ft. is a potential liability to structures on the surface located within 50ft. of the tunnel alignment.

Recommendations: There are three alternative recommendations which should be considered:

1. Accept the risk that the tunnel will have large cave-ins which may reach the surface. In our opinion this is most likely to occur within 500 feet of the south portal. Residences, several residential lots, and Underhill Road could be affected. Potential liability from loss of value of real estate and road damage could amount to one million dollars. Cave-ins reaching to the surface have a remote chance of occuring along the length of tunnel 100 ft. in from the concrete plug near the north portal. Here there is one residence and a cul-de-sac street over the tunnel. The potential loss of value of real estate and road damage could amount to $500,000. The above amounts are order of magnitude numbers and they do not include liability resulting from injury.
2. Replace the deterioated timber support system. The

most feasible method would be to replace the timber with steel sets and shotcrete. This is the modern method to replace timber supports. The length of tunnel involved is 1,890 feet. Contract unit prices for this work are estimated to be $1,500 per linear foot resulting in an estimated project cost of $2,835,000. An advantage of this alternative is the tunnel would be available for use upon removal of the concrete plug and resupporting the rock where the plug was. The estimated cost to remove the concrete and re-support the 124 foot long section is $248,000.00. ($2000.00 per foot).

3. Fill the tunnel where the present cover above the crown is less than 65 feet. The 65 foot is conservative and includes an allowance for future grading and underground construction at grade as well as unknown soil and rock conditions. Because of the deteriorated condition of the timber supports we consider it unsafe to work inside the tunnel. A safer procedure would be to fill the tunnel through holes from above. The procedure would be to drill 12 inch diameter holes from grade to the crown of the tunnel at 40 foot intervals. Pea Gravel would be dropped into the holes using a hopper. Gravel would be added until the cone shaped pile reached the crown of the tunnel. The gravel would next be vibrated and jetted with water to flatten out. Next

a high slump low strength grout would be pumped down the holes. We recommend that 440 feet at the south portal and 120 feet south of the concrete plug near the north portal be filled. The holes would also be grout filled. At the south portal, good access over the tunnel is available as the land is vacant and has a slope less than 15%. Near the concrete plug, holes would need to be drilled at Buida Court and on private property. It seems likely that property owners would cooperate because their property would benefit. At the south portal, a solid grout plug a few feet thick would permenatly seal the tunnel. The estimated cost to fill the tunnel as noted is $300,000.00.

If alternatives 2 or 3 are to be considered we strongly recommend that the work be accomplished as soon as possible. Within a few years large cave-ins could occur which would make relining or filling the tunnel much more difficult.

Please call us if you have any questions.

Sincerely yours,

Robert W. Copple

Robert W. Copple

RC/ms

RAILROAD TUNNEL BETWEEN CORTE MADERA AND MILL VALLEY

Engineers Cost Estimate - Alternative No. 3 Filling Tunnel at South Portal and South of the Concrete Plug at the North Portal.

No.	Item	Quanity	Unit	Unit Price	Price
1.	Mobilization, Access Roads Survey, Set Up	1	L.S	$30,000	30,000
2.	Drilling 12 inch holes	800	L.F.	35.00	28.000
3.	Pea Gravel	3900	C.Y.	25.00	97,500
4.	Grout	1500	C.Y.	60.00	90,000
5.	Seal South Portal	1	L.S.	5,000	5,000
6.	Subtotal				250,500
7.	Contingency (10%)	1	L.S.	25,000	25,000
8.	Engineering	1	L.S.	20,000	20,000
	Total Project Cost				295,500
				Say	$300,000

Note:

Unit Prices include necessary incidental work and contractors overhead and profit.

COPPLE FOREAKER ASSOCIATES
Consulting Engineers
1203 3rd Street
SAN RAFAEL, CALIFORNIA 94901
(415) 456-7283

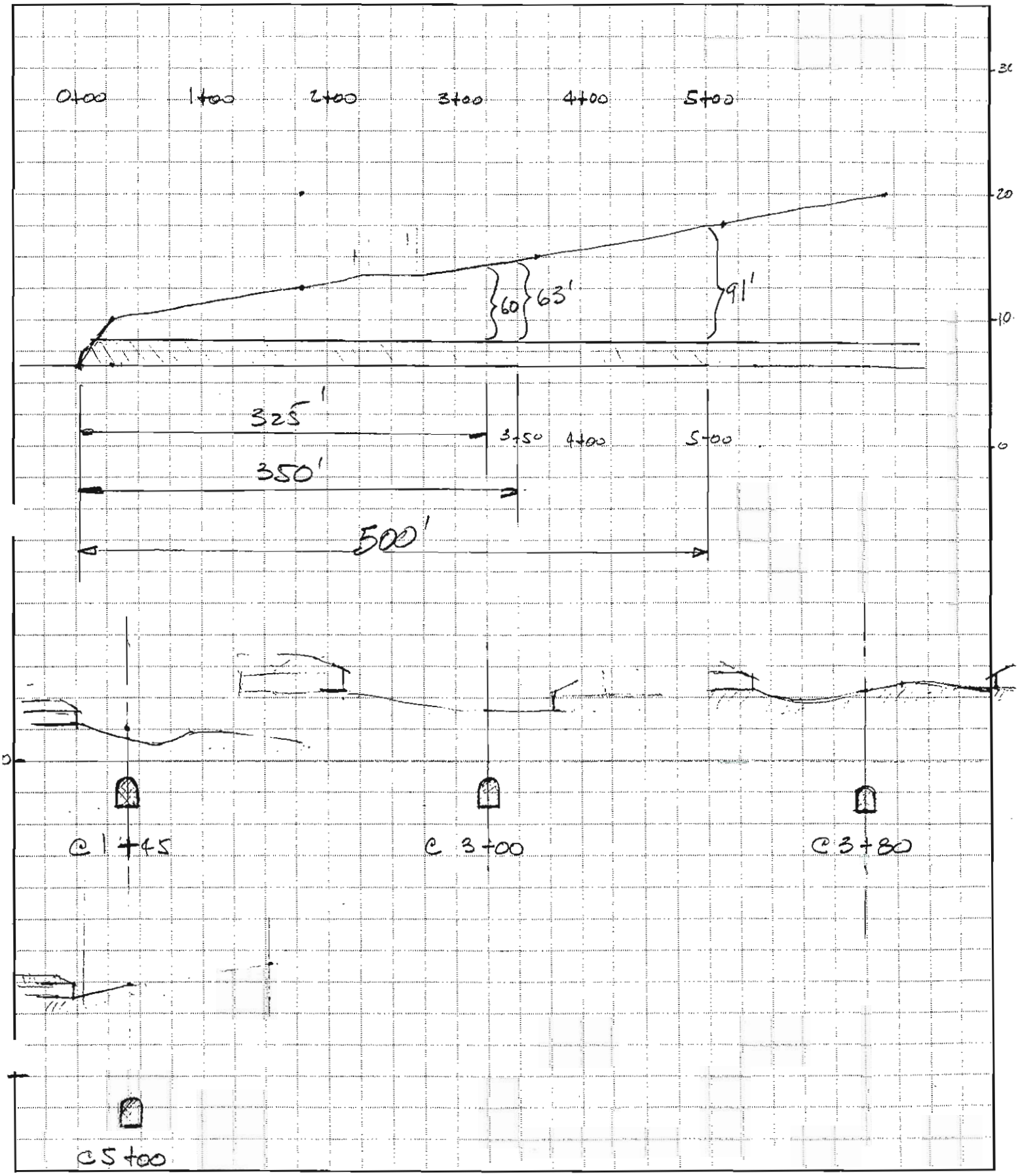
JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

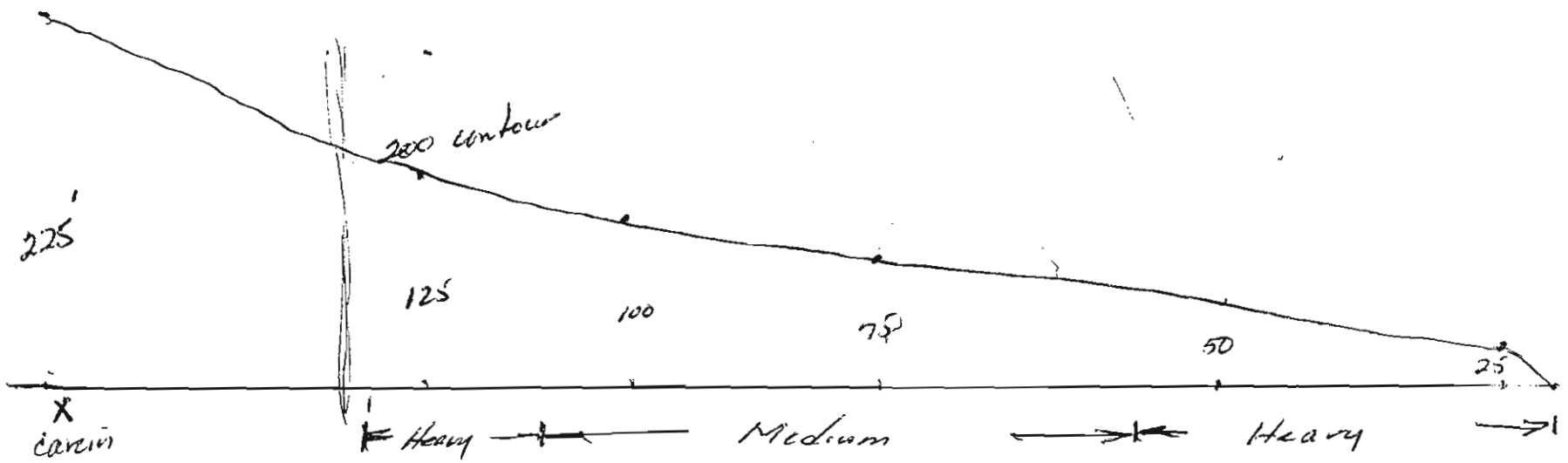
CHECKED BY _____ DATE _____

SCALE _____



Tunnel height 20'

700' to be filled



COPPLE FOREAKER ASSOCIATES
Consulting Engineers
1203 3rd Street
SAN RAFAEL, CALIFORNIA 94901

(415) 457-4020

LETTER OF TRANSMITTAL

DATE	JOB NO.
February 18, 1982	8123

ATTENTION: Dick Tait

RE: Railroad Tunnel Corte Madera

TO R. C. Harlen & Associates
P.O. Box 7717
San Francisco, CA. 94120

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☒ Prints ☐ Plans ☐ Samples ☐ Specifications
☒ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	7/81		Profile Corte Madera Railraod Tunnel
1	7/15/81		Report on Tunnel to Robert A. Middagh

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval
☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution
☒ As requested ☐ Returned for corrections ☐ Return _____ corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

COPY TO _____

SIGNED: _____

...s at once

COPPLE FOREAKER ASSOCIATES
CONSULTING ENGINEERS
1203 THIRD STREET
SAN RAFAEL, CALIFORNIA 94901

ROBERT W. COPPLE
CIVIL & STRUCTURAL ENGINEER
RAY W. FOREAKER, JR.
CIVIL & MECHANICAL ENGINEER
JOHN C. BETONTE, JR.
CIVIL ENGINEER

TELEPHONE 457 4030
AREA CODE (415)

March 8, 1982

Mr. Robert A. Middagh
Chief Real Property Agent
Department of Public Works
P.O. Box 4186
San Rafael, CA. 94913

Subject: Evaluation of Tunnel Cave-in and Subsequent Repairs near the South Portal of the Railroad Tunnel between Corte Madera and Mill Valley.

Dear Bob:

In late December, 1981, the decayed and weakened tunnel support timbers near the south portal collapsed and a large cave-in occurred. The cave-in reached the surface approximately forty (40) feet above the crown of the tunnel. A large depression at the surface caused adjacent areas to settle and to move laterally into the cave-in. The residence at #34 Underhill Road was damaged. Underhill Road and the underground utilities contained therein were affected.

Emergency repairs were undertaken by the Southern Pacific Railroad Company. Rock was dumped into the cave-in to stabilize the immediate area. This proved to be effective. Elevations taken by the Railroad Company indicate that the residence at #34 Underhill Road and Underhill Road have settled very little since then.

The small settlements observed probably result from adjustment and consolidation of the surrounding soil rather than an enlarged cave-in. We expect this consolidation to continue for several years but at a decreasing rate.

After the cave-in was stabilized and to prevent other cave-ins, the Railroad Company attempted to fill the tunnel adjacent to the cave-in. Two holes were drilled approximately forty (40) feet and seventy-five (75) feet north of the cave-in. The holes were within and just north of Underhill Road. The holes which intersected the crown of the tunnel were filled to the surface with pea gravel. No attempt was made to vibrate or flatten the pea gravel within the tunnel. Three holes were drilled south of the cave-in and a pit was dug just above the south portal. Pea gravel was dumped into these holes to a level just below the crown of the tunnel. The pea gravel could be observed from the portal. The pit above the portal was completely filled with pea gravel.

Next, a grout slurry was pumped into the three holes. The grout could not be observed within the tunnel because the portal had been filled with pea gravel. An earth embankment was placed over the portal completely sealing this end of the tunnel.

We believe that the procedures used to fill the tunnel south of the cave-in will be effective. However, the procedures used did not permit close inspection of the tunnel filling and large voids could be present. These voids could collapse with settlement occurring at

the surface above. It seems unlikely however that serious damage to adjacent properties would occur.

We believe that the procedures used to fill the tunnel north of the cave-in probably does not fill more than two thirds of the tunnel between the two holes. Here collapse of the timber supports could cause a cave-in with some settlement at the surface. A large cave-in extending to the surface is possible but unlikely.

North of the last (northernmost) hole the thickness of rock above the crown of the tunnel increases as does the total cover over the tunnel. Presumably for this reason, the Railraod Company did not attempt to fill any-more of the tunnel.

In our report of July 15th, 1981, we recommended that the tunnel be filled four hundred forty (440) feet in from the south portal. The Railraod Company has attempted to fill two hundred seventy-five (275) feet including the cave-in.

Had the tunnel been filled prior to the cave-in, the procedures used could be closely observed with assurance that the filling would be effective. Because of the emergency nature of the Railroad Company's recent work, careful inspection and monitoring was not possible. The cave-in and the recent work also makes it difficult to inspect any future filling.

In addition to filling four hundred forty (440) feet at the south portal, in our July 15th, 1981 report, we recommended filling one hundred (100) feet in from the concrete plug near the north portal. These recommenda-tions were made after careful analysis of the available

data and consultation with our engineering geologist. We believe these recommendations still apply; however, different procedures must be considered because the recent cave-in prevents inspection of work near the south portal. In addition, tunnel cave-ins have an emotional element similar to earthquakes or nuclear power plants. For example, it is not inconceivable that homeowners whose residences are near the tunnel could question whether our recommendations are sufficiently conservative. Experts often differ by wide margins. Often the expert who is most conservative or most skilled at persuasion of political bodies or the courts will prevail. For this reason we recommend that to secure the tunnel in a manner that would prevent future claims, that our recommendations of July 15th, 1981 be modified as follows:

1. That seven hundred twenty (720) feet of tunnel in from the south portal be filled by the same method as described in our July 15th, 1981 report (drill holes at forty (40) foot centers to the crown of the sewer and fill tunnel with pea gravel and grout) however, inspection of the work using remote T.V. cameras at adjacent holes is recommended.
2. That two hundred (200) feet of tunnel in from the plug near the north end be filled using remote T.V. cameras for inspection.
3. That an allowance for future claims by the owners of #34 and #35 Underhill Road be made.
4. That an allowance for future repairs to Underhill Road and for underground utilities be made.

5. That future construction within one hundred fifty (150) feet of the tunnel be prevented unless specific geotechnical engineering evaluation is submitted with each building permit application. Deep borings should be required as part of each evaluation. Cooperation of the Cities of Mill Valley and Corte Madera would be required.

We estimate that the cost of implementing our recommendations as follows:

1.	Filling tunnel as noted in items #1 and #2 above with allowance for work already accomplished by the Railroad and the cave-in	$400,000
2.	Allowance for future claims by owners of residences on Underhill Road	$50,000
3.	Allowance for repairs to Underhill Road and to utilities	$20,000
4.	Contingency allowance for frivolous claims, and the cost of defense and cost of consultants relating to such claims	$20,000
	Total Cost of Work and Allowances	$490,000

The above recommendations and cost estimates are based on our review of the technical data and also on our observations as to how the community and the courts have handled similar problems.

This report has been prepared at this time to meet your time schedule. Some additional date has been promised by the Railroad Company relating to quantities, dates, field notes and materials used during their recent work. We are expecting this data shortly. It is unlikely that this forthcoming information would change our recommendations or estimates.

Please call us if you have any questions.

Sincerely,

Robert W. Copple

Robert W. Copple

RWC/lo

#8123

COPPLE FOREAKER A OCIATES
Consulting Engineers
1203 Third Street
SAN RAFAEL, CALIFORNIA 94901
(415) 457-4030

JOB CM Tunnel 8123
SHEET NO. 1 OF 1
CALCULATED BY RWC DATE 3-8-82
CHECKED BY DATE
SCALE

Prelim Cost Est.

720
150
870 new length of tunnel to be filled
540 former length " " " " "
275 length of tunnel already filled

Estimated Cost

$$\frac{870 - 275}{440} \times 290{,}000 \approx 400{,}000$$

COPPLE FOREAKER ASSOCIATES
Consulting Engineers
1203 3rd Street
SAN RAFAEL, CALIFORNIA 94901

(415) 457-4030

LETTER OF TRANSMITTAL

DATE	JOB NO.
March 8, 1982	8123

ATTENTION: Robert A. Middagh

RE: Corte Madera Mill Valley Tunnel

TO Department of Public Works
P.O. Box 4186
San Rafael, CA. 94913

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☒ Reports

COPIES	DATE	NO.	DESCRIPTION
4	3/8/82		Evaluation of Tunnel Cave-in and Subsequent Repairs of the Railroad Tunnel between Corte Madera and Mill Valley.

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
☒ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☒ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 19_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

COPY TO _____

SIGNED: _____

If enclosures are not as noted, kindly notify us at once.

RECEIVED MAR 9 1982

331-3 (Tunnel #1-S205. Br.)
March 6, 1982

CM Tunnel
8123

Robert W. Copple
Copple Forsaker Associates
Consulting Engineers
1203 Third Street
San Rafael, Cal. 94901

Subject: Tunnel No 1 - Mill Valley - Corte Madera

Gentlemen:

Pursuant to our recent phone conversation, I'm enclosing for your use a table indicating quantities of pea gravel and sand slurry placed in each hole we established in Tunnel No 1. Also, enclosed is letter report from McPhails Inc. San Rafael indicating the composition of the sand slurry placed in the tunnel.

For your information, Basalt Products has stated that pea gravel weights 2680 lbs. per yard and 6X3 rock weights 3400 lbs per yard respectively.

K. B. Dan

	Tons	Yards
Hole No	Pea Gravel	Sand Slurry
#1	420 T	0
#2	450 T	94
#3	350 T	35
#4	210 T	0
#5	185 T	5
#6	525 T	4
Totals	2140 Tons	138 yds

Note:

1437 tons of 6x3 rock placed between holes 4 & 5

PROPOSED CONCRETE MIX DESIGN

DATE: March 6, 1982

THE FOLLOWING MIX DESIGN IS SUBMITTED FOR USE ON THE SUBJECT PROJECT. ALL WEIGHTS ARE IN S.S.D. CONDITION, MOISTURE CORRECTIONS WILL BE MADE AT THE TIME OF BATCHING.

GENERAL CONTR: Maggioria-Ghilotti .PROJECT: N.W.P. Tunnel

.LOCATION: Scott Valley; Mill Valley, Ca.

AGG. SOURCE: COURSE: [illegible] .FINE: Basalt-Healdsburg

MAX. AGG: -- .CEMENT TYPE: Perm Type II Mod. .MIN CMT CONTENT: N/S

MIN. STRENGTH IN ____ DAYS: N/S PSI. SLUMP: 7" + .MISC: ____

MIX NO: M-2 .USE: Fill .PLACEMENT: Conventional

MATERIALS: (ONE CUBIC YARD)	SSD WEIGHT	ABSOLUTE VOLUME	SPEC. GRAVITY
CEMENT:	282 lbs.	1.43	
AGGREGATE: Concrete Sand	2922	17.54	2.67
AGGREGATE:			
AGGREGATE:			
AGGREGATE:			
AIR: Darex AEA	6%	1.62	
WATER: Total Demand 48 gal	400	6.41	
TOTAL CONSTANT WEIGHT:	3604	27.00	

ADMIXTURE: WRDA w/Hycol @ 3.5 oz./cwt = 10 oz/yd.

ADMIXTURE: ____

FRESH UNIT WEIGHT: 133.48 #3 . W/C RATIO: ____ BY WGT.

RESPECTFULLY SUBMITTED,
MC PHAIL'S, INC.

Rich Camgros

917 C Street • San Rafael • (415) 453-6070
Mail Address: Post Office Box 1290 • San Rafael, California 94915

HARDING-LAWSON ASSOCIATES
ENGINEERS, GEOLOGISTS AND GEOPHYSICISTS

7655 REDWOOD BOULEVARD
P.O. BOX 578
NOVATO, CALIFORNIA 94948 415/892-0821 TELEX 340523

ALASKA
CALIFORNIA
HAWAII
ILLINOIS
NEVADA
TEXAS
WASHINGTON
WASHINGTON, D.C.
SAUDI ARABIA

May 1, 1981
2693,003.02

Mr. Robert W. Copple
Copple and Foreacker Associates
1203 Third Street
San Rafael, California 94901

Dear Mr. Copple:

Report
Geologic Evaluation
Abandoned Railway Tunnel
Marin County, California

This letter reports the results of our geologic evaluation of an abandoned railway tunnel near Alto on the Northwestern Pacific Railway Company's former Sausalito Branch Line, Marin, County, California.

We understand that the County of Marin is considering purchase of the railway right-of-way including the tunnel as part of their "Rails to Trails" program. There is concern regarding the liability that would be incurred from possible future collapse of the tunnel. Roadways and utilities have been constructed across the right-of-way and several homes approach very close; one home is over the tunnel near the north portal. The tunnel is presently sealed by a concrete plug near the north portal and a wooden bulkhead at the south portal. The concrete plug was placed beneath the home over the tunnel as a precautionary measure. Through loss of circulation, accelerated deterioration of the timber support is likely. Inspection of the tunnel by railway personnel during November, 1976, revealed that caving had occurred in several sections.

The object of our evaluation is to provide

1. A description of the geology based on available data and a geologic reconnaissance of the right-of-way over the tunnel.

2. An estimate of the probable future risk of tunnel collapse to the surface.

3. Suggested mitigation measures with their general cost range.

4. Possible methods by which improved data could be obtained such as by geophysical or drilling methods.

Geology

Library research revealed there are no detailed published geologic maps of the tunnel area. Our interpretation of the geology is based upon our reconnaissance mapping of the right-of-way and nearby areas, and on geologic data in our files from previous exploratory work in the Scott Highlands and Scott Valley subdivisions of Mill Valley lying west and east, respectively, of the right-of-way. The findings of our reconnaissance mapping are summarized in the attached Geologic Profile.

Rock exposures are generally poor and widely spaced; consequently, persistence of the rock types shown and their detailed structure and engineering properties at the tunnel level are relatively unknown. Much of our interpretation is based upon experience through subsurface investigation in areas of similar geology.

The probability of future caving to the surface through loss of timber support is appreciably greater where all of the materials between the tunnel and the surface are relatively soft and incompetent. Erodibility and loss of strength through saturation from infiltrating surface water are the characteristics most relevent to the caving potential. Materials in this area most susceptible to caving are the overburden soils and the rocks with soil-like properties including deeply weathered graywacke or greenstone and intensively sheared and altered shale. Hard graywacke, even with locally interbedded shale, where hard and competent below the weathered zone would probably stand without appreciable caving after timber support is lost.

Based on the limited data it is apparent that the more susceptible zones where caving might reach the surface include the weathered rock zones near the tunnel portals and the altered chert and shale zone. Other relatively soft, incompetent rock includes possible shear zones or shale both of which are seldom exposed in natural outcrops but may exist within the graywacke zone shown on the profile.

CONCLUSIONS

Estimated Collapse Risk

The probability that collapse might extend to the surface depends upon both the competence of the materials above the tunnel and the total height between the tunnel back and the surface. As an example, in relatively competent rock such as the unweathered graywacke, localized collapse generally progresses until a natural arch is formed. Where the rock is more fractured or contains appreciable shale, more extensive collapse might occur but would fill the tunnel and the collapse void due to the greater volume of the collapse debris than the in-place rock. Where the height above the tunnel back is great, collapse in less competent rock would probably not reach the surface.

In deeply weathered or highly sheared and less competent rock such as altered shale, even with pods and lenses of hard chert, the collapse debris could be eroded and softened so as to flow lengthwise in the tunnel away from the immeidate collapse area. The natural arching effect might be prevented by erosion of descending surface water along sheared or fractured zones. Nevertheless, collapse to the surface would depend upon the distance to the surface. It might, however, be simply a matter of time unless mitigating steps were taken.

Possible Mitigation Measures

The obvious most effective mitigating measures would be to either line the tunnel with steel and concrete supports or fill it with concrete. Either would be costly; conventional steel arch-reinforced concrete would probably be most costly due to the hazard in removing the existing timber supports. The cost of concrete filling would probably be on the order of $600 per linear foot; conventional reinforced concrete lining would probably be four to five times that amount.

Shotcrete lining of the tunnel over the existing timber supports would probably be ineffective since the timber would continue to deteriorate and the shotcrete alone would provide no appreciable structural support.

Filling of the tunnel either with concrete or other material such as sand or rock quarry waste, would probably have to be accomplished from the surface due to the hazard of working in the tunnel in its present condition. Filling therefore, would require drilling of large diameter holes from the surface. For greater efficiency to reduce costs, drilling of these holes should be accomplished by a large rotary-air type rig. However, that would require construction of wide access roadways and leveled drill sites. This might not be permissible or feasible in developed areas due to existing improvements such as landscaping, large trees, steep narrow roadways or driveways, etc. In that situation, smaller, less efficient and higher cost-per-foot drilling equipment would be necessary.

Complete filling of the tunnel would probably not be necessary. Provided there is relatively competent graywacke in about the middle third, collapse in that area even it it occurred, would probably not reach the surface due to the bulking effect. Elsewhere, complete filling may or may not be necessary; that would depend upon the type of rock and the height between the tunnel and surface. By filling the tunnel at intervals, collapse debris from less competent materials would be prevented from flowing lengthwise in the tunnel. However, close spacing of filling and drill holes would be necessary.

Assuming hole spacing and filling on the order of 50 to 100 feet apart, we estimate that the cost for about two-thirds of the tunnel length would be in the general range of $100,000 to $200,000. The actual cost would depend upon the specific rock conditions, access problems to drill holes in presently developed residential area, and so forth.

Further Investigation

In order to optimize the cost to benefit ratio, further investigation would be appropriate. If filling were undertaken, the efforts could be concentrated in sections of the tunnel more susceptible to caving, whereas zones of hard rock in the deeper sections of tunnel could be avoided.

Even if the tunnel were safe to enter, detailed mapping of rock conditions is effectively prevented by the existing timber and lagging. We believe that the most effective method to provide the needed data would be through seismic velocity measurements from the surface which

by recently developed computerized analysis, would be capable of measuring sonic velocities indicative of rock type and competence along the axis of the tunnel. For added confidence of interpretation, the data would be confirmed by widely spaced preliminary drill holes for geologic logging. These holes could later be reamed to larger diameter for use in the tunnel filling.

Because of the danger of fire and its potentially highly adverse effects, the south portal of the tunnel should be protected by a concrete bulkhead to replace the present timber bulkhead. In the event that the right-of-way and tunnel are acquired, this replacement should be undertaken as soon as possible in advance of other mitigation measures.

Yours very truly,

HARDING-LAWSON ASSOCIATES

Erwin C. Winterhalder
Engineering Geologist - 272

ECW/gpl

Attachment: Geologic Profile

2 copies submitted

HARDING-LAWSON ASSOCIATES

Engineers, Geologists and Geophysicists

SHEET 1 OF _____

JOB NO. 2.93.003.02

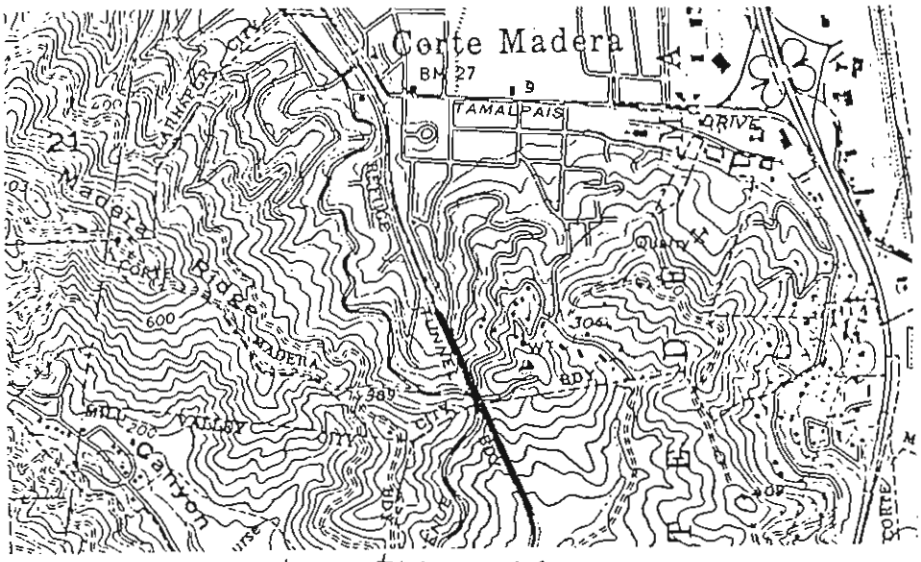
DATE 4-30-91

PROJECT Alto Hill - Geologic

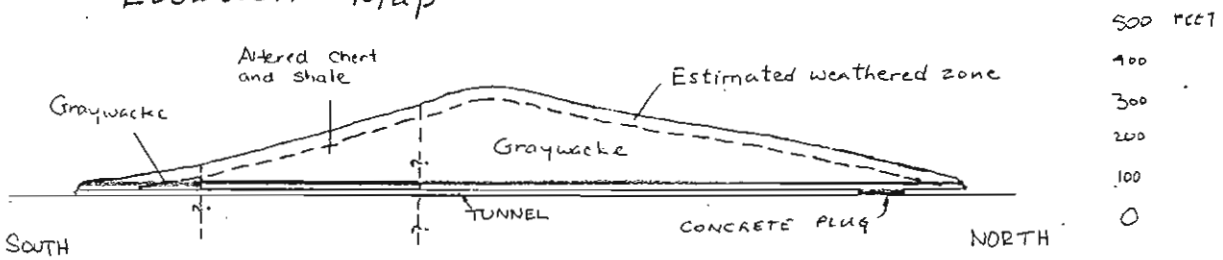
COMPUTED BY LST

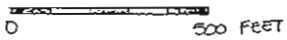
SUBJECT Profile of Railroad Tunnel

CHECKED BY ECW



Location Map





— Graywacke and thin zones of interbedded shale, decomposed and soft due to weathering near surface but generally hard and competent below a depth of approximately 30 feet; Poorly exposed; may contain large zones of greenstone and shale.

— Altered chert and shale; poorly exposed but believed to consist of hard pods and lenses of chert in a matrix of soft sheared shale..

#8123

JOHN A. TRANTINA
CONSULTING ENGINEERING GEOLOGIST
536 SEA VIEW DRIVE
EL CERRITO, CA 94530
PHONE (415) 525-3756

June 29, 1981

Mr. Robert W. Copple
Copple and Foreacker Associates
1203 Third Street
San Rafael, CA 94901

Structural Evaluation
Northwestern Pacific Railway
Company Tunnel, Marin County

Dear Mr. Copple:

Introduction

This report is a summary of my observations and opinions in reference to the structural competency of an abandoned tunnel on the Sausalito Branch Line of the Northwestern Pacific Railway Company. The County of Marin is concerned about the condition of the tunnel and its liability to structures on the surface in the event physical changes in the rock and the existing support should occur over a long period of time.

The engineering geological evaluation was based on information obtained from the following references, personal discussions, and other sources:

(a) Northwestern Pacific Railway Company's chart showing construction data for the tunnel which is designated as No. 1 - M.P. 11.69, Corte Madera.

(b) Letter dated March 17, 1981, from Southern Pacific Land Company addressed to Mr. Robert A. Middagh, Chief Real Property Agent, County of Marin, Department of Public Works, San Rafael, California.

(c) Letter dated June 8, 1972, from Mr. F. T. Matthais, Vice President, Transportation Projects of Kaiser Engineers, 300 Lakeside Drive, Oakland, California, addressed to Mr. Robert E. Shields, Golden Gate Bridge Highway and Transportation District, Presidio Station, San Francisco, California. Subject: Inspection of Northwestern Pacific Tunnel between Corte Madera and Mill Valley, 18 May 1972.

(d) Report of Harding-Lawson Associates, Engineers, Geologists and Geophysicists, Novato, California, dated May 1, 1981. Subject: Geologic Evaluation, Abandoned Railway Tunnel, Marin County, California.

(e) On-site discussion with Mr. J. F. Lynch, Chief, Engineering Design and Construction, Southern Pacific Land Company, Southern Pacific Building, San Francisco, California, on June 25, 1981.

(f) Surface reconnaissance along tunnel alignment and examination of rock outcrops.

(g) Inspection of approximately 150 ft. of tunnel from the south portal.

General Discussion

The tunnel was constructed in 1884. The excavated rock section is 16 ft. wide, 20 ft. high, and 2170 ft. long. It is supported by 10 in. x 14 in. redwood timbers spaced from 24 in. to 60 in. apart. The tunnel is fully lagged with 2 in. thick, 5 in. to 8 in. wide redwood.

According to published geologic maps, reports prepared by others, and surface reconnaissance of the area, the tunnel was excavated in the Franciscan formation. The formation is composed of interbedded sandstones, shales and local units of conglomerate, chert, and serpentine, all exhibiting complex structures. Based on information from the above references, particularly on information contained in the inspection report prepared by Kaiser Engineers in 1972, it is reasonable to conclude that, beginning at the south portal, the tunnel penetrated approximately 300 ft. of sandstone (graywacke), 500 ft. of shale and chert, and 1370 ft. of sandstone (graywacke).

In general the sedimentary series of rocks in the Franciscan formation are well bedded and reasonably competent; however, the rock has undergone widespread structural changes caused by regional deformation. Therefore it is assumed that the rock excavated from the 700 ft. section of tunnel from the south portal was very blocky and seamy under little to moderate side pressure. Records show that this section and the 200 ft. section approximately 1500 ft. from the south portal required closely spaced timber supports. According to the inspection report and conversation with representatives of the Northwestern Pacific Railway Company, one fairly large cave-in and one small one occurred in areas where the timber sets were closely spaced. The cave-ins occurred since the line was abandoned in 1971.

Very blocky and seamy rocks will tend to spall and form an arch if the crown is unsupported. The rule of thumb is that the height of the arch is approximately one-half the width of the tunnel. In this case if a section of the timber sets should fail, it is reasonable to expect spalling or cave-in of the crown to reach a height of 8-10 ft. The adjustment of stresses that would occur in the rock above the arched section could be in the order of 20-30 feet. Therefore any section of tunnel whose present cover is less than approximately 40 ft. is a potential liability to structures on the surface located within 50 ft. of the tunnel alignment.

Recommendations

1. Since the tunnel was not properly prepared for inspection and the rock visible only through cracks in the lagging, it was not possible to make a reliable prediction of the structural competency of the rock in the crown. Therefore it is strongly recommended that the

section of the tunnel whose present cover above the crown is less than 60 ft. be considered in need of structural supports, either replaced with steel sets and shotcrete or filled with quarry rock and cement slurry.

2. If Marin County decides that the tunnel will never be rehabilitated for use in the future, then filling the tunnel with quarry rock and cement slurry would be the most economical and maintenance-free method of eliminating the potential liability.

3. It is recommended that at least 500 ft. of tunnel from the south portal be filled with quarry rock and cement slurry or any similar material that will provide stability to the rock mass.

4. The tunnel is considered to be hazardous because of the deteriorated support system and inadequate ventilation. Therefore, it is recommended that cost estimates be prepared on the basis that filling will be done from the surface through 24 in. diameter holes. The spacing of holes will depend on the quantity of quarry rock that will be placed before the remaining cavity is filled with cement slurry or low slump concrete.

5. No remedial measure will be needed to increase the structural integrity of the tunnel under more than 60 ft. of cover. If the existing support should fail and cave-ins should occur, the tunnel will fill up with displaced rock fragments before an unsupported arch approaches a critical distance of the surface.

6. According to information obtained from discussions on the site with representatives of the Northwestern Pacific Railway Company, the gunite section of tunnel at the north portal was designed and constructed as a permanent lining, therefore is not considered as a potential liability to structures above the tunnel.

Sincerely yours,

John W. Trantina

JAT:fm

Southern Pacific
Land Company

Southern Pacific Building • One Market Plaza • San Francisco, California 94105 • (415) 362-1212

REAL ESTATE

541 1000 IN REPLY PLEASE REFER TO

S. A. SUTFIN
GENERAL MANAGER, REAL ESTATE
R. E. MESICK
ASSISTANT GENERAL MANAGER, REAL ESTATE
C. W. JOHNSON
O. L. OSNESS
ASSISTANTS TO GENERAL MANAGER, REAL ESTATE

March 17, 1981

Sausalito Branch-GE-10

County of Marin
Department of Public Works
P.O. Box 4186, Civic Center
San Rafael, California 94903

Attention: Mr. Robert A. Middagh
Chief Real Property Agent

Gentlemen:

Please refer to your letter of December 23 and subsequent delivery of a draft of option agreement covering Northwestern Pacific Railroad Company's former Sausalito Branch in Marin County.

As pertains to Section 4 of the draft, relating to the abandoned tunnel between Mill Valley and Corte Madera, believe it is necessary to emphasize several points:

1) The tunnel was originally constructed in 1884 and maintained until the line was abandoned in 1971. At that time, heavy timber bulkheads were built to close both ends of the tunnel. In 1975, a concrete plug, 124' in length was placed near the north portal as shown on the attached profile.

2) The original tunnel support system consisted of redwood timber sets in a 7 segment configuration spaced from about 2 to 4 feet in the region underlying the proposed house. The timber sets were fully lagged both sides and above the crown with split redwood approximately 2 inches thick and ranging from 5 to 8 inches wide.

3) The regional geology through which the tunnel was bored is the Franciscan formation with short sections of intrusive basalt and disbase and radiolarian chert near the northern end.

4) The concrete plug at the north end, and the timber bulkhead at the south end have virtually cut off air circulation in the tunnel. The lack of air circulation coupled with the water that drips into the tunnel has created a highly humid atmosphere which has resulted in the deterioration of the timber support system.

5) The tunnel was last inspected in November of 1976, at which time it was reported that there was caving in of several sections of the tunnel.

6) A private party offered to purchase the tunnel during February 1977. The intent was to place a properly designed reinforced concrete lining within the tunnel and use it for commercial purposes. The offer was from a party recognized as being knowledgeable in tunnel and underground construction, and included an offer to accept future liability from date of purchase. The transaction failed since we were unable to deliver fee title to the premises and the applicant allegedly feared a future claim on profits from heirs of the original grantor.

7) Northwestern Pacific Railroad Company makes no representations as to the condition of the tunnel or the cost to cover any deficiencies. If County of Marin opts to fill or partially fill the tunnel by other than conventional means or attempts to reduce its exposure through exercise of its police powers, it must do so at its own behest and not upon the recommendation or alleged recommendation of NWPRRCo.

8) Northwestern Pacific Railroad Company claims no expertise in filling of tunnels.

9) It is recommended the County contract for the services of a competent engineer to review this problem. If Marin County does acquire the tunnel, NWPRRCo. will credit an amount equal to one-half of this engineering cost - to a maximum of $2,500 - towards the purchase price for the tunnel and adjoining right of way.

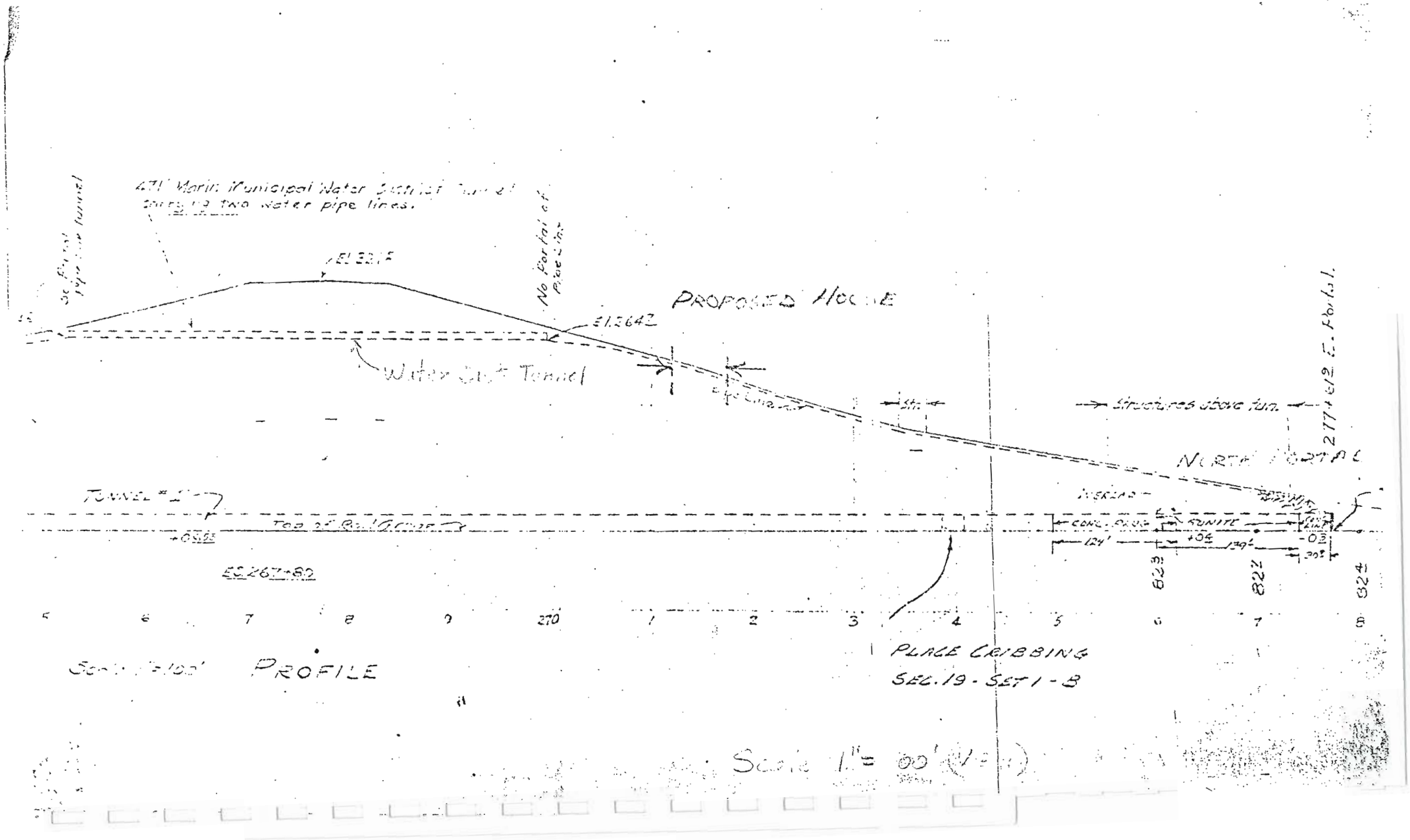
10) County would indemnify NWP against any liability arising out of the existence of the tunnel.

Thank you for your cooperation.

Very truly yours,

S. A. Sutfin Jr.

OLO/bjs


471' Marin Municipal Water District Tunnel
carrying two water pipe lines.
EL 332.5
PROPOSED HOUSE
EL 326.2
Water Supply Tunnel
Structures above tun.
NORTH PORTAL
TUNNEL "L"
TOP OF BENCH
EQ 267+80
CONC. PLUG
GUNITE
PLACE CRIBBING
SEC. 19 - SET 1 - B
PROFILE
Scale 1" = 20'
Scale 1" = 60'

Southern Pacific
Land Company

Southern Pacific Building • One Market Plaza • San Francisco, California 94105 • (415) 541-1000

REAL ESTATE

S. A. SUTFIN
VICE PRESIDENT AND GENERAL MANAGER
R. E. MESICK
ASSISTANT TO VICE PRESIDENT
C. W. JOHNSON
O. L. OSNESS
ASSISTANTS TO GENERAL MANAGER, REAL ESTATE

IN REPLY PLEASE REFER TO

SAUSALITO BRANCH-GE-10
September 9, 1982

Mr. Robert A. Middagh
Chief Real Property Agent
County of Marin
P. O. Box 4186
San Rafael, CA 94913

Dear Mr. Middagh:

Please refer to your letter of July 20, 1982, regarding County's offer to purchase Railroad's Sausalito Branch right-of-way.

Your proposal appears to be generally acceptable. Provided the Marin County Board of Supervisors approves your proposal, please advise in order that I may solicit approval of our management. This should not be construed as a commitment, however, as this would require formal approval of Railroad's management.

As you are aware, Northwestern Pacific Railroad Company claims only easement rights to the tunnel area. It may be necessary for the County to purchase remaining rights from owners of the fee title if the County ever opts to reopen the tunnel for rapid transit or other purposes.

As previously discussed, the County may avoid unreasonable claims from owners of the fee title provided they are contacted using an eminent domain action as the vehicle to force a decision. The present monetary value of the tunnel might be determined by identifying those owners who are willing to accept a quitclaim to the tunnel area from the Railroad without monetary consideration (thereby indicating the tunnel has some value, but relieving the County of any liability at this time), as opposed to owners who are not willing to accept a quitclaim from the Railroad without monetary consideration (thereby indicating the tunnel may have a negative value and therefore of minimal value in determining damage to the fee owner in the eminent domain action).

If you opt to follow the latter course of action, our proposed option would not cover the tunnel area, but the option for release of balance of First Release could not be exercised unless the eminent domain action was filed with or before the exercise of option.

Very truly yours,

RLM/gjd

499-6578

July 20, 1982

Southern Pacific Land Company
Southern Pacific Building
One Market Plaza
San Francisco, CA 94165

Attention: Mr. O. L. Osness
Assistant to General Manager, Real Estate

Reference: Sausalito Branch - GE-10

Dear Mr. Osness:

Subsequent to our recent phone conversation, I would like to present the County's tentative proposal to you for consideration. The pending situation with the home located over a portion of the tunnel just south of the North Portal has caused a slight delay in our negotiations, but I'm sure we can get over this hurdle as we have in the past. The option that I would like to propose to the Marin County Board of Supervisors if the Railroad concurs would be as follows:

PROPOSED RAILROAD OPTION BREAKDOWN

1. Pay Railroad $10,000 for 15-month option. This amount to apply against purchase price if option is exercised within 15-month option period or forfeited if any portion of option is not exercised.

2. Pay Railroad $4,000 per year - $1,000 for existing bike path rental (currently being paid) and $250 per month for rental lease at Gate 6. Total payment per year of $3,000 (12 x $250.00 = $3,000).

3. First Release

   Parcels "A", "B", "C-1", "T", "I", "J", "K", "U", "Q" and Portion "P".

   Pay Railroad $900,000 and assume tunnel liability 200 feet south of the concrete plug on North Portal to a point which is 720 feet north of the South Portal.

This modification is required as a result of the pending problem on the residence at 101 Stetson Avenue in Corte Madera. In order to present this option to the Board of Supervisors with the Committee's blessing it has been necessary to alter our previous verbal understanding by increasing the amount of available cash to the Railroad in the First Release from $850,000 to $900,000. The Committee has indicated that they will not recommend the tunnel liability acceptance to the Board when the consulting engineer's report indicates that that portion of the tunnel requires fill. The Board simply does not have any cash available to cure that situation at the time of the first release. It may be necessary for the Railroad to fill the area under 101 Stetson Avenue prior to even an acceptance of the option because of the pending problem. At least this way the Railroad would get $50,000 in cash out of the First Release to offset any monies expended by the Railroad to cure this pending situation. I hope this modification is acceptable because I have explored every possibility to achieve this solution and it simply boils down to cash flow and tunnel liability stigma.

4. Second Release

Upon payment of $874,760 to the Railroad by County (via Larkspur developer) the Railroad will deed to County/Developer Parcels "L", "P" and Parcel "X" and the County will accept the tunnel liability from the north edge of Underhill Road to a point ~~530~~ 445 feet north of the north edge of Underhill Road.

AGREED MAYER 8-30-82 WITH CHANGE

The County would be in a position at the time of the Second Release to assume the burden of paying for the tunnel corrective work as indicated in the "Copple Report." The Second Release may be accelerated out of sequence only if the County accepts the tunnel liability from the north edge of Underhill to a point which is 200 feet south of the concrete plug on the North Portal and pays the Railroad an additional $50,000 in cash.

RECAP OF COMPENSATION TO RAILROAD

*First Release	$ 900,000
**Second Release	874,760
	$1,774,760

*Subject to tunnel liability as set forth in Paragraph 3.

**Subject to tunnel liability as set forth in Paragraph 4.

I hope this option proposal meets with your approval and if so I'll present this immediately to our Committee and the Board of

Supervisors as soon as I receive your letter of acceptance.

I sincerely hope the next proposed acquisition of the 8½ miles between San Rafael and Ignacio is absent of the many changing problems we have faced on this strip of right-of-way.

I hope you are feeling better, Oscar. Please feel free to call me if you have any questions regarding this proposal.

Very truly yours,

Robert A. Middagh
Chief Real Property Agent

RAM:ab

cc: Ron Mayer

499-6578

October 6, 1982

Board of Supervisors
County of Marin
Civic Center
San Rafael, California

Re: Northwestern Pacific Railroad
Right-of-Way Option

Dear Board Members:

For approximately 10 years the Board of Supervisors has expressed an interest in acquiring the five and one-half miles of abandoned railroad right-of-way between the Sausalito City Limits and Tamal Vista Drive in Corte Madera. Availability of funds has precluded this proposed acquisition until 1978, when the County received a grant from the Heritage Conservation and Recreation Service, a branch of the Department of Interior. The County acquired approximately two and one-quarter miles of this right-of-way with these grant funds and in 1980 secured in public ownership that portion of the railroad right-of-way lying between Coyote Creek in Mill Valley and the south portal of the railroad tunnel lying about one mile north of East Blithedale Avenue in Mill Valley.

Earlier last year your Board approved the expenditure of $10,000.00 for an option to secure the right-of-way between Coyote Creek behind Howard Johnson's Motel in Mill Valley and the Sausalito City Limits. This right-of-way is the only pedestrian link between Mill Valley and Sausalito. A portion of this right-of-way includes an existing bike path which presently is leased by the Railroad to the County for $1,000 a year on a month-to-month basis. It also includes the area between Gate 6 Road and the Sausalito City Limit line, a portion of which is proposed to be a parking lot for the Gates Co-op., Inc. and Waldo Point Harbor. The Railroad presently leases a portion of this right-of-way to the County for $250 per month and the County subleases said right-of-way to the Gates Co-op. and they presently make this monthly payment.

The Railroad has patiently waited for the County to raise the required funds to purchase the remaining portion of their abandoned right-of-way and has in the past and recently turned down many offers from private individuals to purchase portions of this right-of-way. I believe at this time it is appropriate to say that this is the last available opportunity to purchase this right-of-way from the Railroad.

Proposed funding for this acquisition by the County fell $642,000 short of the County's appraised value and approximately $1,175,000 under the Railroad's appraised values and the Railroad was firm in their negotiations that the County's acquisition include the tunnel between Mill Valley and Corte Madera.

Portions of this tunnel, which was abandoned in 1971, were filled with concrete, gunite plugs and rock by the Railroad and as a result of their abandonment the railroad was left with no easement rights, only the tunnel liability. Absence of required funds based on the County's own appraisal and pending offers to the Railroad from private parties to acquire portions of the Richardson Bay right-of-way required the County to consider the tunnel liability in the acquisition negotiations. Your Board approved a contract to secure the services of a private engineering firm (Copple-Foreaker Associates) to explore and evaluate ways to minimize this tunnel liability. This report recommended filling additional portions of the tunnel which had not already been filled by the Railroad. The Railroad has deeded back portions of their right-of-way north of the tunnel and filled approximately 575 feet of the tunnel itself which precludes consideration of any use of the right-of-way as a transportation corridor. However, the proposed option provides for a continuing public ownership of the old railroad right-of-way between the south portal of the tunnel to a point approximately 300 feet north of Gate 6 Road in Sausalito. Pedestrian and bike path use would be preserved and linked to the existing bike path in the City Limits of Sausalito. Portions of the old railroad right-of-way in Sausalito have been in private ownerships and developed by the private sector which would preclude any use of the railroad right-of-way through Sausalito as a transportation corridor.

I have negotiated what I feel is a most desirable option of the County when you keep in mind the fact that the County's appraisal for the right-of-way along the Richardson Bay frontage (Parcels "A", "B" and "C-1") including three Richardson Bay tidelots (Parcel "T") is $1,570,260 and the best the County can generate in funds is $928,230. The Railroad is willing to deed the County additional portions of their right-of-way north of the tunnel in Corte Madera and Larkspur (Parcels "J", "K", "U", "Q", and a portion of "P"), portions of which are presently developed with a bike path that is on a license which is subject to a 30-day cancellation.

The proposed option involves two separate releases.

The First Release of this option would result in the County's ownership of all of the above parcels for the payment of $900,000, with the County assuming a portion of the liability to the Mill Valley/Corte Madera tunnel. The portion of tunnel liability we would be assuming would require no fill or corrective work according to our Copple Engineering Report. As I mentioned before, lack of available funding based on our own appraisal requires assumption of portions of the tunnel liability. The Railroad has agreed to retain that portion of the tunnel which lies south of the north edge of Underhill Road (275 feet) as well as 500 feet of the northerly portion of the tunnel. Major portions of the tunnel the Railroad would be retaining liability for has had corrective work done by the Railroad and it was very difficult to negotiate this condition with the Railroad when they are giving the County a credit of $704,762 for the tunnel liability based on our appraised values for just the First Release.

The Second Release involves the sale of portions of the right-of-way in Larkspur (Parcels "L", Portion of "P" and "X"), and based on what the Railroad is willing to accept, vs. what a Larkspur developer is willing to pay the County, would result in an additional $362,000 to the County and that money would be used to fill the portion of the tunnel the County would be accepting the liability for when the Second Release is exercised. Copple's estimate for filling this portion of the tunnel is approximately $222,500, which would leave the County with approximately $167,730 after the First and Second Releases are exercised and after all the corrective work is done on the portion of the tunnel the County would be accepting.

The following is a brief outline of the proposed option between the County of Marin and the Northwestern Pacific Railroad which would require funding from HUD, the San Francisco Foundation, Cal-Trans, Parks and Recreation and the sale of portions of the railroad right-of-way in the vicinity of Gate 6 Road and the old Baltimore Station in Larkspur.

Breakdown of Option Between County of Marin and Northwestern Pacific Railroad:

1. Pay Railroad $10,000 for 15-month option. This amount to apply against purchase price if entire option is exercised or otherwise non-refundable.
2. County Pays Railroad $4,000 per year during 15-month option period for lease of existing bike path along Richardson Bay and Waldo Point parking lot. County has been paying $1,000 per year for existing bike path. $3,000 per year for Waldo Point parking lot has been paid to Railroad by Gates Co-op via County Sublease.
3. Total settlement with Railroad is $1,774,760 to be made in two releases and County acceptance of portions of the tunnel liability as follows:

FIRST RELEASE

TO RAILROAD	PARCELS TO BE DEEDED TO COUNTY	PORTION OF TUNNEL LIABILITY TO BE ACCEPTED BY COUNTY
$ 900,000	"A", "B", "C-1", "T", "I", "J", "K", "U", "Q" & Ptn. of "P"	200' south of concrete plug on north portal to a point which is 720' north of south portal. *Note: This portion of the tunnel requires no corrective work per Copple Engineering Report.*

SECOND RELEASE

(To be totally funded by sale of portions of railroad right-of-way in Larkspur. Balance of funds to County to be used for tunnel fill)

$ 874,760	"L", "P" and "X"	North edge of Underhill Road to a point 445' north of north edge of Underhill Rd. *Note: This portion of the tunnel required approximately $222,500 of fill per Copple Engineering Report.*

$1,774,760 TOTAL SETTLEMENT TO RAILROAD

It is recommended that your Board direct staff to negotiate the two releases along the lines indicated above and to prepare the necessary documentation for Board action.

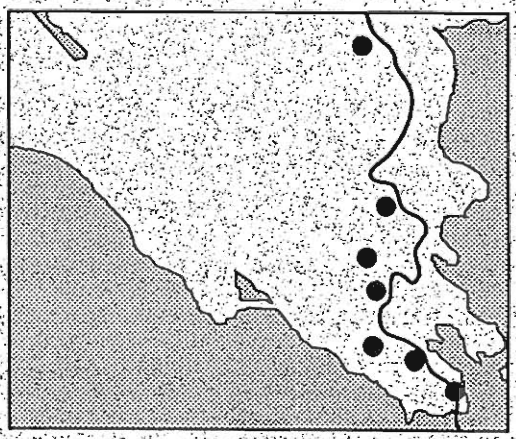
Very truly yours,

Robert A. Middagh
Chief Real Property Agent

RAM:ab

cc: Board Members
Aides
Administrator
Auditor-Controller
County Clerk
Grand Jury
Press
b County Counsel
Mario Balestrieri
Pierre Joske
Don Dickenson
June Baker

MARIN COUNTY NORTH-SOUTH BIKEWAY FEASIBILITY STUDY



Marin County
Department of Parks,
Open Space and Cultural Services

November 1994

BRADY AND ASSOCIATES, INC. PLANNERS AND LANDSCAPE ARCHITECTS

a. Corte Madera-Mill Valley Tunnel. This tunnel, also known as the Alto Tunnel, connects Corte Madera and Mill Valley in the general alignment of Camino Alto. It is the longest tunnel on the right-of-way, with a length of over one mile. Most of this single-bore tunnel is already owned by Marin County, and it is not in use. This tunnel has collapsed in many places, and has been filled with concrete to stabilize properties situated above it. Exact cost estimates for rehabilitating the tunnel are not available, but it appears that repairs would cost well over the $3 million which have been projected for rehabilitation of the shorter Cal Park Hill tunnel. The length of the tunnel would also make it difficult to light and secure for bicyclist use.

b. Cal Park Hill Tunnel. This tunnel runs parallel to Highway 101 just north of Sir Francis Drake Boulevard, connecting Larkspur Landing with San Rafael. It is a double-bore tunnel, meaning that it has room for two tracks, although only one track is installed in it. This tunnel is currently collapsed in approximately one-third of its length due to a fire in 1992, and repair costs have been estimated at $3 million. Currently, it is projected that the entire double-bore width will be needed for rail transit.

c. Puerto Suello Tunnel. This tunnel connects downtown San Rafael with the Northgate/Civic Center area through Puerto Suello Hill. This single-bore tunnel is currently operational, having been rehabilitated with concrete walls by the Southern Pacific Transportation Company before the County took over ownership of the NWPRR right-of-way. This tunnel is just barely wide enough for single track rail service, so its entire width will be needed for transit.

F. Wetlands

The Northwest Pacific Railroad right-of-way runs through the eastern portion of the County on lowlands along San Francisco Bay. Many of these lands were previously filled, and some areas still have coastal wetlands on them. A generalized map of wetland areas is shown in Figure 42, and areas with wetlands are described in more detail in the discussions of potential alignments in Chapter III.

If the NWPRR right-of-way is used for expanded rail transit or a bikeway, right-of-way widening could require filling of wetlands in the areas indicated. Filling of wetlands has significant environmental effects, and needs to be approached with care. Filling of wetlands is regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act, and requires a permit. Fill of over one acre requires a site-specific permit, and generally

Appendix A
ALTO TUNNEL RECONSTRUCTION

■ ■ ■

The Alto Tunnel is approximately 2,183 feet long and extends from near the intersection of Vasco Drive and Vasco Court in Mill Valley to Tunnel Lane in Corte Madera. The tunnel is a timber-supported, single-track, narrow-gauge railroad tunnel that was originally constructed in 1884. The approximate dimensions of the tunnel are 12 feet wide and 16 feet high, above the top of rails. Marin County owns most of the tunnel right-of-way, and approximately 150 to 200 feet at each portal is owned by Southern Pacific Railroad Company and/or the adjacent property owners.

A. Present Status of the Tunnel

Both portal ends of the tunnel collapsed some time ago. As a precautionary measure to prevent further collapse, a portion of the tunnel was backfilled with gravel, rock, debris and cement grout. It is estimated that this backfilling occurred for about 150 feet from each portal end. The condition of the remainder of the tunnel is unknown and cannot be accurately determined without driving an access adit or shaft and entering the tunnel for inspection. It is likely that some deterioration of the timber supports has occurred since the tunnel was closed off at the portals, which may have resulted in further collapse of portions of the tunnel. If timber failure occurred, some rock probably collapsed above it to form a natural arch above the support system, leaving most of the tunnel self-supporting. However, a total collapse would be likely wherever the rock is badly crushed or broken. In addition, the tunnel may be filled with water if it is below the water table.

B. Probable Construction Methods to Repair the Tunnel

Based on Jacobs Associates' experience with reconstructing similar railroad tunnels, the probable construction methods to repair the Alto Tunnel would be as follows:

- Excavate the existing collapsed portals to form a new tunnel face, and stabilize the newly cut slopes.
- Construct a new concrete portal structure at each portal.
- Grout the backfilled sections of tunnel for stabilization and excavate a new tunnel through these sections. Support of these sections would probably require steel ribs at 4 feet centers and lagging between the ribs. A final cast-in-place concrete lining would complete these sections of tunnel. Excavation of these backfilled sections of tunnel could probably be best accomplished with a roadheader. This same method of construction may also be applicable to other totally collapsed sections of tunnel that may be encountered.
- Portions of the tunnel where the timber supports are still in place may be stabilized by replacing the timber support with steel ribs on 4 feet centers and applying approximately 3 or 4 inches of fiber reinforced shotcrete between the steel ribs. In sections where good quality rock exists, the steel ribs may be omitted and support could consist of rock bolts and 3 inches of fiber reinforced shotcrete or shotcrete alone without rock bolts.

C. Assumed Condition of the Tunnel for Reconstruction Estimates

Since we have no actual knowledge of the present condition of the tunnel, some assumptions are necessary to provide a basis for a preliminary reconstruction approach and cost estimate. Based on Jacobs Associates' experience with similar railroad tunnels, the following conditions are assumed:

- The tunnel is backfilled with gravel, debris, and cement grout for a distance of 150 feet at each portal.
- An additional 200 feet of tunnel collapsed after the closing of the portals.
- Approximately 900 feet of tunnel will require replacement of the timber supports with steel rib support and fiber reinforced shotcrete lagging.
- The remainder of the tunnel (783 feet) will require rock bolt and fiber reinforced shotcrete support.
- Rail and ballast will be removed and a concrete invert with drainage will be placed.
- Permanent lighting will consist of fluorescent fixtures.

- Permanent ventilation will probably not be required. Natural draft should be quite adequate.

D. Construction and Engineering Costs

Based on Jacobs and Associates' experience and the above-stated assumptions, a conceptual cost estimate has been prepared. This estimate is shown in the body of the study. The unit costs used were developed from applying labor costs, equipment operating and depreciation costs, expendable and permanent materials. Details of this cost development are not shown.

Construction costs to reconstruct the Alto Tunnel and convert it to a bikeway would be approximately $4 million. Engineering and construction management costs would be approximately $600,000, for a total of $4.6 million.

The cost to construct a new parallel tunnel would be approximately $7 million, with engineering and construction management costs of about $1 million, for a total of $8 million. We are not sure a new tunnel could be constructed within the existing right-of-way, as the separation between tunnels needs to be approximately 20 feet.

INTER-OFFICE MEMORANDUM

Department of Public Works

REAL ESTATE SECTION
TELEPHONE 499-6578

August 1, 2000

TO: Supervisor Kress

FROM: Terry Toner
Chief Real Property Agent

RE: Alto Tunnel
Ownership Research

We have completed the ownership research of the tunnel between Mill Valley and Corte Madera. It is owned partly by the County of Marin and the Northwestern Pacific Railroad Company (NWP). County received a portion of the tunnel by quitclaim deed recorded 12/30/83 #83-0065633. It gave County whatever rights the NWP had at that time. We do not know it was fee or easement. It gives County that portion of the tunnel between a point which is 490 feet south of the north portal to a point which is 720 feet north of the south portal. See Parcel H, Exhibit "A" of the deed enclosed. County owns the "old railroad right-of-way" up to the south portal and north from the north portal. I have enclosed a diagram that depicts the intent of the deed.

TT:tt

Enclosures

cc: Supervisor Rose
Pat Faulkner
Mike Sadjadi
Rick Carlsen

safe routes marin
A Project of the Tides Center
391 Miller Ave. Suite 200
Mill Valley, CA 94941
(415) 389-8838

CC:A11805

July 11, 2000 VIA FAX

To: Terry Tamm : F4

From: JOHN KRESS

Supervisor Annette Rose
Room 329 Civic Center
3501 Civic Center Drive
San Rafael, CA 94903

Dear Supervisor Rose,

Thank you for taking the time to meet with us last week to discuss our vision for creating safer pedestrian and cycling routes in Marin County, and specifically the proposed project for the Alto Tunnel.

We appreciate your support and interest in this project, and your awareness of how improvements in Marin County's multi-use path infrastructure can encourage walking and cycling, make things safer for those who live here, and help reduce the environmental liabilities associated with driving.

As promised, I am forwarding contact information for the person at the Union Pacific Railroad in Omaha, Nebraska who I have had discussions with regarding donations of the final parcels of land comprising the Alto Tunnel. A quitclaim deed turned over the majority of the tunnel to the County in 1983. This deed shows that the extreme northern and southern ends were retained by the railroad. In my conversations with Union Pacific, they have expressed a desire to donate these remaining parcels.

The person to speak with at UPRR is Lisa Burnside. Her information follows:

Lisa L. Burnside, Manager - Real Estate	
Union Pacific Railroad Company	(402) 997-3596
1800 Farnam Street	(402) 997-3601 - FAX
Omaha, NE 68102	LLBURNSI@notes.up.com

We are continuing to raise awareness of the opportunity that the Alto Tunnel presents and are having discussions with city council members in both Mill Valley and Corte Madera. Also, we recently met with Supervisor Kinsey and Supervisor Kress as well to introduce our organization and discuss the Alto Tunnel proposal.

As we pointed out at our meeting, the logical, and necessary, next step is to conduct a thorough engineering assessment of the Alto Tunnel. Such a study can answer many questions about costs, the condition of the tunnel, what design options are available

to rehabilitate the tunnel, etc. This information is needed to make fair comparisons about the costs and benefits of the options available to improve the dangerous and inefficient linkage between Mill Valley and Corte Madera. The Draft Marin County Bicycle and Pedestrian Master Plan calls for such an assessment, and it seems likely that this recommendation will remain in the Master Plan when finalized and approved by the County later this summer.

Thank you again for your time and consideration, and please do not hesitate to call me if you have questions or comments about the Alto Tunnel.

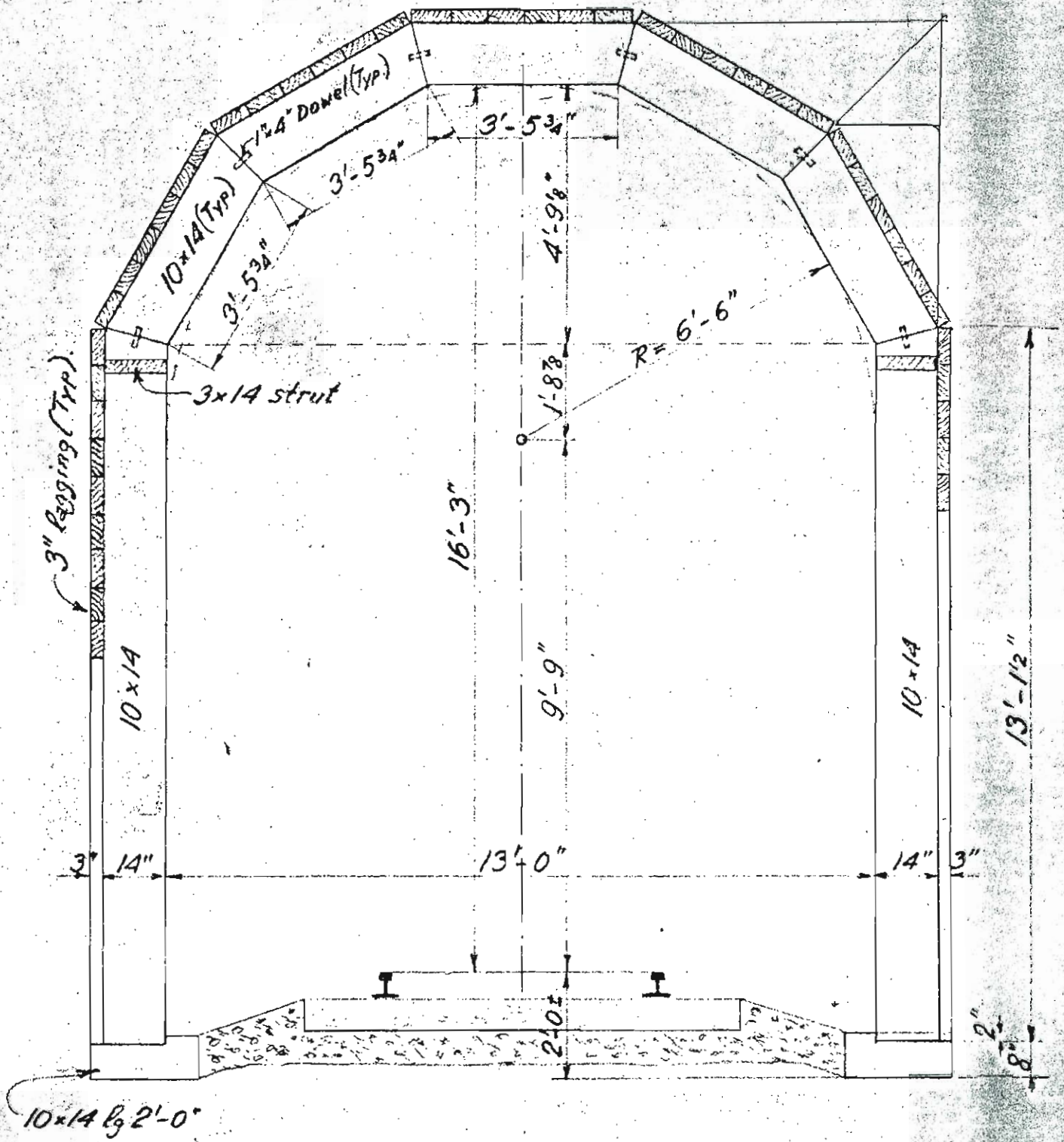
Sincerely,

Paul M. Carroll

Paul M. Carroll
Project Director

Cc: Supervisor Kinsey
Supervisor Kress
Supervisor Brown
Supervisor Murray

Appendix B - Plans



TUNNEL No 1

Typical "as built" section

Scale 3/8" = 1 ft.