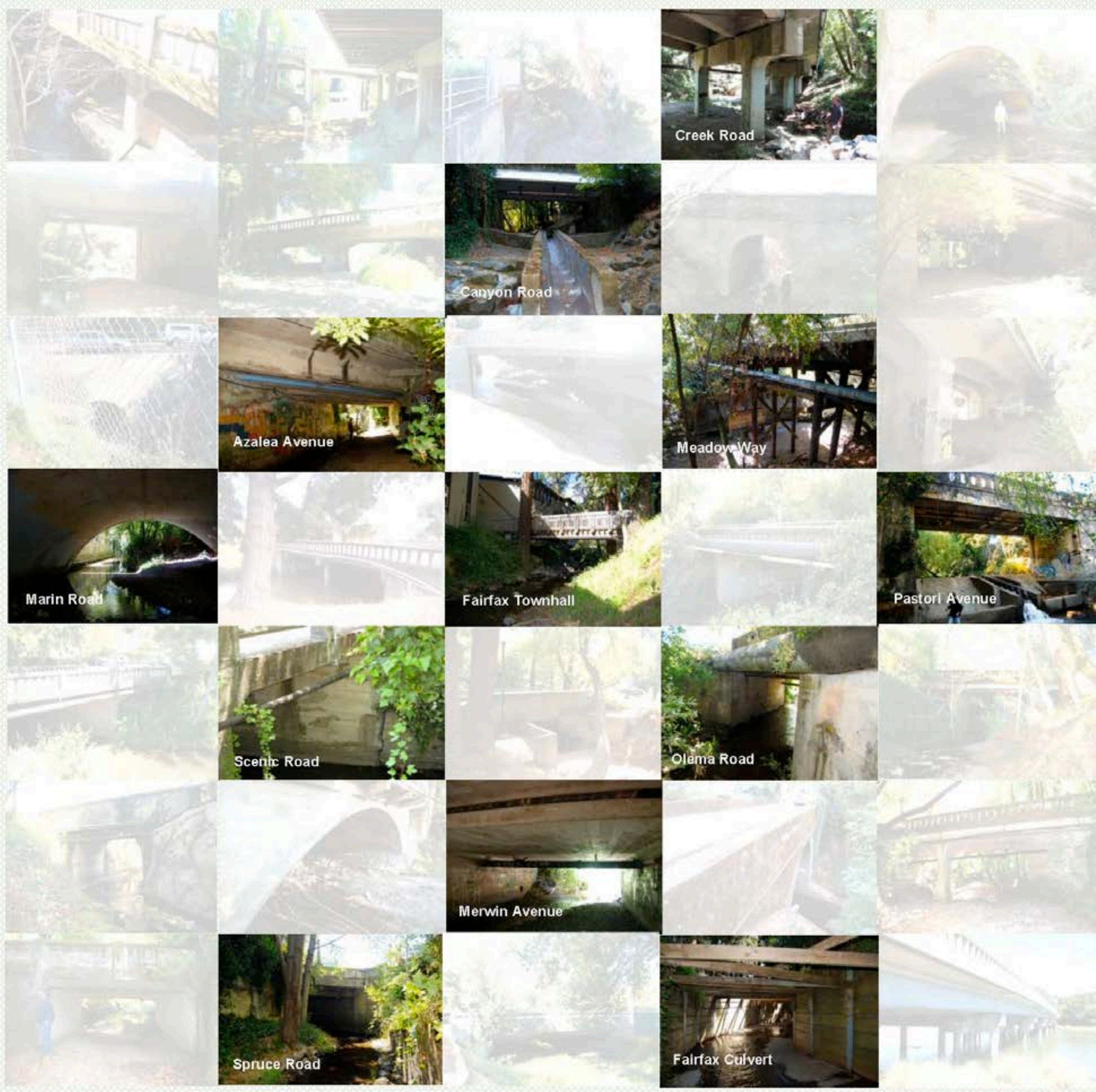
Summary of Seismic Retrofit Strategy Report for Creek Road Bridge over San Anselmo Creek



California Infrastructure Consultancy · MGE Engineering, Inc.

A Joint Venture

Submitted to the Town of Fairfax

Department of Public Works

January 21, 2014

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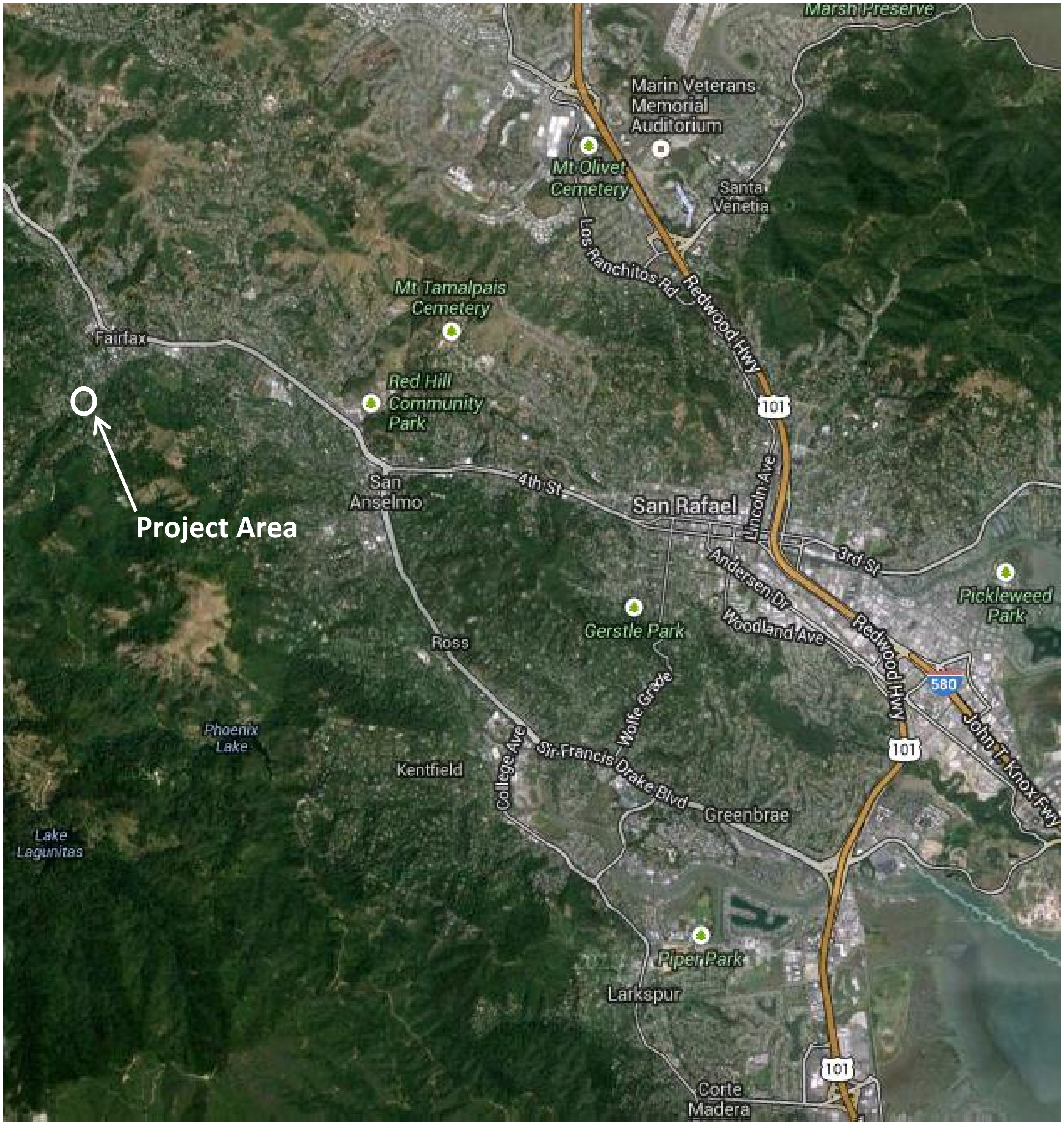
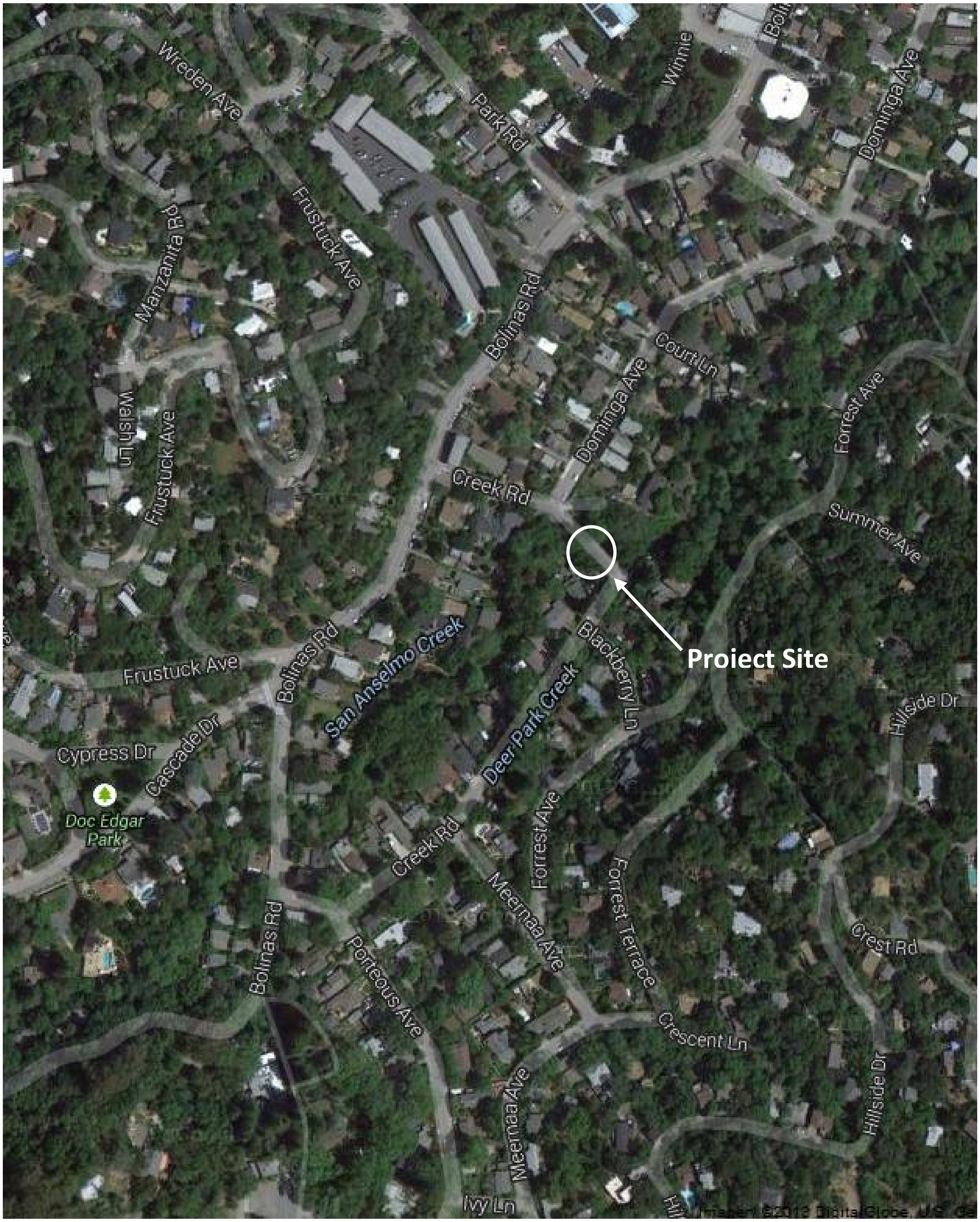
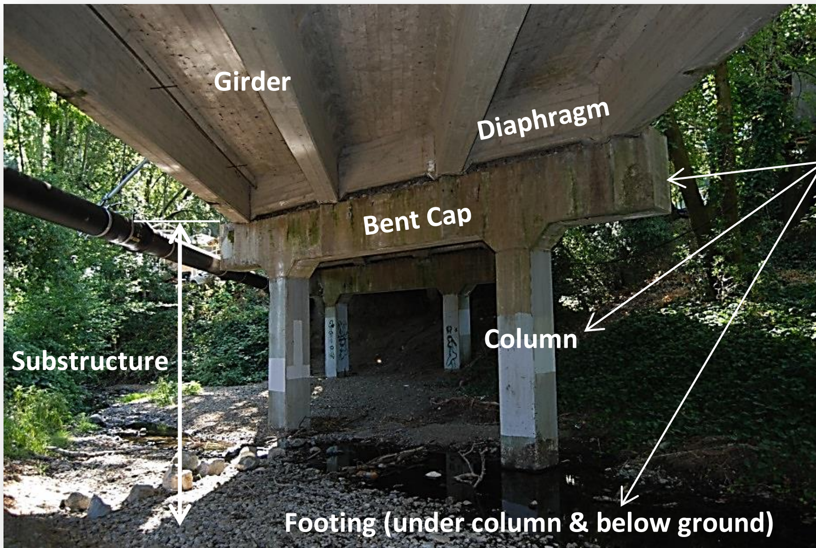


Regional Map



Location Map

Commonly Used Bridge Terminology in This Report



Note: the combination of columns, bent cap and footings is called a "Bent."

Substructure Area

Substructure Area

Overhang Area at the edge of deck

Superstructure Area

Executive Summary

Creek Road Bridge is a four-span, simply supported concrete T-beam structure on sets of 2-column bents and abutments, constructed over San Anselmo Creek in 1929. The 85-year old bridge has been known to be seismically vulnerable to forces from the maximum credible event (MCE) for this site since mid-1990s. This report was prepared as part of the federally funded Highway Bridge Program (HBP) for such local agency bridges administered by Caltrans, for which the Town of Fairfax is the lead agency. Several federal and state agencies have budgetary and/or permit approval and funding authority on this project.

With any record plans absent for the bridge, field measurements of its components were made to create an as-built Bridge General Plan, and for use in the computer analysis models. Tests on cores taken from the bridge showed that the concrete is sound and has hardened to 5,200 psi on the average. Ground penetrating radar (GPR) revealed the reinforcement patterns in the columns and bent cap and their sizes were determined from concrete spalls exposing rusty rebars. These investigations confirmed sparsely and seismically inadequate reinforcement patterns typical of the bridge's vintage. The site was drilled at two locations by the geotechnical engineer to explore the subsurface properties of the soils for the analysis models and future design. Locations and sizes of the footings were determined by poking long bars through the cover soil, but the footing thicknesses could not be determined.

The analysis included computer models of the bridge for dynamic (seismic) displacement demands on the bridge. Loads and displacements from up to 50 modes of seismic oscillations along the two orthogonal axes of the bridge captured the expected seismic demands on the bridge. Pushover analysis captured the ultimate capacity of the bridge to sway longitudinally and laterally before collapsing under the seismic loads. The following seismic response has been observed:

1. The girders and substructure are not tied together and there are no longitudinal or transverse shear keys on the bent caps to stop the girders from unseating, leading to collapse of the bridge.
2. Due to the small size of the columns, lack of adequate main vertical reinforcement and little steel rebar ties to confine the column cores, they are incapable of sustaining the seismic displacement or "plastic" shear demands and fail in both the transverse and longitudinal directions. The term plastic refers to seismic loads beyond the column's elastic capacity to bounce back.
3. All bent caps have inadequate capacity to take the column plastic bending moments transversely.
4. The footings are too small to resist the overturning moments and vertical loads, and will rotate excessively even if the columns were made to hold up. They are also likely inadequate for bending moments and shear, but this could not be confirmed due to the unknown footing thicknesses.

Each of the above mechanisms will potentially lead to a catastrophic seismic collapse of the bridge, which would result in the loss of life. As defined by Federal Highway Administration, this is a Category 1 bridge and its retrofit has been deemed mandatory. The bridge is not a lifeline structure and, as such, retrofitting will focus on preventing its collapse only, even though considerable damage may result.

Three seismic retrofit concepts, retrofit through widening and total bridge replacement options were considered. Initial construction, lifecycle and future capital expenditures cost estimates ranged from $3.18 million for retrofit to $3.79 million for replacement and $4.21 million for widening. Design and environmental phase are expected to take through the end of 2015 for any of the options considered. If construction begins in April 2016, it could finish in one season for retrofit and in two for replacement.

Considering the cumulative retrofitted bridge's lifecycle costs being borne by the Town, the design team recommends bridge replacement with a quality, low-maintenance concrete bridge that will have nearly a century of new life. The final decision will be that of the community and the Town of Fairfax.

Summary of Analyses, Findings, Issues, Retrofit Alternates and Recommendations

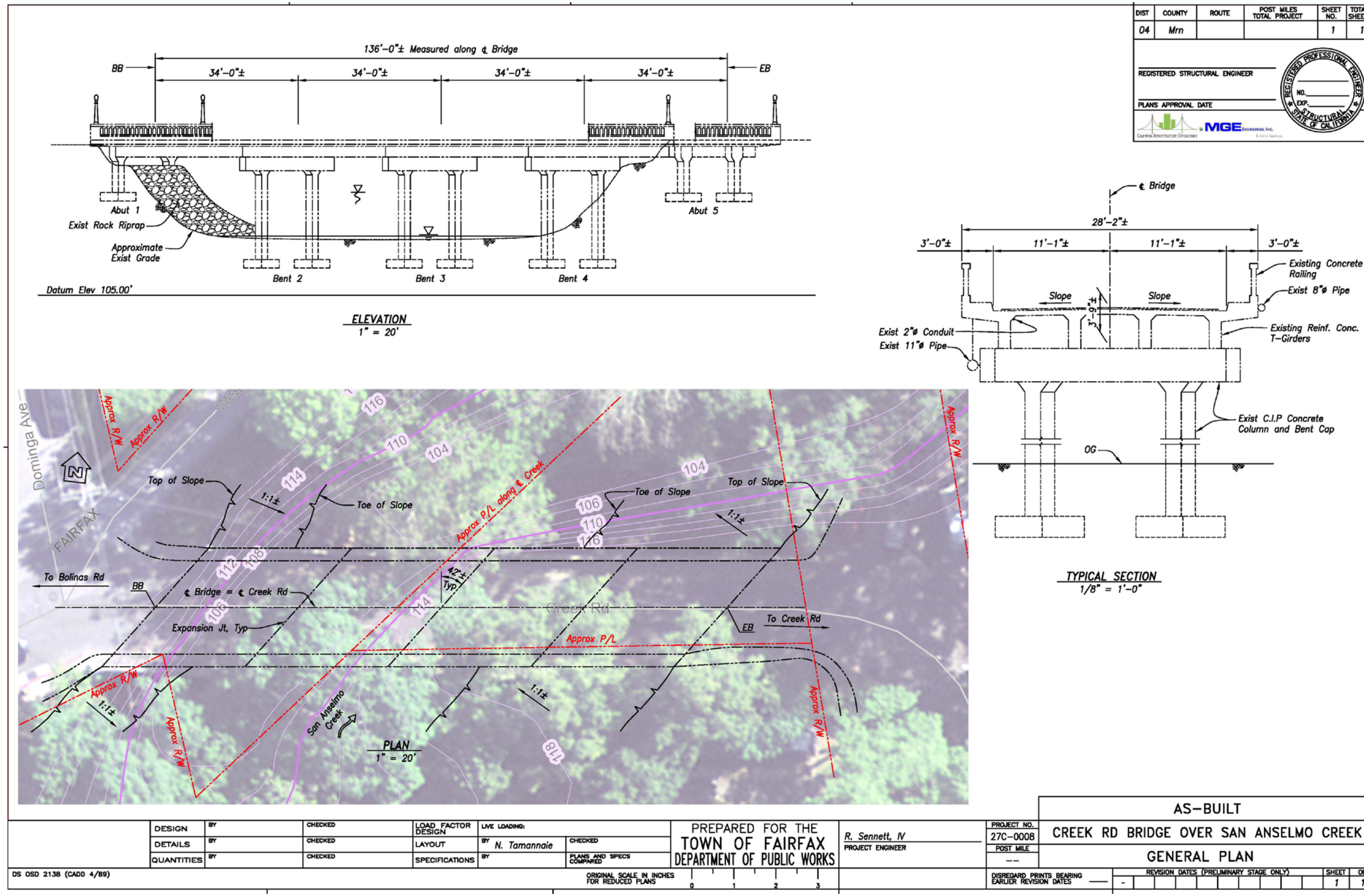
Introduction and Background - This bridge over San Anselmo Creek is reported to have been constructed in 1929. The four-span reinforced concrete structure is made up of four sets of reinforced concrete T-girders, simply supported on three sets of two-column bents in the creek and on an abutment at each river bank. The abutments are somewhat unusual in the way that, instead of being solid continuous walls, they are built similar to the bents on columns and, presumably, footings and buried in the embankment. The bridge is approximately 136 feet long and 28.2 feet wide. It supports two narrow, 10-foot-wide lanes and narrow non-ADA compliant sidewalks on each side. The bridge has a Sufficiency Rating (SR) of 57.9 (from 100) and an average daily traffic (ADT) of less than 300. The SR is further explained in this report. Caltrans has listed the bridge as ineligible for National Register of Historic Places (NRHP), which totally eases the cultural resources requirements on the bridge when being worked on. There are no as-built plans available for the bridge, but a typical Caltrans type as-built bridge General Plan has been prepared by this engineering team and included in this report.

In 1997, while Caltrans led the bulk of the Local Agency Seismic Safety Program, the bridge was found to be seismically vulnerable and a set of seismic retrofit plans was prepared for it. The work lacked environmental and hydraulic studies and did not have proper bridge foundation investigation done, and was not completed. The project did not go beyond the preliminary set of plans stage and funding for it was ultimately de-obligated, perhaps because environmental studies were not conducted to obtain the necessary permits. Since then, Caltrans' seismic retrofit and ground motion criteria have evolved considerably. The Seismic Safety Program now runs with the local agency in the lead and is supported by funds from federal Highway Bridge Program (HBP), as well as Caltrans and other State funds.

This bridge is located on a wide section of San Anselmo Creek. It experienced a significant washout and undermining of its west abutment during the floods of New Year's eve, 2005, although the water never exceeded a 7-8 feet height above the creek bed nor did it impinge on the girders. The washout may be attributed to not only the forces of the flow and soil conditions, but the unusual abutment configuration described earlier. The bridge was closed to vehicular traffic due to its gaping abutment exposure while the Town obtained funds and implemented repairs for it. During that time, motorists used a detour around the bridge via other streets. The abutment was underpinned and protected with a substantial course of rock riprap in 2008 and the bridge reopened after the repairs.

Bridge abutment washout & exposure of New Year's Eve 2005

Subsequently, a September 2010 bridge scour Plan of Action (POA) report by CIC team members found no signs of new significant bridge foundation scour. None of the bridge footings were exposed during the field investigations. The riprap has, however, had the effect of reducing scour potential at the bent adjacent to this abutment (Bent 2) and slightly increasing scour potential at Bent 3 near the creek center. From field visits and probings it is surmised that each bridge column sits on 6' x 6' spread footings approximately 5 feet below the creek bed. The thickness of the footings cannot be determined without extensive excavations.



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Approximate Exist Grade
Bent 2
Bent 3
Bent 4
Abut 5
Datum Elev 105.00'
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Exist 8"ø Pipe
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Exist C.I.P Concrete Column and Bent Cap
OG
TYPICAL SECTION
1/8" = 1'-0"
Dominga Ave
FAIRFAX
Approx R/W
Approx R/W
Top of Slope
1:1±
Toe of Slope
Approx P/L along ℄ Creek
Toe of Slope
Top of Slope
1:1±
To Bolinas Rd
BB
℄ Bridge = ℄ Creek Rd
47°± Typ
Creek Rd
Expansion Jt, Typ
EB
To Creek Rd
Approx P/L
Approx R/W
1:1±
Approx R/W
San Anselmo Creek
1:1±
Approx R/W
PLAN
1" = 20'
116
110
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112
108
106
114
118
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Public Right-of-Way and Private Land Ownership at the Project Area – The exhibit on the previous page shows an aerial photo of the project area and public right-of-way (ROW) and private land ownership. At the first look, the parcel lines look unconventional, but property records have been researched and it is believed the boundary lines are correct. However, extended research of the title reports and actual field monumentation to determine the parcel lines with 100% accuracy will be performed in the second phase of the project. As shown on the aerial, at two locations along the south edge of the bridge, the structure may be encroaching on private parcel lines, the easements for which will be identified.

It is not anticipated that any new property takes will be needed for the final design. As part of the federal and State processes, all easements and right-of-way descriptions will be established through legal agreements, including ones with the adjacent land owners, when necessary, in order for the ROW phase of the project to be certified by Caltrans.

Seismic Condition of the Existing Bridge - In these seismic evaluations the bridge was analyzed for its seismic performance according to the Caltrans "No Collapse" criteria and the latest bridge seismic engineering. The criteria assure a no-collapse scenario during the Maximum Credible Event (MCE) for non-lifeline bridges, where no loss of life or catastrophic collapse is allowed to occur, although the bridge may sustain substantial damage. Creek Road Bridge is not considered to be a lifeline bridge. Lifeline facilities, such as the Golden Gate Bridge, are on major roadways where the shutting down of the facilities after a large-scale disaster cannot be afforded, and are designed or retrofitted to sustain only minor damage during the MCE.

The initial Preliminary Engineering (PE) phase of this project was to determine the seismic retrofit strategy for the bridge. Since there are no as-built plans available for the bridge, field measurements of all relevant bridge parts were taken and the actual depth and size of the bridge foundations were field-verified. The design team's materials testing subconsultant, WJE, obtained several cores from the bridge concrete at various critical locations and the concrete's compressive strength was determined through specific tests. WJE also used ground penetrating radar (GPR) to look through the concrete beyond its surface and revealed the reinforcement details in critical bridge components. After drilling two borings and conducting site investigations, a preliminary Bridge Foundation Report has been prepared by the geotechnical engineer and used in the analysis. All data were input in the global computer models of the bridge and its critical elements, such as the columns and bent caps. Analyses were performed to ascertain if a collapse mechanism would develop as a result of the MCE.

The bridge will experience seismic accelerations up to 1.35 g at the ground level. Due to the bridge construction details, typical vulnerabilities in the substructure and foundation, common to the vintage of such construction, became evident in the analyses, as follows:


Lack of connection between girders and bent cap is evident

- Being a series of simple spans, the bridge superstructure is not rigidly connected to the substructure to participate in its seismic resistance, and instead sits on the bent caps and columns as dead weight.

- The lack of connectivity between the super- and substructure, and lack of shear keys acting as stoppers, pose a real danger of the bridge superstructure unseating from the bent caps during a large seismic event and resulting in collapse. The edge of deck is currently offset on each side of the expansion joints, pointing to differential movements of the spans relative to each other due to past seismic events, extreme creek flows, or both. Other distress caused by these movements,

such as a cracked bent cap beam corner caused by grinding from the superstructure, is also evident as shown below.

- If the superstructure doesn't unseat itself during a large seismic event, its dead inertia will sway back and forth and laterally and puts extreme bending and compressive loads on the base of the columns and on the footings. The concrete columns cores in the bridge lack adequate steel rebar to confine them and will collapse under the extreme cyclic seismic loads predicted.
- The bent caps are poorly reinforced. The analysis showed them failing in bending, caused by the columns' ultimate plastic moments under the seismic loads plus the structure's dead weight.

- The bridge is founded on relatively small spread footings, which are also seismically inadequate. The footings fail due to bearing and overturning plastic moments from the columns. Additionally, they are expected to break up due to their thin depth and typically sparse reinforcement before even reaching bearing thresholds.

Overall, it has been determined that this is a Category 1 bridge, meaning that in its current condition it is subject to catastrophic collapse that can result in the loss of life. These conditions necessitate bridge seismic retrofit or replacement, whichever is more feasible after lifecycle cost analysis. Retrofitting will include fixing the columns and foundations, tying the super- and substructure together with restrainer cables, constructing shear keys atop the bent caps and the use of seismic approach slabs at each bridge end. Several options to implement these measures have been presented in this report. The purpose of investigating the various options, including bridge widening and replacement, is to identify feasibility, environmental impacts and costs and provide information for the public and the Town of Fairfax to make an informed decision and choice for the future of the bridge.

Other Deficiencies of the Existing Bridge– As noted earlier, the bridge has a sufficiency rating of 54.1 out of 100 possible points. This number represents a weighted evaluation of several bridge attributes through a formula devised by the Federal Highway Administration (FHWA). This algorithm is used by Caltrans after its biennial inspections of the local agency bridges that are in the National Bridge Inventory (NBI), in which Creek Road Bridge and several other Fairfax bridges belong. It's an overall score for the bridge's functionality, composed of ratings (0 to 9) for its various components and attributes. Every two years the results are published by Caltrans in a Bridge Inspection Report (BIR), which is shared with the local agency, in this case the Town of Fairfax Public Works Department.

The latest BIR from 2010 shows the Structural Evaluation of the bridge and its Deck Geometry both receiving scores of 4 out of 9. The condition of the Deck and Superstructure received a score of 7 and Substructure received a 6. In terms of Traffic Safety, which in this case the bridge rails are cited, the score is a series of zeroes, pointing to substandard railings. The sidewalks are also substandard and not ADA-compliant. It must be noted that the biennial ratings of the bridge elements do not take into consideration the seismic attributes of the bridge and only deal with the everyday functioning of the bridge, hence this report.

The BIR notes numerous concrete spalls (flaking and chipping), exposing the reinforcement and resulting in its rusting. These preventive maintenance needs must be addressed during the construction of any of the four retrofit options presented, and will naturally go away if the bridge is replaced. Funding for these corrections will be included by this federal/State program.

Seismic Retrofit Options - Several seismic retrofit options were studied and costs associated with each alternate estimated. (A 25% contingency was applied to all costs.) Other cost items considered in the estimate are water diversion, traffic control, vegetation restoration and lifecycle (maintenance, repairs and replacement) costs. Where applicable, existing utilities will be maintained in place, but some options will require relocations. Access to and construction work in San Anselmo Creek, likely by ramping locally to the creek bed area, will be necessary.

The three main options considered are described below.

Option 1 – Seismically retrofit the existing bridge by:

a. Enlarging its bent foundation footings and strengthening the columns by casting concrete infill walls between each pair. To do this, each of the six bridge footings in the creek will need to be exposed and made larger. The infill wall, dowelled into the insides of the columns and the underside of the bent cap, closes the huge rectangular space between the sets of columns at each bent. The columns and caps will no longer be separate entities but act together as a huge diaphragm that will be hard to tip over sideways. Having enlarged the footings, the structure will also resist any longitudinal seismic movements. With this approach, the deficiencies of the concrete cap beams over the columns, potentially leading to their brittle failure, are addressed as well.

b. Placement of cable restrainers to tie the superstructure together over the cap beams and a transverse and longitudinal shear key system at each bent to keep the superstructure seated on the bent caps and engage the rest of the substructure.

c. Construction of seismic approach slabs at the existing bridge abutments. Repairs requiring joint seal replacements at the abutments and the three bent locations on the bridge are also included.

This has been named Option 1A. As a subset of Option 1, shifting some of the retrofit work to the roadway level, in place of enlarging the footings, in order to minimize impacts on the creek bed, was considered. Instead of large excavations to enlarge the footings to check the bridge's longitudinal seismic movements, the option of using waffle slabs at the abutments (Option 1B), or casting large diameter (6') cast-in-drilled-hole pile shafts (Option 1C), in conjunction with infill walls between the columns, were considered. A waffle slab is a structural system involving a concrete approach slab connecting to the back of the abutment and sitting atop a cellular structure, supported on small diameter cast-in-drilled-hole (CIDH) piles.

The bridge will need to continue having its regular biennial inspections after retrofit construction. Maintenance work resulting from these inspections over the remaining life of the bridge is expected. It turns out for this option, whether footings are enlarged or the retrofit is shifted to the topside, the construction estimate of cost for this retrofit scheme, without lifecycle costs and construction management, is virtually the same and approximately $1,050,000. Option 1C is shown on page 12.

Option 2 – This approach is shown on page 13 and includes:

a. Widening the bridge on the north side (where right-of-way is readily available) as both a seismic retrofit measure and to gain 4'-wide shoulders (doubling as Class II bike lanes) standard and ADA-compliant 5'-wide sidewalks on both sides of the bridge. The new total width will increase from 28'-2" to 44 feet. Bridge widening will involve adding an independent, precast double T-beam superstructure with a depth of 3'-2", supported on three sets of double-column bents on 4' diameter pile shafts in line with the existing bents. By tying the new and existing bridges together, the lateral seismic movements of the latter will be kept in check. This is partial retrofit.

b. Complete the retrofit with large diameter CIDH piles or waffle slabs at the abutments, as described in Options 2 and 3 above. Although a one-sided widening in this fashion is not ideal, this option satisfies the seismic concerns of the bridge as well as improves its every service by providing safer non-motorized travel for the neighborhood.

c. Repairs requiring joint seal replacement at five locations on the existing bridge are also included.

Work for this alternative also includes utility relocations and modifying the approach roadways at both ends of the bridge, as well as Dominga Avenue and Wessen Lane, for the widened bridge. The final approach layout will actually be improved and traffic calming measures can be implemented. The cost of Option 2retrofit concept, without lifecycle costs and construction management, is estimated to be $2,243,000.

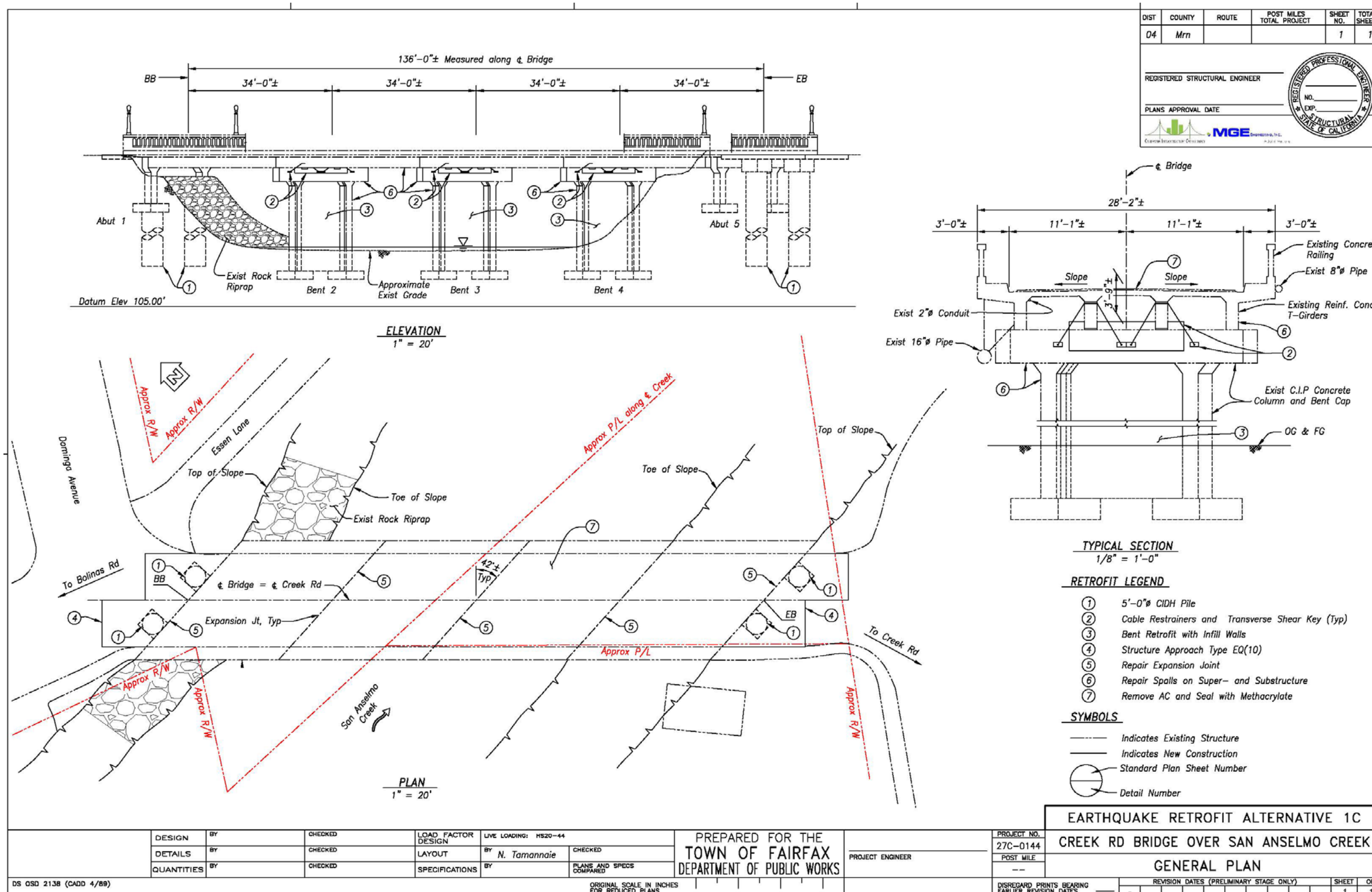
Option 3, Bridge Replacement – Seismic retrofit strategy requires that bridge replacement also be considered as a retrofit option. A new bridge would have two standard 12' lanes, two 4' shoulders (or bike lanes) and standard sidewalks and a total width the same as the widening option (Option 2 above), or 44 feet. A new bridge would be shifted north slightly to free up the right-of-way easement along its south edge.

The bridge considered would have a two-span cast-in-place concrete box girder superstructure with a depth of 3'-9", supported on a single two-column bent composed of 4'-diameter CIDH pile shafts, shown on page 14. A new bridge would have a structural concrete approach slab at each end and rock slope protection at both abutments. The abutments would be supported on 24" cast-in-drilled-hole concrete piles. Slight street intersection modifications at the junctions with Dominga Avenue and Wessen Lane would be implemented and traffic calming measures could be implemented.

Overall, the bridge would help vehicular and non-vehicular traffic considerably and guarantee a long service life for the creek crossing with minimal maintenance efforts. Having fewer supports in the creek and improved abutments, lack of bridge scour and better conveyance of debris and drift through the bridge opening would also be positive results. All utilities would be housed inside the bridge, either in the boxed cells if they are large pipes, or in the sidewalks and railings if they are smaller conduits. Street lighting, if deemed necessary, could be another added amenity. The bridge shown in this report is fairly generic and a concept only. A detailed process with the public and others to consider and incorporate design ideas, including bridge types and aesthetics, would be implemented for bridge replacement.

Bridge replacement cost estimate, without lifecycle and construction management costs, is $2,653,000.

Detour - For each of the above three options the bridge can be closed off during construction and the local traffic detoured during construction. Alternatively, the work can be performed with occasional partial closures while allowing the traffic through, albeit more slowly. Total closure and detouring of the traffic will generally result in higher contractor efficiency, faster completion and certain economies of the construction bid price. This detour is shown on page 15.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To Bolinas Rd
℄ Bridge = ℄ Creek Rd
42°± Typ
Expansion Jt, Typ
Approx P/L
To Creek Rd
San Anselmo Creek
Approx R/W
Approx R/W
PLAN
1" = 20'
RETROFIT LEGEND
1 5'-0"ø CIDH Pile
2 Cable Restrainers and Transverse Shear Key (Typ)
3 Bent Retrofit with Infill Walls
4 Structure Approach Type EQ(10)
5 Repair Expansion Joint
6 Repair Spalls on Super- and Substructure
7 Remove AC and Seal with Methacrylate
SYMBOLS
Indicates Existing Structure
Indicates New Construction
Standard Plan Sheet Number
Detail Number
EARTHQUAKE RETROFIT ALTERNATIVE 1C
CREEK RD BRIDGE OVER SAN ANSELMO CREEK
GENERAL PLAN
DESIGN
DETAILS
QUANTITIES
BY
CHECKED
LOAD FACTOR DESIGN
LIVE LOADING: HS20-44
LAYOUT
BY N. Tamannaie
SPECIFICATIONS
PLANS AND SPECS COMPARED
PREPARED FOR THE TOWN OF FAIRFAX DEPARTMENT OF PUBLIC WORKS
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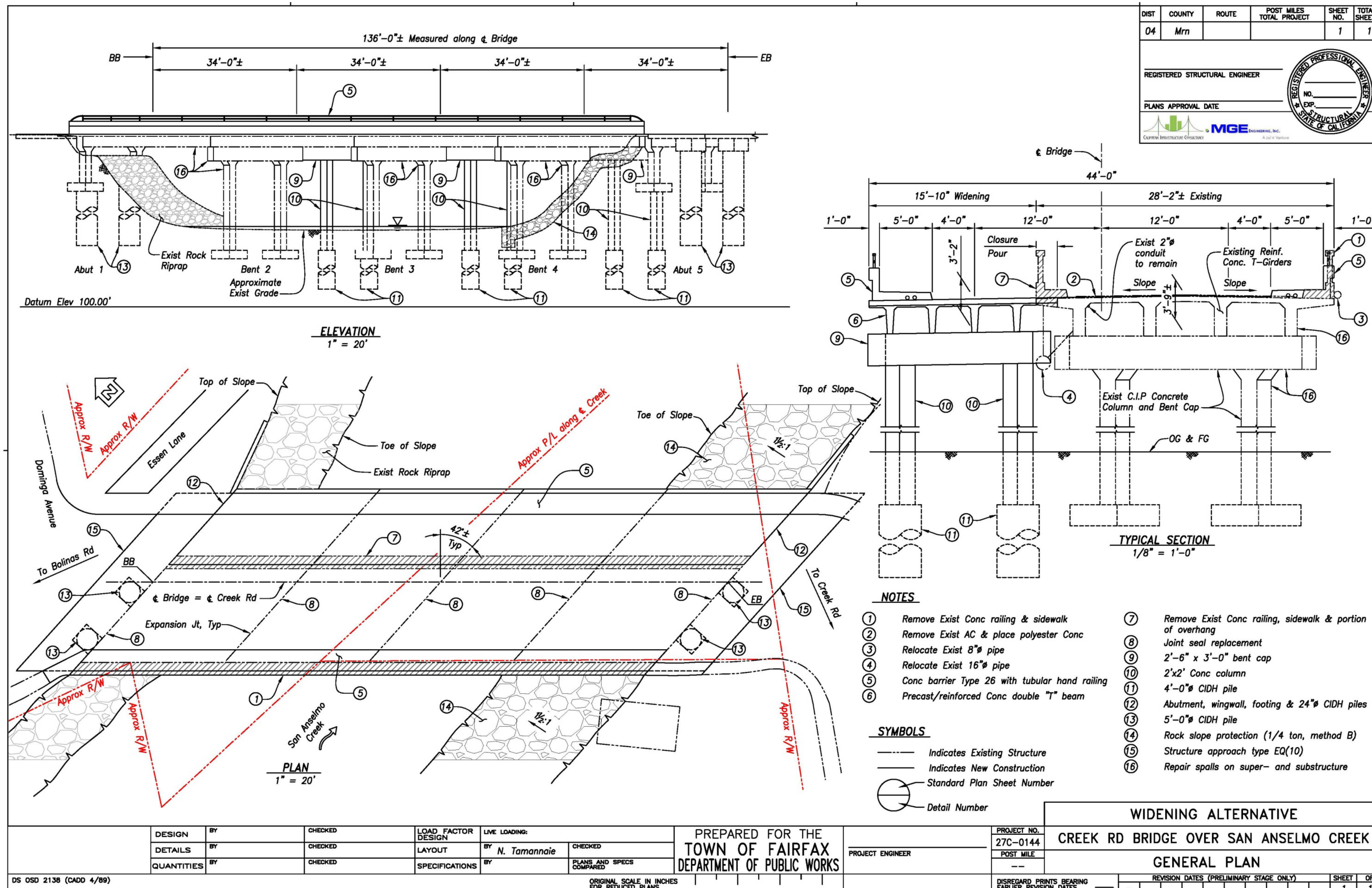
SHEET 1 OF 1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Expansion Jt, Typ
EB
To Creek Rd
Approx R/W
Approx R/W
San Anselmo Creek
1½:1
Approx R/W
PLAN
1" = 20'
NOTES
1 Remove Exist Conc railing & sidewalk
2 Remove Exist AC & place polyester Conc
3 Relocate Exist 8"ø pipe
4 Relocate Exist 16"ø pipe
5 Conc barrier Type 26 with tubular hand railing
6 Precast/reinforced Conc double "T" beam
7 Remove Exist Conc railing, sidewalk & portion of overhang
8 Joint seal replacement
9 2'-6" x 3'-0" bent cap
10 2'x2' Conc column
11 4'-0"ø CIDH pile
12 Abutment, wingwall, footing & 24"ø CIDH piles
13 5'-0"ø CIDH pile
14 Rock slope protection (1/4 ton, method B)
15 Structure approach type EQ(10)
16 Repair spalls on super- and substructure
SYMBOLS
Indicates Existing Structure
Indicates New Construction
Standard Plan Sheet Number
Detail Number
DESIGN
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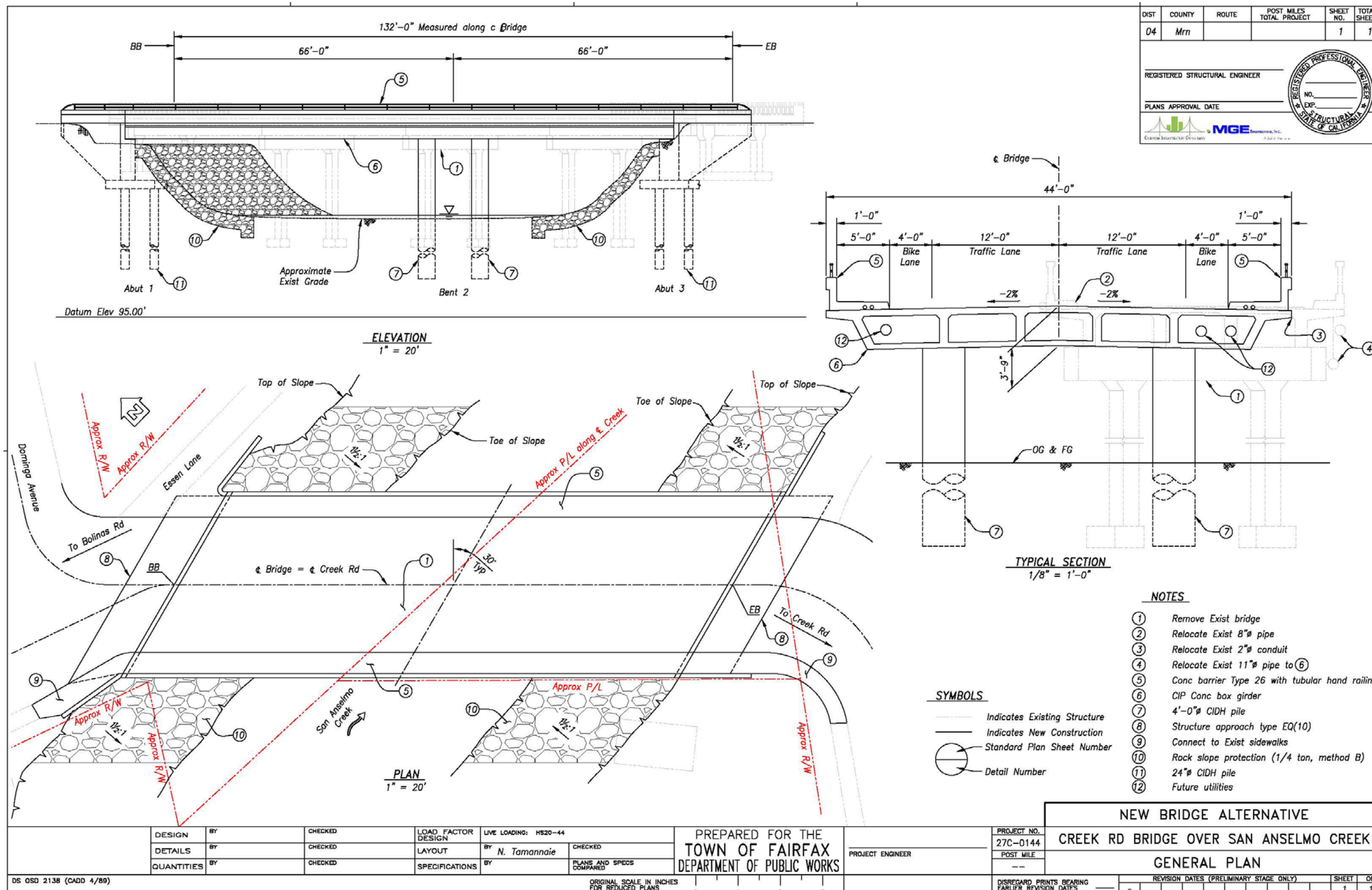
SHEET 1
OF 1


132'-0" Measured along ℄ Bridge
BB
EB
66'-0"
66'-0"
Abut 1
Bent 2
Abut 3
Approximate Exist Grade
Datum Elev 95.00'
ELEVATION
1" = 20'
℄ Bridge
44'-0"
1'-0"
5'-0"
4'-0"
Bike Lane
12'-0"
Traffic Lane
-2%
3'-9"
OG & FG
TYPICAL SECTION
1/8" = 1'-0"
Top of Slope
Toe of Slope
Dominga Avenue
Essen Lane
Approx R/W
Approx P/L along ℄ Creek
To Bolinas Rd
℄ Bridge = ℄ Creek Rd
30° Typ
To Creek Rd
Approx P/L
San Anselmo Creek
PLAN
1" = 20'
SYMBOLS
Indicates Existing Structure
Indicates New Construction
Standard Plan Sheet Number
Detail Number
NOTES
1 Remove Exist bridge
2 Relocate Exist 8"ø pipe
3 Relocate Exist 2"ø conduit
4 Relocate Exist 11"ø pipe to 6
5 Conc barrier Type 26 with tubular hand railing
6 CIP Conc box girder
7 4'-0"ø CIDH pile
8 Structure approach type EQ(10)
9 Connect to Exist sidewalks
10 Rock slope protection (1/4 ton, method B)
11 24"ø CIDH pile
12 Future utilities
DIST 04
COUNTY Mrn
SHEET NO. 1
TOTAL SHEETS 1
REGISTERED STRUCTURAL ENGINEER
PLANS APPROVAL DATE
NEW BRIDGE ALTERNATIVE
CREEK RD BRIDGE OVER SAN ANSELMO CREEK
GENERAL PLAN
PROJECT NO. 27C-0144
PREPARED FOR THE TOWN OF FAIRFAX DEPARTMENT OF PUBLIC WORKS
LIVE LOADING: HS20-44
N. Tamannaie
DESIGN
DETAILS
QUANTITIES
LAYOUT
SPECIFICATIONS
PROJECT ENGINEER
DS OSD 2138 (CADD 4/89)

Creek Road Bridge Detour Map

Design and Construction Schedules - The design process is greatly driven by the environmental studies and permits. Generally, since each alternative presented requires access to, and excavation and construction in the creek, the nature of environmental studies and permits remains similar. These studies and agency permits will require approximately 18 months to complete. Since the process is federally funded, both National Environmental Protection Act (NEPA) and California Environmental Quality Act (CEQA) requirements must be satisfied for the permits to be granted so that the project can move forward to construction.

Each season of construction work in the creek is limited to the period from mid-April to mid-October. Outside of this time window, work at the bridge topside and street level can go on unimpededly. It is anticipated the bridge construction for any of the retrofit options will take one season and widening or replacement will need two seasons for construction. The goal is to have the design and permits package ready for bidding by the first quarter of 2016 so that by April 15 of the same year a construction contract is awarded and a contractor can be in the creek working. Without unforeseen complications, such as those arising from environmental or funding issues, it is anticipated that the above elements of schedule are achievable and we propose the following overall general schedule:

Public approval of the design option:	January 29, 2014
Caltrans funding of the PE phase (design and environmental studies):	April 1, 2014
Clear NEPA/CEQA, obtain agency permits and finish final design:	April 2014 – December 2015
Certify right-of-way:	June 2015 - December 2015
Bid and award period:	January 2016 - March 2016
Begin Construction:	April 15, 2016
Complete Construction	February 2017 – July 2017

The above completion date is variable, depending on the alternate selected. The front end of the schedule (timing of Caltrans funding of PE phase by April 2014) may be somewhat aggressive. Barring delays, such as those caused by funding or environmental issues during design or construction, finishing by mid-2017 will be still entirely possible.

Cost Summary - A summary of estimates for initial and long-term costs are provided on page 17 and a discussion of the costs of the alternatives, in the context of their advantages/disadvantages and costs, has been provided on page 18. All elements of the project, including bridge replacement, when approved, are anticipated to be 100% funded through various state and federal programs, as follows:

Project Phase	Fairfax Funds	State Funds	Federal Funds
Preliminary Engineering (PE), including design, environmental and other design related activities	0%	0%	88.53% (HBP) 11.47% (Toll Credit)
Right-of-way (ROW)	0%	0%	88.53% (HBP) 11.47% (Toll Credit)
Construction (CON), including construction management	0%	11.47% (State Prop. 1B)	88.53% (HBP)

It must be noted that the pool of Proposition 1B funds for seismic retrofit is a limited sum ($120 million), managed and allocated by Caltrans and includes replacement or widening resulting as part of seismic retrofit. The funds are assigned on a first-come-first-served basis and once they run out Caltrans participation of 11.47% will not be guaranteed. For this reason, it is imperative that the Preliminary Engineering (PE) and ROW phases of the project be finished as soon as possible.

The table below shows a summary of the costs of the 3 main options for the bridge, including widening and replacement. Long-term lifecycle costs are also included for an 80-year design life period.

Option	Type of Seismic Retrofit Work	Present Worth (2017) Cost Estimates				
		Initial Construction (CON)		Construction Engineering (CE - 15% of CON)	Lifecycle (Routine Maint.) +Any Replacement	Total
		Retrofit, Widening or Replacement	Bridge Preventive Maintenance			
1C	Infill walls; two 5' diameter CIDH piles at abutments; & restrainers and transverse shear keys at bents	$969,069	$81,000	$157,510	$1,975,500	$ 3,183,080 Say **$3.18 m**
2	Widen bridge on one side to width of 44'; 5' dia. CIDH piles at each abutment and two 10' approach slabs	$2,089,630	$153,422	$336,458	$1,833,600	$4,213,110 Say **$4.21 m**
3	Replace bridge with a 2-span cast-in-pace concrete bridge with width of 44'	$2,653,365	$0	$398,005	$739,500	$3,790,869 Say **$3.79 m**

Recommended Alternative – To summarize the various attributes of the five options discussed, each alternate's advantages, disadvantages and total cost are compared below:

Alternative	Costs (Construction + Routine & Preventive Maintenance)	Advantages	Disadvantages
1C (Retrofit only)	Construction + CM Costs: $1.21 m Lifecycle & Future Capital Costs: $1.97 m Total: $3.18 million	• Least amount of disturbance in creek • Short one-season project • No falsework required • Least expensive alternate	• Limited bridge life, 30-40 years • Bridge and sidewalks remain narrow, no bike lanes • Regular maintenance needed • Aesthetically neutral • Large CIDH pile installation messy for a couple of weeks • Lifecycle and future capital costs (nearly $2 m) paid by Fairfax
2 (Retrofit with Widening)	Construction + CM Costs: $2.58 m Lifecycle & Future Capital Costs: $1.63 m Total: $4.21 million	• Added bike lanes and standard sidewalks • A full one-season project • No falsework required	• Existing bridge portion will have limited life (30-40 years maximum) and need to be replaced in the future • Moderate Maintenance needed • Aesthetically neutral • Most expensive alternate • Lifecycle and future capital costs (nearly $1.6 m) paid by Fairfax
3 (Replace Bridge)	Construction + CM Costs: $3.05 m Lifecycle Costs: $0.74 m Total: $3.79 million	• Added bike lanes and standard sidewalks • 75 -100 years of life • Low maintenance • Aesthetically pleasing • Lowest lifecycle cost ($740 k) • Bridge no longer encroaching on privately owned parcel	• Bridge foundation work in creek • May require falsework in creek • Total cost roughly 20% more expensive than retrofit, but 11% less than widening • Longest construction, likely two seasons

* Note: CM = Construction Management (cost factor = 15% of Construction)

CIC-MGE recommends Option 3, bridge replacement. This recommendation is based on the fact that the overall costs of the different alternates, including long-term costs, are very close and there is an opportunity to upgrade to modern multimodal standards with a low-maintenance and aesthetically pleasing bridge with nearly a century of service life. Additionally, for retrofit option, the long-term lifecycle and future capital improvements costs will be borne by the Town, which can be avoided.

The final decision will be that of the community and the Town of Fairfax. To facilitate the process, this abbreviated report and the full version of it will be posted on the project's web site and discussed with the community during the workshop scheduled for January 29, 2014. The Fairfax Town Council will be considering the subject after this meeting. Any option ultimately adopted by the Town of Fairfax will also need to be accepted and approved by Caltrans.

Appendix B – Sample Bridge Photographs

Figure 1- Northwest entrance to the bridge

Figure 2 – Close proximity of private parcels to the bridge

Figure 3 –Abutment washout of New Year's Eve 2005

Figure 4 –Bridge closure after flooding of December 2005

Figure 5 –Abutment fortifications after repairs

Figure 6 – A Plaque on the bridge

Figure 7- Utility pipe on the bridge

Figure 8 – Exposed rebar due to insufficient concrete cover

Figure 9 – Exposed rebar on girder

Figure 10 –Retrofit infill wall will be between the columns

Figure 11 –Filled-in and offset expansion joint

Figure 12 – Offset expansion joint and substandard barrier