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CSRD RAIL TRAIL
BRIDGE ASSESSMENT

June 11 2021

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1.0 Introduction

Bourcet Engineering was engaged to provide a visual comprehensive review and upgrade recommendation for safety to the bridges along the decommissioned railway line between Grindrod, BC and Armstrong, BC. The Shuswap Trail Alliance (STA) is converting the decommissioned Canadian Pacific Railway (CPR) line into a recreational day use trail. The Columbia Shuswap Regional District (CSRD) Rail Trail consists of four [4] bridges; the Rosemond Lake bridge at kilometer (km) 17, bridge at km 40, Stepney Cross Road bridge at km 42 and Fortune Creek bridge at km 49. All the bridges were constructed at various times by CPR and were originally part of an active railway line. The track is decommissioned and since, the bridges have not been used or maintained.

Bourcet Engineering conducted field investigations on all the bridges on April 20, 2020. This provided a spring setting for the visual examinations. There was no noticeable snow on or around the bridges to visually impede the investigation. In addition, the water levels at Rosemond Lake, km 40 and Fortune Creek, were low enough to allow close examination of the abutments and bearing lines of the bridges. The water level at Stephney Cross Road bridge was significantly higher and did not allow for much inspection except from the bridge deck or top banks. Overall, Bourcet assessed that the high-water level for the season had not been achieved yet.

The four [4] bridges are all constructed similarly, with creosote treated lumber in various sizes. There are multiple bearing lines that support large main beams. All the bridges have pile supports and creosote treated railway tie decks. The bridge's intended use is for foot, bike, and horse traffic as well as potentially sporadic small maintenance vehicles. The trails are not intended to be used by motorized recreational vehicles.

This report will provide a description of each bridge's current construction as well as any noted fatigue, damage or deterioration observed. It will also describe the extent of both the remediation work and the minimum safety upgrades required to accommodate the traffic.

2.0 Rosemond Lake Bridge Km 17

2.1 Bridge Description

The Rosemond Lake Bridge (Figure 2.1.1) separates the Shuswap River from Rosemond Lake (Figure 2.1.2). It is positioned between Swansea Point, BC and Grindrod, BC. The bridge is located at kilometer 17 along the proposed trail line.

FIGURE 2.1.1-ROSEMOND LAKE BRIDGE

FIGURE 2.1.2-BRIDGE LOCATION & WATER SOURCES

Rosemond lake bridge is 12'-0" wide and 42'-2" long. It is constructed out of creosote treated wood members. The existing deck varies between 9"x7½" treated ties at 2'-0"c/c and 7"x7" treated ties with a bottom plywood shim at 2'-0"c/c spacing. This maintains an overall deck tie spacing of 1'-0 c/c with each tie having an average 9" overhang from the main beam edge. The deck ties are supported by [3] main beam lines. The main beams consist of [2] 9½"x19½" solid timbers 6" apart per line. The beam lines have a max spacing of 2'-1" and an anchor timber/spacer at the interior bearing lines. A drip cap was observed over the main beams to protect them.

The main beams are supported by [4] bearing lines; [1] at each end and [2] interior lines situated 15'-5" from abutment A and 11'-9" from abutment B. The 16"x12" secondary beams are supported by either [5] or [6] 12" diameter piles. The piles are vertical and embedded into the riverbed or grade at unknown depths. An average pile height of 8'-6" was measured from top of grade to underside of secondary beam, for the interior bearing lines. The [2] interior bearing lines have 3"x10" cross braces on both sides. Some piles appear to have had previous remediation work completed. This is apparent by the 11½"x11½"x2'-0" deep square pile splices observed in various locations. Reference Figure 2.1.3 and attachment #1 S1.1 for layout drawings of the existing Rosemond Lake bridge.

Abutments A and B are situated directly behind the end bearing lines. The abutments are constructed similarly with built up creosote treated 12" deep horizontal members stacked vertically. The abutment heights and widths vary to accommodate the grade. Abutment A averaged 8 visible courses high with abutment B closer to 5 visible courses. Similar connections

were observed throughout the bridges, which consist of ¾" diameter thru bolts, plate washers and nuts.

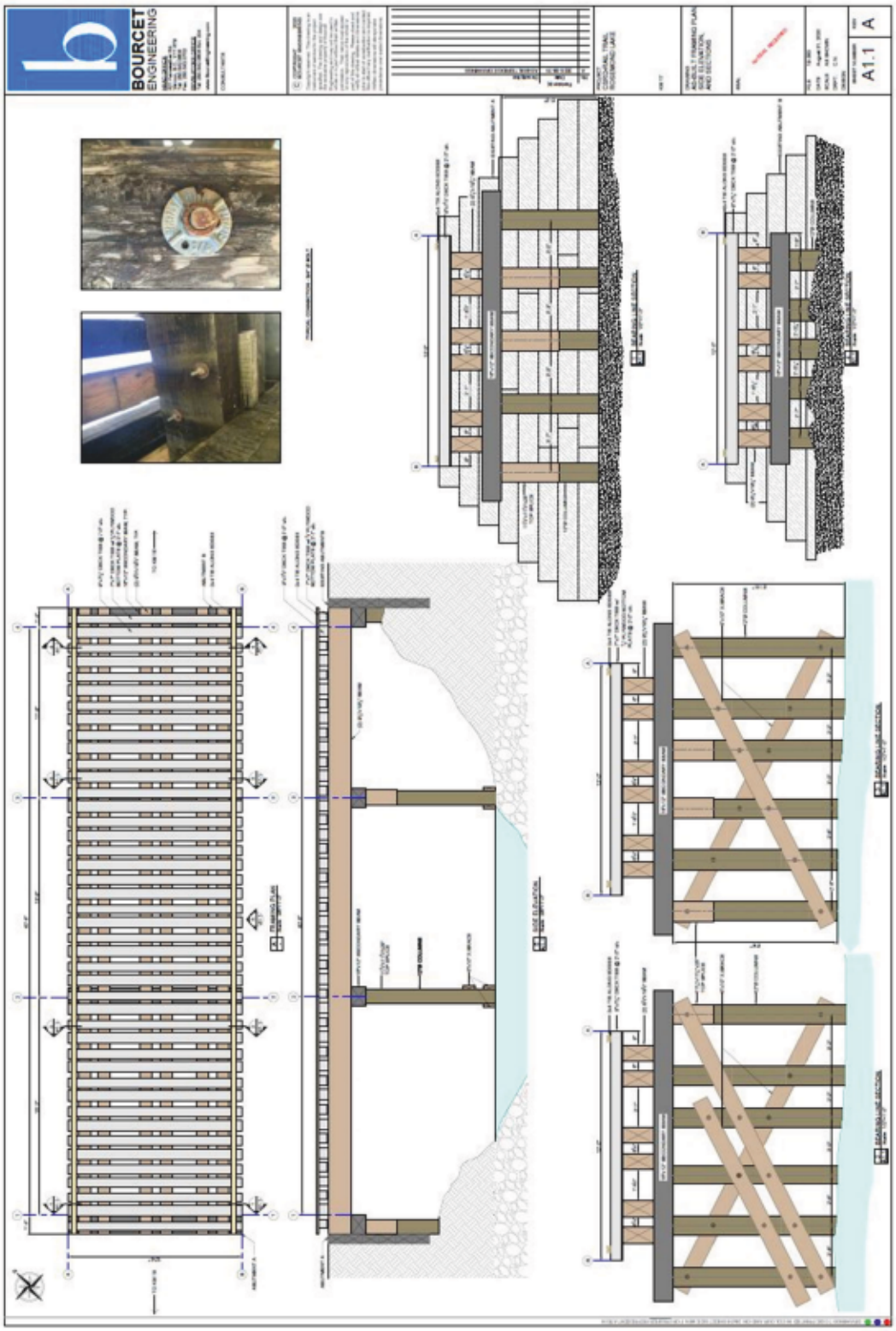


FIGURE 2.1.3-ROSMOND LAKE BRIDGE- EXISTING AS-BUILT INFORMATION

2.2 Bridge Observation and Condition

Rosemond Lake bridge was observed to be structurally sound with an overall condition of moderate-good. Deterioration, fatigue, and rot were observed in localized areas within the structure. Bourcet Engineering observed that the main beams, secondary beams, piles, and cross bracing were in good condition. The majority of the observed deterioration was in the deck ties and abutments. All observations and condition descriptions are listed below:

1. Deck Ties- 9"x7½" creosote treated ties and 7"x7" treated ties with a bottom plywood shim @ overall 1'-0"c/c spacing. {Figure 2.2.1}
    a. 40'-8" long surface with 43 deck ties in total.
    b. 12'-0" long ties with about 9" overhang (of the rail ties over the beam support).
    c. Deterioration and rot observed on 20-22 of the ties as indicated in Figure 2.2.2.

FIGURE 2.2.1-DECK TIES AND DETERIORATION

FIGURE 2.2.2-DETERIORATED DECK TIES

2. Main Beams (3 total)- [2] ply 9½"x19½" solid treated timbers approximately 6" apart. {Figure 2.2.3}
    a. Maximum spacing of 2'-1" between main beam lines.
    b. Maximum span 15'-2" and minimum span 11'-9".
    c. Overall beam condition is good. A drip cap over the beams helped to preserve the beam conditions.
    d. Beam spacer/anchor at each bearing line where [2] ¾" diameter thru bolts are located; refer to Figure 2.2.3 and Figure 2.2.4.

3. Secondary Beams (4 total)- 16"x12" creosote treated solid timbers. {Figure 2.2.5 & Figure 2.2.6}
    a. Typical beam length of 16'-0" with an average 1'-4" overhang from pile ends.
    b. Overall beam condition is good with no visible deterioration or rot observed.
    c. Spacers from main beam notched at secondary beam locations to provide top saddle for stability of secondary beam. {Figure 2.2.4}

FIGURE 2.2.3- MAIN BEAMS

FIGURE 2.2.4-SPACER CONNECTION

FIGURE 2.2.5-SECONDARY BEAM

FIGURE 2.2.6-SECONDARY BEAM

4. Piles-average 12" diameter creosote treated piles. {Figure 2.2.7}
    a. Embedded into the earth or water at unknown depths.
    b. All the piles have a vertical alignment. {Figure 2.2.8}
    c. There are 4 bearing lines with either 5 or 6 piles per bearing line.
    d. Pile heights vary as grade varies with a maximum visible height of 9'-0".
    e. Overall pile condition is good with signs of previous remediation work. The remediation work consisted of replacing sections of piles with treated 11½"x11½"x25" deep (average) treated members as shown in Figure 2.2.9.
    f. There were signs of abandoned piles near the bearing line 11'-9" from abutment B. There were assumed to have been from a previous bearing line that was moved/replaced by CPR prior to the decommissioning of the line. {Figure 2.2.8}

FIGURE 2.2.7- PILES

FIGURE2.2.8-EXISTING & PREVIOUS PLIES

FIGURE 2.2.9-PILE SPLICE

5. Cross Bracing-3"x10" treated members.
    a. Cross bracing observed on interior bearing lines only.
    b. Typically, 1 brace per side in opposite orientation to create an "X" as shown in Figure 2.2.10. Some had multiple brace members per side
    c. Braces anchored with ¾" diameter thru bolts and large washers to piles similar to other connections. {Figure 2.2.11}

FIGURE 2.2.10-CROSS BRACING "X"

FIGURE 2.2.11-BRACE CONNECTION

6. Abutments-12" deep creosote treated built up members.
    a. Overall the abumtnets for this bridges were in poor condition.
    b. Abutment A (Grid Line 1 in Figure 2.1.3) about 8'-0" or 8 visible courses high. This abutment had multiple locations of deterioration, rot and fatigue throughout. {Figure 2.2.12 and 2.2.13}
    c. A section of abutment A had been previously remediated and was supported by plywood, and a brace back to the main bridge beam. {Figure 2.2.14}
    d. Abutment B (Grid Line 4 Figure 2.1.3) about 5'-0" or 5 visible courses high. This abutment showed signs of fatigue [Figure 2.2.15].

FIGURE 2.2.12-ABUTMENT A

FIGURE 2.2.14-ABUTMENT A

FIGURE 2.2.14-REMEDIATION

FIGURE 2.2.15-ABUTMENT B

2.3 Recommendations and Upgrades

An overall assessment of the Rosemond Lake Bridge confirms it is in moderate-good condition with some remediation work required. In addition to the structural remediation work, some safety upgrades are also essential. The safety upgrades include improving the usability of the bridge surface and adding safety features such as guard rails along the bridge.

Bourcet Engineering (BE) recommends replacing the bridge deck and abutments. The main beams, secondary beams, piles and cross braces can remain with no upgrades required. BE also recommends that yearly inspections on the bridge be performed to ensure the maintained condition of the members and connections. The inspections should be completed at the same time each year and should document any changes in member or connection condition. If deterioration or rot are noticed a professional should be consulted. Moss and/or mildew were not documented on this bridge but if they start to form, treatment is recommended.

Both existing abutments show signs of fatigue and deterioration with abutment A having previous remediation work visible. BE recommends replacing both abutments with a similar treated built-up abutment. Ideally, excavate from the back and replace the existing railway ties with 6"x12" solid timber treated members. ¾" diameter rods should be inserted vertically through the solid members @ 16"c/c. The buried configuration (including tie backs etc) and depth of the abutments is unknown but, is assumed to be in a similar condition to the visible portions and will require replacement. The length and height of the new abutments should match the existing where possible and is dictated by the site conditions/grade.

The majority of the existing deck ties require replacement. Improving the deck surface by removing tripping hazards, large gaps or openings between members to ensuring serviceability by multiple users (people, bikes, horses and other pets etc) is one of the required safety upgrades. The remediation work and surface safety upgrades should be completed simultaneously. BE recommends replacing all the deck ties with new treated solid 6"x6" Douglas-fir #2 or better ties @ 3-0" c/c spacing. The new deck ties should be secured to the main beams using [1] 3/8" diameter GRK RSS galvanized structural screw per beam ply, to a maximum of 6 per tie. The bridge surface should be solid decking running perpendicular to the deck ties (in line with the path direction). Use treated, 1½" thick D-fir decking, secured using [2] 3/8" diameter GRK RSS galvanized structural screws per support. The finish of the surface material, milled or rough or stained etc., is at the discretion of the CSRD and STR.

Additional safety features such as guard rails are also required on both sides of the bridge. BE was informed that the guard should not project past the bridge ends and that if a projection is required it will be provided by the CSRD/STR. The guard is to be 4'-6" tall, off the deck surface, and provide horizontal rails with a maximum spacing of 6" (150mm). The guard will be constructed using treated 6x6" vertical posts at a maximum spacing of 6'-0"c/c. The columns will be anchored to the side of the main beams with (2) 5/8" diameter lag bolts and to the new deck ties with (1) 5/8" diameter bolt. The guard should have a sloped top rail to prevent moisture and snow collections. Any material finishes are at the discretion of the CSRD and STR. Refer to the attached construction drawings for the guard details and bridge specific remediation notes (attachment #2).

3.0 Bridge Km 40

3.1 Bridge Description

The bridge at km 40 (Figure 3.1.1) spans over Fortune Creek (Figure 3.1.2). It is positioned near Enderby, BC and is located at kilometer 40 along the proposed rail trail line.

FIGURE 3.1.1-BRIDGE KM 40

FIGURE 3.1.2-BRIDGE LOCATION & WATER SOURCES

This bridge is 10'-0" wide and 44'-8" long. Similar to the Rosemond Lake bridge, it is constructed of creosote treated wood members. The existing deck ties are 7½"x7½" treated ties at 1'-0"c/c spacing. The deck ties are supported by [2] main beam lines consisting of built up [4] ply 9½"x17½" treated timbers. The main beams lines are 2'-0" apart and are anchored to the secondary beams with bolted 6"x4" angle iron connections.

The main beams are supported by [4] bearing lines; [2] interior lines and [1] at each end. The secondary beams are 14"x14" solid creosote treated timbers situated 15'-2" from abutment A and 15'-6" from abutment B. The bearing lines contain [5] or [6] 14" diameter wood piles. The majority of the piles are vertical with the exception of the end piles on the [2] interior bearing lines. These end piles are battered; this means that they are installed at an angle. The angles of installation appeared to vary but helps provide additional stability against water thrust forces. All the columns are embedded into the riverbed or grade at unknown depths. An average interior bearing line pile height of 7'-7" was measured from top of grade to the underside of secondary beam. The [2] interior bearing lines have 4"x8" cross braces on both sides. Reference Figure 3.1.3 for layout drawings of the existing Km 40 bridge.

Abutments A and B are situated directly behind the end bearing lines. The abutments are constructed similarly with built up treated horizontal members stacked vertically. The abutments heights and widths vary to accommodate the grade. Abutment A averaged 5 visible courses high with abutment B shorter at 3 visible courses high. Similar connections were observed throughout the bridges. They consisted of ¾" diameter thru bolts, large washers and angle iron plates.

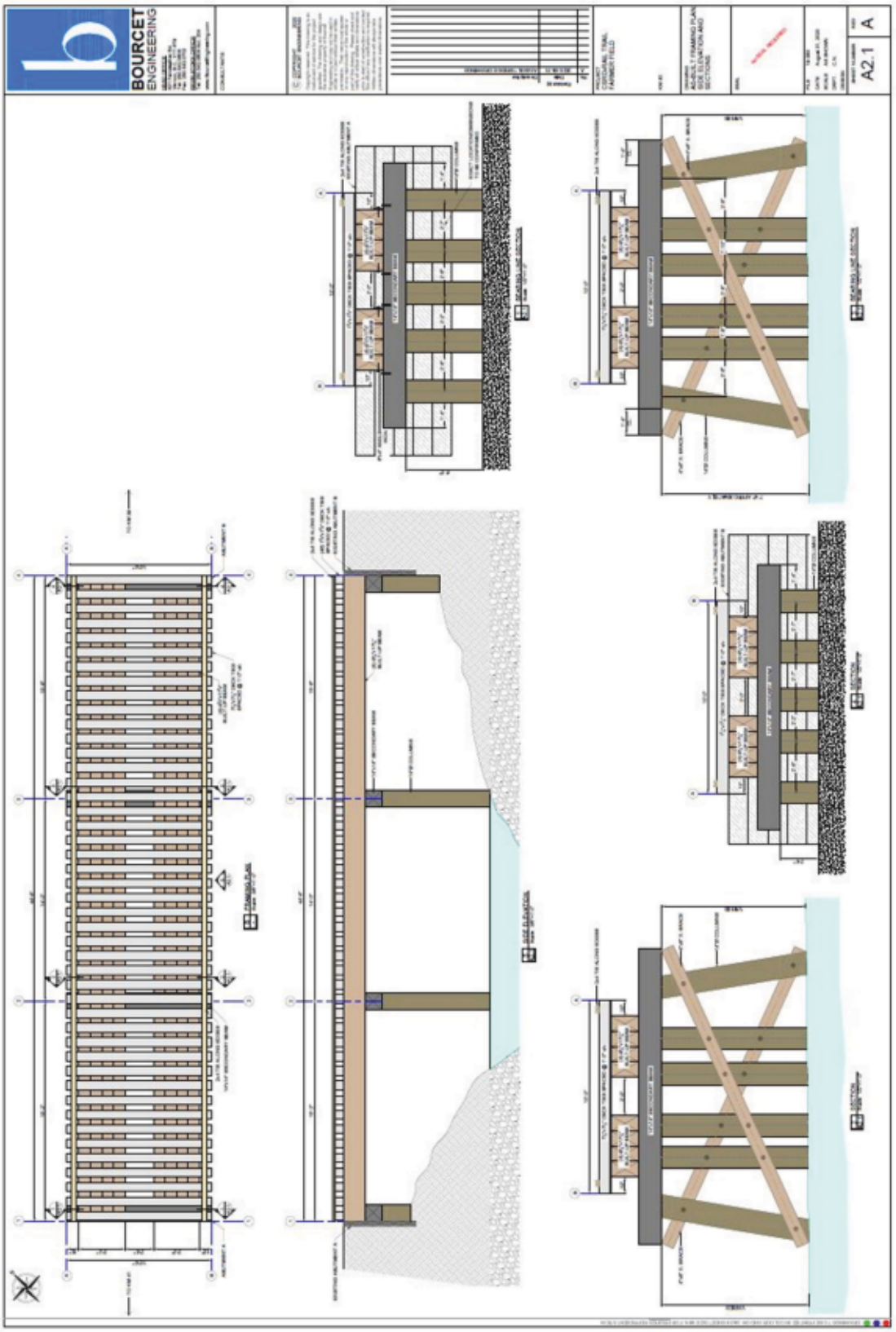


FIGURE 3.1.3-BRIDGE AT KM 40- EXISTING AS-BUILT INFORMATION

3.2 Bridge Observation and Condition

The bridge at km 40 was observed to be structurally sound, with an overall condition of moderate. Deterioration, fatigue, and rot were observed in localized areas within the structure. Bourcet Engineering detected that the main beams, secondary beams, piles, and cross bracing were all in good condition. The majority of the deterioration was observed on the deck ties with fatigue noticed in the abutments. All observations and condition descriptions are listed below.

1. Deck Ties- 7½"x7½" creosote treated deck ties @ 1'-0"c/c spacing. {Figure 3.2.1}
    a. Deck is 44'-8" long with 46 deck ties in total.
    b. Existing surface is 10'-0" wide with each rail tie having about a 10" overhang on both sides.
    c. Deterioration and rot observed in the ties as indicated in Figure 3.2.2. & Figure 3.2.3.

FIGURE 3.2.3-EXISTING DECK

FIGURE 3.2.2-DECK DETERIORATION

FIGURE 3.2.3-DECK DETERIORATION

2. Main Beams (2 total)- [4] ply 9½"x17½" built up creosote treated timbers. {Figure 3.2.4 & 3.25}
    a. Maximum interior spacing of 2'-0" between beams.
    b. Maximum span 15'-6" and minimum span 14'-0".
    c. Overall beam condition is good.
    d. Beam are anchored to secondary beams with 6"x4" angle iron connections.
    e. The built-up beams are anchored together with ¾" diameter thru bolts along their span. {Figure 3.2.7}

3. Secondary Beams (4 total)- 14"x14" creosote treated solid timber beams. {Figure 3.2.5 & 3.2.6}
    a. Beam lengths vary between 14'-0" and 12'-6" with a typical pile overhangs of 16" (from piles on ends).
    b. Overall beam condition is moderate with some green mildew and moss observed, refer to figure 3.2.8 near abutment A.
    c. 6"x4" angle iron connections are used to anchor the main beam and secondary beams. {Figure 3.2.7}

FIGURE 3.2.4- MAIN BEAMS

FIGURE 3.2.5-MAIN & SECONDARY BEAM

FIGURE 3.2.6-SECONDARY BEAM

FIGURE 3.2.7-ANGLE CONNECTION

FIGURE 3.2.8-MOSS/MILDEW

4. Piles-14" diameter treated piles {Figure 3.2.9}
    a. Embedded into the earth or reiverbed at unknown depths.
    b. There are 5 or 6 piles per bearing line.
    c. Most columns have vertical alignment except the end piles of the middle bearing lines that are battered. Battered columns are at an angle to help provide stability and compensate for water thrust forces. {Figure 3.2.10}
    d. Pile heights vary as grade varies with a maximum visible height of 7'-8".
    e. The pile connection to the secondary beam was not visible. {Figure 3.2.11}

5. Cross Bracing-4"x8" creosote treated bracing members. {Figure 3.2.10}
    a. Cross bracing observed on interior bearing lines only.
    b. Typically, 1 brace per side in opposite orientated to create an "X".
    c. Braces anchored with ¾" diameter thru bolts and large washers to piles. {Figure 3.2.12 & 3.2.13}

FIGURE 3.2.9-PILES

FIGURE 3.2.10-BATTERED PILES & X BRACING

FIGURE 3.2.11 PILE/BEAM CONNECTION UNKNOWN

FIGURE 3.2.12-X BRACE CONNECTION

FIGURE 3.2.13 THRU BOLTS

FIGURE 3.2.14 ABUTMENT A

FIGURE 3.2.15 ABUTMENT A (TOP VIEW)

6. Abutments-12" deep creosote treated built up members.
    a. Overall the abumtents for this bridge were in moderate to poor condition.
    b. Abutment A (Grid Line 1 in Figure 3.1.3) is about 5'-0" or 5 visible courses high. This abutment showed signs of fatigue and deterioration. {Figure 3.2.14 and 3.2.15}
    c. Abutment B (Grid Line 4 Figure 2.1.3) about 3'-0" or 3 visible courses high. This abutment showed signs of fatigue. {Figure 2.2.16}

FIGURE 3.2.16- ABUTMENT B

3.3 Remediation and Upgrades

The kilometer 40 bridge has an overall assessment of moderate condition. Most members are in good condition with some remediation work required. In addition to the structural remediation work, some safety upgrades are also essential. The safety upgrades include improving the usability of the bridge surface and adding safety features such as guard rails along the bridge.

Bourcet Engineering (BE) recommends replacing the bridge deck and abutments. The main beams, secondary beams, piles and cross braces can remain with only minor remediation work required. BE also recommends that yearly inspections on the bridge be performed to ensure the condition of the members and connections are maintained. The inspections should be completed around the same time each year and should document any changes in condition. If deterioration or rot are noticed a professional should be consulted or the member replaced with an equivalent treated member.

Some of the members were partially coated with mildew or moss. Mildew and moss typically appear in areas of prolonged moisture exposure. Moss specifically, will retain moisture on the wood surface long after a storm event. Eventually, the retained moisture will penetrate the wood leading to damage and deterioration of the member. The moss and mildew appeared to only effect the surface of the members at the time of BE's site visit. BE recommends remediating the

moss and mildew from all material surfaces. If and damage, deterioration or rot were observed under the mold/moss consult BE. Annual maintenance to prevent the growth of moss and mildew may be required on all the bridges.

Both existing abutments show signs of fatigue and deterioration. BE recommends replacing the abutments with similar treated built-up abutments. Excavate from the back and replace the existing railway ties with 6"x12" solid timber treated members. ¾" diameter rods should be installed vertically through the solid members @ 16"c/c. The buried configuration, such as tie backs etc, and depth of the abutments is unknown but, is assumed to be in similar condition to the visible portions and will require replacement. The length and height of the new abutments should match the existing where possible and accommodate the site conditions/grade. Refer to the bridge upgrade drawings file (attachment #2) for clarification on the design.

The majority of the existing deck ties require replacement. Improving the deck surface is a safety upgrade requirement. The upgrades should remove any tripping hazards, large gaps or openings between members to ensuring serviceability by multiple users (people, bikes, horses and other pets etc) on the bridge surface. The remediation work and surface safety upgrades should be completed simultaneously. BE recommends replacing all the deck ties with treated solid 6"x6" Douglas-fir #2 or better ties @ 3'-0" c/c spacing. The new deck ties should be secured to the main beam with [1] 5/8" diameter GRK RSS galvanized structural screw per beam ply with a maximum of [6] anchors per tie. The new bridge surface is solid treated decking running perpendicular to the deck ties or in line with the trail direction. Use treated, 1 ½" thick D-fir decking, secured using (2) 5/8" diameter GRK RSS galvanized structural screws per support. The finish of the surface material, milled or rough or stained etc., is at the discretion of the CSRD and STR. Refer to the bridge specific drawing files (attachment #2) for clarification on the new deck framing.

Additional safety features such as guard rails are also required on both sides of the bridge. BE was informed that the guard should not project past the bridge ends and that if a projection is required it will be provided by the CSRD/STR. The guard is to be 4'-6" tall and provide horizontal rails with a maximum spacing of 6" (150mm). The guard will be constructed using treated 6x6" vertical posts at a maximum spacing of 6'-0"c/c. The columns will be anchored to the main bridge beams used [2] 5/8" diameter lag bolts and to the deck ties with [1] 5/8" diameter thru bolt. The rail should have a sloped top rail to prevent moisture and snow collections. The CSRD and STR will comment on any surface material finishes for the guard rail. Refer to the attached construction drawings for the guard details and bridge specific remediation notes (attachment #2).

4.0 Stepney Cross Road Bridge Km 42

4.1 Bridge Description

The Stepney Cross Road bridge is located at km 42 along the proposed rail trail {Figure 4.1.1}. The bridge spans over Fortune Creek near the Stepney Cross Road and Stepney Road intersection. {Figure 4.1.2}

FIGURE 4.1.1-STEPNEY CROSS ROAD BRIDGE

FIGURE43.1.2-BRIDGE LOCATION

This existing structure is 10'-0" wide and the shortest bridge at only 15'-6" long. Similar to the other bridges, it is constructed of creosote treated wood members. The existing deck ties are 7½"x7½" treated ties at 1'-0"c/c spacing. The deck ties are supported by [2] main beam lines consisting of 2'-4"x17" timber members (built-up). The main beams lines are 2'-8" apart and are anchored to the secondary beams with bolted 6"x4" angle iron connections.

The main beams are carried by [2] bearing lines, [1] at each end. The secondary beams are 14"x14" solid treated timbers situated at abutment A and abutment B. The bearing lines contain [3] wood piles. All the piles appear to have a vertical orientation and are embedded into the riverbed at unknown depths. The water level was the highest on this bridge and limited access and visibility under the deck surface. In addition, no cross bracing was noticeable on either bearing line. Reference Figure 4.1.3 for layout drawings of the existing Stepney Cross Road bridge.

Abutments A and B appear to be constructed similarly with built up treated horizonal members stacked vertically. The abutments heights were similar on both ends at about 3 visible courses high. Their widths varied to accommodate the grade. Similar connections to the other bridges were observed; ¾" diameter thru bolts, large washers and angle iron plates.

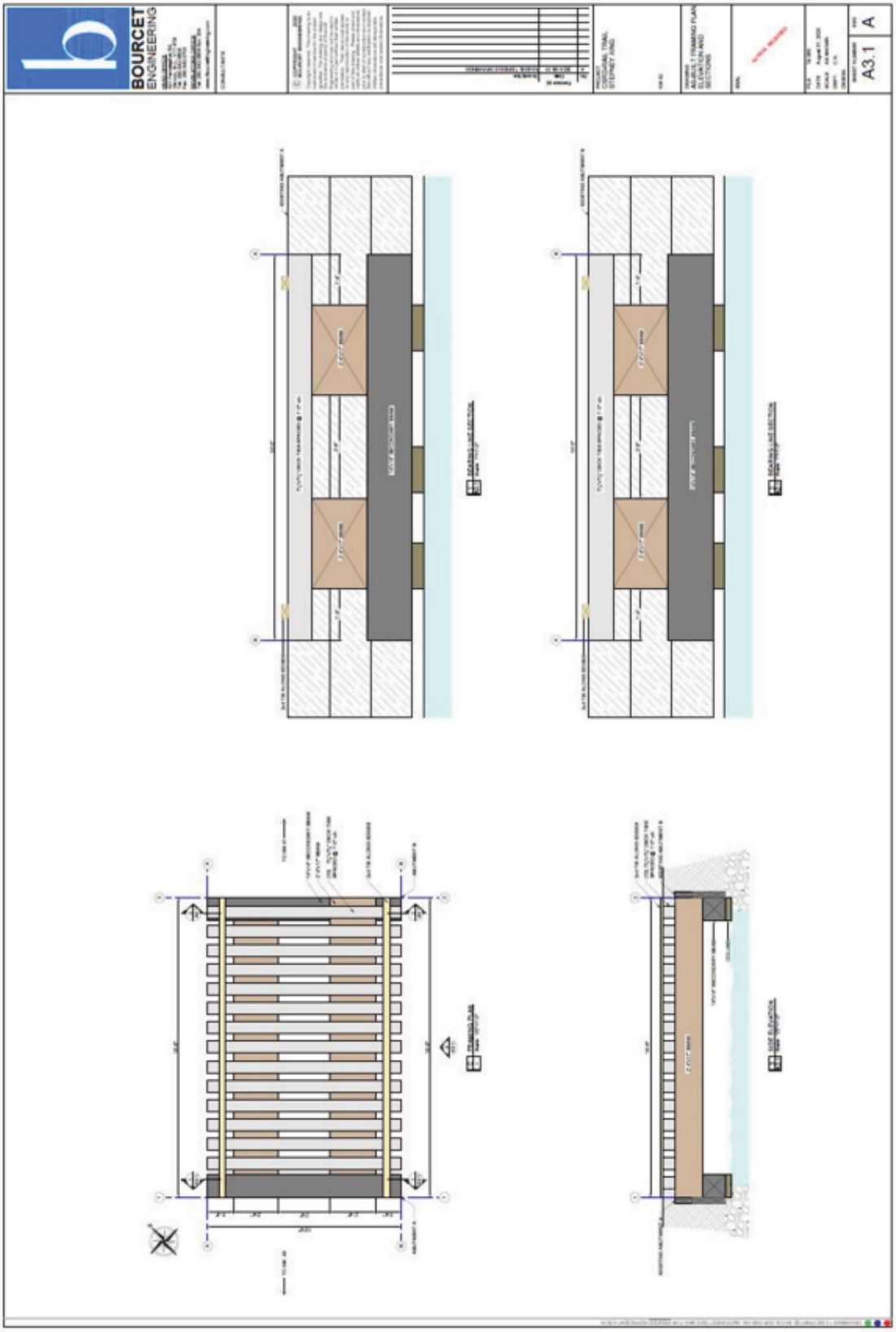


FIGURE 4.1.3-BRIDGE AT STEPNEY CROSS ROAD KM 42- EXISTING AS-BUILT INFORMATION

4.2 Bridge Observation and Condition

The Stepney Cross Road bridge at km 42 was in moderate condition. Deterioration, fatigue, rot and mildew within the bridge structure were documented. Bourcet Engineering (BE) could not visually confirm the condition of the existing piles due to the height of the water. Overall, the main beams and secondary beams appeared in good condition with some mildew observed. The majority of the deterioration and fatigue was noticed in the deck ties and abutments. All observations and condition descriptions are listed below.

1. Deck Ties- 7½"x7½" creosote treated deck ties @ 1'-0"c/c spacing. {Figure 4.2.1 & 4.2.2}
    a. Surface is 15-6" long with about 15 deck ties in total.
    b. Typically, a 1'-4" overhang was measured for the ties over the main beams.
    c. The surface width is 10'-0"
    d. Deterioration, rot and age were observed in the majority of the ties. {Figure 4.2. & 4.2.3}

FIGURE 4.2.1-DECK TIES

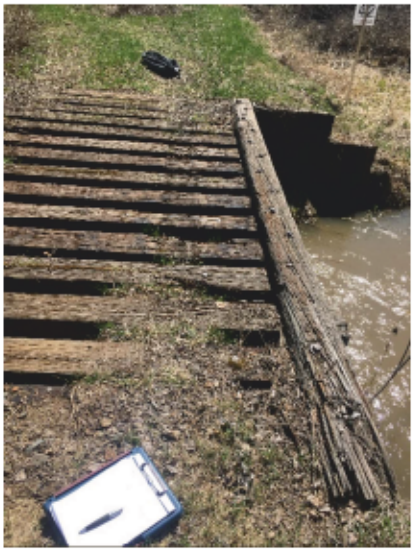


FIGURE4.2.2-DECK TIES

FIGURE 4.2.3-DECK TIE DETERIORATION

2. Main Beams (2 total)- 2'-4"x17½" creosote treated timber beams (built -up). {Figure 4.2.4 & 4.2.5}
    a. Maximum interior spacing of 2'-8" between the beams (measured form the top).
    b. The beams have a span of 15'-6".
    c. The beams appeared to be built-up, but the width of each ply was hard to confirm from the surface. Visibility was obscured by dirt and debris that had fallen between the ties.
    d. Overall beam condition is moderate. With visible green mildew along their sides. {Figure 4.2.6}
    e. Beam are anchored to secondary beams with 6"x4" angle iron connections.
    f. The built-up beams are anchored together with ¾" diameter thru bolts along their span. {Figure 4.2.7}

3.

FIGURE 4.2.4-MAIN BEAM-LOOKING NORTH

FIGURE 4.2.5-MAIN BEAM-LOOKING SOUTH

FIGURE 4.2.6-MAIN BEAM MILDEW

FIGURE 4.2.7-ANGLE CONNECTION

4. Secondary Beams (2 total)- 14"x14" creosote treated solid timber beams. {Figure 4.2.8 & 4.2.9}
    a. Beam lengths are approximately 10'-0" and have a pile overhang (from piles on ends).
    b. Overall beam condition appeared to be moderate with green mildew observed.
    c. 6"x4" angle iron connections used to anchor main beam and secondary beam. {Figure 4.2.7}
    d. Underside visual examination was not possible due to high water levels.

5. Piles-circular treated piles. {Figure 4.2.9 & 4.2.10}
    a. Existing piles are embedded into the water at unknown depths.
    b. There are 3 piles per bearing line.
    c. The piles appeared to have vertical alignment based on the small portion visible.
    d. At time of inspection, the piles were almost completely submerged. This made confirming their visible condition difficult. {Figure 4.2.9}

FIGURE 4.2.8-SECONDARY BEAM WITH MILDEW

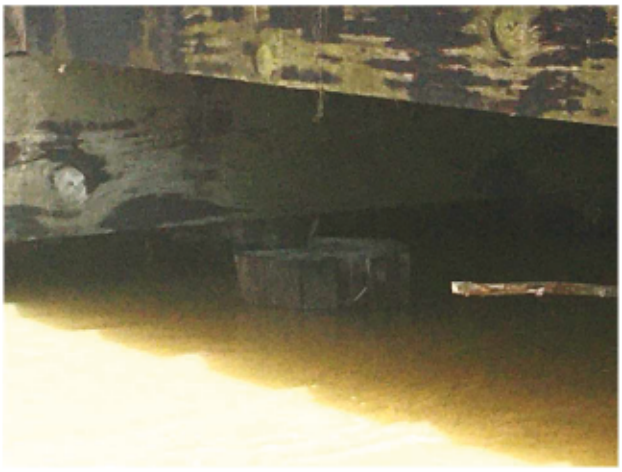


FIGURE 4.2.9-SECONDARY BEAM

6. Abutments-12" deep creosote treated built up members.
    a. Overall the abumtents for this bridges were in poor condition.
    b. Abutment A (Grid Line 1 in Figure 3.1.3) about 3'-0" or 3 visible courses high. This abutment showed signs of fatigue.
    c. Abutment B (Grid Line 2 Figure 3.1.3) about 3'-0" or 3 courses high. This abutment showed signs of fatigue and deterioration. Refer to figure 4.2.11.

FIGURE 4.2.10-PILES

FIGURE 4.2.11-ABUTMENT B- DETERIORATION

4.3 Remediation and Upgrades

The Stepney Cross Road bridge at km 42 was in moderate condition but does require some remediation work. In addition to the structural remediation work, some safety upgrades are also essential. The safety upgrades include improving the usability of the bridge surface and adding safety features such as guard rails along the bridge.

Bourcet Engineering (BE) recommends replacing the bridge deck and abutments. The main beams, secondary beams, piles and cross braces can remain with only minor remediation work required. BE also recommends that yearly inspections on the bridge be performed to ensure the condition of the bridge is maintained. The inspections should be completed near the same time annually and should document any changes in condition. If deterioration or rot are noticed a professional should be consulted or the member replaced with an equivalent treated member.

Most of the visible support members contained mildew or moss on their surface. Mildew and moss as previously described, can contribute to damage and deterioration of the members. During BE's site visit, the mildew appeared to only effect the surface of the members. BE recommends removing all the mold and mildew from all structure surfaces and annual maintenance performed to prevent future growth on the bridge structure.

Both existing abutments show signs of fatigue and/or deterioration. BE recommends replacing both abutments with a similar treated built-up members. Ideally, excavate, from the back, and remove the existing abutments. Replace with 6"x12" solid timber treated members and ¾" diameter rods inserted vertically through the solid members @ 16"c/c. The buried configuration (tie backs etc) and depth of the abutments is unknown but, is assumed to be in similar condition to the visible portions and will require replacement. The length and height of the new abutments should match the existing where possible and accommodate the site conditions/grade. Refer to the bridge upgrade drawings file (attachment #2) for clarification on the design.

The majority of the existing deck ties require replacement. Improving the deck surface is a safety upgrade requirement. The upgrades should remove any tripping hazards, large gaps or openings between members to ensuring serviceability by multiple users (people, bikes, horses and other pets etc.). It is recommended that the remediation work and surface safety upgrades should be completed together. BE recommends replacing all the deck ties with treated solid 6"x6" Douglas-fir #2 or better ties @ 3'-0" c/c spacing. The new deck ties should be secured to the main beam using [1] 5/8" diameter GRK RSS galvanized structural screws per beam ply with a total of [6] anchors per tie. The new bridge surface, running perpendicular to the deck ties or in line with the path direction, should be 1 ½" thick treated D-fir decking. The decking should be secured with (2) 5/8" diameter GRK RSS galvanized structural screws per support. The finish of the surface material is at the discretion of the CSRD and STR. Refer to the bridge specific drawing files (attachment 2) for clarification on the new deck framing.

Additional safety features such as guard rails are also required on both sides of the bridge. The guard is to be 4'-6" tall, off the deck surface, and requires 2x6" horizontal rails with a maximum spacing of 6" (150mm). It will be constructed using treated 6x6" vertical posts at a maximum spacing of 6'-0"c/c. The columns will be anchored to the side of the main beams with [2] 5/8" diameter galvanized lag bolts and into the new deck ties with [1] 5/8" diameter thru bolt. The guard will have a sloped top rail to prevent moisture and snow collections. Refer to the attached construction drawings for the guard details and bridge specific remediation notes (attachment #2).

5.0 Fortune Creek Bridge Km 49

5.1 Bridge Description

Fortune Creek bridge (Figure 5.1.1) spans over Fortune Creek. The bridge is located near Armstrong, BC and runs parallel to the Vernon/Sicamous Highway (97A). It is adjacent to the Fortune Creek Rest Area; refer to Figure 5.1.2. The bridge is located at kilometer 49 along the proposed rail trail line.

FIGURE 5.1.1-FORTUNE CREEK BRIDGE

FIGURE 5.1.2-BRIDGE LOCATION & WATER SOURCE

This bridge is 10'-0" wide and 45'-6" long; the longest bridge considered in this report. It is constructed out of creosote treated wood members. The existing deck is constructed out of 7½"x7½" treated ties at 1'-0"c/c. The deck ties are supported by [2] main beam lines. The main beams are [4] ply 9"x17½" built up treated timbers with a spacing of 2'-4". The main beams are anchored together with ¾" diameter thru bolts and large washer plates at various spaces. In addition, they are also anchored with 4"x6" angle connections to the secondary beams.

The main beams are supported by [4] bearing lines; [1] at each end and [2] interior lines. They are situated 14'-1" from abutment A and 16'-5" from abutment B. The secondary beams are 14"x14" treated solid timbers that have a 14"x4" top plate. The secondary beam/top plate are anchored to the main beam with 4"x6" angle connections. The secondary beams are carried by plies (each line has varying numbers 3, 4, 6, or 7). The piles are 10" diameter treated members that have a vertical alignment. They are embedded into the riverbed or grade at unknown depths. An average pile height of 3'-4" was measured from the top of grade to underside of secondary beam at the interior bearing lines. The piles have a protective wrap as a pile cap to protect them from moisture damage. It appears remediation work had been previously completed as cut off piles exist beside the existing bearing lines. There are no cross braces included in the bridge design. Reference Figure 5.1.3 for layout drawings of the existing as built bridge.

Abutments A and B are situated directly behind the end bearing lines. The abutments are constructed similarly with built up treated horizontal members stacked vertically. Abutment A also had a couple treated vertical members along its face. This varies from the other bridge

abutments. The abutments heights and widths vary to accommodate the grade with abutment A averaged 6 visible courses high and abutment B closer to 4 visible courses high.

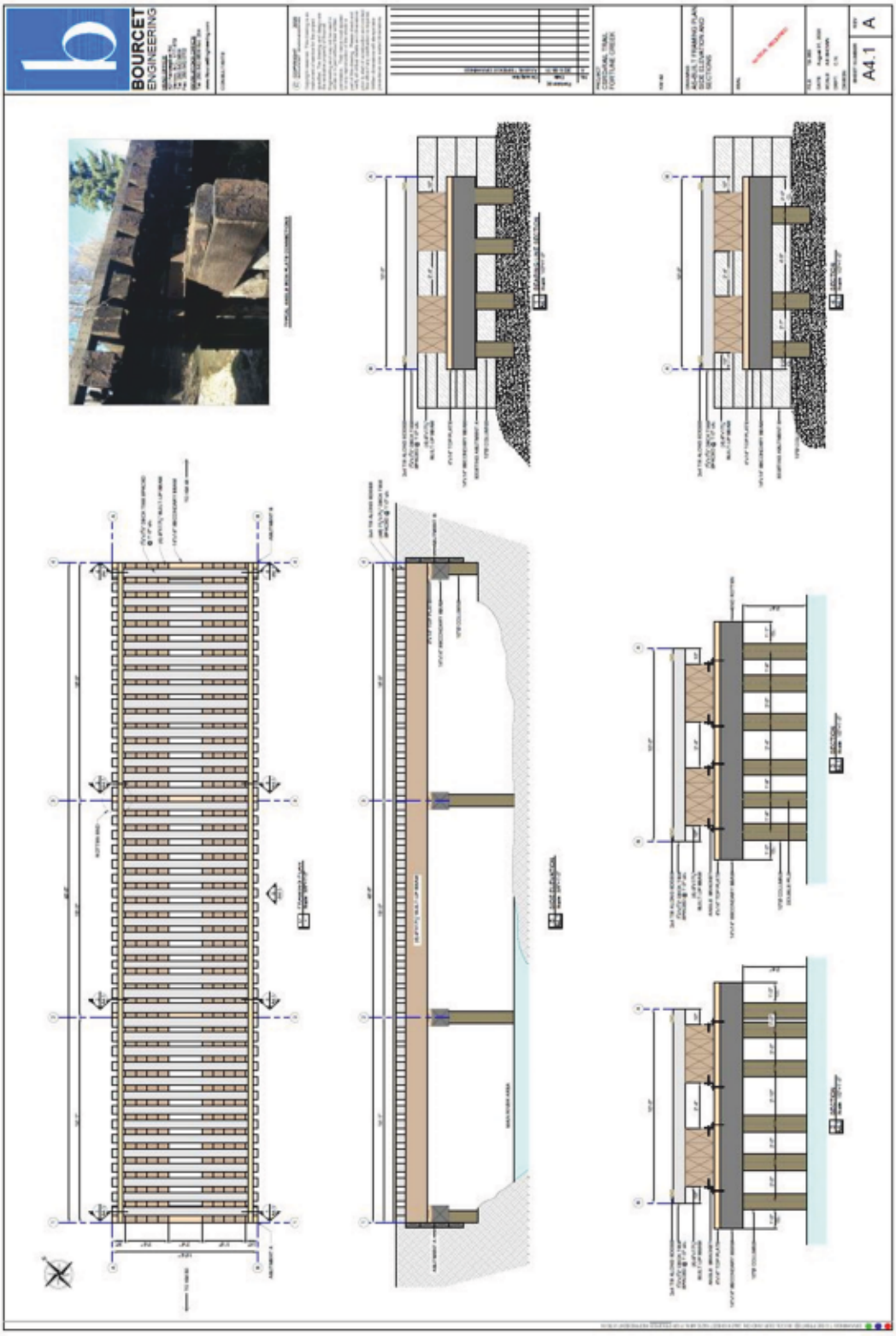


FIGURE 5.1.3-FORTUNE CREEK BRIDGE - EXISTING AS-BUILT INFORMATION

5.2 Bridge Observation and Condition

The Fortune Creek bridge is located at km 49 along the rail trail and is in moderate-okay condition. Deterioration, fatigue, and rot were observed within the bridge structure. In general, the main beams, secondary beams and piles appeared in good condition with a section of localized rot and minor mildew observed. The majority of the deterioration and fatigue was obsereved in the deck ties and abutments. All observations and condition descriptions are listed below.

1. Deck Ties- 7½"x7½" creosote treated deck ties @ 1'-0"c/c spacing. {Figure 5.2.1 & 5.2.2}
    a. The bridge is 45'-06" long and has about 46 deck ties in total.
    b. The bridge deck is 10'-0" wide and the ties have a typically overhang of 10" on both sides.
    c. Deterioration, rot and age were observed in the ties. {Figure 5.2.3}

FIGURE 5.2.1-DECK TIES

FIGURE 5.2.2-DECK TIES

FIGURE 5.2.3-DECK TIE DETERIORATION

2. Main Beams (2 total)- [4] ply 9"x17½" creosote treated built-up timber beams. {Figure 5.2.4 & 5.2.5}
    a. The main beams have a maximum interior spacing of 2'-4".
    b. Their maximum span is 16'-5" and minimum span is 14'-1".
    c. Overall beam condition is good.
    d. The beams are anchored together with ¾" diameter thru bolts with large washers along their length.
    e. The main bean is also anchored to the secondary beam with 6"x4" angle iron connections. {Figure 5.2.6}

3. Secondary Beams (4 total)- 14"x14" creosote treated solid timber beams. {Figure 5.2.7}
    a. The secondary beams have continuous 14"x4" top plates that the main beams bear on. {Figure 5.2.8}
    b. Beam lengths vary but average about 11'-6" and have a typical pile overhangs of 1'-0" (from piles on ends).

c. Overall beam condition is moderate except for bearing line 3, as noted on grid line 3- Figure 5.1.3. The south end of the secondary beam show signs of deterioration and rot. {Figure 5.2.9}
d. 6"x4" angle iron connections are used to anchor the main beam and secondary beam. {Figure 5.2.8}

FIGURE 5.2.4-BUILT UP MAIN BEAM

FIGURE 5.2.5-BUILT UP MAIN BEAM

FIGURE 5.2.6 ANGLE CONNECTION

FIGURE 5.2.7-SCEONDARY BEAM

FIGURE 5.2.8-SECONDARY BEAM & CONNECTION

FIGURE 5.2.9-BEARING LINE 3-SOUTH END-DAMAGE

4. Piles-circular treated piles {Figure 5.2.10}
    a. Embedded into the grade/water at unknown depths.
    a. The number of pies per bearing line varies between 3 and 7.
    b. Protective wraps are present on all pile as pile caps. They appear to be in good condition and are still protecting the piles. {Figure 5.2.10}
    c. Bearing line 2 has a double pile, second from the north end. {Figure 5.2.11}
    d. The piles are vertically aligned consistently. {Figure 5.2.12}
    e. Remediation work was previously completed on this bridge. There are cut off piles extruding from the ground near bearing line 1 and 4. {Figure 5.1.3}

FIGURE 5.2.10-PILES WITH WRAPS

FIGURE5.2.11-DOUBLE PLIE

FIGURE 5.2.12-PILES VERTICALLY ALIGNED

FIGURE 5.2.13-PREVIOUSL CUT OFF PILES LINES

5. Abutments- 4"x12" creosote treated built up members.
    a. Overall the abumtents for this bridges are in poor condition.
    b. Abutment A (Grid Line 1 in Figure 5.1.3) is about 6'-0" or 6 visible courses high and showed signs of fatigue. Only some of the abutment was visible behind bearing line 1. {Figure 5.2.14 & 5.2.16}
    c. Abutment B (Grid Line 4 Figure 5.1.3) about 4'-0" or 4 visible courses high. This abutment showed signs of fatigue and deterioration. There were noticeable gaps between the abutment members allowing the ground material to penetrate. {Figure 5.2.15 & 5.2.17}

FIGURE 5.2.14-ABUTMNET A & BEARING LINE 1

FIGURE 5.2.15-ABUTMNET B

FIGURE5.2.16-ABUTMENT A

FIGURE 5.2.17-ABUTMETN B-DETERIORATION

5.3 Remediation and Upgrades

The Fortune Creek bridge at km 49 of the rail trail was in moderate-okay condition but does require some remediation work. In addition to the structural remediation work, some safety upgrades are also essential. The safety upgrades include improving the usability of the bridge surface and adding safety features such as guard rails along the bridge.

Bourcet Engineering (BE) recommends replacing the bridge deck and abutments. The main beams, most secondary beams, piles and cross braces can remain with only minor remediation work required. BE also recommends that yearly inspections on the bridge be performed to ensure the maintained condition of the members and connections. The inspections should be completed annually and should document any changes in member and/or connection condition.

If deterioration or rot are noticed a professional should be consulted or the member replaced with an equivalent treated member.

A potion of the support members contained minor mildew on their surface. Mildew and moss as previously described can contribute to damage and deterioration of the members. The mildew appeared to only effect the surface of the members at the time of BE's site visit. BE recommends remediating the mold and mildew from all surfaces. Annual maintenance to prevent the growth of moss and mildew may be required on the bridge.

The secondary beam on bearing line 3, grid line 3, Figure 5.13 and Figure 5.2.9, has documented rot and deterioration on its end. It appeared that the rot only effected the cantilevered beam end. Due to this, BE recommends replacing and/or removing the deteriorated section of the secondary beam. [2] options are provided depending on the extent of the decay and deterioration.

- Temporarily support the bridge structure and cut only the overhanging portion of the beam about 1'-0" (to the end pile edge).
- If no signs of deterioration, damage or rot are visible within the beam; prepare the cut end with treated paint (if required) and the required remediation is completed.
- If damage is still visible at the cut section, the secondary beam will need to be removed and replaced back to the center of the next support pile (The length of replacement is governed by the extend of the damage. When no deterioration is noted within the beam the replacement can stop.
- Replace the removed beam sections with an equivalent sized treated wood member.
- Secure the new beam to the piles with galvanized structural screws inserted at 45-degree angles.

Both existing abutments show signs of fatigue and/or deterioration. BE recommends replacing both abutments with a similar treated built-up abutment. Ideally, excavate from the back and replace the existing railway ties with 6"x12" solid treated timber members. Install ¾" diameter rods inserted vertically through the solid members @ 16"c/c. Abutment A has additional treated vertical members on its face. Replace and re-install the vertical members to match the original construction. The buried configuration and depth of the abutments is unknown but, is assumed to be in similar condition to the visible portions and will require replacement. The length and height of the new abutments should match the existing where possible and accommodate the site conditions/grade. Refer to the bridge upgrade drawings file (attachment #2) for clarification on the design.

The majority of the existing deck ties require replacement. Improving the deck surface is also a safety upgrade requirement. The upgrades should remove any tripping hazards, large gaps or openings between members to ensuring serviceability by multiple users (people, bikes, horses and other pets etc.). The remediation work and surface safety upgrades should be completed simultaneously. BE recommends replacing all the deck ties with treated solid 6"x6" Douglas-fir #2 or better ties @ 3'-0" c/c spacing. The new deck ties should be secured to the main beam using [1] 5/8" diameter GRK RSS galvanized structural screw, per beam ply or to a maximum of 6 per tie. The new bridge surface should be solid 1 ½" thick Douglas-Fir treated decking. The decking should run perpendicular to the deck ties or in the path direction. Secure the decking

with [2] 5/8" diameter GRK RSS galvanized structural screws per support. The finish of the surface material is at the discretion of the CSRD and STR. Refer to the bridge specific drawing files (attachment #2) for clarification on the new deck framing.

Additional safety features such as guard rails are also required on both sides of the bridge.. The guard is to be 4'-6" tall (off the deck surface) and provide horizontal rails with a maximum spacing of 6" (150mm). The guard will be constructed using treated 6x6" vertical posts at a maximum spacing of 6'-0"c/c. The columns will be anchored to the main bridge beams with [2] 5/8" diameter lag bolts and to the new deck ties with [1] 5/8" diameter through bolt. The guard should have a sloped top rail to prevent moisture and snow collections. Refer to the attached construction drawings for the guard details and bridge specific remediation notes (attachment #2).

6.0 Conclusion

Overall, Bourcet Engineering's visual comprehensive review of the existing four [4] bridges along the decommissioned railway line between Grindrod, BC and Armstrong, BC, yielded moderate condition assessments. The four bridges are the Rosemond Lake bridge at kilometer (km) 17, bridge at km 40, Stepney Cross Road bridge at km 42 and Fortune Creek bridge at km 49 The new recreational day use trail bridges will require some remediation and replacement work at all bridge locations.

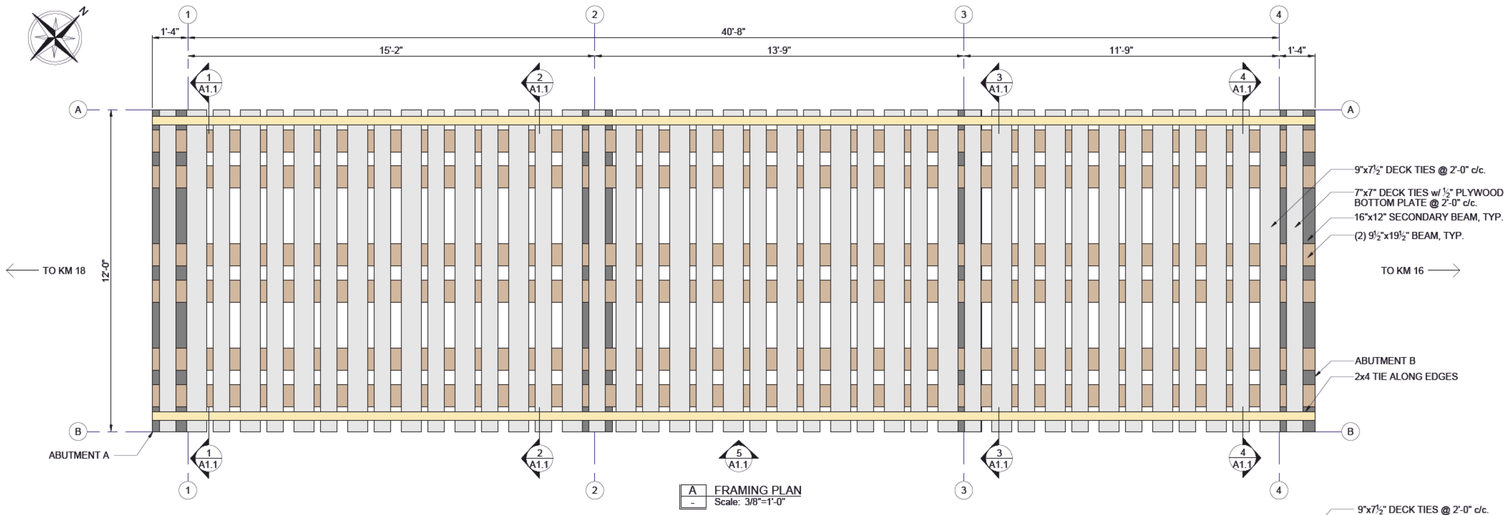
The majority of the remediation work involves the deck ties and abutments of all four bridges. With minor site-specific other work required such as mildew remediation and specific member rot replacement. In addition to the remediation work, safety and usability upgrades are required at all four bridge locations. These upgrades include improving the usability and safety of the bridge deck surface; as well as providing guard rails along all the bridges. All the required remediation work and upgrades is detailed in the construction drawings included as attachment #2.

.

7.0 Attachments

1) CSRD-Rail Trail -As built Drawings 2020-08-31
   (also included as figures in the report)

2) CSRD-Rail Trail-Construction Drawings 2021-05-20



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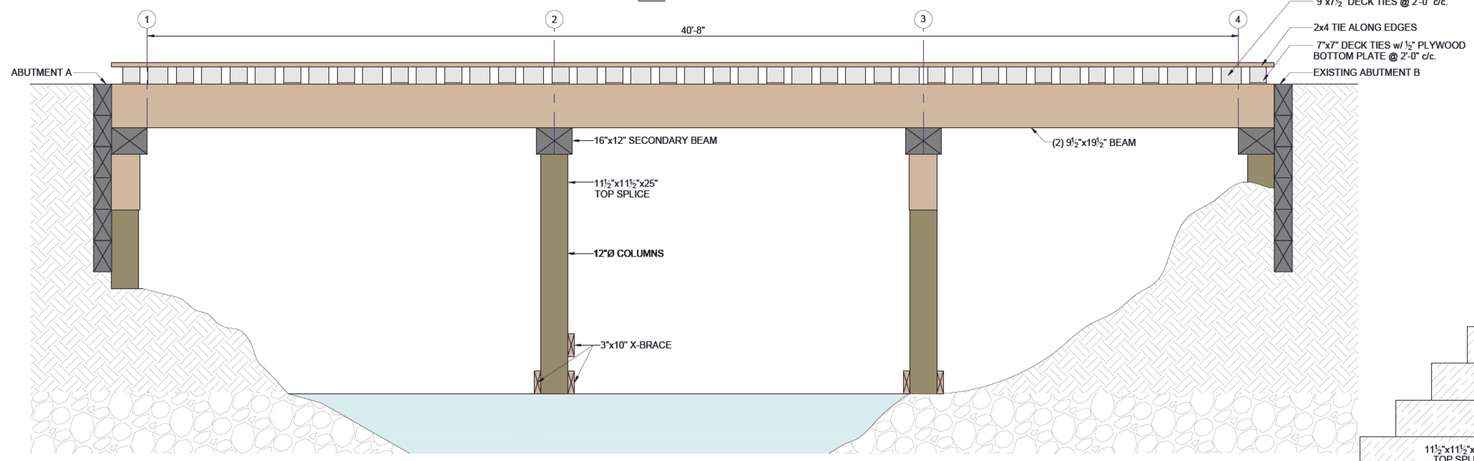

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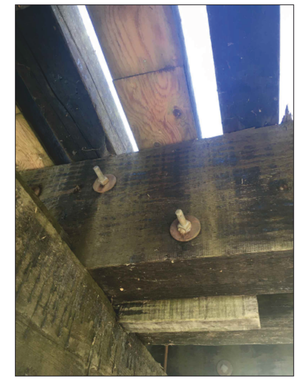
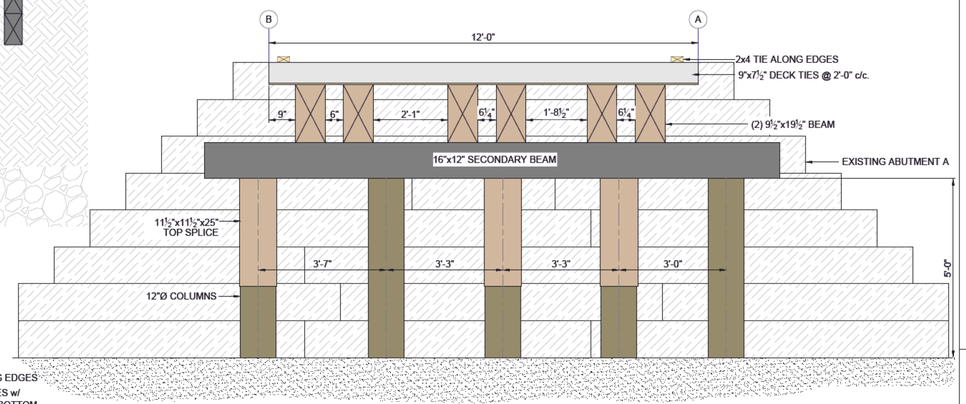


TYPICAL CONNECTION - 3/4" Ø BOLT



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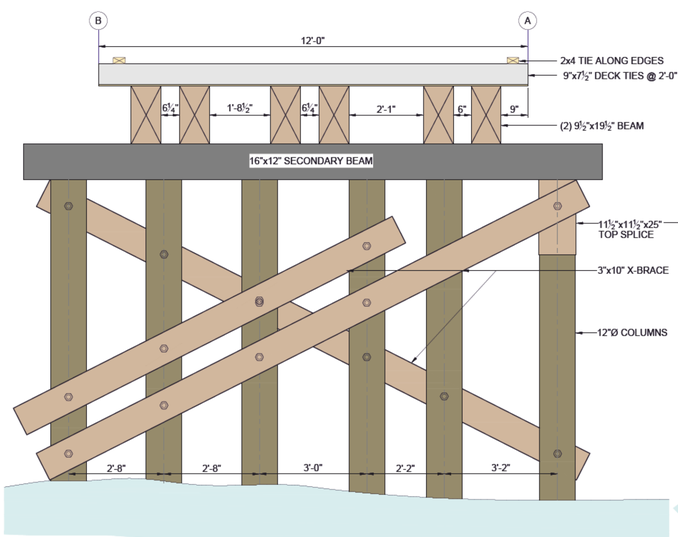

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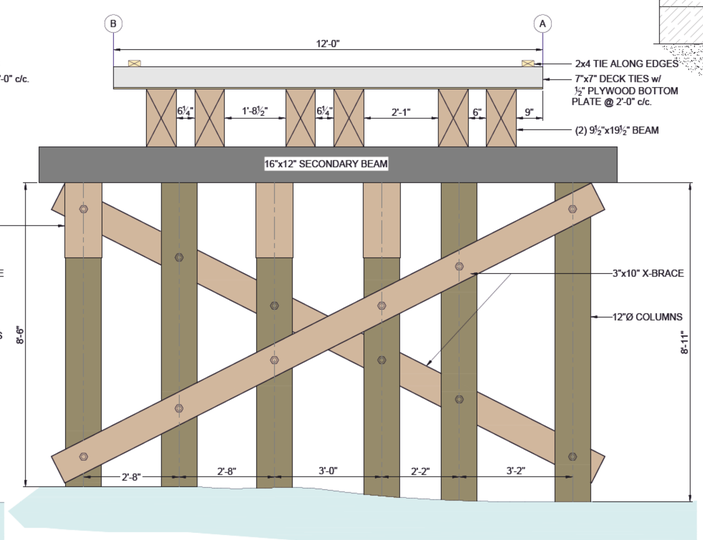

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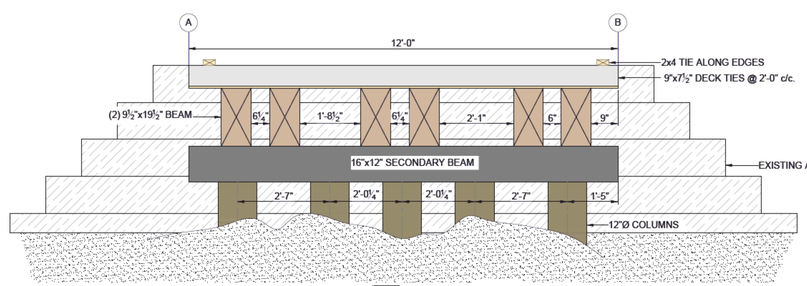

4 BEARING LINE SECTION
A1.1 Scale: 1/2"=1'-0"

DRAWINGS TO BE PRINTED IN COLOUR AND ON 24x36 SHEET SIZE MIN. FOR PROPER REPRESENTATION

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CONSULTANTS

No.	Revision(s) Date	Description
A	2020-08-31	AS-BUILT BRIDGE DRAWINGS

PROJECT
CSRD-RAIL TRAIL
ROSEMOND LAKE

KM 17

DRAWING
AS-BUILT FRAMING PLAN, SIDE ELEVATION, AND SECTIONS

SEAL

No SEAL REQUIRED

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DATE	August 31, 2020
SCALE	AS SHOWN
DRFT.	C.N.
DESIGN	

SHEET NUMBER A1.1

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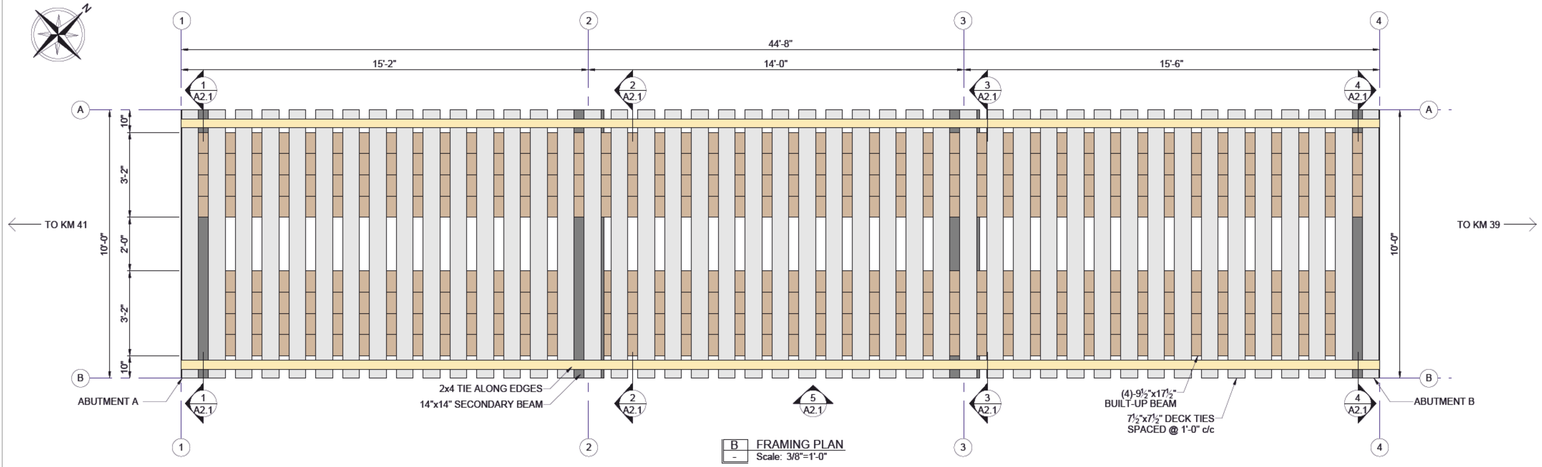

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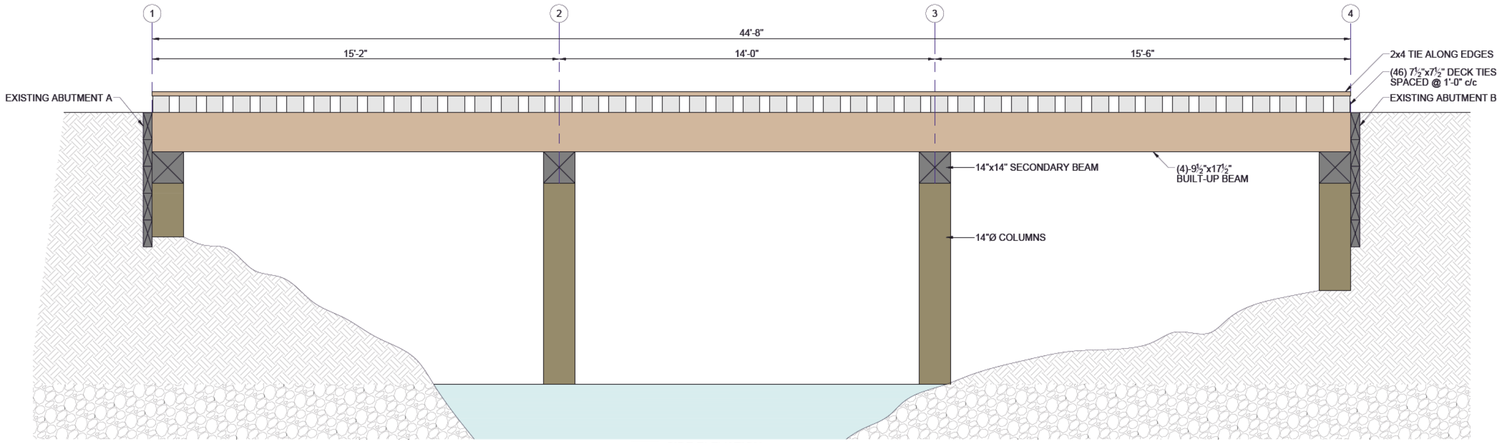

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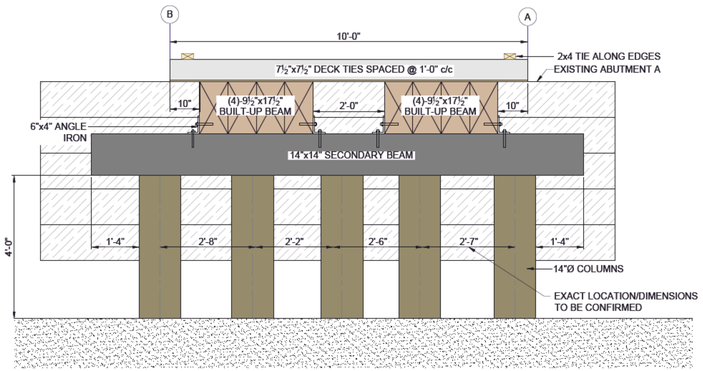

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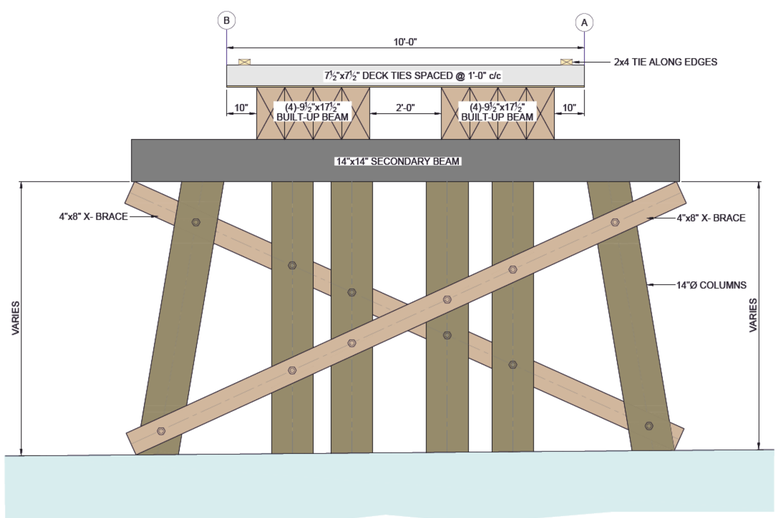

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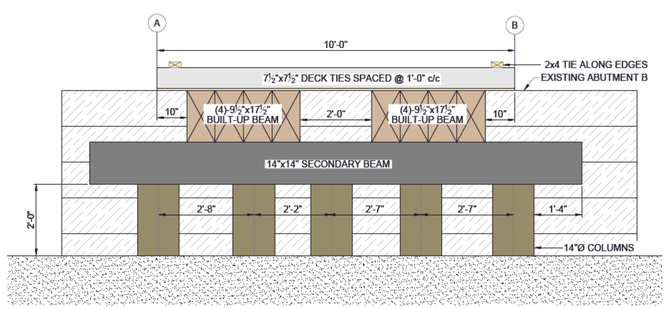

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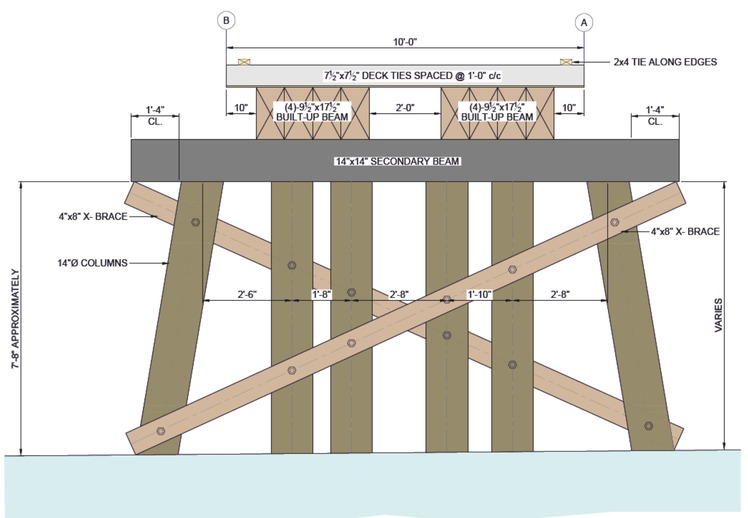

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CONSULTANTS

No.	Revision(s) Date	Description
A	2020-08-31	AS-BUILT BRIDGE DRAWINGS

PROJECT
CSRD-RAIL TRAIL
FARMER FIELD

KM 40

DRAWING
AS-BUILT FRAMING PLAN, SIDE ELEVATION AND SECTIONS

SEAL

No SEAL REQUIRED

FILE	19-383
DATE	August 31, 2020
SCALE	AS SHOWN
DRFT.	C.N.
DESIGN	

SHEET NUMBER A2.1

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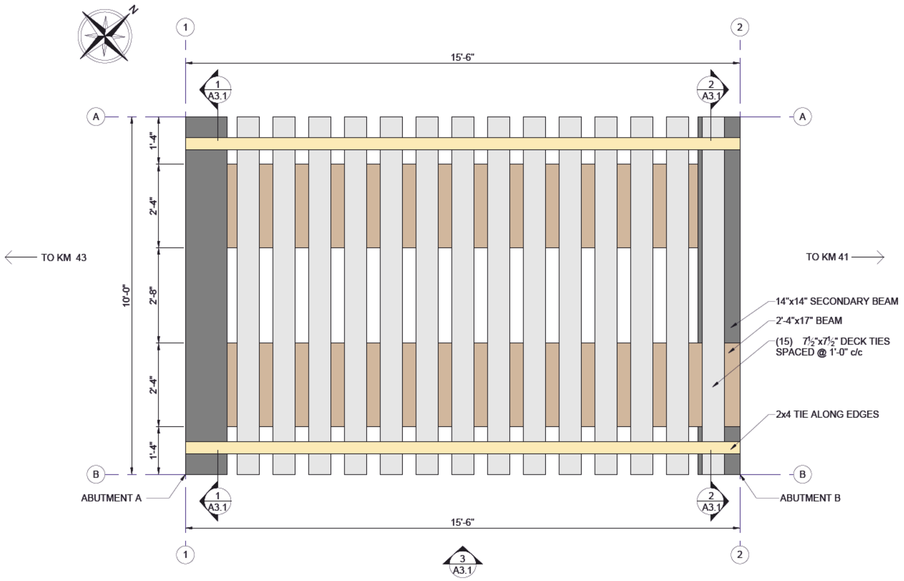

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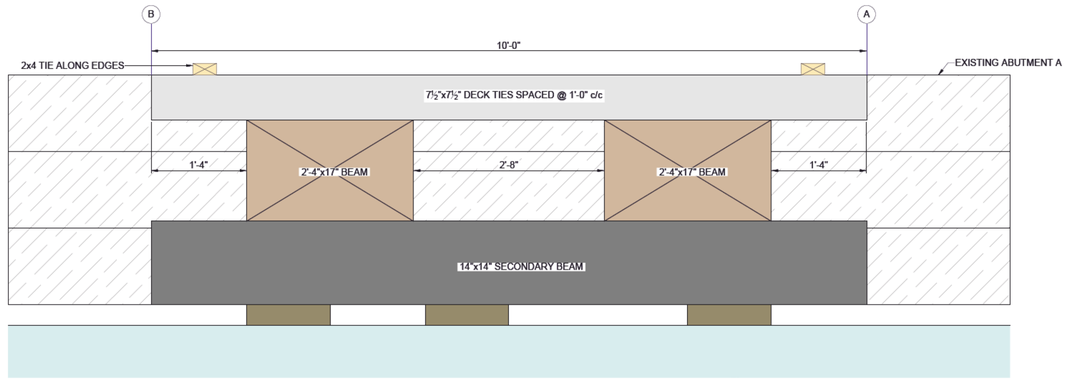

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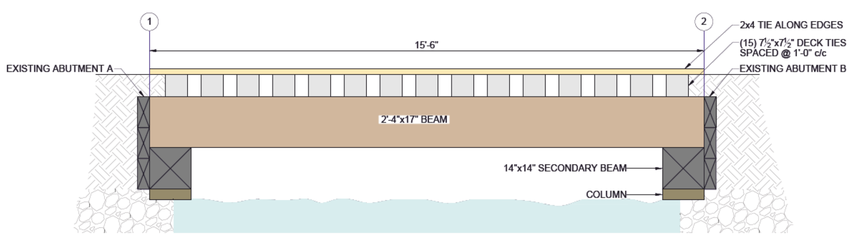

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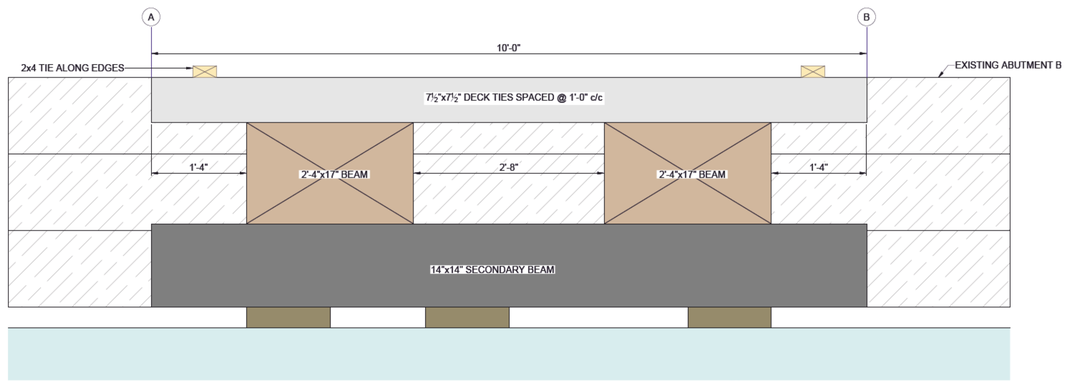

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CONSULTANTS

No.	Revision(s) Date	Description
A	2020-08-31	AS-BUILT BRIDGE DRAWINGS

PROJECT
CSRD-RAIL TRAIL
STEPNEY XING

KM 42

DRAWING
AS-BUILT FRAMING PLAN, ELEVATION AND SECTIONS

SEAL

No SEAL REQUIRED

FILE 19-383
DATE August 31, 2020
SCALE AS SHOWN
DRFT. C.N.
DESIGN

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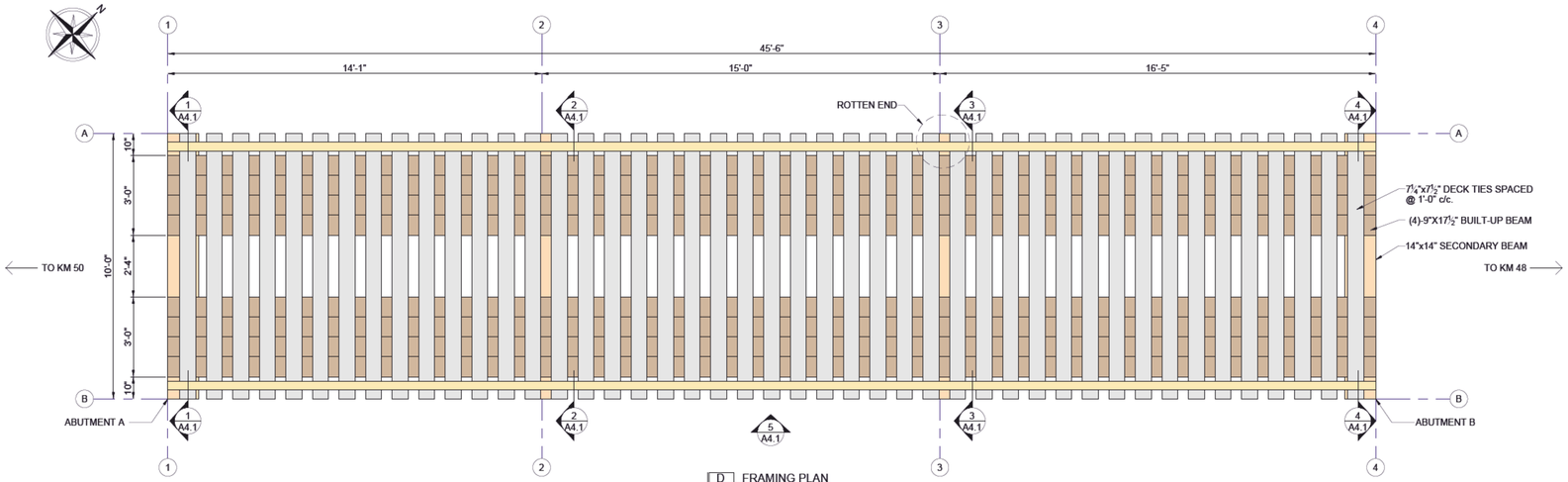

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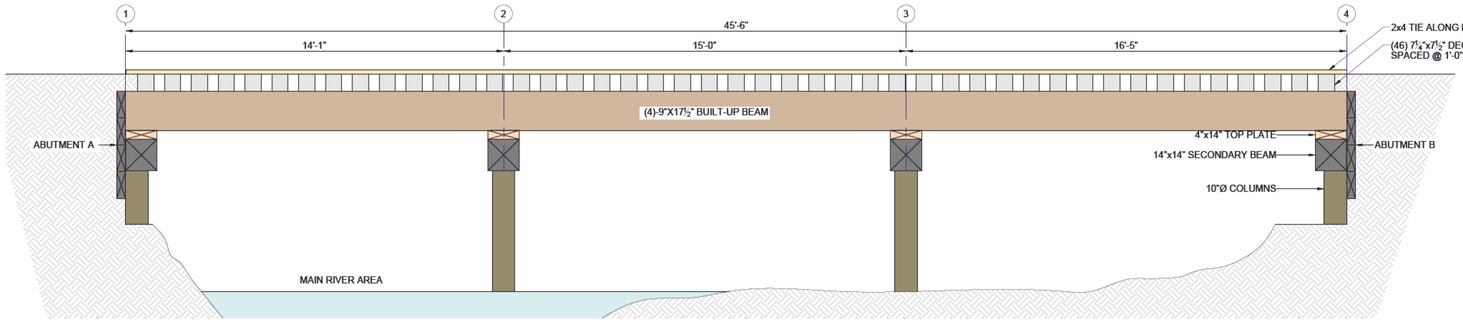

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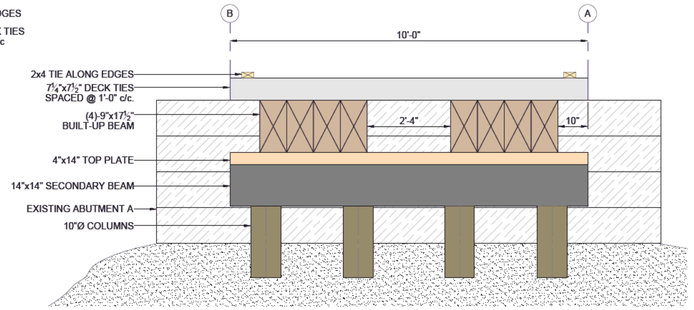

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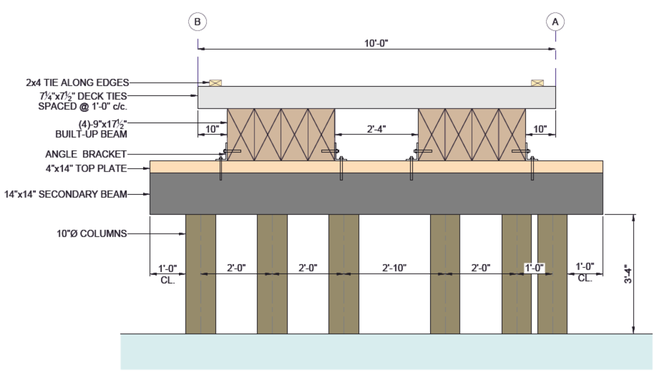

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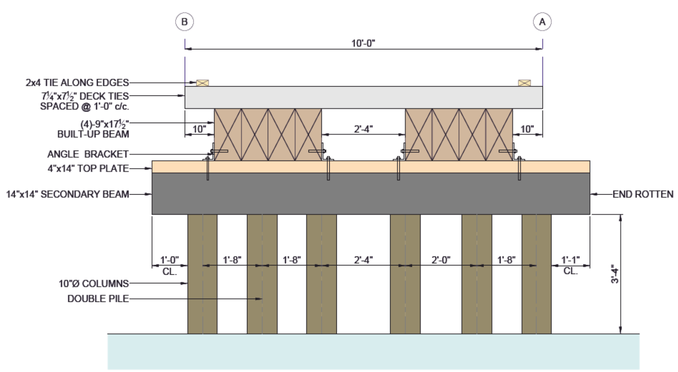
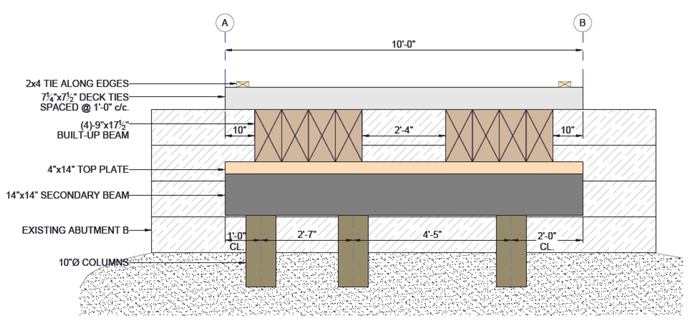
Scale: 1/2"=1'-0"



3 A4.1 SECTION
Scale: 1/2"=1'-0"



4 A4.1 SECTION
Scale: 1/2"=1'-0"

TYPICAL ANGLE IRON PLATE CONNECTIONS

BOURCET ENGINEERING

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CONSULTANTS

No.	Revision(s)	Date	Description
A		2020-08-31	AS-BUILT BRIDGE DRAWINGS

PROJECT
CSRD-RAIL TRAIL
FORTUNE CREEK

KM 49

DRAWING
AS-BUILT FRAMING PLAN, SIDE ELEVATION AND SECTIONS

SEAL

No SEAL REQUIRED

FILE	19-383
DATE	August 31, 2020
SCALE	AS SHOWN
DRFT.	C.N.
DESIGN	

SHEET NUMBER	REV
A4.1	A

DRAWINGS TO BE PRINTED IN COLOUR AND ON 24x36 SHEET SIZE MIN. FOR PROPER REPRESENTATION

GENERAL NOTES

These documents are to represent the structural design only. It is not the engineers responsibility to determine any locations on site. It is the sole responsibility of the legal land surveyor. Any reference to lot line are for display purposes only. It is the owners sole responsibility to confirm appropriate setbacks, or to confirm whether there is a statutory building scheme or other change on title to the land that in any way restrict construction on, or use of the lands.

These drawings are to be held to determine the general character and quality of work, as well as details of the same. Parts not detailed shall be constructed in accordance with the best practice of work of this class, so as to afford the required strength and quality of the design to logically complete the parts they compose.

All necessary fire, theft and liability insurance (including W.C.B.) shall be provided by the contractor, and shall be accounted for.

Give 48 hours notice to the Project Engineer for all required inspections:

1. Completion of foundation excavation.
2. Completion of framing.

The Contractor shall be responsible for obtaining all required permits for construction.

Quality of construction and materials used shall generally conform to the British Columbia Building Code, latest edition, or the requirements of the local authorities having jurisdiction, or as otherwise shown on the drawings, whichever is most restrictive.

Check all notes and dimensions on site before commencing any work. Any conflict in dimensioning between notes, or in the requirements of the local authorities having jurisdiction, or as otherwise shown on the drawings, whichever is most restrictive.

Locate all service runs, connections and install to suit the requirements of the authorities having jurisdiction.

Where any doubt exists as to the extent or intent of the work, the Contractor shall seek clarification from the Owner or Project Engineer.

Sealed shop drawings and a schedule S-B are to be submitted to the Engineer for the following (contact Bourcet Engineering prior to commencing for details and specifications):

1. Glue laminated structural units.
2. Structural composite lumber products.

The Contractor shall submit to the Engineer shop drawings for review prior to fabrication. When submitting shop drawings, the Contractor shall notify the Engineer in writing of changes made therein from the Contract Drawings or Specifications. The Contractor shall make any changes in the shop drawings which the Engineer may require, consistent with the contract and shall submit the revised prints to the Engineer for review.

The Engineer's review of such drawings or the revised drawings shall not relieve the Contractor from responsibility for errors made by the Contractor therein, or for changes made from the Contract Drawings or Specifications not covered by the Contractor's written notifications to the Engineer.

Review shall not be construed as relieving the Contractor from responsibility for the completeness and accuracy of work and its conformity with plans and specifications.

Allow a minimum of 5 working days for review of each submission of shop drawings. Allow more time when large quantities of shop drawings are submitted. Submit in general conformity with the sequence of construction intended. Coordinate with the consultant. Shop drawings received on non-buisness days or after noon will be date stamped the following day.

If required, CAD files of the full set of Structural Drawings are available "AS-IS" for use in the preparation of shop drawings provided that the owner and the owner's consulted (including Bourcet Engineering) are not held responsible for any errors or omissions on the drawings. These CAD drawings are not to be scaled.

The Engineer reserves the right to reject any materials which, in his opinion, are defective, faulty, or in any way do not conform to the drawings or specifications. The Contractor must bear the full cost of replacing such defective materials without an extra charge.

DESIGN LOADS

MARA

1. Ground snow load :	84 psf
2. Floor live load:	100 psf
3. Floor dead load:	25 psf

CSA-S6-14 BIKE BARRIER LOADS: 1.2 KN/m LATERALLY AND VERTICALLY SIMULTANEOUSLY

REFERENCE STANDARDS

British Columbia Building Code, 2018 and documents designated in table 1.3.1.2. therein.

HILTI CONCRETE ANCHORS

Predrilled adhesive anchors are Hilti Products. Anchors shall be installed according to manufacturer's instructions. Obtain on site training of installers by HILTI Representative prior to installation. Obtain training card or letter from HILTI.

HILTI Epoxies to be used as follows:

1. HY-200 max: Clean, dry, match tolerance hole diameter, and hammer drill hole.
2. RE-500: Clean, dry/wet, oversized, diamond core or hammer drilled holes and underwater applications.
3. HIT HY-70: To be used in masonry. Check HILTI Technical Guide for load capacities. In cases where HILTI does not provide load capacity such as unknown materials, site testing is required to confirm load capacity.
4. All holes to be blown out with air gun and brushed prior to injecting epoxy. Follow Manufacturer's hole cleaning requirements / procedures.

Threaded rods to be HILTI HAS Rods as below, see drawing details for selected rods:

1. HILTI HAS E Standard (ISO 898 Class 5.8)
2. HILTI HAS Super (ASTM 193 B7)
3. HILTI SS (AISI 304/316 SS)
4. HILTI HIT-TZ Rods & HILTI TZ Rods+HY-200 max can be used in un-cleaned holes.

Alternate Rods such as all threaded rods may be acceptable, if they meet the following HILTI Requirements:

1. Rods shall be free of oil and grease. Clean rods should be stored indoors or in sealed containers.
2. Rods shall be galvanized according to ASTM B633, including cut ends. Rod ends must be coated in the same manner as the shaft. Spray paint rust inhibitors are not acceptable.
3. Rods shall meet minimum mechanical / chemical requirements as Hilti Rods.
4. SS nuts should have threads coated with wax to prevent gailing (bonding between rods and nuts).

Injection of adhesives shall be performed in accordance with manufacturer's instructions that accompany the product to produce an air-void free injection. Use HILTI PROFI KIT for proper hole preparation.

Drill shall be performed with a rotary hammer drill and carbide tipped drill bit in accordance with instructions accompanying adhesive cartridges.

Alternate drilling methods, such as diamond coring, must be approved by the Engineer of Record.

Special Conditions, such as water saturated concrete, water filled holes, underwater and overhead installation must be approved by the Engineer of Record.

Overhead anchors must be installed using the HILTI PROFI Accessories to ensure correct adhesive injection.

Anchor capacity used in design is based on the guidelines published by HILTI. Alternative Fastening Systems proposed by the Contractor shall be submitted to the Structural Engineer for review and approval. Manufacturer's published data, including load resistance's, in-service & installation temperature, creep testing, freeze/thaw testing, comprehensive installation instructions and availability for onsite training must be included in proposal.

The Contractor shall retain a HILTI Representative to provide on site anchor installation training for all the HILTI products specified. The Structural Engineer of Record must receive documented confirmation that Contractor's personnel are trained prior to commencement of installation of the anchors.

ROUGH CARPENTRY

All lumber grades shall be in accordance with the National Lumber Grading Authority (NLGA Canada) and shall conform to CSA 0141-05 for Softwood Lumber, Min grade No. 1 or 2 SPF, Lumber shall be dry with maximum moisture content of 12%. Identify lumber by official grade mark to show symbol of grading agency, mill number/name, grade, species, species grouping or combination designation, rules of grading & extent of seasoning at manufacture.

Plywood products shall conform to CSA 0121-08 for Douglas Fir Plywood and CSA 0151-00 for Western Softwood Plywood.

Wood in contact with concrete or masonry to be pressure treated. If below grade, separate from concrete and block with moisture barrier.

Cuts in structural members shall be approved by the Engineer prior to commencement.

Notching and drilling of framing members to conform to BC Building Code dated 2018 Subsection 9.23.5 and as follows:

- Holes to be no less than 4Ø c/c apart
- Centre holes in studs
- Where load-bearing studs are notched, reinforced by nailing one additional stud beside each stud that has been notched.

TIMBER FASTENERS

The contractor is responsible for sourcing an affordable fastener that meets the strength and finishing requirements of the project.

The contractor shall submit their proposed fasteners specifications for review by the Structural Engineer, prior to proceeding with purchase.

Unless otherwise noted, the following **partially threaded** self-tapping screws are acceptable:

1. SFS Intec - WFC, WFR, and WFD
2. GRK Fasteners - R4 , and RSS
3. HECO - TOPIX
4. SWG (Wurth) - ASSY SK, ASSY SK Ecofast, and ASSY KOMBI

Unless otherwise noted, the following **fully threaded** self-tapping screws are acceptable:

1. SFS Intec - WT
2. HECO - TOPIX-CC, and TOPIX-T
3. SWG (Wurth) - ASSY plus VG

When used in combination with architecturally exposed steel plates, screws shall have a tapered screw head unless noted otherwise. Steel should be countersunk to receive tapered screw heads. Holes are not to be oversized.

When used in combination with steel plates not exposed to sight, screws with a hex head should be used for faster installation, unless noted otherwise.

Review manufacturer's specifications and recommendations for installation information.

All fasteners to be clearly identified on shop drawings.

U.N.O, Timber frame nailing shall conform to Part 9 of the BC Building Code dated 2018.

TEMPORARY BRACING AND SHORING

Make adequate provisions for all loads acting on the structure during erection. Provide temporary shoring and bracing to keep the structure plumb and in true alignment during construction.

Temporary bracing and shoring are the responsibility of the contractor. All shoring shall be designed by a professional engineer retained by the contractor. Prepare shoring drawings signed and sealed by the Engineer; said Engineer is also responsible for field reviews of shoring.

COMPOSITE STRUCTURAL LUMBER

These products shall be designed and manufactured to the standards set forth in the applicable National Evaluation Service, Inc. (NES) Report or CCMC Report.

When requested, a complete set of design calculations shall be prepared by the manufacturer under the supervision of a Registered Professional Engineer.

The products shall be manufactured in a plant approved for fabrication by the third party inspection agency.

The products shall be identified by a stamp indicating the product type, grade, NES Report or CCMC Report number, manufacturer's name, plant number, and the independent inspection agency's logo.

All hardware is to be supplied by the beam supplier in accordance with details contained in the contract drawings.

All manufactured beams are to be minimum 2.0E 2,950 Fb, unless noted otherwise.

Up to 3-ply LVL / LSL / VSL / PSL built-up beams may be nailed with two rows of 3½" common nails at 0'-10"o.c., or bolted with 2-rows of ½"Ø bolts at 2'-0"o.c. max. All built-up beams 4-ply or greater must be bolted with 2-rows of ½"Ø at 1'-4"o.c. max.

GLUE LAMINATED STRUCTURAL UNITS

Verify location of all site concrete, structural steel, masonry and timber that glue laminated members will attach to or align with and ensure that site work is at proper elevation and location. Advise the Engineer, in writing, all discrepancies between measurements taken and those shown on the drawings, prior to commencement of the work.

Fabrication of glue laminated members shall be restricted to a fabricator qualified under CSA 0177-06.

After installation, advise the Engineer to permit inspections. Any modifications or repairs deemed by the Engineer to be necessary due to faulty handling or installation shall be made by the Contractor at his own expense.

The Engineer may if desired, require physical tests made on the test specimens for materials used. Test and test specimens are to conform to CSA specifications. Mill test certificates may be accepted at the option of the Engineer.

All glue laminated members shall be manufactured in accordance with CSA 0122-06. Moisture content of members at time of manufacture shall not exceed 10%.

Where indicated on the plans, holes, cutting, etc. shall be provided for installation of the work of other trades requiring the same. No additional holes or cutting other than shown on the drawings shall be done without the permission or approval of the Engineer.

Materials: Unless noted otherwise, provide:

1. All laminated wood stock shall be Douglas Fir coast region and graded in accordance with CSA 086.1-09.
   Beams:
   0.01 Stress Grade — 24f-E, 24f-Ex (where noted)
   0.02 Service Grade — Interior, Exterior
   0.03 Appearance Grade — Industrial, Paint
2. Glue used to bond laminations shall be water-resistant type with a mold inhibiting additive meeting CSA 0122-06.
3. All glue laminated members shall be sealed with 3-coatsTimberlox 4435 end sealer & 2-coats Timber lox 403 side sealer applied in the shop prior to shipment. seal all cut, notches, slots, ect.

REQUIRED FIELD REVIEW LIST:

CONTACT BOURCET ENGINEERING PRIOR TO ALL INSPECTIONS WITH A MINIMUM OF 48 HOURS NOTICE

DO NOT COVER STRUCTURAL COMPONENTS PRIOR TO INSPECTIONS.

I. FRAMING

II. ABUTMENT

III. ROUGH CARPENTRY/ENGINEERED FLOOR SYSTEM

STRUCTURAL DRAWING LIST

ITEMS NOT SPECIFICALLY DETAILED AND DIMENSIONED ON THESE DRAWINGS ARE TO CONFORM TO PART 9 BCBC 2018 AND ARE OUTSIDE OF BOURCET ENGINEERING'S SCOPE

BOURCET ENGINEERING

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CONSULTANTS

No.	Revision(s) Date	Description
A	2021-04-27	Issued for Review
B	2021-05-03	Issued for Review
0	2021-05-19	ISSUED FOR CONSTRUCTION

PROJECT
CSRD-RAIL TRAIL

DRAWING
STRUCTURAL SPECIFICATIONS

SEAL

June 11 2021

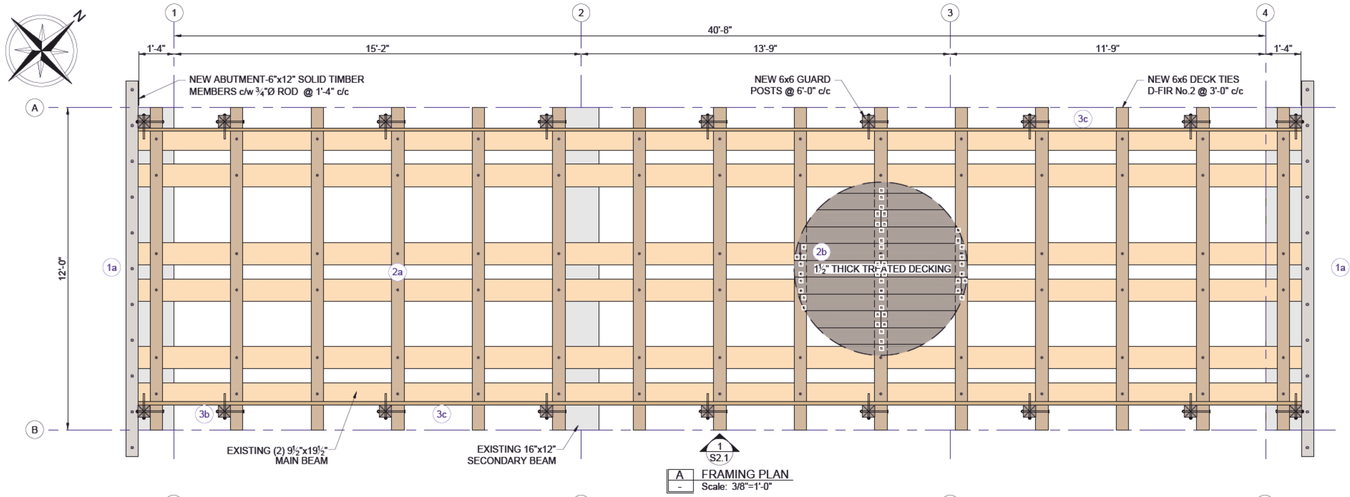
FILE	19-383
DATE	May 20, 2021
SCALE	N/R
DRFT.	C. Neufeld
DESIGN	A. CREIGHTON, P. ENG.

SHEET NUMBER S1.1

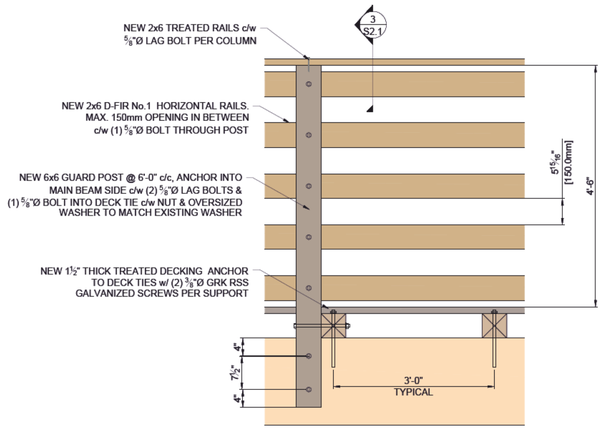
1 of 5

REV 0

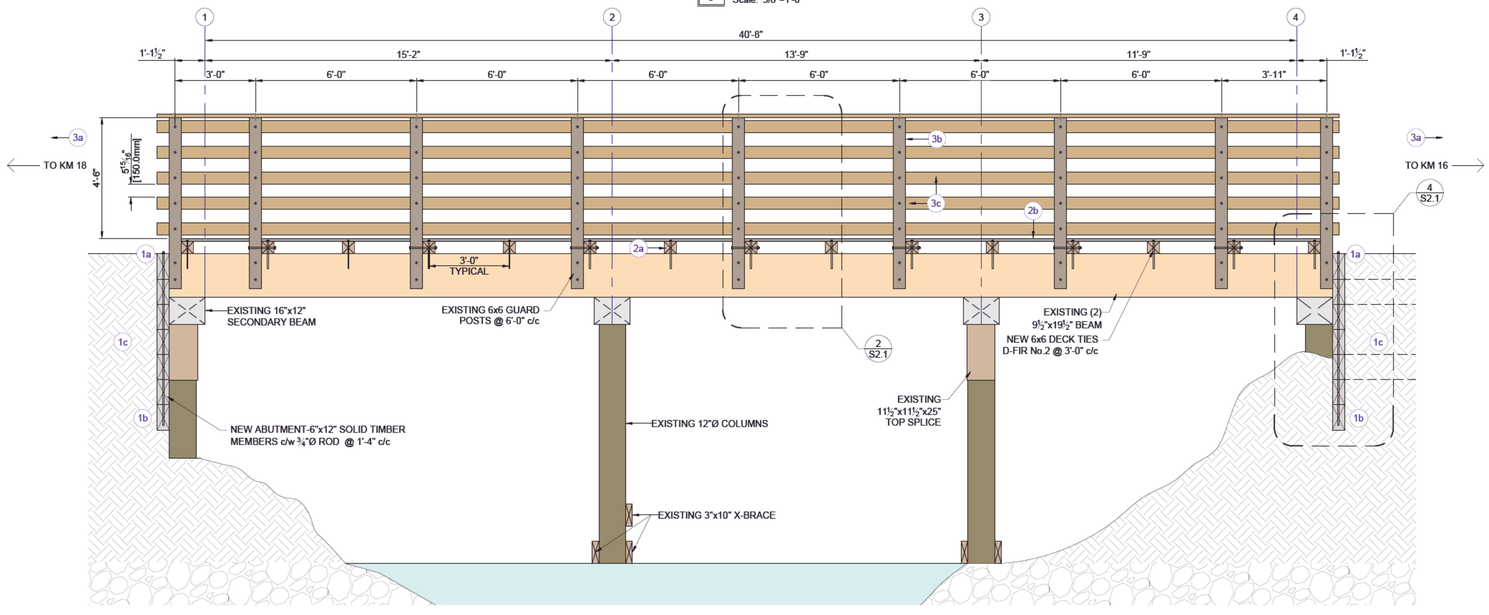
DRAWINGS TO BE PRINTED IN COLOUR AND ON 24x36 SHEET SIZE MIN. FOR PROPER REPRESENTATION



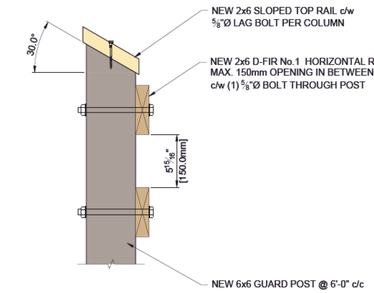
A FRAMING PLAN
Scale: 3/8"=1'-0"



2 S2.1 GUARD POST CONNECTION DETAIL
Scale: 3/4"=1'-0"



1 S2.1 FRAMING ELEVATION
Scale: 3/8"=1'-0"



3 S2.1 SLOPED TOP RAIL DETAIL
Scale: 1-1/2"=1'-0"

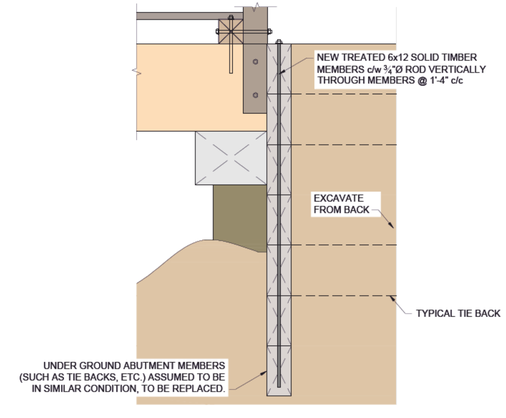
RECOMMENDATION/REPLACEMENT AND SAFETY UPGRADES :

1. ABUTMENT REPLACEMENT
   a. NEW TREATED 6x12 SOLID TIMBER MEMBERS c/w ¾"Ø ROD VERTICALLY THROUGH MEMBERS @ 1'-4" c/c.
   b. UNDER GROUND ABUTMENT MEMBERS (SUCH AS TIE BACKS, ETC.) ASSUMED TO BE IN SIMILAR CONDITION, TO BE REPLACED.
   c. IDEALLY EXCAVATE FROM BACK.

2. BRIDGE DECK TIES
   a. NEW 6x6 D-FIR No.2 or BETTER TREATED TIES @ 3'-0" c/c.
      c/w (1) ⅜"Ø GRK RSS GALVANIZED STRUCTURAL SCREW PER BEAM. MAXIMUM OF (6) PER TIE.
   b. NEW 1½" THICK TREATED DECKING ANCHOR TO DECK TIES w/ (2) ⅜"Ø GRK RSS GALVANIZED SCREWS PER SUPPORT.
   c. DECK SURFACE FINISH TO BE CONFIRMED BY CSRD & STR.

3. GUARD POSTS
   a. BOTH SIDES NO PROJECTION PAST BRIDGE ENDS (RETURNS/BANK GUARDS BY OTHERS, IF REQUIRED).
   b. NEW 6x6 POST x 4'-6" HIGH OFF BRIDGE DECK @ 6'-0" c/c, COLUMNS ANCHOR INTO MAIN BEAM SIDE c/w (2) ⅝"Ø LAG BOLTS & (1) ⅝"Ø BOLT INTO DECK TIE.
   c. ALL CONNECTIONS c/w NUT AND OVERSIZED WASHER TO MATCH EXISTING.
   d. 2x6 D-FIR No.1 HORIZONTAL RAILS. MAX. 150mm OPENING IN BETWEEN c/w (1) ⅝"Ø BOLT THROUGH POST.
   e. TOP RAIL SLOPED AS PER DETAIL.

4. MOLD & MILDEW
   a. ENSURE NO MOL/MILDEW PRESENT. IF NOTICED, REMEDIATE OFF MEMBER SURFACES.



4 S2.1 TYPICAL ABUTMENT DETAIL
Scale: 3/4"=1'-0"

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CONSULTANTS

No.	Revision(s) Date	Description
A	2021-04-27	Issued for Review
B	2021-05-03	Issued for Review
0	2021-05-19	ISSUED FOR CONSTRUCTION

PROJECT
CSRD-RAIL TRAIL
ROSEMOND LAKE

KM 17

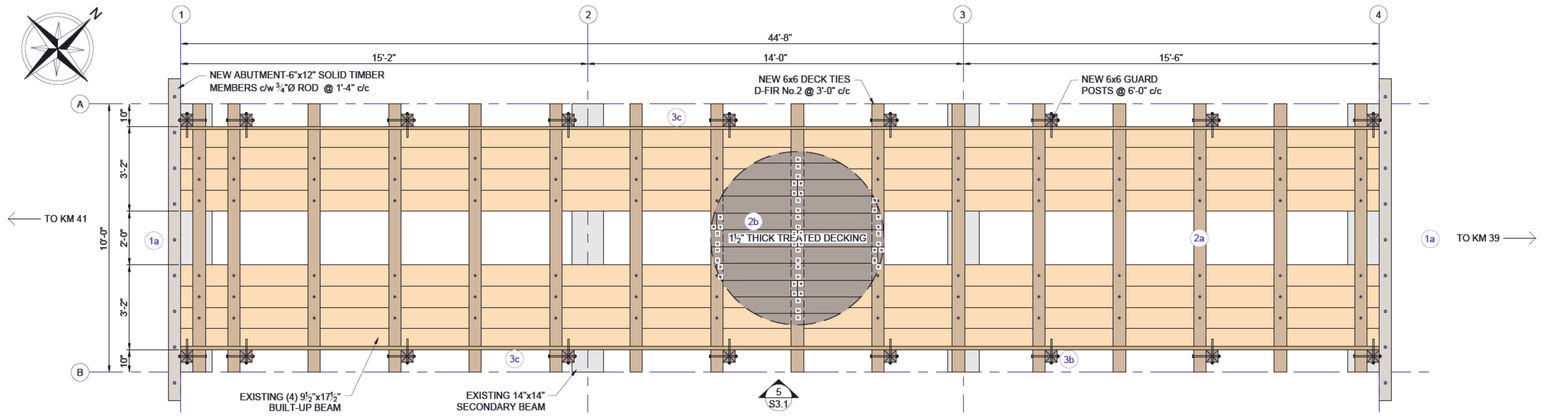
DRAWING
FRAMING PLAN, FRAMING ELEVATION AND CONN. DETAILS

SEAL
June 11 2021

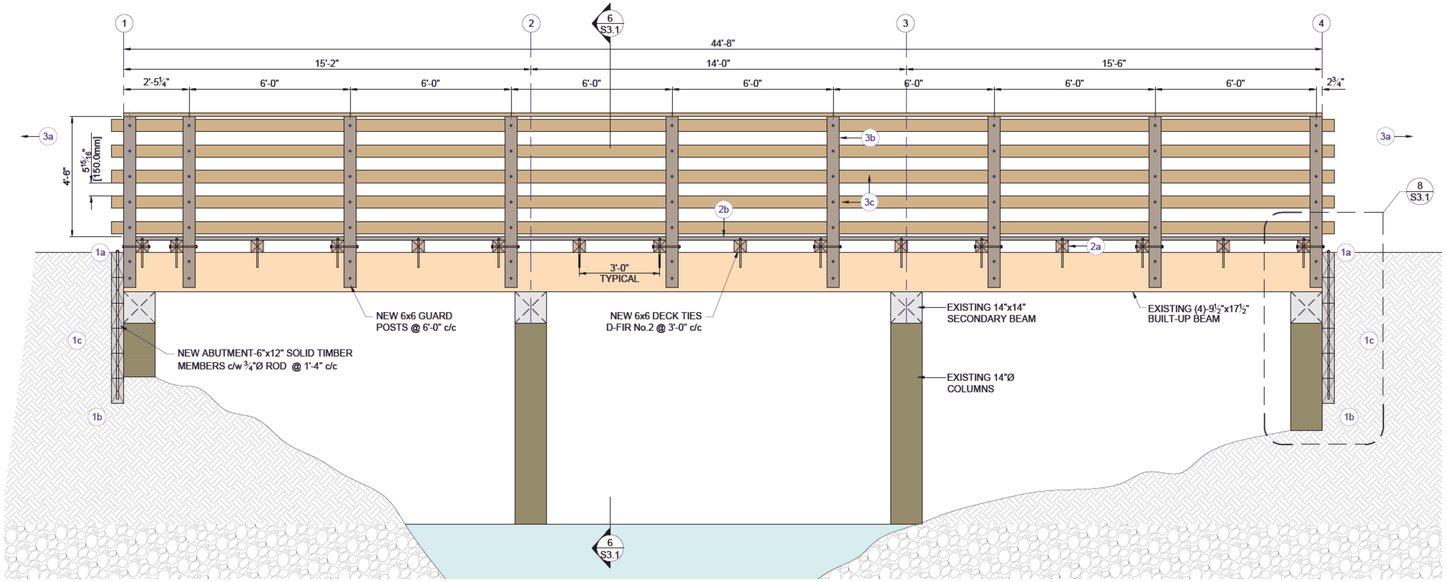
FILE	19-383
DATE	May 20, 2021
SCALE	AS SHOWN
DRFT.	C. Neufeld
DESIGN	A. CREIGHTON, P. ENG.

SHEET NUMBER S2.1
REV 0
2 of 5

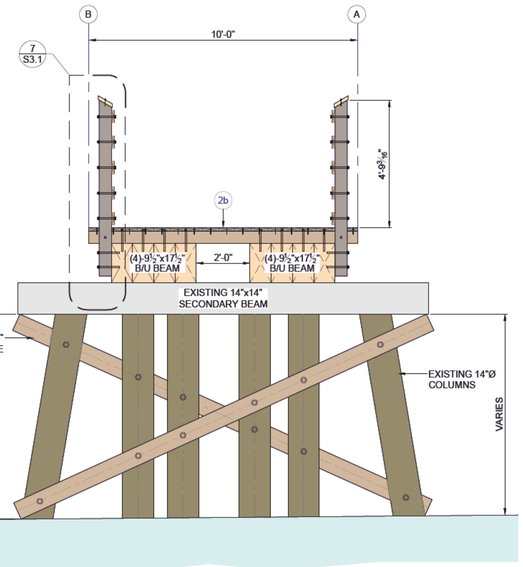
DRAWINGS TO BE PRINTED IN COLOUR AND ON 24x36 SHEET SIZE MIN. FOR PROPER REPRESENTATION



B FRAMING PLAN
Scale: 3/8"=1'-0"



5 S3.1 FRAMING ELEVATION
Scale: 3/8"=1'-0"



6 S3.1 FRAMING SECTION
Scale: 3/8"=1'-0"

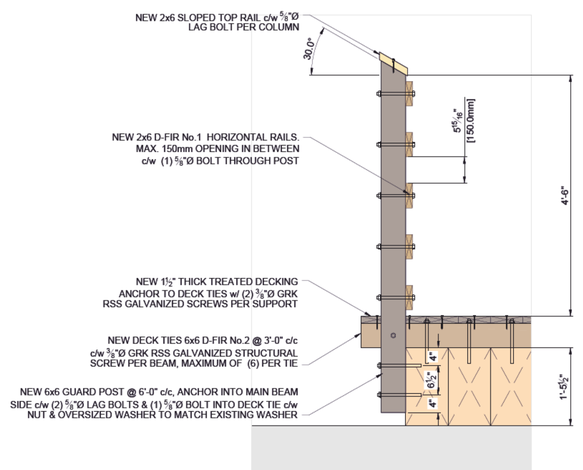
RECOMMENDATION/REPLACEMENT AND SAFETY UPGRADES :

1 ABUTMENT REPLACEMENT
- a. NEW TREATED 6x12 SOLID TIMBER MEMBERS c/w ¾"Ø ROD VERTICALLY THROUGH MEMBERS @ 1'-4" c/c.
- b. UNDER GROUND ABUTMENT MEMBERS (SUCH AS TIE BACKS, ETC.) ASSUMED TO BE IN SIMILAR CONDITION, TO BE REPLACED.
- c. IDEALLY EXCAVATE FROM BACK.

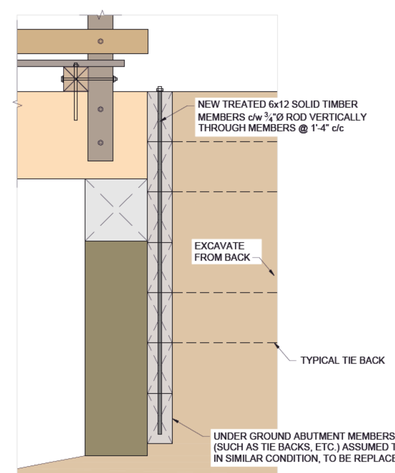
2 BRIDGE DECK TIES
- a. NEW 6x6 D-FIR No.2 or BETTER TREATED TIES @ 3'-0" c/c. c/w (1) ⅜"Ø GRK RSS GALVANIZED STRUCTURAL SCREW PER BEAM. MAXIMUM OF (6) PER TIE.
- b. NEW 1½" THICK TREATED DECKING ANCHOR TO DECK TIES w/ (2) ⅜"Ø GRK RSS GALVANIZED SCREWS PER SUPPORT.
- c. DECK SURFACE FINISH TO BE CONFIRMED BY CSRD & STR.

3 GUARD POSTS
- a. BOTH SIDES NO PROJECTION PAST BRIDGE ENDS (RETURNS/BANK GUARDS BY OTHERS, IF REQUIRED).
- b. NEW 6x6 POST x 4'-6" HIGH OFF BRIDGE DECK @ 6'-0" c/c, COLUMNS ANCHOR INTO MAIN BEAM SIDE c/w (2) ⅝"Ø LAG BOLTS & (1) ⅝"Ø BOLT INTO DECK TIE.
- c. ALL CONNECTIONS c/w NUT AND OVERSIZED WASHER TO MATCH EXISTING.
- d. 2x6 D-FIR No.1 HORIZONTAL RAILS. MAX. 150mm OPENING IN BETWEEN c/w (1) ⅝"Ø BOLT THROUGH POST.
- e. TOP RAIL SLOPED AS PER DETAIL.

4 MOLD & MILDEW
- a. ENSURE NO MOL/MILDEW PRESENT. IF NOTICED, REMEDIATE OFF MEMBER SURFACES.



7 S3.1 GUARD POST CONNECTION DETAIL
Scale: 3/4"=1'-0"



8 S3.1 TYPICAL ABUTMENT DETAIL
Scale: 3/4"=1'-0"

DRAWINGS TO BE PRINTED IN COLOUR AND ON 24x36 SHEET SIZE MIN. FOR PROPER REPRESENTATION

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CONSULTANTS

No.	Revision(s) Date	Description
A	2021-04-27	Issued for Review
B	2021-05-03	Issued for Review
0	2021-05-19	ISSUED FOR CONSTRUCTION

PROJECT
CSRD-RAIL TRAIL
FARMER FIELD

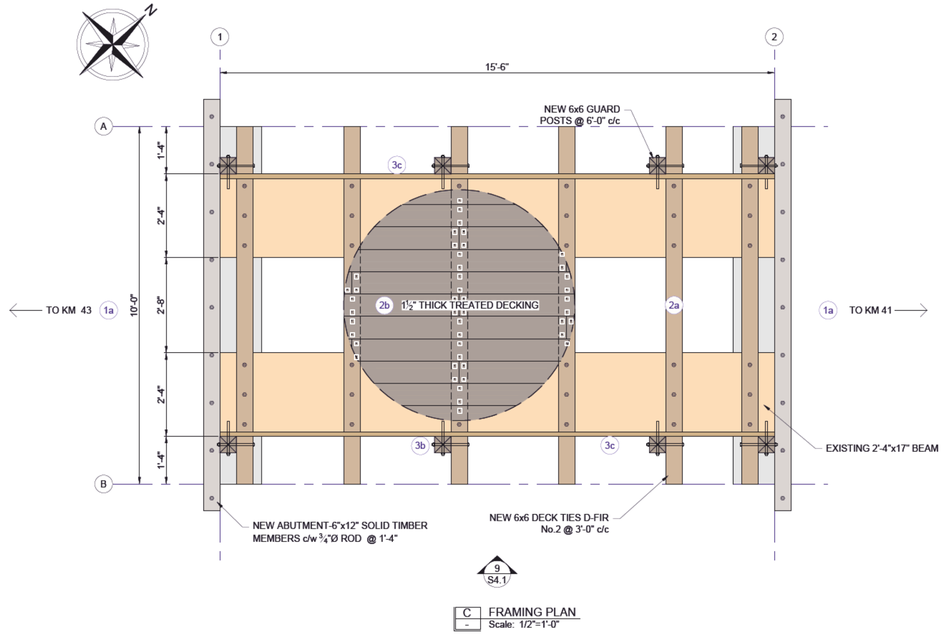
KM 40

DRAWING
FRAMING PLAN, FRAMING ELEVATION, FRAMING SECTIONS AND CONN. DETAILS

SEAL
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA
June 11 2021

FILE	19-383
DATE	May 20, 2021
SCALE	AS SHOWN
DRFT.	C. Neufeld
DESIGN	A. CREIGHTON, P. ENG.

SHEET NUMBER S3.1
REV 0



C FRAMING PLAN
Scale: 1/2"=1'-0"

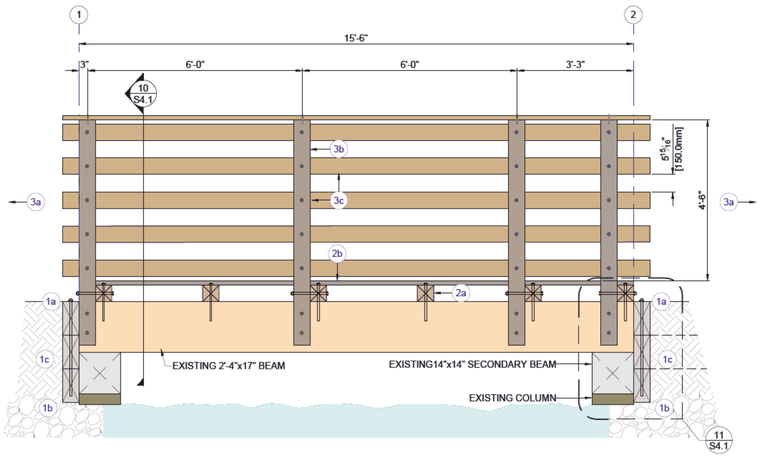
RECOMMENDATION/REPLACEMENT AND SAFETY UPGRADES :

1 ABUTMENT REPLACEMENT
- a. NEW TREATED 6x12 SOLID TIMBER MEMBERS c/w ¾"Ø ROD VERTICALLY THROUGH MEMBERS @ 1'-4" c/c.
- b. UNDER GROUND ABUTMENT MEMBERS (SUCH AS TIE BACKS, ETC.) ASSUMED TO BE IN SIMILAR CONDITION, TO BE REPLACED.
- c. IDEALLY EXCAVATE FROM BACK.

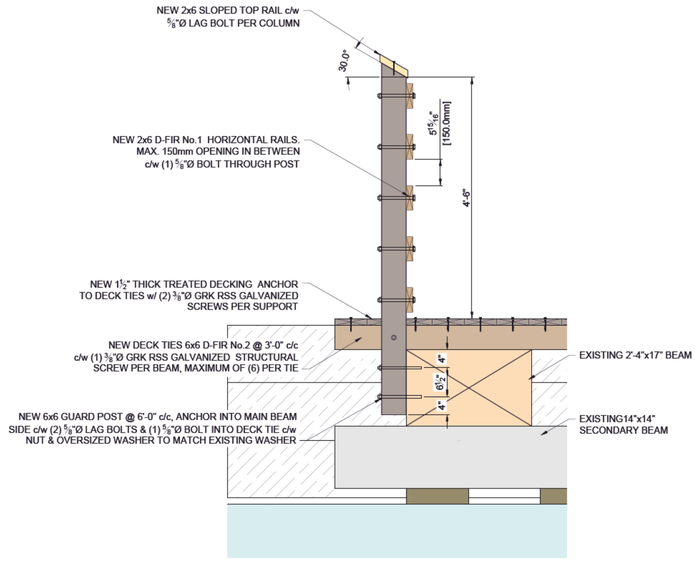
2 BRIDGE DECK TIES
- a. NEW 6x6 D-FIR No.2 or BETTER TREATED TIES @ 3'-0" c/c. c/w (1) ⅜"Ø GRK RSS GALVANIZED STRUCTURAL SCREW PER BEAM. MAXIMUM OF (6) PER TIE.
- b. NEW 1½" THICK TREATED DECKING ANCHOR TO DECK TIES w/ (2) ⅜"Ø GRK RSS GALVANIZED SCREWS PER SUPPORT.
- c. DECK SURFACE FINISH TO BE CONFIRMED BY CSRD & STR.

3 GUARD POSTS
- a. BOTH SIDES NO PROJECTION PAST BRIDGE ENDS (RETURNS/BANK GUARDS BY OTHERS, IF REQUIRED).
- b. NEW 6x6 POST x 4'-6" HIGH OFF BRIDGE DECK @ 6'-0" c/c, COLUMNS ANCHOR INTO MAIN BEAM SIDE c/w (2) ⅝"Ø LAG BOLTS & (1) ⅝"Ø BOLT INTO DECK TIE.
- c. ALL CONNECTIONS c/w NUT AND OVERSIZED WASHER TO MATCH EXISTING.
- d. 2x6 D-FIR No.1 HORIZONTAL RAILS. MAX. 150mm OPENING IN BETWEEN c/w (1) ⅝"Ø BOLT THROUGH POST.
- e. TOP RAIL SLOPED AS PER DETAIL.

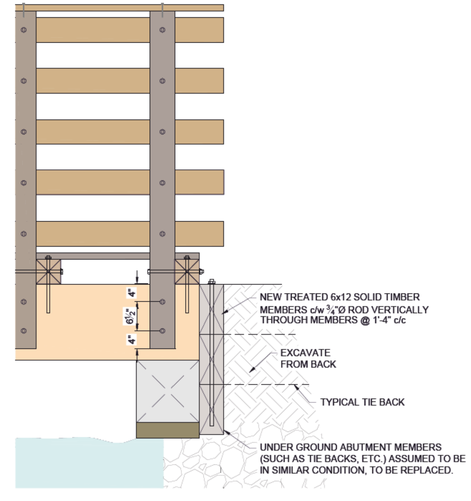
4 MOLD & MILDEW
- a. ENSURE NO MOL/MILDEW PRESENT. IF NOTICED, REMEDIATE OFF MEMBER SURFACES.



9 S4.1 FRAMING ELEVATION
Scale: 1/2"=1'-0"



10 S4.1 GUARD POST CONNECTION DETAIL
Scale: 3/4"=1'-0"



11 S4.1 TYPICAL ABUTMENT DETAIL
Scale: 3/4"=1'-0"

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CONSULTANTS

No.	Revision(s) Date	Description
A.	2021-04-27	Issued for Review
B.	2021-05-03	Issued for Review
0	2021-05-19	ISSUED FOR CONSTRUCTION

PROJECT
CSRD-RAIL TRAIL
STEPNEY XING

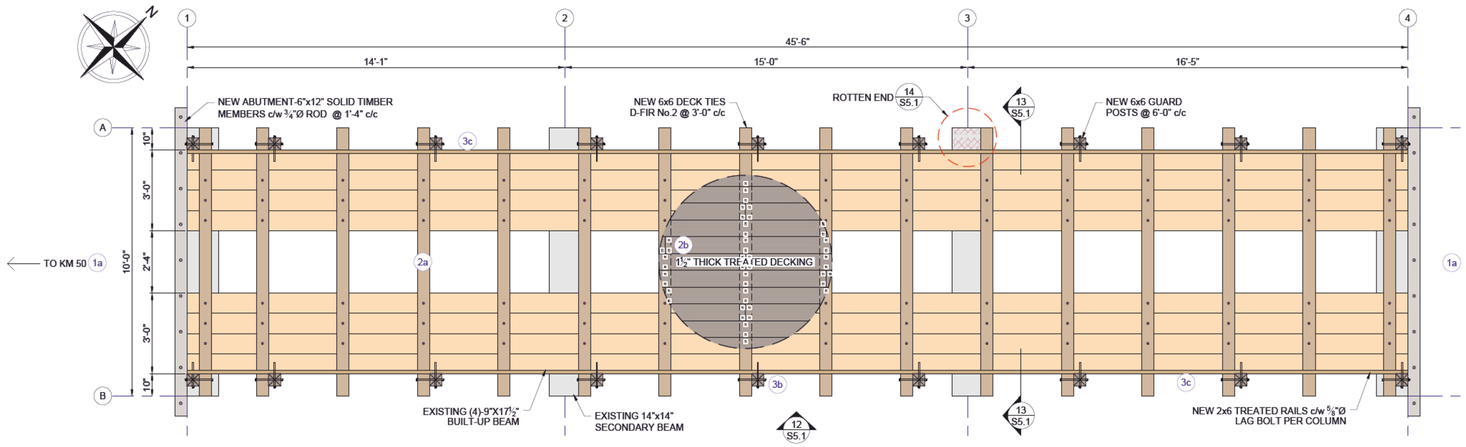
KM 42

DRAWING
FRAMING PLAN, FRAMING ELEVATION AND CONN. DETAILS

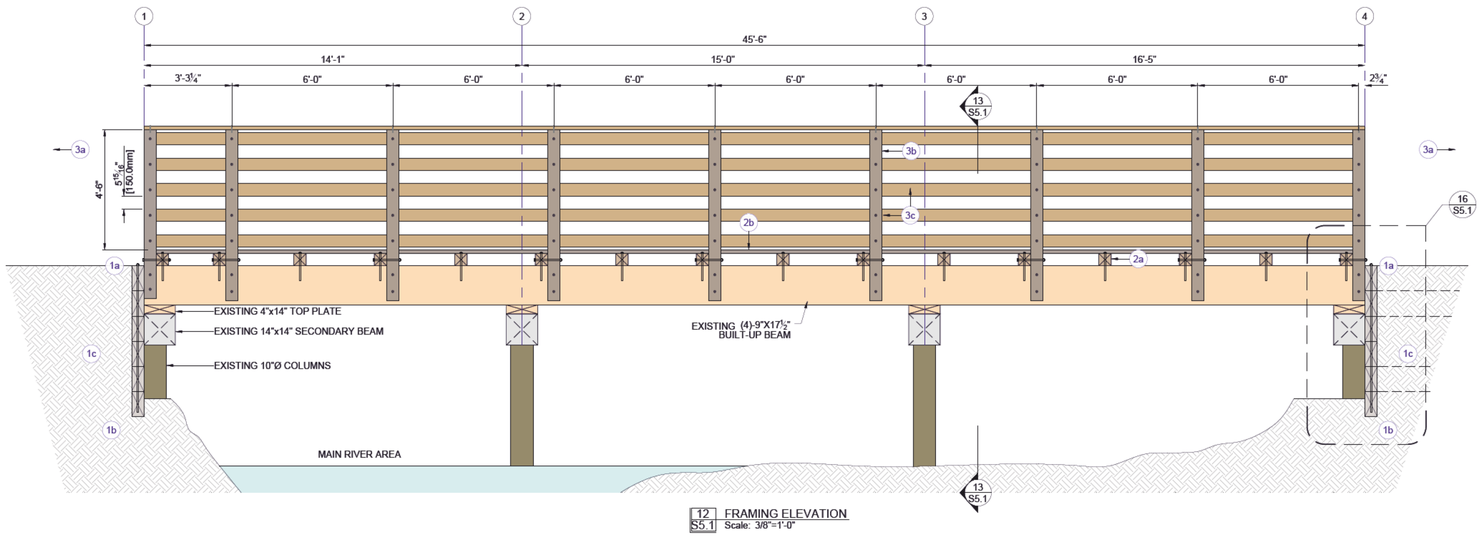
SEAL
June 11 2021

FILE	19-383
DATE	May 20, 2021
SCALE	AS SHOWN
DRFT.	C. Neufeld
DESIGN	A. CREIGHTON, P. ENG.

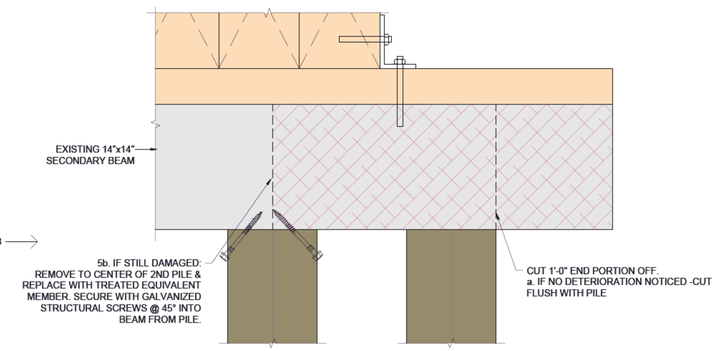
SHEET NUMBER S4.1
REV 0



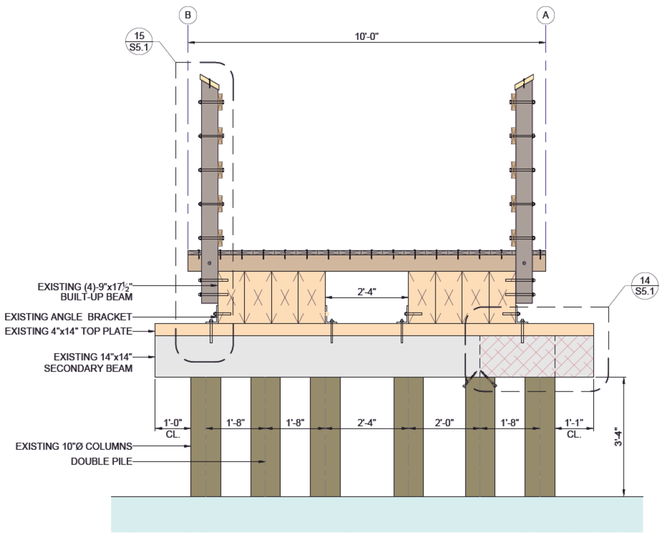
D FRAMING PLAN
Scale: 3/8"=1'-0"



12 S5.1 FRAMING ELEVATION
Scale: 3/8"=1'-0"



14 S5.1 BEAM REPAIR DETAIL
Scale: 1-1/2"=1'-0"



13 S5.1 FRAMING SECTION
Scale: 1/2"=1'-0"

RECOMMENDATION/REPLACEMENT AND SAFETY UPGRADES :

1 ABUTMENT REPLACEMENT
- a. NEW TREATED 6x12 SOLID TIMBER MEMBERS c/w ¾"Ø ROD VERTICALLY THROUGH MEMBERS @ 1'-4" c/c.
- b. UNDER GROUND ABUTMENT MEMBERS (SUCH AS TIE BACKS, ETC.) ASSUMED TO BE IN SIMILAR CONDITION, TO BE REPLACED.
- c. IDEALLY EXCAVATE FROM BACK.

2 BRIDGE DECK TIES
- a. NEW 6x6 D-FIR No.2 or BETTER TREATED TIES @ 3'-0" c/c. c/w (1) ⅜"Ø GRK RSS GALVANIZED STRUCTURAL SCREW PER BEAM. MAXIMUM OF (6) PER TIE.
- b. NEW 1½" THICK TREATED DECKING ANCHOR TO DECK TIES w/ (2) ⅜"Ø GRK RSS GALVANIZED SCREWS PER SUPPORT.
- c. DECK SURFACE FINISH TO BE CONFIRMED BY CSRD & STR.

3 GUARD POSTS
- a. BOTH SIDES NO PROJECTION PAST BRIDGE ENDS (RETURNS/BANK GUARDS BY OTHERS, IF REQUIRED).
- b. NEW 6x6 POST x 4'-6" HIGH OFF BRIDGE DECK @ 6'-0" c/c, COLUMNS ANCHOR INTO MAIN BEAM SIDE c/w (2) ⅝"Ø LAG BOLTS & (1) ⅝"Ø BOLT INTO DECK TIE.
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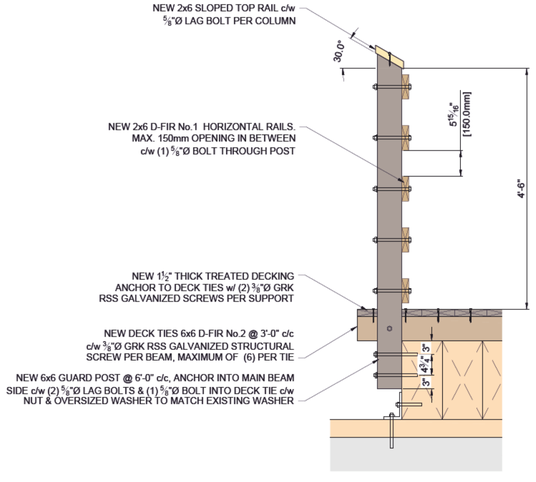
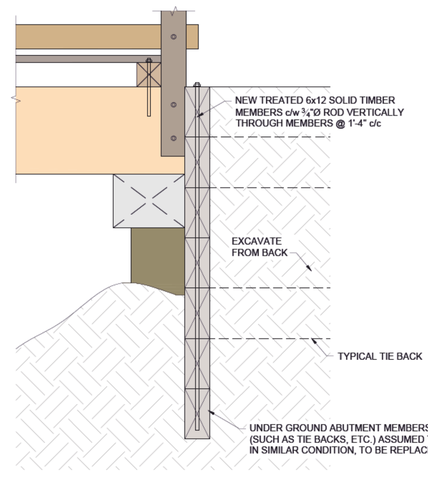
- e. TOP RAIL SLOPED AS PER DETAIL.

4 MOLD & MILDEW
- a. ENSURE NO MOL/MILDEW PRESENT. IF NOTICED, REMEDIATE OFF MEMBER SURFACES.

5 BEAM REPLACEMENT
TEMPORARY SUPPORT BRIDGE, CUT 1'-0" DAMAGED END PORTION OFF.
- a. IF NO DETERIORATION NOTICED- CUT FLUSH TO PILE LOCATION.
- b. IF DAMAGE STILL VISIBLE -REMOVE TO SECOND PILE & REPLACE WITH NEW EQUIVALENT TREATED MEMBER
- b. SECURE WITH GALVANIZED STRUCTURAL SCREWS @ 45° INTO BEAM FROM PILE.



15 S5.1 GUARD POST CONNECTION DETAIL
Scale: 3/4"=1'-0"



16 S5.1 TYPICAL ABUTMENT DETAIL
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FORTUNE CREEK

KM 49

DRAWING
FRAMING PLAN, FRAMING ELEVATION, FRAMING SECTION AND CONN. DETAILS

SEAL
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DATE	May 20, 2021
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DESIGN	A. CREIGHTON, P. ENG.

SHEET NUMBER S5.1
REV 0
5 of 5

DRAWINGS TO BE PRINTED IN COLOUR AND ON 24x36 SHEET SIZE MIN. FOR PROPER REPRESENTATION