Ventura County Transportation Commission (VCTC)

Santa Paula Branch Line (SPBL) Track Assessment Report

Introduction and Objectives

Wilson & Company completed a high-level track assessment of the Ventura County Transportation Commission (VCTC) Santa Paula Branch Line (SPBL) tracks on August 5 - 6, 2020. During these days, a spot check of ±25 miles of track were visually inspected between Mile Post (MP) 404.70 and MP 429.23. The SCRRA / FWRY operating maintenance limits of this track is at MP 404.70 and is indicated in the field by the sign shown in Image 1. This report is prepared for inclusion in the VCTC Request for Proposals for a railroad operator after expiration of the current operator lease, which ends on June 30, 2021.

A map of the SPBL can be found under Appendix A. The objective of the track assessment is to determine the conditions of the existing track and provide recommendations that will establish the basis for potential SPBL track enhancements, assuring the maintainability and safety of the railroad.

The Santa Paula Branch Line is an active track which serves limited freight and passenger operations with the current condition of the corridor being a FRA Class 1 standard which allows freight and passenger speeds of 10 and 15-miles per hour, respectively.

This assessment compares SPBL track conditions to the FRA safety standards to determine identified defects. An FRA Class 1 track containing a defect is, by definition, unsafe. Identification and remediation of track issues that threaten safe operation is the most important objective. It is important to note that even though the tracks were assessed based on the Federal Railroad Administration Track Safety Standards, inspection reports were not part of the scope of this track assessment project. Wilson & Company previously completed annual bridge inspection services within the SPBL during the second week of December 2019. Structure inspection reports covered under the bridge inspection services are omitted from this Track Assessment Report.

Image 1. MP 404.70: SCRRA / FWRY operating Maintenance Limits

Track Assessment Approach

Walking provides the best view of the track components. An on-track spot-check assessment was conducted at SPBL track to observe their existing conditions, potential maintenance needs and life cycle replacement. The track assessment included:

- Roadbed.
- Track Geometry.
- Track Appliances and Track-Related Devices.
- Transitional Areas and Walkways.

EXECUTIVE SUMMARY

SPBL tracks are in compliance with minimum FRA Class 1 track standards for rail freight operations at 10 MPH. Comments and recommendations are as follow,

A) Although no major rail defects were identified, it is recommended to perform an internal rail inspection to identify non-visible defects based on the metal decay found within much of the SPBL. Continuous internal rail inspection can detect defects before they grow to dangerous size, and is the only way to find certain defects before the rail fails.

B) It is recommended to perform dynamic gauge measurements on the tracks under loaded conditions.

C) Switch 3860 at MP 424.24 and switch 3864 at MP 424.44 are missing cotter pins. It is recommended all switches shall have functional cotter pins.

D) Design of an underdrain system (or surface drainage) and replacement of the track structure with properly graded ballast rock is recommended to fix the drainage deficiencies between Mileposts 408.15 and 412.50. Inadequate track drainage is one of the major reasons for shortened track component life.

E) There is a missing/buried 18-inch Corrugated Metal Pipe (CMP) at MP 412.15. As a result, water is sheet flowing through the ties causing erosion around and under the tie. A similar issue of sheet flow through ties resulting in erosion was noted at MP 412.17. Replacement and/or a properly maintained Best Management Practice (BMP) with adequate ballast is recommended at these locations.

F) The majority of culvert elements present conditions of accumulated sediment and material inside and by the approaches of the pipes which could block the expected flow of water. It is recommended to maintain all BMP’s to ensure proper flow of water as designed.

G) During future crosstie replacement efforts, fresh ballast should be installed under and around the crossties to maintain the track surface, alignment, crosslevel, and drain water away from the track. The new ballast will prolong the life of the crossties, and elastically absorb the impact and dynamic energy imparted by the fully loaded passing cars.

H) If a track is scheduled to be out of service for periods of time, such as Track 3775, it is recommended to remove them from service. Before a track is removed from service it must be protected and a red board should be displayed to advise all the crews. Once the track is scheduled to be in service, the track shall be fully inspected before resuming traffic.

I) It is recommended updating all missing, broken, bent, faded and/or vandalized stop signs and railroad crossing signs in order to meet MUTCD and CPUC standards.

J) The Texaco Private at-grade crossing located at MP 424.98 is recommended to be upgraded. This crossing consists of deteriorated wood with exposed rebar which could cause damage to vehicular traffic.

K) An open gate was observed fouling the tracks at the Private At-Grade Crossing at MP 413.02. It is recommended to advise any adjacent owners they are not allowed to place objects within four feet of the nearest rail.

L) Periodical spraying of chemical herbicides should be used to effectively kill weeds in the roadbed.

Track Assessment Findings

A discussion of the findings are outlined below,

1. Roadbed
   1.1. Drainage
   The existing track roadbed consists of broken stone ballast from MP 404.70 to MP 407.79 shown in Figures 2 and 3 below.

Image 2. MP 405.00 Track Roadbed by SCRRA / FWRY operating Maintenance Limits.

Image 3. MP 407.79 Ballast Limits.

Approximately 50% of the remaining SPBL between MP 407.79 to MP 429.23 consists of alluvial rock rounded in shape, with no angular edges present, poorly graded on top of a weak subgrade as shown in Figure 3. Over most of the site the ballast rock is fouled with dirt and fine soils.

Image 4. MP 425.00 Track Roadbed.

The remaining 50% of the remaining SPBL between MP 407.79 to MP 429.23 showed little or no signs of ballast. Drainage is a key objective in track design and maintenance, inadequate track drainage is one of the major reasons for shortened track component life. The fouled ballast found in the SPBL roadbed is failing to provide drainage for the tracks. The fine soils from the subgrade layer have risen to the surface preventing drainage of the storm water which in turn is causing accelerated decay of crossties and inducing alignment and surface deviations along the tracks.

Image 5. MP 408.5 Lack of Ballast.

Special attention to the roadbed is needed between Mileposts 408.15 and 412.50. Very poor and/or no ballast was observed which is the main cause of erosion of soil between and around ties. Although no rainfall was detected prior to this assessment, the south side of tracks within this section indicate signs of erosion and standing water (Figure 6). In addition to rainfall, irrigation from numerous farms located on both sides of tracks may be enhancing this issue. Poorly graded ballast rock does not drain adequately creating subgrade saturation. Design of an underdrain system and replacement of the track structure with properly graded ballast rock is recommended to fix this issue.

Image 6. MP 408.3 Erosion / Poor Ballast

There is a missing/buried 18-inch CMP at MP 412.15. As a result, water is sheet flowing through the ties causing erosion around and under the tie. A similar issue of sheet flow through ties resulting in erosion was noted at MP 412.17. Replacement and/or a properly maintained BMP with adequate ballast is recommended at these locations.

Image 7. MP 412.15 Erosion

All culverts under 40 inches in diameter and ditches along the tracks were inspected during the track assessment. Refer to Wilson & Company 2019 bridge inspection reports for structures greater than 40 inches in diameter.

All pipe elements located were structurally sound. The majority present conditions of accumulated sediment and material inside and by the approaches of the pipes which could block the expected flow of water. It is recommended to maintain all BMP’s to ensure proper flow of water as originally designed.

A list of existing culverts are shown in Table 1,

Mile Post	Diameter (Inches)	Material	Comments
404.70	12”	CMP	Maintenance Required
404.93	18”	CMP	Clear
405.20	58”	CMP	Maintenance Required
405.21	30”/18”	CMP	Maintenance Required
406.09	24”	CMP	Not Confirmed
406.88	30”	CMP	
406.90	3x4	Treated Wood Box Culvert	Not Confirmed
409.20	12"	CMP	
409.27	18”	CMP	
409.29	27”	Steel Pipe	
410.88	4-48x54	CMP	
411.02	65x40	CMPA	
411.14	58”x36”, 43x48	CMP, WBC	
411.30	(3) 36”	CMP	Maintenance Required
411.30	36” x22”	CMP	
411.57	18”	CIP	
412.15	18”	CMP	Not Confirmed. Missing or buried.
412.21	12”	CMP	
412.29	(2) 12”	CMP	
413.82	12”	CMP	Clear
416.24	18”	CMP	
416.50	18”	CMP	
415.50	18”	CMP	
418.02	18”	CIP	Not Confirmed. Missing or buried.
418.33	18”	CIP	Not Confirmed. Missing or buried.
418.38	18”	CIP	Not Confirmed. Missing or buried.
418.55	36”	CMP	
419.25	36”	CMP	
419.48	12”/24”	CIP	
419.59	18”	CIP	
420.33	18”	CMP	
420.87	18X48	Treated Wood Box Culvert	
420.92	18”	CIP	
420.95	18”	CIP	
421.19	18”	CMP	
421.20	29x18	CMPA	
421.61	17x48	Treated Wood Box Culvert	
421.95	12”	CMP	
422.12	30”	CMP	
422.40	18”	CMP	
422.44	48”	CMP	
422.74	18”	CMP	
422.80	18”	CMP	
423.72	12”	CMP	
423.76	36x58”	CMPA	
425.05	30”	CMP	Maintenance Required
425.25	60”	CMP	Clear
425.25	12” / 18”	CMP	Not Confirmed. Missing or buried.
425.30	12” /18”	VCP	Maintenance Required
425.35	12”	VCP	Maintenance Required
425.46	18”	CIP	Not Confirmed. Missing or buried.
425.50	18”	CIP	Maintenance Required
425.66	(2) - 18"	CMP	Maintenance Required
426.60	(3) - 36"	CIP	Clear
426.95	(2) - 18"	CMP	Clear
427.48	40”	CMP	Not Confirmed
427.96	(3) 24”	CMP	Maintenance Required
428.19	(2) - 36”	CIP	Clear
429.11	11'	RT Culvert	Maintenance Required

Table 1. Existing Culverts Located along SPBL

'Maintenance required' mentioned in Table 1 refers to clearing the culverts from sediment and material accumulated inside and by the approaches of the pipes. 'Not Confirmed' mentioned in Table 1 refers to a culvert not able to be located as a result of excess vegetation, restricted access or buried.

List of acronyms from Table 1 can be found below.

BMP – Best Management Practices
CIP – Cast Iron Pipe
CMP - Corrugated Metal Pipe
CMP A - Corrugated Metal Pipe Arch
RT – Rectangular
VCP - Vitrified Clay Pipe
WBC - Wood Box Culvert

Image 8. MP 425.05 Tree Growing at 30" CMP Opening

1.2. Vegetation

Although weeds and vegetation were found within some areas of the SPBL tracks, the current condition at the time of assessment does not represent problems. In all locations where employees are expected to walk along the tracks and near turnouts, the roadbed is clear from excess vegetation. Additionally, vegetation does not obstruct visibility of grade crossings, railroad signs nor fixed signals. Periodical spraying of chemical herbicides should be used to effectively kill weeds in the roadbed.

2. Track Geometry
   2.1. Gauge

Standard track gauge is 56 ½ inches. The minimum gauge allowed by the Track Safety Standards is 56 inches for all track classes, and the maximum gauge for Class 1 track is 58 inches. Gauge is measured between the heads of the rails at right-angles to the rails in a plane five-eights of an inch below the top of the rail head.

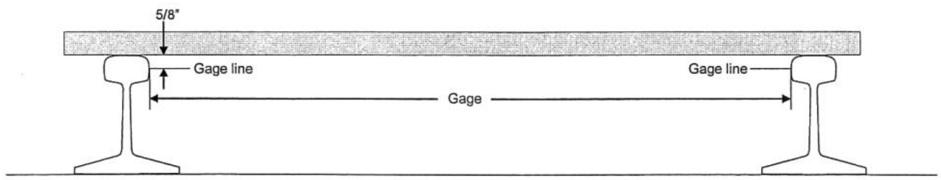


Figure 1. Track Gauge.

Track gauge measurements during the SPBL track assessment was accomplished using a two-step procedure, handheld track gauge and tape measure. Using a tape measure provides the ability to easily compensate for metal flow on the rail head. In accordance with Track Safety Standards (TSS) all gauge readings and measurements during the track assessment reflect track movement under load.

Image 9. Handheld Track Gauge.

Track gauge was measured through spot-checks and grade-crossings while walking along the SPBL, as well as where visual indications of potential gauge problems were present, including skewed ties, high spikes, obvious alignment changes (especially at joints) and signs of lateral rail movement. A ¼ inch was added to the gauge measurements where metal flow in the head of the rail was present and where evidence was found on the tie surface that the plates are moving laterally under load. This evidence is characterized by shiny wood fibers burnished by the action of the tie plate sliding laterally under each passing wheel. At the far extent of the plate movement, upturned wood fibers will be evident. A gap between the base of the rail and the tie plate shoulders indicates that the rail is likely moving laterally against the shoulder of the tie plate.

FRA specifies in section 213.13 of the Track Safety Standards:

When unloaded track is measured to determine compliance with this part, the amount of rail movement, if any, that occurs while the track is loaded must be added to the measurement of the unloaded track.

In practical terms, the FRA indicates that to correctly assess gauge conditions, any evidence of dynamic gauge widening should be added to the static, or unloaded gauge.

Image 10. Measuring Track Gauge.

The basic problems with having track gauge too narrow are derailments and damage to the track. Decaying timber crossties due to ballast not draining water properly is one of the potential conditions which may contribute to narrow gauge, other important factors are:

- Insufficient ballast.
- Poor ballast quality or disturbed ballast.
- Weak subgrade.
- Inadequate rail anchorage and spiking patterns.

Additionally, all these factors may cause track alignment problems that are discussed in Section 2.2. Tight gauge is often common in newly maintained track where crews have not paid proper attention to gauging.

It is recommended that SPBL representatives perform dynamic gauge measurements on the tracks under loaded conditions. A dynamic track analyzer (see Figure 2) attaches the gauge to each rail on the field side and reads the gauge when a railcar passes by.

Figure 2. Dynamic Track Analyzer

2.2. Alignment

Horizontal track alignment is a combination of tangent sections and curve sections of various types. A tangent is a straight section of track, and regardless of the length, the centerline of tangent track should be straight, with no kinks or other sudden changes in direction. Causes of misalignment in tangent track include:

- Improper positioning of rails.
- Loose rail joints.
- Rail forces due to high and low temperatures.
- Defective ties.
- Poor ballast quality.

During the track assessment, the proper alignments were spot-checked in both tangents and curves according to Track Safety Standards:

Class of Track	Tangent Track	Curved Track	
	The deviation of the mid-offset from a 62-foot line [1] may not be more than—	The deviation of the mid-ordinate from a 31-foot chord [2] may not be more than—	The deviation of the mid-ordinate from a 62-foot chord [2] may not be more than—
1	5"	N/A [3]	5"
2	3"	N/A [3]	3"
3	1¾"	1¼"	1¾"
4	1½"	1"	1½"
5	¾"	½"	⅝"

[1] The ends of the line must be at points on the gage side of the line rail, five-eighths of an inch below the top of the railhead. Either rail may be used as the line rail, however, the same rail must be used for the full length of that tangential segment of track.

[2] The ends of the chord must be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.

[3] N/A - Not Applicable.

Table 2. Track Alignment.

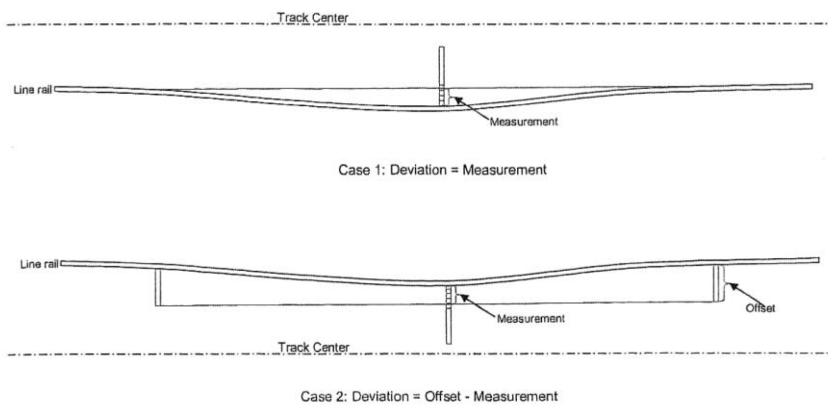


Figure 3. Tangent Track Alignment.

Spot checks of tangent alignments along the SPBL tracks are in compliance with the allowable deviations by the TSS of the mid-offset from a 62-foot line.

2.3. Curves

Curved track includes both circular curves and spirals. Alignment measurements rely upon a chord of prescribed length. The ends of the chord are on the gauge line of the line rail in tangent or the outside rail in a curve. The distance between the center of the chord and the adjacent point on the rail's gauge line is called the mid-ordinate or mid-chord offset (MCO). FRA uses the abbreviation MCO to refer to either term. A 62-chord is standard for alignment measurement in tangent and curves in track Classes 1 – 5.

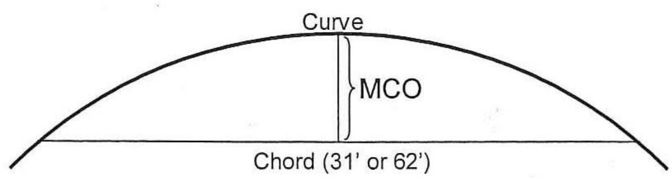


Figure 4. Curve Track Alignment.

In properly aligned simple curves, the MCO is a positive number that is consistent at any point along the curve. Measurements of curve alignments along the SPBL were outside the scope of this report and were not field verified. It is recommended to confirm tracks are in compliance with the deviations of the mid-offset from a 62-foot line allowed by the Track Safety Standards.

2.4. Elevation of curved track and runoff

In curves, the outer rail is typically elevated relative to the inner rail. This elevation counteracts the centrifugal force acting on rolling stock negotiating the curve. Without elevation lateral forces may potentially be large enough to overturn the outside rail. Railroad cars could also experience a wheel climb or overturn. The Track Safety Standards limits the amount of elevation at any point in a curve to not more than eight (8) inches for track Class 1. Crosslevels identified in curves along the SPBL lead track were in compliance.

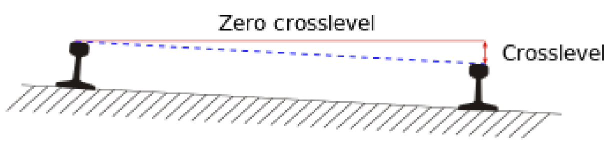


Figure 5. Crosslevel.

2.5. Track surface

Track surface is the adherence of the rails to design elevation, measured at the top of each rail. Track Safety Standards give limits of deviation and variance for track surface. Deviation is the difference between an actual measurement and the intended measurement at the same location. Variation is the difference between any two actual measurements at different locations. The Track Safety Standards define limits for surface irregularities.

Track surface	Class of track				
	1	2	3	4	5
	(inches)	(inches)	(inches)	(inches)	(inches)
The runoff in any 31 feet of rail at the end of a raise may not be more than	3 1/2	3	2	1 1/2	1
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than	3	2 3/4	2 1/4	2	1 1/4
The deviation from zero crosslevel at any point on tangent or reverse crosslevel elevation on curves may not be more than	3	2	1 3/4	1 1/4	1
The difference in crosslevel between any two points less than 62 feet apart may not be more than* 1, 2	3	2 1/4	2	1 3/4	1 1/2
*Where determined by engineering decision prior to the promulgation of this rule, due to physical restrictions on spiral length and operating practices and on spirals per 31 feet may not be more than	2	1 3/4	1 1/4	1	3/4
1 Except as limited by § 213.57(a), where the elevation at any point in a curve equals or exceeds 6 inches, the difference in crosslevel within 62 feet between that point and a point with greater elevation may not be more than 1½ inches. (Footnote 1 is applicable September 21, 1999.)					
2 However, to control harmonics on Class 2 through 5 jointed track with staggered joints, the crosslevel differences shall not exceed 1¼ inches in all of six consecutive pairs of joints, as created by 7 low joints. Track with joints staggered less than 10 feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote. (Footnote 2 is applicable September 21, 1999.)					

Table 3. Track Surface.

- Runoff in 31-feet at the end of a raise. Sudden vertical changes in the track may uncouple cars in a moving train, separate brake hoses, or cause derailments. Spot-checks of runoff conditions observed at the SPBL tracks were within TSS allowable limits (3 ½ inches).

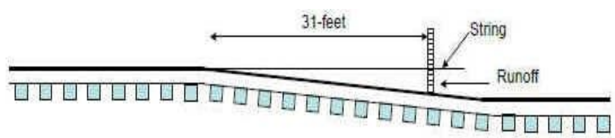


Figure 6. Track Runoff.

- Allowable crosslevel in tangent. Crosslevel is the difference in elevation of the two rail heads at any given location on the track. Tangent track ideally has zero crosslevel (both rail heads are at the same elevation). Any non-zero crosslevel is a deviation from uniform cross level. Minor crosslevel deviations were present at SPBL tracks, however, all measurements were in compliance with the TSS allowable crosslevel limit (3 inches).

- Difference in crosslevel between any two points within 62-feet. This difference in crosslevel is commonly called warp or twist. As a leading cause of track-related derailments, warp is probably the most critical of the surface parameter. Excessive warp induces frame twisting and car rocking that may lead to wheel lift. Crosslevel differences were measured at low rail joints in the SPBL tracks, and the static variations found were less than 3 inches in 62 feet, maximum crosslevel difference allowed by the TSS.

3. Track Structure

3.1. Ballast

Ballast should withstand and distribute the weight of the train and track, maintain the track surface, alignment, crosslevel, and drain water away from the track. Additionally, ballast should provide a dry supporting and cribbing medium to prolong the life of the crossties.

One of the key functions of ballast is to elastically absorb much of the impact and dynamic energy imparted by the passing of traffic, fully-loaded 286,000 lb. railcars. The distribution of the dynamic wheel load at the top of the railhead is directly related to the size of the wheel/rail contact patch area. That size is related to the wheel tread's worn contour and the railhead's worn contour.

Beginning with the rail plate load on the tie, then progressing downwardly, the distribution of the dynamic wheel load is related to the general condition and quality of the rail support structure. The smaller intensity of these stresses at any given depth is the result of track with each tie supporting the rail, ballast clean and mechanically interlocked with an appropriate depth, and a firm and resilient subgrade. The larger intensities of the stresses at any given depth is the result of track having numerous ties providing little support, with fouled ballast and soggy subgrade.

As mentioned in the Drainage Section 1.1, the existing SPBL track ballast consists of broken stone ballast from MP 404.70 - MP 407.79, while approximately 50% of the remaining SPBL between MP 407.79 - MP 429.23 consists of alluvial rock rounded in shape with no angular edges present, poorly graded on top of a weak subgrade. The remaining 50% of the remaining SPBL between MP 407.79 - MP 429.23 showed little or no signs of ballast. In almost the entire site the ballast rock is fouled with dirt and fine soils. As fines accumulate, they retain moisture, serving as a lubricant which further increases the rate of abrasion.

The upper portion of track sections should consist of relatively large particle, clean, open-voided, and free-draining ballast. It serves to disperse the vertical loading down to what can be supported by the lower-quality, smaller-particle sub-ballast. In established tracks like the SPBL tracks, the sub-ballast consists of the smaller-sized ballast employed in earlier times, and its deterioration is proportional to the amount of small particles in the ballast's gradation.

The larger ballast particles control the over-all track stability. Generally, ballast fines migrate downward through the voids with gravity and the migration of moisture, and then accumulate at the depth were the ballast is no longer open-voided. This zone of void-filing accumulation thereby develops upward from the bottom. Once the ballast voids are filled with fines, the ballast has lost much of its elasticity. This loss of ballast elasticity accelerates the loss of track surface and results in a significant increase in need to surface the track.

Several sections in the SPBL tracks, especially in between Mileposts 408 and 429, present severely fouled or insufficient ballast, a defect per Track Safety Standards.

3.2. Crossties

To maintain track geometry, an effective tie must securely hold the rail fasteners (spikes) in place, not to be broken through, not allow passage of ballast through the tie, not to be excessively plate or rail cut, and permit no more than ½ inch of tie plate or rail base lateral movement.

Of the major components of the track structure, timber ties generally have lives that are the least variable with traffic and climate conditions. Although the mechanical action of repeated load cycles from moving trains is a major determinant of tie life, the mechanical action differs from climate, the ballast rock surrounding them and their location along the track. Ties in curves are subjected to lateral steering forces against the outer rail of the curve and lateral twisting forces on the inner rail of the curve (and frequently a severe load imbalance causing one or the other of the two rails, usually the inner rail, to be more severely loaded than would be the case on tangent track).

In sharp curves, the wheel/axle assembly behaves much like a rolling cylinder, scooting and pivoting its way around the curve, with flanges squealing against the gauge side of the outer rail, and treads crunching on the head of the inner rail, see figure 17.

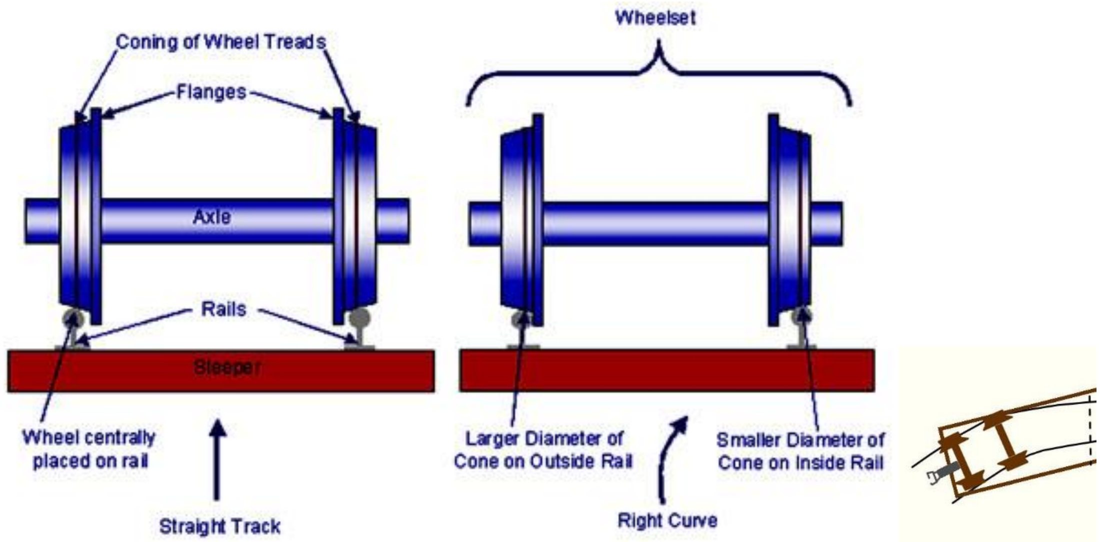


Figure 7. Wheel/Axle assembly.

This effect is not only very hard on the rails, but it is also very hard on the supporting ties. The lateral force against the head of the outer rail tends to widen the gauge in curves, loosen the spikes and cause the field-side of the plat to gouge into the tie. It also can destroy the rail cant making it negative (and even pivoting and scooting of the wheel tread upon the inner rail tends to loosen those spikes as well).Without repeating the proper functions of ballast, it should suffice to say that ballast dumped on top of ties should be as temporary as possible. The ballast contributes to the retention of moisture on the upper surface of the crossties, especially around the critical plate-bearing area. Moisture harms crossties in two ways. First, it promotes the growth of fungi and decay. Secondly, it reduces the bearing strength of wood by a considerable amount. This is most critical in older ties near the end of their useful lives like the ones in the SPBL property, promoting decay and spike killings. The fouled ballast found in the SPBL tracks fails to provide proper mechanical support for the crossties.

Approximately 15% of the existing ties at the SPBL show deterioration from decay in the spike areas. Most of these ties were observed on the eastern portion of the SPBL. Special attention should be provided around MP 421.5 and MP 428.0. Some ties along the corridor were covered in silt and could not be observed. Rotten spots completely covered by the tie plates are evident by loose spikes and hollow sound when stepping on top of them. The TSS requires sufficient effective ties in a track segment to hold gauge, surface and alignment. Using the TSS minimum crosstie numbers as maintenance standards is inadvisable, safe operations require more than the minimum number of effective crossties. As a point of reference, industrial branch lines should have around of 5 effective tangent crossties and 6 in curve per 39 feet (there are typically 24 crossties in a 39 foot rail).

Image 11. Example of loose spike in tie.

Track Safety Standards require each joint to be supported by at least one effective tie centered within a prescribed distance from the joint center (see figure 8). SPBL tracks show no defects regarding effective crossties, crossties quantity and spacing, and joint crossties.

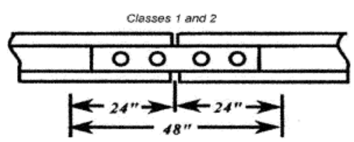


Figure 8. Effective tie under a joint bar.

3.3. Rail

Broken rails have always been a feared cause of derailment, primarily because many latent rail defects are difficult to detect visually and are revealed only when the rail fails under a moving train, often causing a derailment. Rail sections at the SPBL vary which can be found on the Track Charts located under Appendix B.

Shells are one type of rolling contact fatigue identified throughout the SPBL. Shells are identified as progressive horizontal separations, generally on the gauge side of the rail head, which may crack out at any level, usually at the upper gauge corner. Shelling may turn down to form a transverse separation and, once detected, is classified as a detail fracture. Uncapped or gutted shells will result in the dislodgement of parent metal from the rail section.

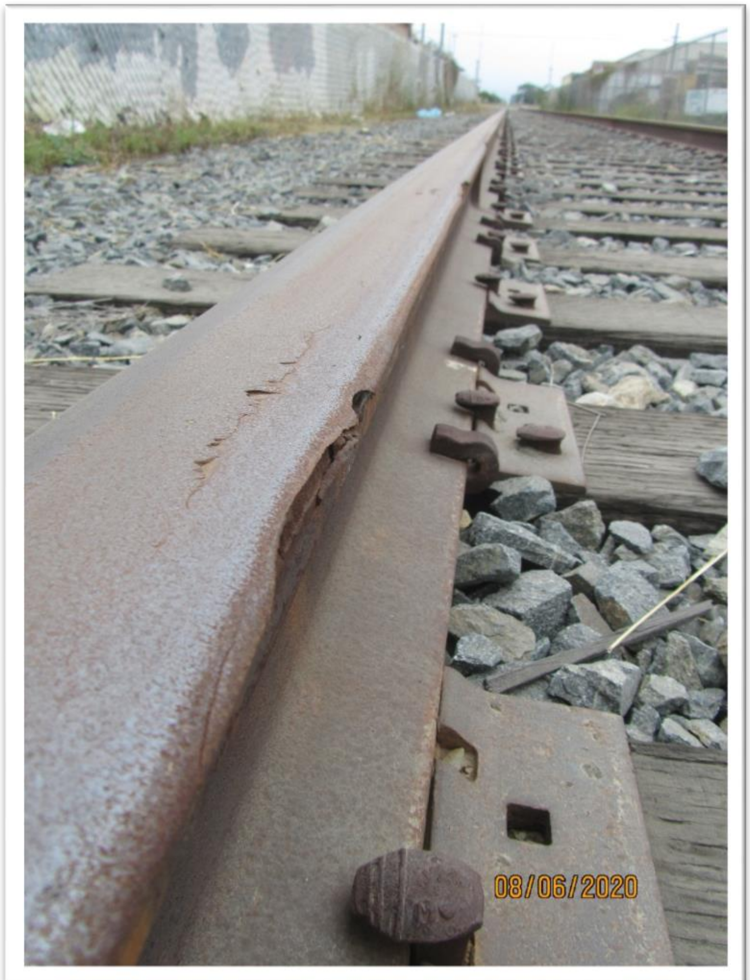


Image 12. 132# Rail Gauge Side Shell Showing Parent Metal Decay, MP 407.55

Much of the rail along the SPBL appears to have swapped with opposite (outer) gauge side rail. This is evident from signs of grinding and/or metal decay shown on the opposite rail gauge side as shown in the photo below.

Image 13. Rail Opposite Gauge Side Shell Showing Parent Metal Decay, MP 411.10

No major rail defects were identified during the SPBL spot-check. Special attention must be given to rail conditions not covered by the TSS, such as chipped rail ends found at numerous joint locations, and several areas presenting rolling contact fatigue (metal flow) along the tracks.

Image 14. Chipped Rail end at MP 422.5

Remedial actions for rail defects should be addressed immediately upon discovery. Generally, rail replacement is the best long-term solution for rail defects, with the remedial actions governing operations before removal of the defective rail. The assigned person (designated by TSS) must visually supervise each operation over the chipped rail ends found at SPBL until rail sections are replaced.

It is recommended that conditions not covered by TSS such as gauge face wear on the high (outer) rail of curves, engine burns, flaking, shelling, corrugations, head checks, corrosion, flattened rail and curve wear should be documented in future inspections to keep track of them. Continuous internal rail inspection can detect defects before they grow to dangerous size, and is the only way to find certain defects before the rail fails. Even though TSS requires internal rail inspection for Classes 3-5 tracks, it is recommended to perform the service to identify non-visible defects.

3.4. Rail end mismatch

Any mismatch on either the gauge face or the tread must be within limits for the track Class. The mismatch limits for Class 1 track is a quarter of an inch (1/4") for both gauge and tread. No rail end mismatches were identified during the SPBL spot-check.

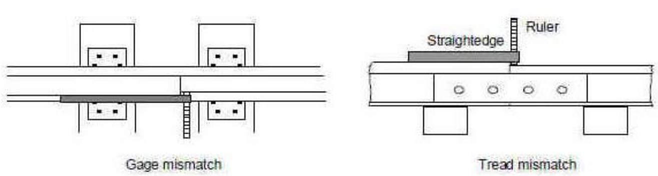


Figure 10. Rail end mismatch.

3.5. Rail joints

Rail joints are weak spots in the track structure; track gauge, alignment and surface defects are common at joints. Loose, cracked or broken joint bars and missing bolts are common defects.

Joint bars must be the correct design and dimensions for the rail section. Many joint bars are labeled for their corresponding rail section. Compromise joint bars must be compatible with both rails in the joint. Severely worn or incorrectly sized bars can lead to damage to the rail, bars, and fasteners. Any misapplication of bars is potentially a willful act.

Each joint bar shall be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations.

Image 15. Rail joint matching rail sizes, MP 408.0

3.6. Tie plates

Tie plates reduce rail pressures on the tie and help maintain gauge. Plates, like joint bars, are designed for certain rail base widths. With improper size plates, the rail fasteners (spikes) may not be in the correct location to secure the rail.

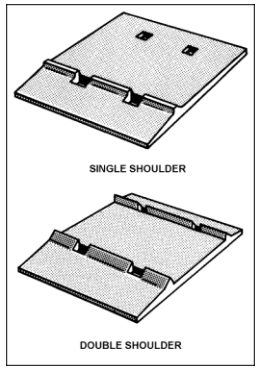


Figure 11. Tie plates.

If the curve is superelevated, and if the train is moving at a speed lower than the equilibrium speed, the inward tilt of the train without the offsetting centrifugal force causes a severe transfer of weight off the outer rail and onto the inner rail. This greatly increases the rate at which the plates under the inner rail will cut into the ties. Due to action of centrifugal force on a curve, wheels tend to move out.

3.7. Rail fastening systems

With wooden ties, cut spikes are the most common fastener. Fastener performance is critical, fasteners are 'effective' when gauge is being maintained. Decaying crossties (due to fouled ballast) fail to effectively fasten the rail against the tie plates and crossties. This condition interferes maintaining gauge and support in the track.

3.8. Turnouts and track crossings

Turnouts and track crossings have many components and host a great variety of defect possibilities.

The TSS requires all turnout and track crossing fastenings to be present and in proper working order. In addition to rail joints, turnouts and track crossings are potential weak spots in the track structure. They receive higher than normal lateral and vertical loads, increasing the likelihood of defects.

Mile Post	Crossing	DOT Crossing Number	CPUC Crossing Number	Protection
404.70	Bristol Road	745675K	001BE-404.70	CPUC Standard #9A Gates
405.20	Montgomery Ave.	745676S	001BE-405.30	CPUC Standard #9
405.52	Potomac Ave Pedestrian Crossing	745677Y	001BE-405.50-D	Pedestrian Flashers
406.05	Petit Avenue	903183R	001BE-406.05	CPUC Standard #9
406.80	Saticoy Avenue	745679M	001BE-406.80	CPUC Standard #9A
407.07	Private Crossing	745680G		Stop sign and private railroad crossing sign
407.37	Wells Road	753802E	001BE-407.50	CPUC Standard #9A
407.50	L.A. Avenue	745681N	001BE-407.55	CPUC Standard #9
407.60	Alelia Street	745682V	001BE-407.60	CPUC Standard #9
408.24	Private Crossing	745683C		Stop sign and private railroad crossing sign
408.48	Private Crossing	745684J		Stop sign and private railroad crossing sign
408.58	Private Crossing	745685R		Stop sign and private railroad crossing sign
408.70	Private Crossing	745689T		Stop sign and private railroad crossing sign
408.90	Private Crossing	745691U		Stop sign and private railroad crossing sign
409.03	Private Crossing	745692B		Stop sign and private railroad crossing sign
409.31	Private Crossing	745698S		Stop sign and private railroad crossing sign
409.56	Private Crossing	745700R		Stop sign and private railroad crossing sign
409.80	Private Crossing			Stop sign and private railroad crossing sign
410.20	Todd Road	745690M	001BE-410.20	CPUC Standard #9
410.99	Private Crossing			Stop sign and private railroad
411.30	Briggs Road	745694P	001BE-411.30	CPUC Standard #9
411.46	Private Crossing			Stop sign and private railroad Crossing sign
411.55	Private Crossing			Stop sign and private railroad crossing sign
411.90	Private Crossing	745704T		Stop sign and private railroad crossing sign
411.95	Private Crossing	745723X		
412.15	Private Crossing	745724E		Stop sign and private railroad crossing sign
412.23	Private Crossing	745725L		Stop sign and private railroad crossing sign
412.39	Todd Lane Private	745701X	001BE-412.35-X	CPUC Standard #9
412.52	Private Crossing	745727A		Stop sign and private railroad crossing sign
412.58	Private Crossing	968261B		Stop sign and private railroad crossing sign
412.70	Telegraph Road	745708V	001BE-412.70	CPUC Standard #9
412.80	Peck Road	745709C	001BE-412.80	CPUC Standard #9
413.02	Private Crossing	745734K		Stop sign and private railroad crossing sign
413.04	Pedestrian Crossing	745711D	001BE-413.04-D	Stop sign and private railroad crossing sign
413.10	Private Crossing	745752H		Stop sign and private railroad crossing sign
413.25	Private Crossing	745754W		Stop sign and private railroad crossing sign
413.32	Cameron St	745714Y	001BE-413.20	CPUC Standard #9
413.47	Steckel Drive	903179B	001BE-413.47	CPUC Standard #9
413.60	Dean Drive	745716M	001BE-413.60	CPUC Standard #9
413.85	Fire Access Road	745717U	001BE-413.85-CD	
413.90	Palm Avenue	745718B	001BE-413.90	CPUC Standard #9
414.00	Olive Street	745719H	001BE-414.00	CPUC Standard #9
414.10	4th Street Ped	745720C	001BE-414.10-D	CPUC Standard #9
414.35	7th Street	745721J	001BE-414.30	CPUC Standard #9
414.36	Santa Barbara Street	745722R	001BE-414.36	CPUC Standard #9
414.40	8th Street	745723X	001BE-414.40	CPUC Standard #9
414.50	9th Street	745724E	001BE-414.50	CPUC Standard #9
414.70	10th Street	745726T	001BE-414.70	CPUC Standard #9
414.90	12th Street	745727A	001BE-414.90	CPUC Standard #9
415.64	Private Crossing	968257L		Stop sign and private railroad
415.85	S. Hallock Drive	968261B		CPUC Standard #9
415.90	Padre Lane	917316W	001BE-415.88	CPUC Standard #9
416.05	Telegraph Road(Hwy 126)	745729N	001BE-416.05	CPUC Standard #9A
416.08	Private Crossing	745710W		Stop sign and private railroad crossing sign
416.10	Private Crossing	745713S		Stop sign and private railroad crossing sign
416.25	Private Crossing	943924J		Stop sign and private railroad crossing sign
416.60	Willard Road	745734K	001BE-416.60	CPUC Standard #9A

Table 4. At-Grade Road Crossings.

Mile Post	Crossing	DOT Crossing Number	CPUC Crossing Number	Protection
417.49	Private Crossing	745733D		Stop sign and private railroad crossing sign
417.70	Private Crossing	935998F		Stop sign and private railroad crossing sign
417.99	Private Crossing	745735S		Stop sign and private railroad crossing sign
418.49	Private Crossing	745739U		Stop sign and private railroad Crossing sign
418.80	Private Crossing	943928L		Stop sign and private railroad Crossing sign
419.19	Private Crossing			Stop sign and private railroad Crossing sign
419.40	Telegraph Road	745742C	001BE-419.40	CPUC Standard #9A
420.54	Private Crossing	745745X		Stop sign and private railroad Crossing sign
420.90	Private Crossing	745746E		Stop sign and private railroad crossing sign
420.99	Private Crossing	745747L		Stop sign and private railroad crossing sign
421.28	Keith Road - Private Crossing	745751B		Stop sign and private railroad crossing sign
421.90	7th Street	745752H	001BE-421.90	CPUC Standard #9
422.17	Private Crossing	745753P		Damaged Stop sign and private railroad crossing sign
422.80	Cliff Avenue	745754W	001BE-422.80	CPUC Standard #9
423.00	Grand Avenue	745755D	001BE-423.00	CPUC Standard #9
423.50	Goodenough Road	745756K	001BE-423.50	CPUC Standard #9
423.75	B Street	935995K	001BE-423.80	CPUC Standard #9
423.95	Sespe Place	745757S	001BE-423.90	CPUC Standard #9
424.10	A Street	745758Y	001BE-424.10	CPUC Standard #9
424.40	Central Avenue	745759F	001BE-424.40	CPUC Standard #9A
424.45	Pedestrian Crossing			No Signs
424.50	Pedestrian Crossing			No Signs
424.55	Pedestrian Crossing			No Signs
424.60	Pedestrian Crossing			No Signs
424.70	Mountain View Street	745760A	001BE-424.70	CPUC Standard #9
424.98	Texaco Private Crossing			Stop sign and private railroad crossing sign
425.40	Private Crossing			Stop sign and private railroad crossing sign
425.50	Telegraph Road	745762N	001BE-425.50	CPUC Standard #9A
426.10	Fish Hatchery Road	745763V		Stop sign and crossing bucks
426.50	Private Crossing			Stop sign and private railroad Crossing sign
426.95	Private Crossing			Stop sign and private railroad Crossing sign
427.28	Private Crossing	745766R		Stop sign and private railroad Crossing sign
427.40	Private Crossing	745767X		Stop sign and private railroad Crossing sign
427.42	Private Crossing	745768E		Stop sign and private railroad crossing sign
427.65	Private Crossing			Stop sign and private railroad Crossing sign
427.80	Private Crossing	745769L		Stop sign and private railroad Crossing sign
428.20	Lawton Ranch RD Private Crossing	745770F		Stop sign and private railroad Crossing sign
428.30	Cavin Road	745772U	001BE-428.30-X	Stop sign and private railroad Crossing sign
428.40	Private Crossing	745773B		Stop sign and private railroad Crossing sign
428.61	Private Crossing	745774H		Stop sign and private railroad crossing sign

Table 4. At-Grade Road Crossings.

At-grade road crossings identified at SPBL property are within parameters of FRA Class 1 track, 10 MPH.

It is recommended updating all missing, broken, bent, faded and/or vandalized stop signs and railroad crossing signs in order to meet MUTCD and CPUC standards.

The Texaco Private at-grade crossing located at MP 424.98 is recommended to be upgraded. This crosssing consists of deterioriated wood with exposed rebar which could cause damage to vehicular traffic.

An open gate was obverved fouling the tracks at the Private At-Grade Crossing at MP 413.02. It is recommended to advise any adjacent owners they are not allowed to place objects within four feet of the nearest rail.

Image 16. MP 404.70 Bristol Road At-Grade Crossing.

Image 17. MP 405.20 Montgomery Ave. At-Grade Crossing.

Image 18. MP 405.52 Potomac Ave Pedestrian Crossing.

Image 19. MP 406.05 Petit Avenue At-Grade Crossing.

Image 20. MP 406.80 Saticoy Avenue At-Grade Crossing.

Image 21. MP 407.07 Private At-Grade Crossing.

Image 22. MP 407.50 L.A Avenue At-Grade Crossing.

Image 23. MP 407.60 Alelia Street At-Grade Crossing.

Image 24. MP 408.24 Private At-Grade Crossing.

Image 25. MP 408.48 Private At-Grade Crossing.

Image 26. MP 408.58 Private At-Grade Crossing.

Image 27. MP 408.70 Private At-Grade Crossing.

Image 28. MP 410.20 Todd Road At-Grade Crossing.

Image 29. MP 410.99 Private At-Grade Crossing.

Image 30. MP 411.30 Briggs Road At-Grade Crossing.

Image 31. MP 411.46 Private At-Grade Crossing.

Image 32. MP 411.55 Private At-Grade Crossing.

Image 33. MP 411.90 Private At-Grade Crossing.

Image 34. MP 411.95 Private At-Grade Crossing.

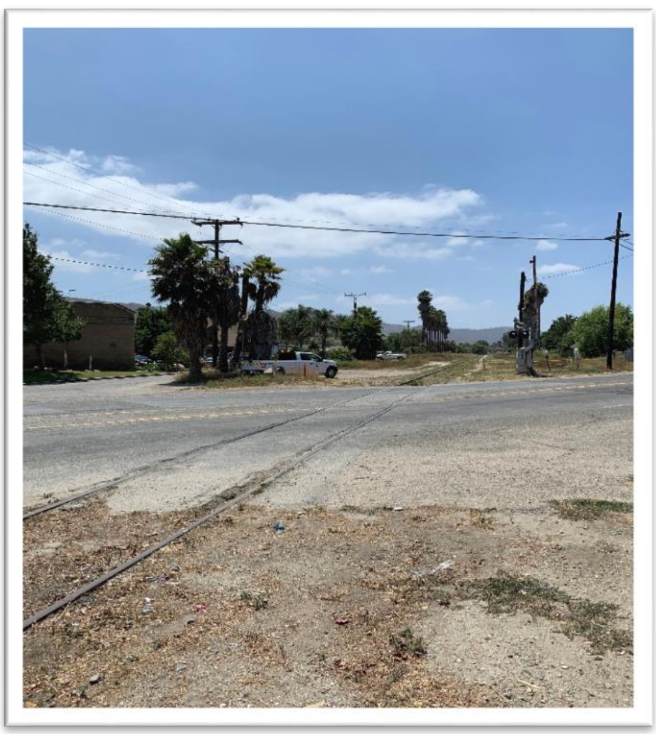


Image 35. MP 412.70 Telegraph Road At-Grade Crossing.

Image 36. MP 412.80 Peck Road At-Grade Crossing.

Image 37. MP 413.02 Private At-Grade Crossing.

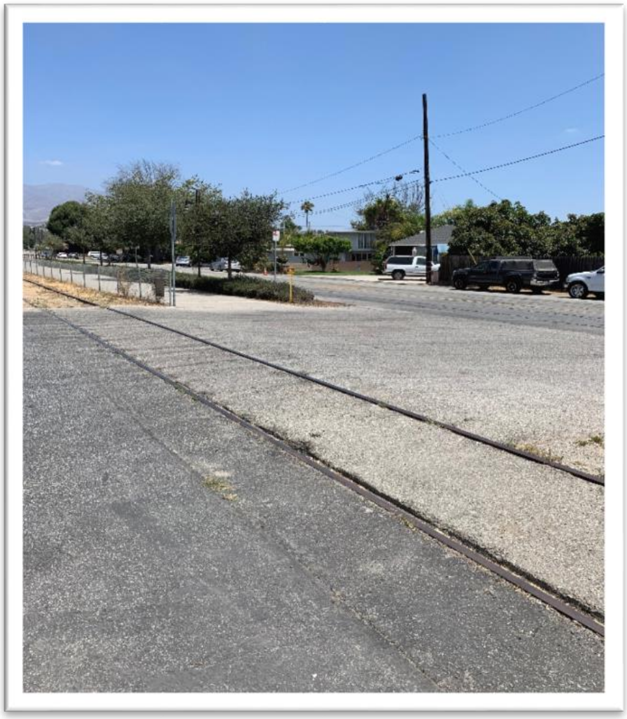


Image 38. MP 413.10 Private At-Grade Crossing.

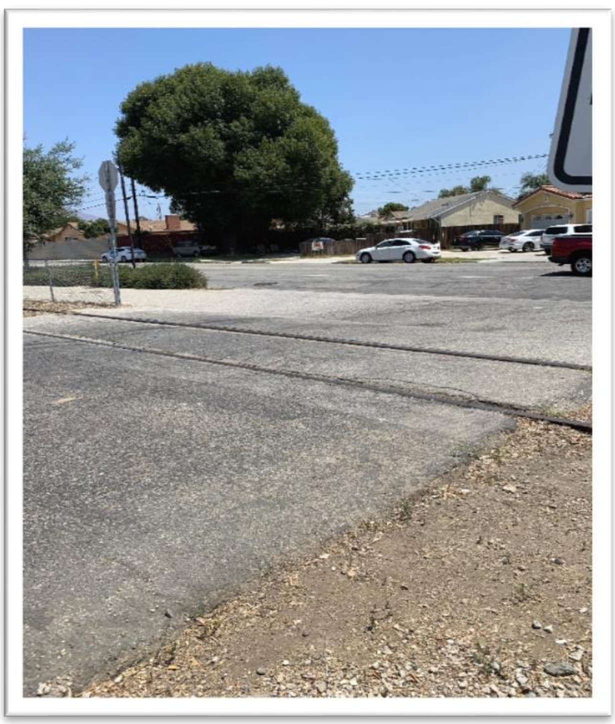


Image 39. MP 413.25 Private At-Grade Crossing.

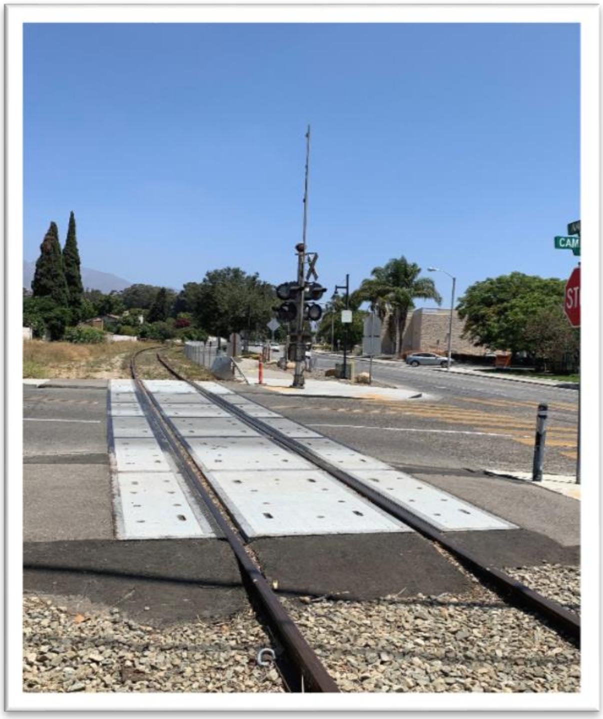


Image 40. MP 413.32 Cameron Street Public At-Grade Crossing.

Image 41. MP 413.47 Steckel Drive At-Grade Crossing.

Image 42. MP 413.60 Dean Drive At-Grade Crossing.

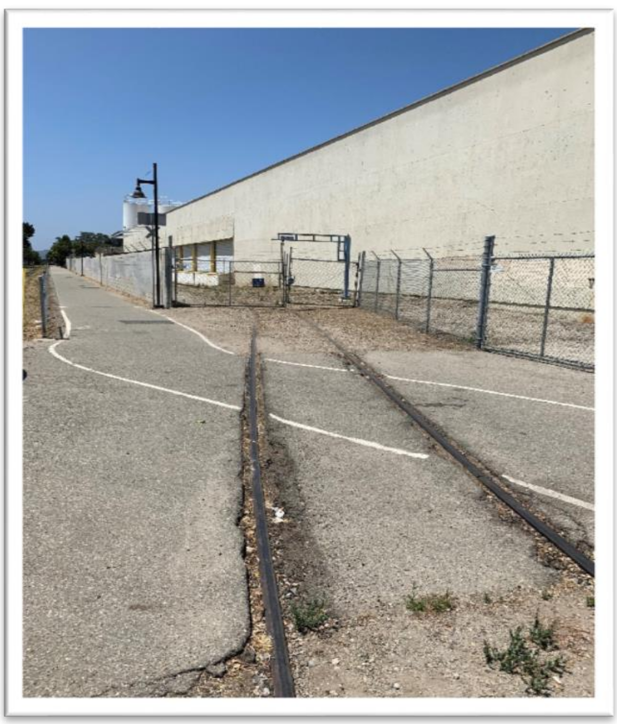


Image 43. MP 413.85 Fire Access Road At-Grade Crossing.

Image 44. MP 413.90 Palm Avenue At-Grade Crossing.

Image 45. MP 414.00 Olive Street At-Grade Crossing.

Image 46. MP 414.10 4th Street At-Grade Crossing.

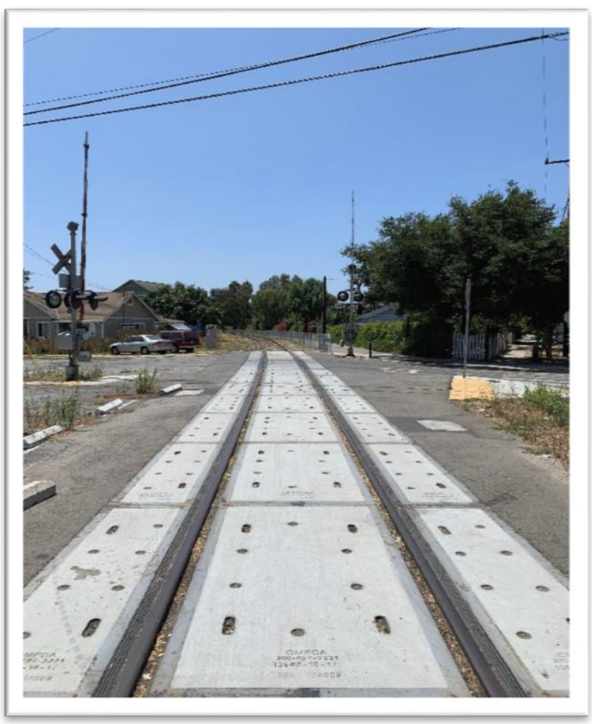


Image 47. MP 414.35 7th Street At-Grade Crossing.

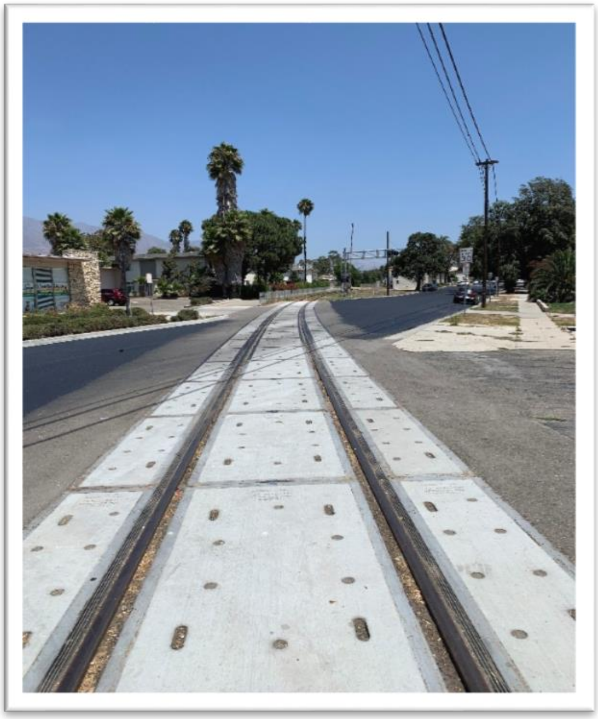


Image 48. MP 414.36 Santa Barbara Street-Grade Crossing.

Image 49. MP 414.40 8th Street At-Grade Crossing.

Image 50. MP 414.50 9th Street At-Grade Crossing.

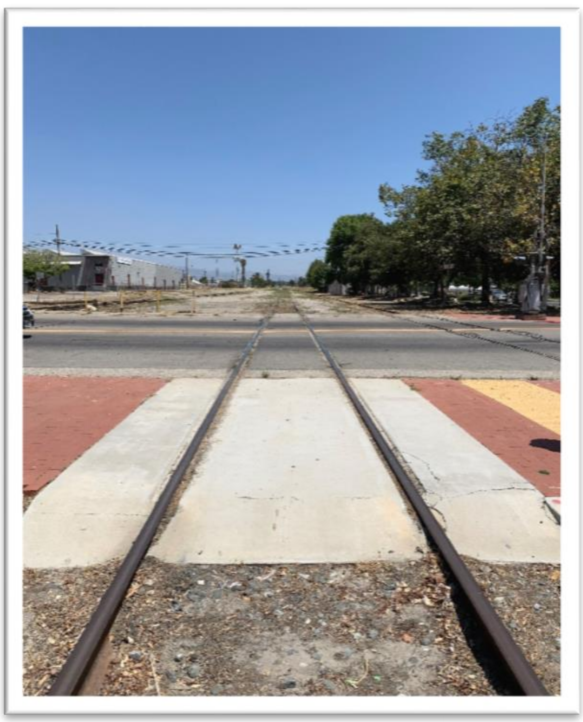


Image 51. MP 414.70 10th Street At-Grade Crossing.

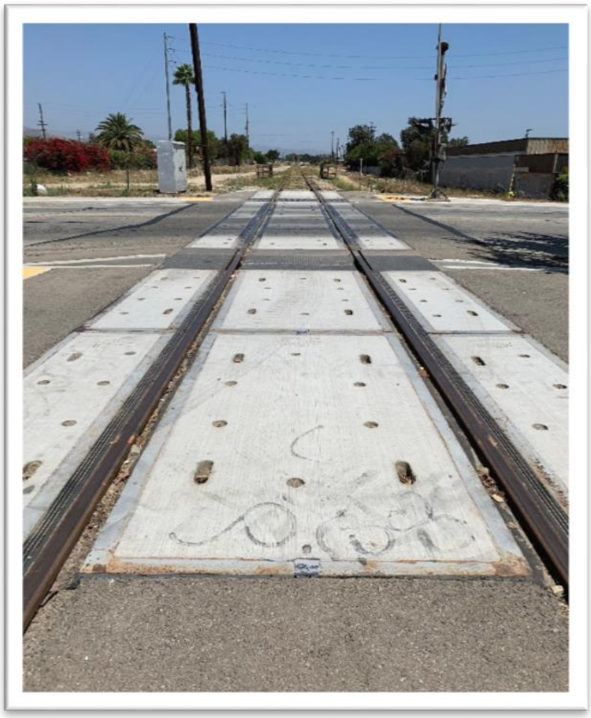


Image 52. MP 414.90 12th Street At-Grade Crossing.

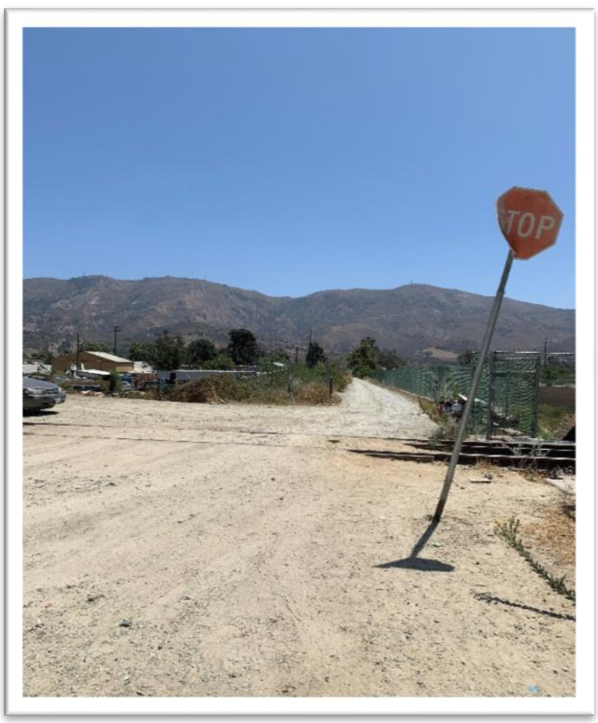


Image 53. MP 415.64 Private At-Grade Crossing.

Image 54. MP 415.85 S. Hallock Drive At-Grade Crossing.

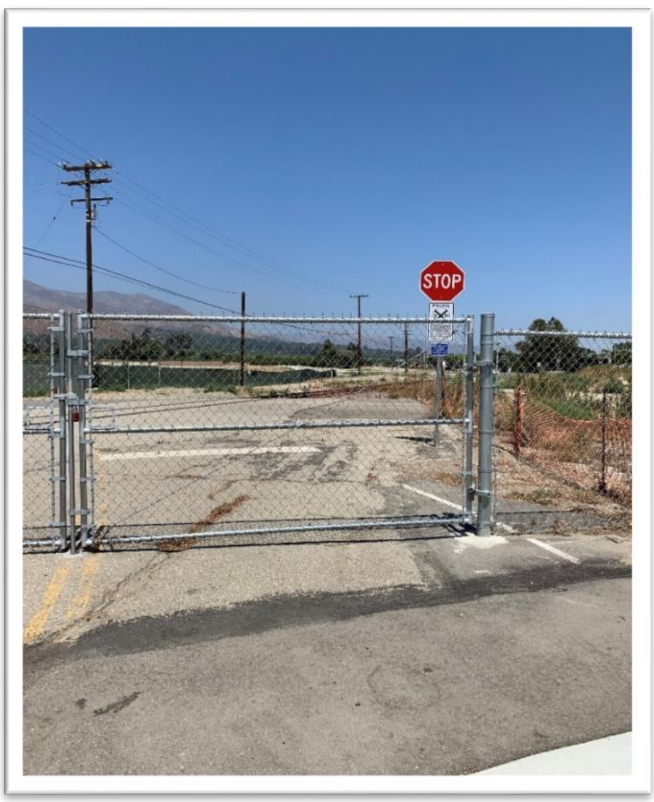


Image 55. MP 415.90 Closed Padre Lane At-Grade Crossing – Closed Temporary emergency crossing for the East Area One (EA1) development.

Image 56. MP 416.05 Telegraph Road (HWY 126) At-Grade Crossing.

Image 57. MP 416.08 Private At-Grade Crossing.

Image 58. MP 416.25 Private At-Grade Crossing.

Image 59. MP 416.60 Willard Road At-Grade Crossing.

Image 60. MP 417.49 Private At-Grade Crossing.

Image 61. MP 417.70 Private At-Grade Crossing.

Image 62. MP 417.99 Private At-Grade Crossing.

Image 63. MP 418.49 Private At-Grade Crossing.

Image 64. MP 419.19 Private At-Grade Crossing.

Image 65. MP 419.40 Telegraph Road At-Grade Crossing.

Image 66. MP 420.54 Private At-Grade Crossing.

Image 67. MP 420.90 Private At-Grade Crossing.

Image 68. MP 420.99 Private At-Grade Crossing.

Image 69. MP 421.28 Keith Road Private At-Grade Crossing.

Image 70. MP 421.90 7th Street At-Grade Crossing.

Image 71. MP 422.17 Private At-Grade Crossing.

Image 72. MP 422.80 Cliff Avenue At-Grade Crossing.

Image 73. MP 423.00 Grand Avenue At-Grade Crossing.

Image 74. MP 423.50 Goodenough Road At-Grade Crossing.

Image 75. MP 423.75+/- B Street At-Grade Crossing.

Image 76. MP 423.95 Sespe Place At-Grade Crossing.

Image 77. MP 424.10 A Street At-Grade Crossing.

Image 78. MP 424.40 Central Avenue At-Grade Crossing.

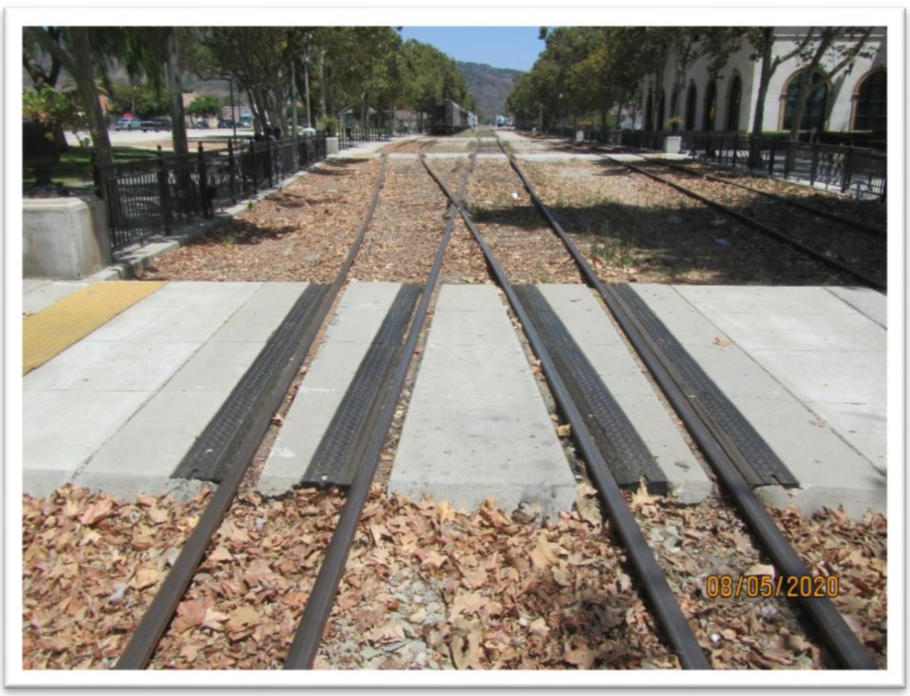


Image 79. MP 424.45 Pedestrian At-Grade Crossing.

Image 80. MP 424.50 Pedestrian At-Grade Crossing.

Image 81. MP 424.55 Pedestrian At-Grade Crossing.

Image 82. MP 424.60 Pedestrian At-Grade Crossing.

Image 83. MP 424.70 Mountain View Street At-Grade Crossing.

Image 84. MP 424.98 Texaco Private At-Grade Crossing.

Image 85. MP 425.40 Private At-Grade Crossing.

Image 86. MP 425.50 Telegraph Road At-Grade Crossing.

Image 87. MP 426.10 Fish Hatchery Road At-Grade Crossing.

Image 88. MP 426.50 Private At-Grade Crossing.

Image 89. MP 426.95 Private At-Grade Crossing.

Image 90. MP 427.28 Private At-Grade Crossing.

Image 91. MP 427.40 Private At-Grade Crossing.

Image 92. MP 427.42 Private At-Grade Crossing.

Image 93. MP 427.65 Private At-Grade Crossing.

Image 94. MP 427.80 Private At-Grade Crossing.

Image 95. MP 428.20 Lawton Ranch Road Private At-Grade Crossing.

Image 96. MP 428.30 Cavin Road At-Grade Crossing.

Image 97. MP 428.40 Private At-Grade Crossing.

Image 98. MP 428.61 Private At-Grade Crossing.

3.1. Switches

The turnout area is absolutely critical in track inspection, all the parts including the movable points, are subject to many potential defects. Switches are referred to the movable rails within the turnouts. Turnout refers to the set of all movable and non-movable parts that allow the railcars to diverge from one track to another (switch points, frog, guard rails, crossties, braces, rods, fasteners, heel blocks, bolts, etc.)

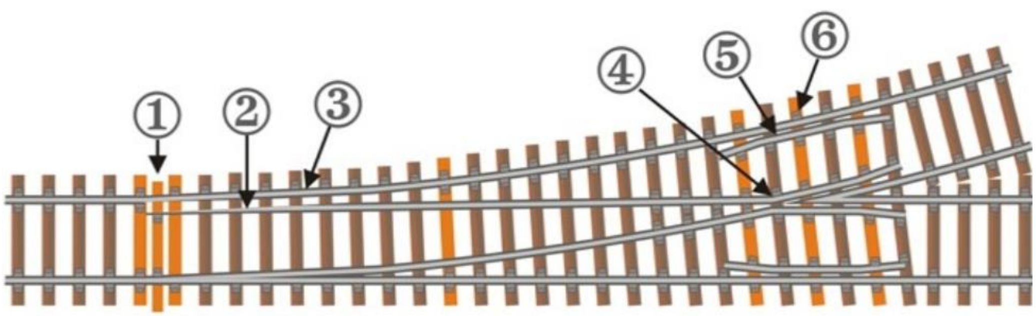
Maintaining the switch points is critical to the safe passage of equipment through the turnout. All switch points in SPBL Turnouts do not show unusual wear or chipping that would prevent them guiding the wheel flange down the desired path. No switches were thrown during this assessment.

Switch 3860 at MP 424.24 and switch 3864 at MP 424.44 are missing cotter pin. It is recommended all switches shall have functional cotter pins.

Image 99. Switch 3860 Missing Cotter Pin

3.2. Frogs

Bolts securely fastened, flangeways clear of obstructions, adequate width in the frog and corresponding guardrails. Crosstie examination was included (due to the high stresses of the wheels against the turnouts), spikes, tie plates, and ballast rock under the frogs. All frogs examined were in acceptable condition.



1. Head Block or Point of Switch
2. Switch Points
3. Heel Block
4. Frog
5. Guard Rail
6. Guard Rail Clamps / Bolts

Figure 12. Turnout components.

4. Track Appliances

4.1. Derails

Derails are safety devices protecting a track against entry or fouling by approaching rolling stock. By directing wheels off the rail, the derail prevents a car or locomotive from passing its location. No derails were inspected as part of this assessment.

4.2. Rail Anchors

Rail anchors control longitudinal rail movement on ties from temperature variations, rail traffic, grade, and train braking. Anchors shall be installed in between crossties and properly attach to the underside of the rail baseplate and bear against the side of the crossties.

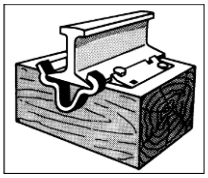


Figure 14 – Rail anchors.

For industrial tracks it is recommended to install rail anchorage at a minimum rate of 16 anchors per 39 feet of rail. Rail anchors found along the SPBL were in acceptable condition.

Image 100. Anchors.

5. Transitional areas and walkways

Walkways shall be constructed and maintained to provide a reasonable regular surface and shall be maintained in a safe condition clear of vegetation, debris, standing water, and other obstruction, which constitute a hazard. Walkways shall be located along both sides of the track for a minimum distance of 125 feet on each side of every switch stand.

Recommendations

1. Designation of Qualified persons to supervise and inspect the track

The Track Safety Standards (TSS) sets minimum standards for individual track conditions. Conditions not meeting the TSS limits clearly compromises safety. However, a combination of conditions, each within the TSS limits, may also result in unsafe tracks. As a collection of minimum safety limits, the SPBL track should be maintained above these minimum guidelines.

FRA holds the general system track owner responsible for track condition and for compliance with the TSS requirements. Owners normally designate responsible individuals in their organization to actually inspect and maintain track. For reliable long term operations, maintenance programs should be established well above the TSS track class limits. Responsible individuals in charge of railroad tracks must develop internal safety standards stricter than, but consistent with, those in TSS. However, safety inspection reports for FRA review need only identify TSS defects.

TSS defines requirements for persons involved in supervising track repairs under traffic conditions and performing track inspections. The requirements for both positions are similar, including experience, training, and demonstrated understanding of the TSS. Supervisors must review remedial actions recommended by inspectors.

SPBL is advised to keep records of the designated Track Supervisor and Track Inspector. The designated personnel must get written authorization from the Track Owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in the TSS.

The SPBL track should be defined as other than Main Track per definition of Main Track and Rule 6.28 in the General Code of Operating Rules for all Railroads.

According to TSS, SPBL tracks, as “other than Main Track” must be inspected monthly with at least 20 calendar days interval between inspections. It is highly recommended to conduct regular on-foot track inspections, especially around curves, turnouts, and at-grade crossings.

Alternatively, if a spur track or several tracks are scheduled to be out of service for periods of time, such as Track 3775, it is recommended to remove them from service. Before a track is removed from service it must be protected and a red board should be displayed to advise all the crews. Once the track is scheduled to be in service, the track shall be fully inspected before resuming traffic.

2. Track Structure

For certain areas where drainage is a concern and the surrounding ground line allows for it, the existing track shoulder ballast can be cut away opening up the ends of the ties and track structure to drain. This can be accomplished by using either a ballast regulator or other mechanical means. This process will also help establish a parallel drainage ditch along the track. This method, along with applying additional ballast and surfacing the track (2”-3” raise), will allow water that is currently trapped around the tie to drain away from the track structure.

Areas where ties need to be replaced, it is recommended to replace with new medium traffic ties spaced at 21.25” on center and should be installed on top of a 6” layer of new clean ballast rock. Clean ballast will renew the track surface, drainage, crosslevel, profile and alignment. The open-voids that the ballast provides beneath the ties will compensate for the rate of fines accumulated over the time.

Once the 6 inches of existing material under the ties has been removed, it is recommended to scarify and re-compact 3 – 4 inches of the existing plugged subgrade. Silty and sandy gravels are typically found in the subgrade layer along the tracks. Tracks that have been restored to at least 6 inches of clean ballast rock atop the remaining plugged re-compacted layer below, perform remarkably reaching nominal track life extensions of 30 years.

It is important to note that the simple action of undercutting the ties and getting the ballast cleaned would not provide a long term solution. The high levels of fines in the existing ballast and the non-angular poorly graded gravel in it, represent a limitation to extend the life of the track.

Class 2 (1" – 3/8") ballast rock is highly recommended. Rock free from loam, dust and other foreign particles and should not have less than 75% crushed particles with two or more fractured faces. It is important that the ballast is hard, dense, of angular particle structure, providing sharp corners and cubicle fragments and free of deleterious materials.

Ballast materials shall provide high resistance to temperature changes, chemical attack, have high electrical resistance, low absorption properties and free of cementing characteristics. Materials shall have sufficient unit weight (measured in pounds per cubic foot) and have a limited amount of flat and elongated particles (slag is not a recommended ballast material).

NOMINAL BALLAST SIZE - PERCENT PASSING (BY WEIGHT)											
SIZE No.	SQ. OPENING	2 ½"	2"	1 ¾"	1 ½"	1 ¼"	1"	3/4"	1/2"	3/8"	No. 4
Class 2	1" - 3/8"				100		90 - 100	40 - 75	15 - 35	0 - 15	0 - 5

Table 5. Class 2 Ballast Gradation.

Additionally, 9 inches on ballast beyond the edge of the ties (shoulder areas) and 3:1 slopes should be considered for the ballast section.

Ballast should be uniformly distributed and the track raised, lined surfaced and tamped, with the finished surface of the ballast dressed in accordance with the existing top of rail elevation. Track gauge must be set at 56 ½ inches to compensate for the extreme weather conditions present in the area.

3. *Drainage*

Design of an underdrain system (or surface drainage) and replacement of the track structure with properly graded ballast rock is recommended to fix drainage defects. Inadequate track drainage is one of the major reasons for shortened track component life. Without proper drainage water sets within the track structure, the ballast section becomes fouled with dirt, and also softens the surrounding crossties allowing the spikes to become loose, which ultimately leads to compromised track integrity.

There is a missing/buried 18-inch Corrugated Metal Pipe (CMP) at MP 412.15. As a result, water is sheet flowing through the ties causing erosion around and under the tie. A similar issue of sheet flow through ties resulting in erosion was noted at MP 412.17.Replacement and/or a properly maintained Best Management Practices (BMP) with adequate ballast is recommended at these locations.

Industry studies have shown that track component life can be shortened as much as 50% or more due to track drainage issues and fouled ballast.

Refer to culvert list in Table 1, to clean and maintain culverts along the SPBL tracks.

4. *Turnouts and crossings*

Special attention should be given to turnouts and crossings. Main causes of train derailments are curves, switches and at-grade crossings, and it is mandatory that the individuals inspecting the SPBL tracks know all the parts of the turnouts. Switch 3860 at MP 424.24 and switch 3864 at MP 424.44 are missing cotter pins. It is recommended all switches shall have functional cotter pins.

The Texaco Private at-grade crossing located at MP 424.98 is recommended to be upgraded. This crossing consists of deteriorated wood with exposed rebar which could cause damage to vehicular traffic.

An open gate was observed fouling the tracks at the Private At-Grade Crossing at MP 413.02. It is recommended to advise any adjacent owners they are not allowed to place objects within four feet of the nearest rail.

It is recommended updating all missing, broken, bent, faded and/or vandalized stop signs and railroad crossing signs in order to meet MUTCD and CPUC standards.

Periodical spraying of chemical herbicides should be used to effectively kill weeds in the roadbed.

5. *Rail and Other Track Material (OTM)*

The overall rail condition was found to be in poor condition. Although no major rail defects were identified during the SPBL spot-check, special attention must be given to rail conditions not covered by the TSS, such as chipped rail ends found at numerous joint locations, and several areas presenting rolling contact fatigue (metal flow) along the tracks.

It is recommended that conditions not covered by TSS such as gauge face wear on the high (outer) rail of curves, engine burns, flaking, shelling, corrugations, head checks, corrosion, flattened rail and curve wear should be documented in future inspections to keep track of them. Continuous internal rail inspection can detect defects before they grow to dangerous size, and is the only way to find certain defects before the rail fails. It is recommended to perform ultrasonic rail testing to identify non-visible defects in the rail.