4. TRAIL DESIGN GUIDELINES

This chapter provides specific design guidelines for the Humboldt Bay Trail that are consistent with the guidelines currently observed in California and in the United States. Ultimately, the trail extension must be designed to meet both the operational needs of the roadway and railway system and area businesses as well as the safety of trail users. The challenge is to find ways of accommodating motorized and non-motorized uses with minimum compromising of safety or functionality.

Planning, design, and implementation standards in this document are derived from the following sources:

- Rails-with-Trails: Lessons Learned, U.S. Department of Transportation, August 2002.
- American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, 1994.
- AASHTO, Guide for the Development of Bicycle Facilities, 1999.
- U.S. Department of Transportation (USDOT), Federal Highway Administration (FHA), Manual of Uniform Traffic Control Devices (MUTCD), 2000.
- Caltrans: Highway Design Manual (Chapter 1000: Bikeway Planning and Design)
- Institute of Transportation Engineers (ITE), Design and Safety of Pedestrian Facilities, 1994.
- Rails-to-Trails Conservancy, Rails-with-Trails, Sharing Corridors for Transportation and Recreation, 1996.

The sources listed above provide details on many aspects of trails, but a) may contain recommendations that conflict with each other; b) are not, in most cases, officially recognized "requirements;" and c) do not cover all conditions. All design guidelines must be supplemented by the professional judgments of the trail designers and engineers.

The above design standards and/or guidelines will be applied to the fivetrail scenarios:

1. Highway and multi-use trail within and/or adjacent to the Highway 101 right-of-way.
2. Rail with multi-use trail within the North Coast Railroad's right-of-way.

The Humboldt Bay Trail will accommodate a wide range of users, including pedestrians, persons in wheelchairs, and bicyclists of varied abilities including family cycling. Assumptions regarding trail design include:

- Minimum tread width: eight feet, but will attempt to be 10 feet wherever possible.
- Typical shoulder width of trail: two feet.
- Minimum setback from edge of highway to edge of tread: five feet (without a barrier).
- Minimum setback from edge of highway to edge of tread: two feet (with barrier).
- Minimum setback from railroad track centerline to obstructions or edge of trail tread: eight-and-a-half feet.
- Typical setback from edge of tread to obstructions and buildings: three feet.

4.1 Highway and Multi-Use Trail Design

The Caltrans Highway Design Manual recommends separation between bike paths and Highways.

Multi-use trail parallel to a state highway

"A wide separation is recommended between bike paths and adjacent highways. Bike paths closer than 5 feet from the edge of the shoulder shall include a physical barrier to prevent bicyclists from encroaching onto the highway. Bike paths within the clear recovery zone of freeways shall include a physical barrier separation. Suitable barriers could include chain link fences or dense shrubs. Low barriers (e.g., dikes, raised traffic bars) next to a highway are not recommended because bicyclists could fall over them and into oncoming automobile traffic. In instances where there is danger of motorists encroaching into the bike path, a positive barrier (e.g., concrete barrier, steel guardrailing) should be provided."

4.1.1 Signing and Striping

On trails expecting multiple types of users, trail etiquette signs are recommended. In addition, other warning signs informing users of approaching intersections and crossings of driveways will need to be installed.

Bike path, bike lane, and bike route signing and markings should generally follow the guidelines in the Manual on Uniform Traffic Control Devices. This includes advisory, warning, directional, and informational signs for bicyclists, pedestrians, and motorists. All signs shall be retroreflective on shared-use paths. Lateral sign clearance shall be a minimum of three feet and a maximum of six feet from the near edge of the sign to the near edge of the path. Mounting height shall be between four and five feet from the bottom edge of the sign to the path surface level. The final striping, marking, and signing plan for the Humboldt Bay Trail will be resolved in the full design phase of the trail, and should be reviewed and approved by a licensed traffic engineer or civil engineer. This will be most important at locations where there are poor sight lines from the trail to cross-traffic (either pedestrian or motor vehicle).

A yellow centerline stripe is standard for multi-use paths in several cities, especially at blind corners, high traffic areas, intersection approaches, and/or where nighttime riding is expected with limited lighting.

4.1.2 Intersections and Crossings

It is highly desirable to minimize the number of railroad, roadway, and driveway crossings that occur. As a general rule, when crossings are required, they should occur at established pedestrian crossings wherever possible, or at locations completely away from the influence of intersections.

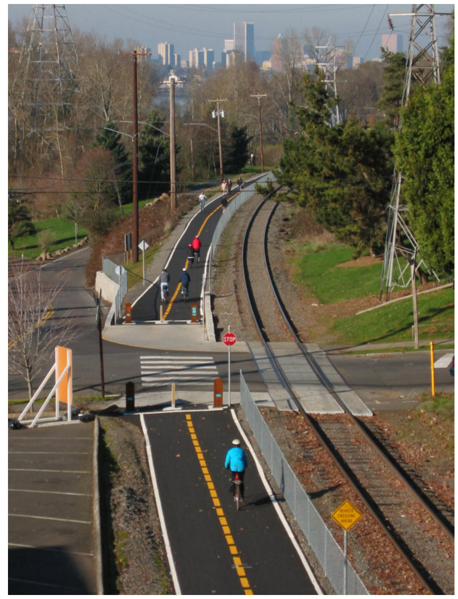
Trail approaches at roadway and driveway intersections should always have Stop or Yield signs to minimize conflicts with autos. Bike crossing stencils may be placed in advance of trail crossings to alert motorists. Ramps should be designed to accommodate the range and number of users.

Right-of-way should be established favoring trail users at private driveways.

The Humboldt Bay Trail will have several at-grade roadway crossings. Warning signage must be included at each crossing location to alert motorists and trail users to the crossing locations and regulations.

4.1.3 Trail-Roadway Crossings

The proposed Humboldt Bay Trail is not anticipated to include many at-grade roadway crossings, but will cross a number of driveways, including some commercial businesses fronting onto Highway 101. Improvements to acceleration and deceleration lanes planned by Caltrans in front of those businesses on the west side of Highway 101 will need to be coordinated with trail crossings at those locations. Each of these requires specific design treatments to improve trail user safety.



Trail-roadway crossing on the Springwater Trail in Portland, OR.

When considering a proposed off-street multi-use path and required at-grade crossings of roadways, it is important to remember two items: 1) trail users will be enjoying an auto-free experience and may enter into an intersection unexpectedly; and 2) motorists may not anticipate bicyclists riding out from a perpendicular trail into the roadway. However, in most cases, an at-grade trail crossing can be properly designed to a reasonable degree of safety and meet existing traffic engineering standards.

Evaluation of multi-use trail crossings should involve an analysis of vehicular traffic patterns, as well as the behavior of trail users. This includes traffic speeds (85th percentile), street width, traffic volumes (average daily traffic and peak hour traffic), line of sight, and trail user profile (age distribution, range of mobility, destinations). A traffic safety study should be conducted as part of the actual civil engineering design of the proposed crossings to determine the most appropriate design features. This study would identify the most appropriate crossing options given available information, which must be verified and/or refined through the actual engineering and construction document stage.

The at-grade trail-roadway crossings may be unprotected, marked crossings. While routing to an existing signal is a common strategy, it is not expected to be used for the Humboldt Bay Trail.

4.1.4 Design Speed

The minimum design speed for bike paths is 20 miles per hour, except on sections where there are long downgrades (steeper than 4%, and longer than 500 feet - not applicable). Speed bumps or other surface irregularities or obstacles should never be used to slow bicycles.

4.1.5 Lateral Clearance on Horizontal Curves

Stopping sight distance on horizontal curves and lateral clearance can be calculated using the equations in the AASHTO Guide 2003. Sight distance is generally not expected to pose a problem on the Humboldt Bay Trail.

4.1.6 Vertical Clearance

A 10-foot vertical clearance should be maintained on multi-use trails. This area should be free from tree limbs and any other obstructions that may interfere with pathway use.

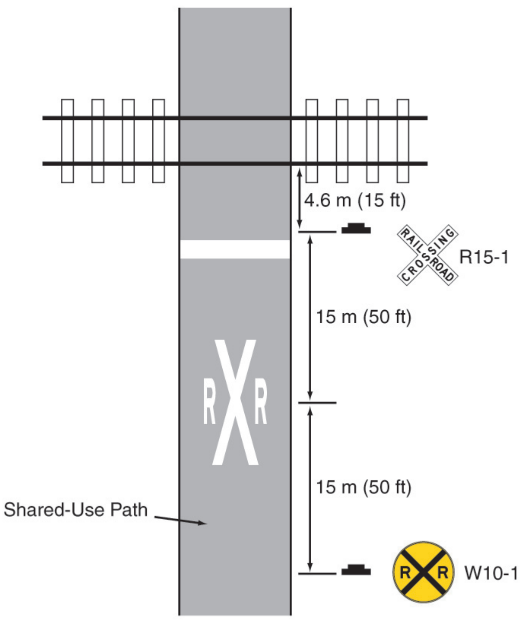
4.1.7 Gradients

Steep grades should be avoided on any multi-use trail, with 5% the recommended maximum gradient. Steeper grades can be tolerated for short distances (up to about 500 feet). The Humboldt Bay Trail Trail corridor is nearly flat for most of the alignment.

4.1.8 Drainage

A 2% cross slope will resolve most drainage issues on a bike path, except along cut sections where uphill water must be collected in a ditch and directed to a catch basin, where the water can be directed under the trail in a drainage pipe of suitable dimensions. The Humboldt Bay Trail runs along a linear corridor, with a gentle slope. No sharp curves exist along the trail.

Bollards prevent vehicles from entering the trail.



MUTCD example of signing and marking for shared-use path / railroad crossing


MUTCD W8-10


Non-MUTCD sign option

4.1.9 Bollards

Bollards at trail intersections and entrances are sometimes used to prevent vehicles from entering. Bollards should be located adjacent to the trail with a removable center bollard for emergency and maintenance access. Bollards should not be located in the travel lanes. Bollards should be designed to be visible to bicyclists and others, especially at nighttime, with reflective materials and appropriate striping.

4.1.10 Access Management

Access for parking, loading, and unloading is an issue for area businesses. Multiple driveways and other accessways create potential points of conflict between vehicles and trail users. Efforts should be made to consolidate and orient driveways and parking spaces so that a minimum number cross the trail.

4.2 Rail-with-Trail Design

This section provides guidance for specific railroad safety issues and other design issues related to rail-with-trails (RWTs). Much of the information in this section is based on the "*Rails-with-Trails: Lessons Learned*" Study. Again, engineering judgment and the requirements of the landholders must be applied.

4.2.1 Railroad Crossings

The preferred Humboldt Bay Trail alignment may include at-grade crossings of the railroad tracks. New pedestrian railroad crossing flashers are typically not required for sidewalk crossings at legal crossings because they are redundant with adjacent vehicle crossing warning equipment.

Efforts should be made to have the multi-use trail cross railroad tracks at as close to a 90-degree angle as possible. As crossing angles deviate from perpendicular angles, possibilities increase for a bicycle wheel to become trapped in the flangeway, or cyclists to lose traction on wet rails. AASHTO guidelines do not specify a minimum crossing angle; however, they do recommend that any crossing that is less than 45 degrees should be accompanied by a widening in the trail or shoulder area in order to permit a cyclist to cross the track at a safer angle, preferably perpendicular.

Standard concrete railroad crossings with compressible flangeway fillers permit rail operations while creating a smooth or subtle bump for cyclists.

Crossing materials should be skid resistant. Colored surfaces also help alert cyclists to potential conflict points. Rubber and concrete materials require less maintenance and have a longer lifespan than wood or asphalt.

Signing and marking should be per MUTCD standards. Changes in bicycle surface may be indicated by the W8-10 Bicycle Surface Condition Warning Sign.

4.2.2 Minimum Required Setbacks

Setback is measured from the nearest edge of the trail to the centerline of the nearest railroad track. A review of 65 existing trails as part of the *Rails-with-Trails: Lessons Learned Report* shows wide variance in the setback distance. Researchers attempted to determine if narrower setback distances have a direct correlation to safety problems. However, based on the almost non-existent record of claims, crashes, and other problems on these RWTs, they were unable to conclude a strong correlation between setback and safety. At an absolute minimum, the setback must keep trail users outside the "dynamic envelope" of the trains, defined as "the clearance required for the train and its cargo overhang due to any combination of loading, lateral motion, or suspension failure." Additionally, in corridors with regular use of maintenance equipment that operates outside the dynamic envelope, the setback distance should allow adequate clearance between the maintenance equipment and the trail.

The Federal Railroad Administration (FRA) already publishes minimum setback standards for fixed objects next to active railroad tracks, the distance between two active tracks, and adjacent walkways (for railroad switchmen). These published setbacks represent the legal minimum setbacks based on the physical size of the railroad cars, and are commonly employed along all railroads and at all public grade crossings. Most Public Utilities Commissions (PUCs), which regulate railroad activities within states, also have specific minimum setbacks for any structures or improvements adjacent to railroads, including any sidewalk or trail that parallels active railroad tracks. According to the PUC standards, minimum distances from the centerline of an active railroad to the outside edge of a trail or bikeway is 8.5 feet on tangent and 9.5 feet on curved track.

The *Rails-with-Trails: Lessons Learned Report* outlines preferred setback distances, with encouragement toward as much setback distance as possible. The study details circumstances under which a RWT can be set back a minimum of 10 feet, with greater width preferred.

Rail operators often prefer that reduced setbacks are accompanied by increased safety measures such as fencing.

4.2.3 Fencing and Barriers

Given that Humboldt Bay is a scenic area, the use of fencing may be considered an impairment to the scenic resource. However, given the narrow nature of the corridor and minimal separation from the railroad track, some type of acceptable fencing barrier design will need to be developed.

Fencing separates a multi-use trail from an active rail corridor.

A wide variety of physical barriers are used in RWT corridors. Of the 65 RWT facilities surveyed in the United States today, 71 percent have some type of physical barrier between the trail and tracks. The types of barriers in use include fences, walls, vegetation, grade differences, and ditches.

Operational considerations (right-of-way widths, frequency of use, access to loads, etc.) for the line paralleling the Humboldt Bay Trail may prevent the use of a barrier in some segments.

Fences are the most common type of physical barrier used in RWT corridors. A number of fencing types are available, ranging from simple wood post and rail fences to tall, heavy-duty steel fences. Selection of a fencing type, height, and location depends on the frequency and speed of trains, number of trail users, amount of trespassing anticipated along a given segment of the RWT, concern for entrapment on the wrong side of the fence, and the aesthetic qualities desired.

Need for Fencing

Some factors to consider when deciding on fencing necessity and styles include:

- **Safety**: Fencing can be used as an indicator to alert trail users to a hazard and to reduce inadvertent trespass.
- **Security**: Fencing between the trail and adjacent land uses can protect the privacy and security of adjacent property owners. While crime or vandalism have not proven to be a common problem along most multi-use trails, fencing is often included. The type, height, and material of the fencing are subject to local policies.
- **Fencing height**: The height and design of a fence influences whether lateral movement will be inhibited. Few fences are successful at preventing people from continuing to cross at historic illegal crossing locations. Fencing that cannot be climbed will typically be cut or otherwise vandalized. Heavy-duty fencing such as wrought iron or other styles of fencing that are difficult to climb are often more expensive.
- **Cost**: Fencing and other barriers, depending on the type of materials used and the length, can be costly, so options should be considered carefully.
- **Openings**: Fencing and fence posts, especially end posts, can become collision hazards. The number of openings should be minimized, trail setbacks should be observed, and the design should not present sharp or dangerous protrusions.

Recommendation

Where fencing is to be installed along the corridor, it should be located a minimum of 8.5 feet (9.5 on curves) from the nearest track centerline and three feet from the edge of the trail tread. Where the fence is located within 15 feet of the centerline of the nearest track, it should be designed with periodic removable sections for rail maintenance work, unless adequate access can be provided on the opposite side of the tracks. All fencing should provide breaks or openings at least five feet wide every 500 feet to allow emergency access and escape.

With normal setback, fencing height should range between 36 and 48 inches, with 42 inches standard.

Regardless of fence type, railroad maintenance vehicles and/or emergency vehicles may need fence gates in certain areas to facilitate access to the track and/or trail. Fence design should be coordinated with railroad maintenance personnel, as well as representatives from utilities that extend along the corridor.