

**4-09.1 BRIDGES**

- 4-09.1 (1) BRIDGES USED IN PLACE.** Existing bridges at large stream crossings carrying light traffic may be used in place under certain conditions. Such structures may be narrower and have less loading capacity than the requirements in [Figure 4-04.1](#). Where a location study report does not include a recommendation for the disposition of such structures, the district makes a recommendation, before completing the survey, to the Design Division. Narrow bridges used in place are properly signed with advance warning signs. Guardrail is used at the bridge ends to delineate the width transition.
- 4-09.1 (2) TEMPORARY BRIDGES.** When it is undesirable to disrupt traffic with a road closure or staged construction, it may be necessary to construct a temporary bridge. The ends of temporary bridges are to be provided with protection equal to that of a permanent bridge. This protection may consist of installing appropriate crashworthy end terminals or sand filled impact attenuators, or where possible, extending the end of the guardrail outside of the clear zone.
- 4-09.1 (3) BRIDGE DRAINAGE.** Bridges are provided with a combination of slab drains and drain basins to drain the bridge surface. The Bridge Division will determine the placement of slab drains. Drain basins should be provided on the down-grade side of all bridges. Consideration should be given to providing drain basins on the up-grade side of bridges where the roadway has curb and gutter and there's a possibility of a significant volume of water being carried onto the bridge. Where interchange ramps with curb are involved at the end of a bridge, consideration should be given to carrying bridge drainage along the ramp curb to an outlet on the ramp in lieu of using curb and gutter or drain basins at the concrete approach pavement. The drainage facility beyond the limits shown in the standard plans is designed to meet the existing conditions at the bridge involved, and is generally shown on the culvert section sheets. The district should make a recommendation for handling drainage when submitting bridge survey reports for concurrence by the Bridge Division at the bridge field check or on the bridge field check memorandum.
- 4-09.1 (4) BRIDGE APPROACH SLABS.** Bridge approach slabs are included in the bridge plans prepared by the Bridge Division. Payment for bridge approach slab is included in bridge estimated quantities.
- 4-09.1 (5) CONCRETE APPROACH PAVEMENT.** Concrete approach pavement, as detailed in the standard plans, are specified on the plans at the end of all bridge approach slabs. Details such as type and location of traffic barrier should be coordinated with the Bridge Division. Concrete approach pavement is to be used regardless of mainline pavement type. When pavement or bridge drainage required the use of drain basins they will be constructed within the limits of the concrete approach pavement, as detailed in the standard plans for drain basins.
- 4-09.1 (6) COLOR OF STRUCTURAL STEEL PAINT.** The color of structural steel paint shall be gray (Federal Standard #26373) or brown (Federal Standard #30045) except when approved by the District Engineer and the following conditions are met:
- An agreement with a local entity sponsoring the color is made indicating the local entity shall pay for all costs associated with providing necessary test data, pay for all costs associated with the finish coat in excess of typical costs associated with standard colors, and pay for future costs for applying the finish coat in excess of typical costs associated with standard colors as a condition of continuing the unique color. (The agreement should stipulate that the color will be maintained in the future as mutually agreeable by both parties. The additional cost to the local entity would be determined at that time. Since we require a previously approved "system" be used, the prime coat will be the same as a standard system and should not fail prematurely. If the color fades prematurely and the local entity wants it repainted, they would pay proportionately. If the color fades and the local entity does not want to pay their share, the district would decide when future repainting occurs.) Provide a copy of the agreement with the local entity to the State Bridge Engineer at least three (3) months prior to the plans due date for the bid opening.

- Only approved systems from currently approved manufacturers will be considered (list maintained by the Construction and Materials Division).
- The district or local entity shall provide certified performance data from an independent testing laboratory on samples formulated with the finish coat of the desired color from two paint manufacturers. The Construction and Materials Division maintains the performance data required and can be contacted for further information.

4-09.2 CLIMBING LANES FOR TWO LANE HIGHWAYS. Traditional climbing lanes form three-lane cross sections when used in conjunction with two-lane highways. They are generally applied as a spot improvement, most often on steep sustained grades which cause heavy vehicles, particularly heavy trucks, to travel at slow speeds. This reduces capacity, creates platoons, and increases delay. Additionally, safety problems may arise when the reduction in speed of heavy trucks exceeds 10 mph [15 km/h] along the grade. The use of climbing lanes must be justified and have prior approval from the Design Division. Recommendations are usually made at the preliminary plan stage.

AASHTO presently warrants a climbing lane wherever the speed of truck, with a 300 lb/hp ratio [180 kg/kW ratio], is reduced by 10 mph [15 km/h] or more and the volume and percentage of heavy trucks justify the added cost.

4-09.2 (1) DESIGN. The Highway Capacity Manual and the AASHTO Green Book are the basis for determining the need for climbing lanes. Basic layout of a climbing lane is illustrated in [Figure 4-09.2](#). Standard shoulders are used throughout the length of the climbing lane unless a lesser shoulder width would substantially reduce costs. In no case shall the shoulder width be less than 4 ft. [1.2 m]. Signing and delineation are essential to the operation of climbing lanes. Climbing lanes should be extended over crests whenever possible to facilitate truck acceleration.

4-09.2 (2) SPEED REDUCTION. It is desirable to provide a climbing lane, as an extra lane on the upgrade side of a two-lane highway, where the critical length of grade is exceeded, i.e., where the length of grade causes a reduction of 10 mph [15 km/h] or more in the speed of the loaded vehicles.

4-09.2 (3) JUSTIFICATION - CAPACITY AND COST. Justification for climbing lanes where the critical length of grade is exceeded is considered from the standpoint of highway capacity. Passenger car equivalents so derived are given for various combinations of percent of grade, length of grade, and level of service. In the matter of justifying the cost of providing a climbing lane, another factor is considered. Highway users expect a higher degree of congestion on individual steep grades than over long sections of highways and will tolerate some reduction in freedom of operation on grades, provided the restriction is not extreme or unreasonable. As a matter of practice, the service volume on any individual grade should not exceed that attained by using the next poorer level of service from that used for the basic design of level sections. The one exception is that the service volume derived from employing level of service D should not be exceeded. The 10 mph [15 km/h] speed reduction, which generally corresponds to the speed variation between adjacent levels of service, is the accepted basis for determining the location at which to begin climbing lanes.

4-09.3 CURBS, CURB AND GUTTER. Curbs, and curb and gutter, are used to channelize and guide traffic, to mark traffic lanes, to define medians for safety, to simplify handling drainage, and to reduce right of way requirements.

When curbs are constructed directly beneath guardrail the curb height will be 4 in. [100 mm].

4-09.3 (1) TYPES. Standard curb and curb and gutter types are detailed in the standard plans. Standard types are used whenever practical. Barrier type curbs are used in conjunction with other parallel vertical elements such as walls, bridge rails, adjacent to sidewalk, etc.

4-09.3 (2) CURB OFFSETS. Curbs are designed and located so that they are not hazardous to traffic. Barrier type curbs are offset from the edge of traffic lanes by at least 1 ft. [300 mm], except curbs adjacent to auxiliary lanes 12 ft. [3.6 m]. At least a 4 ft. [1.2 m] curb offset is desirable for short curb sections and for islands.

4-09.3 (3) INTEGRAL CURB. Integral type curbs are either doweled to the pavement or constructed monolithically with the pavement. Integral curb may be used along auxiliary lanes and may also be used along through traffic lanes

where there is not sufficient room for curb and gutter. Payment for integral curb is made based upon curb heights (6 in. [150 mm] and under, and over 6 in. [150 mm]) regardless of type. Type of curb is indicated on the 2B sheets.

4-09.3 (4) STANDARD CURB AND GUTTER. The standard curb and gutter section is used adjacent to through traffic lanes in lieu of integral curbs wherever there is sufficient room. A 4 in. [100 mm] Type 5 aggregate base should be placed beneath curb and gutter (see [Standard Plan 609.00](#)). The plans should specify the type of curb and gutter.

4-09.3 (5) PLANS. Standard curb sections and curb and gutter sections are used if at all practicable. If conditions merit the use of non-standard curb or curb and gutter section, the plans show complete details. The plans clearly indicate the location, type, and quantities for all curbs, and curb and gutters. Integral curb on paved approaches is measured and paid for as part of the approach and is not listed as a separate pay item.

4-09.4 EROSION CONTROL. The purpose of erosion control is to minimize the quantity of erodible sediment leaving the project limits during construction. Of great concern is construction around sensitive areas such as lakes, ponds, rivers, creeks and wetlands. When these water bodies are downstream of the project, appropriate preventive measures should be included in the project. The designer may coordinate with the district roadside personnel to obtain additional assistance with preventive measures.

4-09.4 (1) PERMANENT EROSION CONTROL. Permanent erosion control measures are installed to reduce maintenance costs and to improve appearance. These measures should be constructed as soon as practicable to reduce the need for temporary erosion control measures.

4-09.4 (1) (a) DITCHES. After grading quantities have been balanced to the extent that grades are approximately set, and after culvert flow lines have been set, all ditches are analyzed to determine the necessary erosion control measures. The method of determining the quantity of runoff to ditches and the velocity of flow in ditches is given in [Subsection 9-04.2](#). Details for ditch protection is given in [Subsection 9-04.3](#).

4-09.4 (1) (b) SLOPES. Erosion of slopes is controlled by use of interception ditches and by application of proper slope protection measures such as fertilizing, mulching, seeding, or sodding. A flatter slope allows establishment of vegetation in a timely manner and better compaction, thereby reducing slump problems and slide potential. Where steep slopes are proposed, rock fill should be specified to minimize erosion and the possibility of slides.

The extent and selection of the necessary erosion control measures required for the protection of slopes is based on good engineering judgment, in that less expense should be incurred for these items on improvements in rural areas than in urban areas. In built-up urban areas where any necessary maintenance is costly and difficult to perform, it is essential to reduce erosion to a minimum and provide slopes with a pleasing appearance that will blend with the surrounding improvements.

4-09.4 (1) (c) FERTILIZING, SEEDING, AND MULCHING. Fertilizing, seeding, and mulching are the minimum erosion control measures applied to improvements. When designing the erosion control plan, the district should request a recommendation for fertilizing and seeding/sodding. The Maintenance Division furnishes the rates of application and types of fertilizer, soil neutralizer and seeding to the district. The district includes the types and rates in the proposal as a job special provision. If practicable, the types and rates are constant within any one project. The number of different types and rates are held to a minimum for simplification and to reduce the number of bid items.

4-09.4 (1) (c) 1. FERTILIZING AND SOIL NEUTRALIZATION. Earth shoulders, medians, and the entire roadway outside the roadbed limits, excluding rock or surfaced areas, are fertilized and limed. Separate payment is not made for fertilizing and liming areas to be sodded or seeded by contract.

4-09.4 (1) (c) 2. SEEDING. Earth shoulders, medians, and the entire roadway outside of the roadbed limits, excluding solid rock and surfaced or sodded areas, are seeded. Requests for wildflower areas are reviewed by the Maintenance Division on an individual basis with seeding and fertilizer recommendations made to suit each situation.

The plans specify the seeding mixture, rate of application, and the areas to be seeded in acres [hectares]. In special cases, the seeding may be applied by maintenance forces from construction funds, if requested by the district and approved by the Maintenance Division. Where the work is performed by contract, the seeding item includes fertilizing and liming.

- 4-09.4 (1) (c) 3. MULCHING.** All seeded areas except earth shoulders or areas otherwise protected with some type of erosion control are mulched. Mulch quantities are indicated on the plans by area in acres [hectares].
- 4-09.4 (1) (d) SOD.** Sod can be used as an erosion control measure on slopes and in ditches and is preferred over seeding when it is necessary to quickly establish vegetative growth. In urban areas, it is generally necessary to use sod on all slopes and other areas disturbed during construction to prevent erosion and to provide a pleasing appearance that will blend with the surrounding improvements. Where appearance or the need to quickly establish vegetative growth are not critical, other erosion control measures are considered.
- 4-09.4 (1) (e) TOPSOIL.** Topsoil may be placed in areas where the existing soil will not support vegetation and where a quick growth of grass or sod is necessary to prevent erosion or to improve appearance. This item is usually used in islands, medians, and on slopes in highly improved urban areas where it is impracticable to build the fertility of the soil with fertilizer. Rock or shale cuts may require benching to hold the topsoil on the slope. The plans show the location on which the topsoil is to be placed, the depth and the volume of topsoil required in cubic yards [cubic meters] and any special conditions for placement of the topsoil. A minimum of six inches of topsoil is recommended where it is used.
- 4-09.4 (1) (f) INTERCEPTION LEVEES AND DITCHES.** The plans provide for the construction of interception levees and ditches at the top of earth backslopes of cuts at all locations where the natural ground drains toward the backslope. See [Subsection 9-04.4](#) for more details about interception levees and ditches.
- 4-09.4 (2) TEMPORARY EROSION CONTROL.** A temporary erosion control plan is required for all projects that disturb any land area, including borrow areas. Details of temporary erosion control items are shown on [Standard Plan 806.10](#)

The purpose of the temporary erosion control plan is to prevent the sediment resulting from the contractor's activities from leaving the right of way. It is not the intent to clean up drainage from adjacent property, although this may occur. If stage construction is expected on the project, a separate erosion control plan should be developed for each stage, if applicable. The erosion control plan should attempt to intercept the sediment before it enters crossroad drainage. Temporary erosion control measures are not to be placed in natural drainage or streams.

Sensitive areas are of great concern with regard to temporary erosion control measures. Care should be taken to employ appropriate erosion control measures to prevent sedimentation in nearby lakes, ponds, rivers, creeks, and wetlands. Projects in the vicinity of stream crossings warrant careful attention. [Standard Plan 806.10](#) shows temporary erosion control measures for bridges and box culverts at stream crossings. The Design Division, Construction and Bridge Division are available for design guidance to handle stream crossings. The special provision "Temporary Stream Crossing" should be included in contracts where necessary for movement of contractor's equipment across a stream. Coordination with the appropriate wetland specialist in the Design Division is necessary for all stream crossings to determine any necessary permits.

The designer must determine that sufficient right of way or easement is available for the construction and maintenance of all erosion control devices. This is particularly important when using sediment basins and silt fences. If necessary, easements should be acquired at drainage inlets and outlets.

The erosion control plans should indicate the right of way limits including temporary and permanent easements and construction limits. All permanent drainage structures and temporary erosion control features are shown. Removal requirements for all temporary erosion control features, with the exception of slope drains, may be waived. Slope drains should be designated as "leave in place" or "removal" on the plans. Temporary erosion and sediment control pay items are itemized on the 2B Sheets, including size and depths required for sediment

basins.

- 4-09.4 (2) (a) **TEMPORARY BERMS.** Temporary earth berms constructed at the edge of the embankment during the grading operation will prevent slope erosion and direct run off to a down (slope) drain or catchment area. These berms are used on all grading projects. The quantities are estimated by multiplying the length of embankment in the profile by 1.5. Type "A" berms are constructed at the end of each day's operations on embankments. There is no direct payment made for type "A" berms. Type "B" berms are constructed when embankment operations are shut down over an extended period.

Type C berms are used as a dam-like structure and are most effective at the base of fill for bridges at stream crossings. These berms are constructed of a material meeting the specifications for rock base material. A straw layer or an approval erosion control blanket used on the upslope side of the berm is an effective measure for catching sediment.

Interceptor berms may be used when temporary berms are installed on all grades in excess of 1% or at locations where water is to be carried down the fill slope by temporary or permanent slope drains.

- 4-09.4 (2) (b) **TEMPORARY PIPE SLOPE DRAINS.** Temporary pipe slope drains carry water from a work area to a lower elevation. Temporary pipe slope drains should be placed at 500 ft. [150 m] intervals or as directed by the Engineer. The length of pipe needed is estimated at the average height of fills. For slope drains constructed at 500 ft. [150 m] intervals, an 8 in. [200 mm] smooth conduit or a 12 in. [300 mm] corrugated conduit is suitable.

- 4-09.4 (2) (c) **DITCH CHECKS.** Ditch checks are used to contain sediment on the construction site. The spacing is based on a "toe to top" standard as shown in [Standard Plan 806.10](#). Most ditch checks are constructed to an approximate 18 inch (450 mm) height, although Type II ditch checks are frequently constructed to an approximate 24 inch (600 mm) height. The quantities for pay items should be based on a typical 18 inch (450 mm) ditch check height.

Ditch checks are categorized into two types, Type I and Type II. Type I ditch checks are utilized where drainage areas are 3 acres or less, ditch slopes 10 percent or less and expected ditch flow volumes are small. Type II ditch checks should be utilized for drainage areas of 50 acres or less, ditch slopes 10 percent or less and where high ditch flow volumes are expected. Type II ditch checks are also needed instead of silt fence across most drainage ditches that leave the right of way. If a situation exists where a Type I or II ditch check is not suitable due to site conditions (i.e., a steep ditch with significant drainage area), a combination of ditch checks and erosion control blankets (or rock blanket) should be designed so as to effectively reduce flow velocities in the ditch. Ditch checks at crossroad drainage structures should be placed at the upstream end.

- 4-09.4 (2) (c) 1. **ROCK DITCH CHECKS.** If a rock ditch is specified and located outside the clear zone, consideration should be given to using the check as a permanent erosion control measure.

- 4-09.4 (2) (c) 2. **DROP INLET CHECKS.** Ditch checks are necessary at the upslope side of each median drop inlet and on both sides at low points.

- 4-09.4 (2) (c) 3. **ALTERNATE DITCH CHECKS.** Available products for ditch checks are provided for in the specifications and approved products list. The district geologist and the Research Division are available for further guidance.

- 4-09.4 (2) (d) **SEDIMENT BASIN.** This is a basin that is excavated or an area that is dammed. The basin should have a ponded volume of 1815 ft³ per acre. [125 m³per hectare] of drainage area. It is used for drainage areas of 2 to 5 acres [0.8 to 2.0 ha] or where a roadway cut ditch exceeds 1000 ft. [300 m] in length. Larger drainage areas or longer cut ditches should be divided into smaller areas if possible. The allowable depth of a sediment basin ranges from a minimum of 2 ft [0.6 m] to a maximum of 6 ft [1.8 m]. The allowable width ranges from 5 to 20 ft [1.5 to 6.0 m], and the allowable length ranges from 25 to 200 ft [7.5 to 60 m].

- 4-09.4 (2) (e) TEMPORARY SEEDING AND MULCHING.** This item is normally needed when there is grading on a project with staged and temporary construction. Quantities are determined by calculating the areas of staged and temporary construction, plus 20% to provide for authorized areas through the winter shutdown period that are not ready for permanent seeding.
- 4-09.4 (2) (f) STRAW BALES.** A barrier of baled straw is used to prevent sediment from leaving the construction site. It is used in ditches as ditch checks or along the toe of slope of right of way for fills less than 10 ft [3.0 m] high. Straw bales do not perform well in areas of high runoff flows.
- 4-09.4 (2) (g) SILT FENCE.** Silt fence is used to contain sediment on the construction site. It can be used for ditch checks, along the toe of the fill, along the right of way line, or parallel to streams. It is used to capture sediment from fills over 10 ft [3.0 m] high. On all fills greater than 10 feet [3.0 m] high, consideration should be given to soil erodibility and slope grade for mid-slope runs of silt fence and/or erosion control blankets as described in [Subsection 4-09.4\(2\)\(h\)](#). Silt fence does not perform well in areas of high runoff flows.
- 4-09.4 (2) (h) EROSION CONTROL BLANKETS AND TURF REINFORCEMENT MATS.** There are a number of erosion control blankets and turf reinforcement mats available for consideration for the following situations:

- Fill slopes greater than 10 feet [3.0 m] high
- Ditch slopes greater than 10 percent
- Highly erodible soils
- Fluctuating water levels
- High ditch flows
- High sheet flow
- Standard seeding and mulching will not withstand anticipated runoff
- Around high quality water bodies

Erosion control blankets made of wood, straw or coconut fiber mat, excelsior, paper mat, synthetic mat, jute mesh and other materials have been successfully used on projects. These products are available in short-term photodegradable and extended/long-term degradable. When an erosion control blanket is going to be used, indicate the desired type on the plans based on the engineering properties listed in [Table 4-09.1](#) and [Table 4-09.2](#). Engineering judgment should be used if the soil type does not clearly fall into one of the listed types of soil. For the flexible channel liners, calculate the expected shear stress for the ditch to choose a type. Based upon the determined Manning's coefficient (*n*), the known geometry of the channel, and the estimated depth of water in the ditch, the shear-stress flows can be calculated. The district geologist and the Development and Technology Division are available for further guidance.

**TABLE 4-09.1
SLOPE PROTECTION**

Type	Slope	Type of Soil
A	3:1 or flatter	Clay
B	3:1 or flatter	Sandy
C	steeper than 3:1	Clay
D	steeper than 3:1	Sandy

**TABLE 4-09.2
FLEXIBLE CHANNEL LINER**

Type	Duration	Shear Stress
E	Short-term (up to 2 years)	0-2 lb/ft [0-96 Pa]
F	Short-term (up to 2 years)	0-4 lb/ft [0-192 Pa]
G	Long-term (longer than 2 years)	0-6 lb/ft [0-287 Pa]
H	Long-term (longer than 2 years)	0-8 lb/ft [0-383 Pa]

- 4-09.4 (2) (i) TEMPORARY PIPE.** Temporary pipes are used to carry water under a road that handles traffic, such as a haul road or temporary crossover. The pipe is sized based on a two-year storm.
- 4-09.4 (2) (j) SEDIMENT REMOVAL.** Quantities are estimated using 10 yd³ [8 m³] per sediment basin, 1 yd³ [1 m³] per ditch check, and 1 yd³ per 100 linear ft [1 m³ per 40 m] of silt fence or straw bale barrier.
- 4-09.5 EMBANKMENT PROTECTION.** Types of embankment protection are (1) Rock Fill, (2) Rock Blanket, (3) Revetment, (4) Concrete Slope Protection, and (5) Gabions.
- 4-09.5 (1) ROCK FILL.** The placement of embankments constructed with rock to the controlled gradation required for rock fill is paid for on the basis of placing rock fill by volume. Rock fill is specified where necessary to control embankment erosion, to prevent capillary action from saturating embankments, and to prevent the entrapment of water by the embankment. Sometimes this can be accomplished by constructing the embankment with rock excavation without specifying rock fill. In this case, separate payment is not made for placing the rock. Where rock fill is specified, the plans provide the item for its payment. If the plans do not provide sources for the rock fill material, the plans provide the item for furnishing rock fill. If the plans provide sources for the rock fill, the excavation of the material is paid for under the appropriate roadway excavation item. Rock fill material is secured from roadway excavation, if practicable. If not, the plans provide areas from which the rock fill material is to be obtained. If neither is practicable, the plans provide the item for furnishing rock fill. The plans clearly indicate data by appropriate notes. The plans specify location and dimensions as required to cover the extent of rock fill, and include quantities for its construction.
- 4-09.5 (2) ROCK BLANKET.** Rock blanket is used and specified as required to protect roadway slopes, at bridge ends and culverts, and to protect stream banks. When rock blanket is used under bridge ends, concrete slope protection (See [Subsection 4-09.5\(4\)](#)), should be used as an apron adjacent to the bridge wing walls, as shown on [Standard Plan 611.60](#). The requirement for rock blanket at bridge ends and at large culverts is specified on the bridge field check memorandum. The requirement for rock blanket at other locations is determined during plan field checks. Rock blanket at bridge ends extends to at least 30 ft. [9 m] along the embankment from the bridge abutment on the upstream side, and to at least 20 ft. [6 m] along the embankment on the downstream side, unless otherwise specified on the bridge field check memorandum. Rock blanket is constructed to a thickness of from 1.5 to 3.0 ft. [460 to 900 mm], depending on stream velocities and protection needed. The standard specifications define two types of rock blanket. Type 1 rock blanket is specified where the stream velocity is less than 6 ft/s [1.8 m/s]. Type 2 rock blanket is specified at bridge ends and at other locations where the stream velocity is 6 ft/s [1.8 m/s] or more. The rock blanket is extended to at least 2 ft. [600 mm] below natural ground or finish grade at bridge ends, and to at least 2 ft. [600 mm] below the stream flow line where used on stream banks, unless otherwise specified on the bridge field check memorandum. If the plans provide sources for the rock blanket, the excavation of the material is paid for under appropriate roadway excavation items. Rock blanket material is secured from roadway excavation, if practicable. If not, the plans provide areas from which the rock blanket material is to be obtained. If neither is practicable, the plans provide the item for furnishing rock blanket. The plans clearly indicate these data by appropriate notes. The plans specify type, location and dimensions for rock blanket and include quantities for its construction.
- 4-09.5 (3) REVETMENT.** Revetment is used on stream banks in lieu of rock blanket where the thinner protection provided by the revetment is adequate and where stream bank stability will permit. Light stone revetment is used for stream velocities of approximately 8 ft/s [2.4 m/s] or less or where the height of the revetment is 4 ft. [1.2 m] or less. Heavy stone revetment is used where stream velocities exceed approximately 8 ft/s [2.4 m/s] or where the height of the revetment exceeds 4 ft. [1.2 m]. Grouted revetments should not be used as they do not allow for settling, resulting in cracking and the potential for large washouts. The plans show location, dimensions, and quantities for revetment and specify either light or heavy stone revetment.
- 4-09.5 (4) CONCRETE SLOPE PROTECTION.** Concrete slope protection is usually used under the ends of all grade separation structures, but it may be used at other locations where necessary to prevent slope erosion. Concrete slope protection under grade separation structures is specified on the bridge field check memorandum where required. Concrete slope protection is constructed to a 4 in. [100 mm] thickness, unless otherwise specified on the plans. The 4 in. [100 mm] thickness is usually used under grade separation structures and as an apron

adjacent to bridge wing walls. Thicknesses greater than 4 in. [100 mm] may be specified at other locations. The plans show locations, dimensions, thickness if other than 4 in. [100 mm], and quantities for concrete slope protection.

- 4-09.5 (5) GABIONS.** Gabions are useful to control erosion around bridge and culvert structures or other locations subject to scouring at the base of the embankment or drainage channel. Gabions and mattresses consist of rectangular units, fabricated from welded wire fabric or twisted hexagonal mesh zinc or PVC (polyvinyl chloride) coated wire. Filled with stone, gabions become large, flexible and permeable elements from which a broad range of structures can be built (retaining walls, river bank protection, weirs, etc.). Gabions are divided into cells with diaphragms, whose function is to reinforce the structure. Vegetation that establishes in the gabion will provide further reinforcement. The MoDOT gabion specification in [Section 611](#) is intended for erosion control applications with one or two tiers of gabion baskets, at approximate heights of four feet or less. Applications with higher stacking of baskets that will function as retaining walls will need additional design considerations as to the size and configuration of the gabion.

ASTM Standards A 974-97 and A 975-97 as referenced in Section 611 allow a variety of wire types. The contractor will have the option to select the basket type and manufacturer. The designer should determine if the gabion is subject to standing water. For a wet/dry environment, the plans should note where PVC coated wire is required. The designer may also require a qualified manufacturer's representative to be on-site at the beginning of each gabion installation to review standard installation procedures with the contractor and the owner's representative. If a neat appearance is desired, the plans should require hand stacking of the front face.

- 4-09.5 (6) PLANS.** The plans specify the location and type of embankment protection. No direct payment will be made for any excavating or for other work necessary in preparing the subgrade, trenching or for backfilling required for rock blanket, revetment, or concrete slope protection.

- 4-09.6 FENCING.** All interstate highways shall have continuous fencing on either the right of way line or at or near the access-control line except in areas of precipitous slopes or natural barriers, or where it can be established that such fencing is not necessary to effectively preserve access control.

Fencing types should consist of woven wire and barbed wire fence 54 in. [1365 mm] high for rural and some suburban areas, and chain link fence minimum 60 in. [1525 mm] high for urban and suburban areas and other developed areas where pedestrian control is desirable. Chain link fence shall be used through the limits of rest areas.

Where outer roadways are provided, the use of one-strand access restraint cable (for access control only; see [Standard Plan 606.40](#)) may be considered as a substitute for fencing at the access control line when the primary purpose of fencing is to prevent vehicular movements.

Completed sections of interstate highways should be reviewed and fencing provided in accordance with this criteria. Fencing is to be placed regardless of previous compensation for fencing to property owners.

All fence so provided on the plans shall be maintained by the state.

Fencing for other fully limited access highways should be determined on each individual project's needs but generally will not be required.

Where generally acceptable private fences exist, they may be utilized to develop the necessary continuous fencing but maintenance shall remain the responsibility of the owner.

- 4-09.6 (1) PURPOSE.** The purpose of this policy is to reasonably guarantee access control to the motorist. It is not the intention of this policy to provide fencing on an indiscriminate basis since all fencing provided by the plans is to be maintained by the state. Fencing provided under this policy is access control work not normally anticipated to be done by maintenance forces. At isolated locations effective control can be achieved involving a minimum of work through minor grading, ditching, placement of posts, etc., and is preferable to the development of extensive control by fencing.

- 4-09.6 (2) AGRICULTURAL AREAS.** Fencing may be provided in intensive agricultural areas where cropping on the right of way is likely to occur or where cultivating methods result in conditions requiring extra or more extensive maintenance operations than normal.
- 4-09.6 (3) DRIVE GATES.** Drive gates may be provided at selected locations to assist maintenance operations. Drive gates may also be required at locations involving certain utilities. The use of drive gates should be held to a minimum.
- 4-09.6 (4) PLANS.** Fencing is indicated on plans by appropriate symbol at the time right of way plans are approved by the district. Separate approval of fencing is not required when used in accordance with fencing policy. Plans shall show all drive or walk gates. Utility relocations performed before the fence installation may affect the location of the fence. The district should request a variance to the commission's utility policy from the Design Division to allow utility facilities to be installed, or relocated, 2 to 8 ft. [0.6 to 2.4 m] from the right of way line. This will allow space for the fence to be installed. See [Figure 4-09.3](#) for fencing location and installation information.

Plans shall specify height and type of fence as required and the number of walk and drive gates. Double-drive gates are considered as a single unit. The type of material for the fence (zinc-coated steel, aluminum coated steel, aluminum alloy and vinyl coated steel) is generally at the contractor's option and is not specified in the contract except where special conditions may dictate the use of a specific type. [Figure 4-09.3](#) shows typical installation plans for various conditions. The use of floodgates in fencing should be avoided to the greatest extent possible. To eliminate right of way payment for temporary fencing, a special provision should be provided to require fencing as first order of construction on a project.

- 4-09.6 (5) ONE-STRAND CABLE – ACCESS RESTRAINT.** One-strand cable is used in conjunction with fencing under the fencing policy to restrain access between outer roadways and through lanes. Cable placement is referenced to the outer roadway shoulder. See [Standard Plan 606.40](#) and [Figure 4-09.3](#). One-strand cable is indicated on the plans by the appropriate symbol.
- 4-09.7 GUARDRAIL.** Guardrail is used to protect traffic from roadside obstacles or to prohibit traffic movements. Guardrail is used when the severity of an accident involving an obstacle would be greater than the severity of an accident involving the protective guardrail. Standard design requires a 2 ft. (600 mm) offset behind the guardrail. If the 2 ft offset is not feasible, use of 9 ft. [2700 mm] guardrail posts (Type A guardrail only) at half post spacing may be an option (see [Subsection 4-09.7\(17\)](#)). Use of this design requires approval by design exception (see [Subsection 2-01.8](#) for information regarding design exceptions). Use of 3-strand guard cable, in lieu of guardrail on new construction projects, should be limited to locations outside the clear zone, but where the designer wants to protect an errant vehicle from driving over a steep, high fill area. Substitution of guard cable for guardrail is not recommended on sharp curves or on facilities with high truck traffic. For more information on 3-strand guard cable, see [Subsection 4-04.5\(2\)](#).

4-09.7 (1) DEFINITIONS.

- **TYPE A GUARDRAIL** - single W beam rail with 6'-3" [1905 mm] post spacing.
- **TYPE B GUARDRAIL** - double W beam rail (single beam on each side of post) with 6'-3" [1905 mm] post spacing, generally for use in median.
- **TYPE D GUARDRAIL** - single W beam rail with 12'-6" [3810 mm] post spacing for use at end of road or street.
- **TYPE E GUARDRAIL** - single thrie beam rail with 3'-1½" [953 mm] post spacing.
- **END ANCHOR** - a guardrail end device without a buffer end to develop the full strength of the rail system.
- **EMBEDDED END ANCHOR** - an end anchorage system for guardrail whereby the rail is embedded in a concrete block and buried in the backslope.
- **ROCK FACE END ANCHOR** - an end anchorage system for rail whereby the rail is bolted to a rock face.
- **BLOCKOUT** - spacer block to separate the guardrail beam from the post used on all types of guardrail.

- **BULLNOSE GUARDRAIL SYSTEM** – an enclosed guardrail design that wraps a semi-rigid guardrail around a hazard.

4-09.7 (2) 3R/4R PROJECTS. The necessity of guardrail modifications as a part of a 3R/4R project must be evaluated when work is performed on any state maintained roadway. As used here, work is defined as projects which involve raising the elevation of the traveled way through resurfacing which requires height adjustment of the guardrail (as outlined below) or requiring any other adjustment of the guardrail, but does not include surface maintenance activities (i.e. patching, full depth repair, microsurfacing, seal coating, ultrathin bonded wearing surface, 1 ¾" thin lift overlay, and Recycled Asphaltic Pavement (RAP)).

- On dual lane facilities, guardrail end terminals should be upgraded with an approved crashworthy end terminal in both directions even if the project covers only rehabilitation of the roadway in one direction. A bullnose guardrail system should be installed in both directions on expressways and freeways when applicable (see [Subsection 4-09.7](#)).
- Guardrail or concrete barrier blunt ends located on either side of a two-way roadway or on the guardrail approach end of dual lane facilities must be replaced with an approved crashworthy end terminal even if the project covers only rehabilitation of the roadway in one direction.
- All guardrail turned-down ends, concrete height transitions and Breakaway Cable Terminals (BCT) must be replaced with an approved crashworthy end terminal.
- When crashworthy end terminals are installed, the guardrail should be extended to provide the proper length of need to protect the roadside safety hazard based on current policy. The proper flat recovery area required for the end terminal, as recommended by the manufacturer, should also be provided for on the plans.
- All existing guardrail not warranted by present standards should be removed.
- New guardrail, not salvage rail, should be used for all projects except those involving only guardrail height adjustment.
- If no guardrail currently exists at a particular location along the roadway, then none should be constructed as a portion of a project which provides only resurfacing of the roadway unless:
 1. Other locations of guardrail are adjusted as described in this subsection or;
 2. Warranted by an analysis of accident history or;
 3. Obstacles are introduced within the clear zone (i.e. signing, signals, lighting, etc.), which require guardrail according to existing criteria or;
 4. On NHS Routes only as required by current design criteria.
- Wherever possible, and if the proposed shoulder slope does not exceed AASHTO recommendations, resurfacing of the shoulder should be tapered to minimum thickness (1/2" aggregate size). If this can be done, the guardrail remains at the same relative height as originally designed and no adjustments to the rail are necessary. The accepted AASHTO range in cross slope for bituminous shoulders is 2% to 6%. If the shoulder surfacing cannot be tapered to minimum thickness without exceeding the 6% maximum, the guardrail must be raised. Guardrail should be constructed to present standards and the surfacing on the shoulder should be constructed to the minimum slope in order to accept a future resurfacing without further modifying the guardrail. In any case, it is emphasized that the shoulder surfacing is not planned merely to justify guardrail modifications. A maximum of 8% algebraic difference in the slope of pavement and shoulder at the pavement edge is permitted.
- Wherever the resurfacing of the traveled way and the shoulders affects the height characteristic of the existing rail by 3 in. [75 mm] or more, the height of the guardrail must be adjusted and brought fully up to the present standards. Height variations less than 3 in. [75 mm] do not require adjustment of guardrail.
- Deviations from the standard plans such as not being able to obtain the 2 ft. [0.6 m] distance behind the post to the break point is considered to constitute a special case and justified recommendations should be submitted to the Design Division to enable the use of 9 ft. [2700 mm] posts by design exception. (For more information on the use of 9 ft. [2700 mm] posts, see [Section 4-09.7\(20\)](#)).
- Any unconnected bridge approach guardrail should be connected to the bridge by an acceptable transition design. This work should be accomplished in conjunction with any significant roadway work in the same area.
- Approved crashworthy end terminals meeting NCHRP 350 Test Level 3 (TL-3) criteria should be used on

all roadways with posted speed limits greater than 45 mph [70 km/h]. Test Level 2 (TL-2) end terminals may be used on roadways with posted speed limits of 45 mph [70 km/h] or less, and Test Level 1 (TL-1) end terminals may be used on roadways with posted speed limits of 30 mph [50 km/h] or less.

- On 3R/4R and safety improvement projects that include the installation of guardrail, it is important to upgrade the existing roadside elements in the following order:
 1. All turned-down, blunt ends or other noncompliant NCHRP 350 end terminals must be replaced with an approved end terminal (see [Standard Plans 606.00](#)). Associated “length of need” improvements, (include both upstream and downstream ends of the guardrail) according to current design criteria, are also to be made. As an element of this activity, existing guardrail constructed with steel blockouts and 6’ posts without 2’ of level ground behind the guardrail are to be left in place.
 2. All noncompliant NCHRP 350 attachments of guardrail to a bridge end must be replaced using an approved bridge anchor section (see [Standard Plan 606.22](#)).
 3. In addition, guardrail should be provided to close median bridge gaps.
 4. When it is necessary to replace more than 50% of an existing length of guardrail (not constructed to existing criteria) as a result of slides or extensive damage, the entire length of guardrail should be removed and replaced with new guardrail according to current design criteria.
 5. Fixed objects within the clear zone of the mainline roadway should be removed, relocated, redesigned or shielded in accordance with current design criteria. Fixed objects include non-breakaway signs and luminaries, trees, culvert ends, non-traversable drop inlets, etc. These improvements could be delayed until rehabilitation of the roadway surface is provided as long as the rehabilitation is contained in any of the first three years of the STIP.
 6. Maintenance crossovers located in the median should be improved in accordance with current clear zone requirements. Additionally, the portion of interchange ramps located within the clear zone of the mainline roadway should be upgraded. However, these improvements could be delayed until rehabilitation of the roadway surface is provided as long as the rehabilitation is contained in any of the first three years of the STIP.

This listing is a guide for the design team to address individual guardrail improvements on individual projects. It is not intended to be a strict guide for the selection of projects or the allocation of funds.

- 4-09.7 (3) APPROVED CRASHWORTHY END TERMINALS.** Crashworthy end terminals are defined as the devices used to provide an acceptable level of safety to the end of a roadside barrier or fixed object. Such treatment is required because of the serious consequences that result from a vehicle impacting an untreated barrier. An untreated end can cause an impacting vehicle to abruptly stop, become unstable or roll; it can even penetrate the passenger compartment, all of which increase the risk to the vehicle’s occupants.

An approved crashworthy end terminal is a device or system that has met the safety requirements contained in the NCHRP 350 and has been accepted by the FHWA. The safety requirements of NCHRP 350 are based on several parameters among which are rate of deceleration, tendency to roll, and penetration of the passenger compartment. Within NCHRP 350 are six different test levels that vary depending on the speed, angle of impact and weight or type of vehicle. The test level required for highways in the state highway system is usually Test Level 3 (TL-3). An end treatment satisfying this test level will safely handle the impact of vehicles as large as a 4,400 lb (2000 kg) pickup truck impacting at 60 mph (100 km/h). When the generic term “approved crashworthy end terminal” is used, it most often refers to a TL-3 device. Some crashworthy end terminals are preferable to others at locations with a high frequency of impacts. Where applicable, a public interest finding may be desirable to identify a specific end terminal for a given location. Designers should refer to the information pertaining to crashworthy end terminals available on MoDOT’s website.

- 4-09.7 (3) (a) TYPE A CRASHWORTHY END TERMINAL.** A Type A terminal is an end treatment used for one-sided barriers such as roadside guardrail or roadside concrete barrier. Type A devices can also be used on one-sided barriers in the median, provided sufficient clear space is available behind the system to allow opposite direction traffic to recover from an errant path.

- 4-09.7 (3) (b) TYPE B CRASHWORTHY END TERMINAL.** A Type B terminal is an end treatment used for double-sided barrier, most often in the median. Such a device can safely be impacted from several angles

including, in most cases, the entirely opposite direction. Type B terminals cannot, however, be installed in paved surface locations unless the installation is temporary and the paved area is to be resurfaced after the system's removal.

- 4-09.7 (3) (c) TYPE C CRASHWORTHY END TERMINAL.** A Type C terminal is an end treatment used for double-sided barrier, in gore areas and in the median. Like the Type B, this device can be safely impacted from several angles usually ranging from head-on to the entirely opposite direction. Type C terminals, however, may be installed in both paved and unpaved surface locations, but must be installed on an asphalt or concrete pad in non-paved areas.
- 4-09.7 (3) (d) SAND BARRELS.** Sand barrels are a crash cushioning system that are most often used to shield fixed objects that cannot be removed or relocated. Sand barrels are recommended for temporary usage such as in work zones. A benefit/cost analysis should be conducted before sand barrels are used in a permanent application. The system consists of sand-filled plastic barrels configured in increasing weights from the impact point toward the object. Such an array transfers the vehicle's momentum to the increasing masses of sand in the barrels and provides a gradual deceleration. Refer to Standard Plan 612.20 for additional details.
- 4-09.7 (4) BULLNOSE GUARDRAIL SYSTEM.** The bullnose guardrail system should be used in the medians of expressways or freeways to shield drivers from hazards, such as bridge piers and other obstacles. It is not a crashworthy end terminal, but is rather a non-gating barrier principally constructed of Type E guardrail. As long as the median's vertical differences are minimal or can be graded, the bullnose guardrail system is the preferred treatment for new construction. The bullnose guardrail system requires at least 15 ft (4.5 m) of median width for its construction. The bullnose guardrail system should not be erected between twin bridges. Alternatives are available for twin bridge protection in Standard Plan 606.00. Alternatives requiring a design exception are available for bridge pier and other median hazard protection. Consult [Standard Plan 606.01](#) for grading requirements and other important details.
- 4-09.7 (5) ANCHORED IN BACKSLOPE GUARDRAIL.** In areas of roadway cut section, or where the road is transitioning from cut to fill, designers are encouraged to consider the application of anchored in backslope guardrail. Often this can be accomplished by extending the guardrail beyond the length-of-need to tie the guardrail into the backslope. When properly designed and located, this type of anchor provides full shielding for the identified hazard, eliminates the possibility of an end-on impact with the terminal, and minimizes the likelihood of the vehicle passing behind the rail.
- 4-09.7 (6) END TREATMENT.** The guardrail should be extended outside of the clear zone, or the guardrail end should be embedded into an adjacent embankment or attached to a solid rock face to eliminate the need for a crashworthy end terminal. If these options are not practical, all approach ends of guardrail, as illustrated by the standard plans, are provided with an approved crashworthy end terminal and a separate payment is made for each crashworthy end terminal. The district should indicate on the plans where a crashworthy end terminal is to be installed. All downstream ends on two-way roadways are provided with an approved crashworthy end terminal. All downstream ends on dual lane highways are provided with an end anchor.
- 4-09.7 (7) HIGH FILLS.** Guardrail for embankments is specified on plans for roads with 400 ADT or more. For roads under 400 ADT, guardrail is optional, however, good design judgment should require guardrail when conditions warrant. Guardrail is not normally warranted for embankment height on projects where clear zones are utilized. However, guardrail may be warranted as shown on Figure 5.1 in the AASHTO Roadside Design Guide. Combinations of embankment height and slope that plot above the curve indicate a need for guardrail. Combinations plotting below the curve indicate conditions are less severe without guardrail. However, other factors contributing to accident severity such as hazards located either on or at the toe of the slope should be taken into consideration.
- 4-09.7 (8) FIXED OBJECTS.** Guardrail protection for fixed objects such as trees or utility poles may be necessary. If this protection is required, the protection is determined from the near lane on one direction roadways and from both lanes on a two direction roadway. Guardrail is warranted in advance of any fixed object located within the clear zone provided the object is potentially more damaging than the guardrail if struck by a vehicle and the

object cannot be economically removed, relocated, or made crashworthy by means of breakaway type construction. The fixed object is termed the area of concern and the required type and length of guardrail depends on the size of the object, the distance from the traveled way, the ADT, and the design speed. The length of need of guardrail is the length of the obstacle plus the length of the approach barrier adjacent to traffic (and opposing lane, if needed). The length of need and the flare rate of the guardrail shall be determined in accordance with the procedures contained in Section 5.6.4 of the AASHTO Roadside Design Guide. The general geometric data covering the length of need are illustrated on Figure 5.19 of the Roadside Design Guide.

- 4-09.7 (9) AESTHETIC GUARDRAIL.** Aesthetic guardrail is available for projects located along scenic highways, at scenic overlooks or at other locations where a rustic appearance may be appropriate. Wood, composite or recycled materials are often the primary constituents of this type of guardrail. Because aesthetic guardrail would be expected to cost more than typical guardrail, additional funding shall come from the local jurisdictions, enhancement funds, other non-department sources or a combination of these.

There are no aesthetic crashworthy end treatments approved by MoDOT. Designers incorporating aesthetic guardrail on a project should refer to the information pertaining to crashworthy end treatments available on MoDOT's website. Designers should be aware that for the proper design of guardrail from some manufacturers, the length of need is to begin at least 100 feet (30 m) downstream from the terminal.

Care should be taken by the designer to consider whether a specific appearance is desired for the aesthetic guardrail. If a specific appearance is deemed appropriate in order to coordinate with existing facilities or some other aspect of the scenic location, the designer should specify the system desired with a Job Special Provision.

No approved end terminal exists for most types of aesthetic guardrail. Therefore, in these cases, the end of the rail must be terminated into a backslope or extended to a point outside the clear zone. Specifications in Sec 606 have been prepared in anticipation of the eventual production of approved end terminals for aesthetic guardrail.

- 4-09.7 (10) BRIDGE ENDS.** Guardrail is placed at bridge ends in accordance with typical locations shown in the standard plans for all roads. Approved crashworthy end terminals are provided on guardrail placed for bridge end protection. Guardrail placed for bridge end protection is anchored to the bridge end by a bridge anchor section. In retrofit projects having non-standard transitions and slopes, the connector plates for bridge anchor sections may be slightly adjusted to produce a vertical terminal connector. See [Standard Plan 606.22](#). Existing bridge end connections that do not conform to current standards should be considered for replacement or modification. In order to determine the appropriate solution for the specific non-standard bridge end connection, the the Bridge Division Liaison Engineer should be consulted. Where guardrail at the exit end of a one-way bridge is necessary because of a high fill or other condition, the guardrail is connected to the bridge anchor section.

Guardrail is not generally used to protect traffic from the ends of bridges carrying a crossroad or street over the through lanes in developed areas where speed controls exist or sidewalks are provided. If however, at ends of such bridges the roadway is in a high fill or has sharp curvature, guardrail may be considered.

- 4-09.7 (11) BRIDGE PIERS AND SIGN TRUSSES.** Guardrail is specified for protection of traffic from bridge piers and sign trusses with the exception of those piers and trusses where the pier or truss footing is located outside the clear zone. Typical treatments are indicated in the standard plans.

- 4-09.7 (12) SIGNS.** Guardrail is specified to protect traffic from sign posts which cannot be equipped with a breakaway assembly. Typical treatments are indicated in the standard plans.

- 4-09.7 (13) OUTER ROADWAYS.** Criteria for guardrail use on outer roadways is the same as for other roads except for the shoulder side adjacent to a through lane. Guardrail is specified along outer roadways where the outer roadway is 10 ft. [3 m] or more above the main roadway, and the shoulder of the outer roadway is less than 25 ft. [7.5 m] from the top of the roadway backslope. Sometimes it is more economical to move the outer roadway back sufficiently to eliminate the requirement for guardrail. Guardrail along outer roadways is installed with the face of the rail facing the outer roadway. Type B rail may be required if the guardrail is within the limits of the clear zone for the through lanes.

- 4-09.7 (14) HEADWALLS.** Guardrail is not used to protect traffic from headwalls located outside of the shoulder line of roadways without clear zones unless warranted by high fills. Exceptions include interstate safety modification projects where clear zones are not added and where it may not be economically feasible to extend a large box culvert to locate the headwall outside the clear zone point.
- 4-09.7 (15) MEDIANS.** See [Section 4-04](#). Guardrail may be specified in medians to provide a positive barrier. Guardrail may also be specified to convert an existing raised curb median to a barrier median provided the guardrail is placed with the face at the face of the curb and the center of the rail 21 in. [535 mm] above the pavement elevation at the curb face. Type B guardrail may be used on a raised median width of 2 ft. [600 mm] back to back. For greater widths, two single lines of Type A guardrail will be required. For medians of variable widths a detail in the standard plans provides for transition from Type B to Type A guardrail. Approved crashworthy end terminals are added only at the beginning and ending of a total run of guardrail and not at each break caused by intersections and median openings. Breaks caused by intersections and median openings will be closed by means of a crashworthy special end treatment. For medians on divided pavements where grade differential will not permit standard clear zones, the slope should be modified to provide as safe a slope treatment as possible. Guardrail will not be required except for exceptional or unusual conditions.
- 4-09.7 (16) RESTRICTED LATERAL CLEARANCE.** When piers or other obstacles require guardrail treatment, the back of the guardrail post is to be placed 4 ft. [1.2] from the pier or obstacle. Where the clearance obtained is less than 4 ft. [1.2 m] but more than 2 ft. [0.6 m], 25 ft. [7.5 m] of Type E guardrail shall be used preceding and through the limits of the obstacle. There will be situations with narrow shoulders or with curbed medians when encroachment is not permitted. In such cases, Type E guardrail should be specified requiring 25 ft. [7.5 m] preceding the obstacle and extending through the limits of the obstacle as required. The minimum offset to the obstacle can be eliminated completely by attaching the rail to the obstacle by use of a bridge anchor section.
- 4-09.7 (17) BARRICADE OF EXISTING STREETS AND ROADS.** Where a street or road which is essentially rural in nature is to be closed for a period of time not to exceed approximately five years, permanent barricades as shown on [Standard Plan 612.10](#) are specified. Where the closing of the street or road is anticipated to exceed approximately five years duration in essentially rural areas, and for closing streets or roads in essentially urban areas regardless of time, either Type IV Object Markers only or a combination of Type IV Object Markers and Type D guardrail is specified. Where no hazard exists beyond the end of the closed street or road for a reasonable distance, Type IV Object Markers are sufficient for delineation. Where a hazard exists beyond the end of the closed street or road which is considered equal to or greater than that created by the use of guardrail, a combination of both Type IV Object Markers and Type D guardrail is specified.
- 4-09.7 (18) PLANS.** Guardrail details and typical locations for installation are shown in the standard plans. Guardrail is shown by proper legend on the plan sheets and the station location and quantities are tabulated on the 2B sheets. Quantities are tabulated in 12'-6" [3810 mm] increments. Curved sections of guardrail are to be installed on curves with a radius of 150 ft. [45 m] or less. The plans specify the lengths of curved guardrail and the radius of curvature. Curved guardrail is not tabulated separately on the plans. Examples of guardrail delineation and tabulation is shown in [Section 4-10](#).
- 4-09.7 (19) URBAN SECTION, CURB AND CURB AND GUTTER.** Where barrier curb is used, guardrail is placed with the face at the face of the curb and the center of the rail 21 in. [535 mm] above the pavement elevation at the curb face. Where mountable curb is used, guardrail is placed with the face at the edge of the usable shoulder and the center of the rail 21 in. [535 mm] above the shoulder elevation. Where curb and gutter is used, guardrail is placed with the face at the face of curb and the center of the rail 21 in. [535 mm] above the gutter line. When curbs are constructed directly beneath guardrail, the curb height shall be 4 in. [100 mm].
- 4-09.7 (20) USE OF 9-FT [2700 mm] POSTS.** When a 2-ft. [600 mm] offset for embankments behind the guardrail is not available, 9 ft. [2700 mm] guardrail posts at a 3 ft. 1-1/2 in. [953 mm] spacing with a minimum of 66 inches [1676 mm] embedment will be required. It should be noted that the standard plans for many two-lane and dual-lane facilities constructed in the 1960s and early 1970s show an additional 2 ft. [600 mm] offset for embankments placed in front of or behind the guardrail. A field review by the Design Division personnel of selected projects constructed in the 1960s and early 1970s revealed that in most cases the edge of the traveled way and the embankment were separated by 12 ft. [300 mm], at least 10 ft. [3000 mm] of which was a paved

shoulder. This additional width, or 2 ft. [600 mm] offset, which was usually unpaved, is present even though the typical sections for these projects do not show it.

Due to this fact, designers should conduct a field check to determine whether additional width is available for projects involving extending or replacing guardrail. This field check should include the District Soils and Geology Technician to determine whether the embankment has eroded or if a slide has occurred. If the original 12 ft. [3600 mm] width has significantly eroded, it should also be determined whether the 2 ft. [600 mm] offset can be restored without causing additional failure.

If it is determined that the 2 ft. [600 mm] offset was not originally constructed at the location, a cost analysis should be conducted to determine whether to add a 2 ft. [600 mm] offset to the slope or use 9 ft. [2700 mm] posts with a 3 ft. 1 ½ in. [953 mm] spacing. If it is determined to use the 9 ft. [2700 mm] posts with a 3 ft. 1 ½ in. [953 mm] spacing, the district needs to submit a design exception to the Design Division for placement of guardrail without a 2 ft. [600 mm] offset behind the guardrail.

If the design exception for 9 ft. [2700 mm] posts is approved, the district will need to request the Special Sheet drawing from the Design Division for the designer to implement into the plans.

- 4-09.8 MANHOLES.** Manholes are specified for sanitary sewers and storm sewers at pipe intersections and at locations necessary to provide access to the sewer. Other requirements for manholes in sanitary and storm sewers are given in Chapter IX. Manholes are not installed in traffic lanes if such an installation can be avoided.
- 4-09.8 (1) CONCRETE.** Precast concrete manholes are specified in the plans unless special conditions require cast in place concrete manholes. When precast manholes are specified in a contract the contractor will be permitted to substitute cast in place manholes. Details for each type are shown in the standard plans. The standard manhole will accommodate pipes up to and including 48 in. [1200 mm] in diameter. Larger pipes require special manhole designs. Concrete manholes are used in storm sewer systems. Concrete manholes are used in sanitary sewers, except where local ordinances require brick manholes. Measurement and payment and 2B sheets for precast manholes will be the same as precast concrete drop inlets (see [Subsections 4-09.9 \(1\) and \(3\)](#)).
- 4-09.8 (2) BRICK.** Brick manhole details are shown on standard plans. Brick manholes are used in sanitary sewers where required by local ordinances. Brick masonry is used to adjust existing manholes in accordance with the details shown on standard plans.
- 4-09.8 (3) FRAME AND COVER.** All manholes, whether concrete or brick, require a manhole frame and cover as detailed on standard plans. The frame and cover is tabulated on the plans with the manhole, indicating the type of cover required. A frame with a locking cover is specified when a manhole is located in a pavement area.
- 4-09.8 (4) PLANS.** The plans show the location, size, and depth of concrete manholes. The size of a precast manhole is the maximum diameter section required. The plans show the location, size, and depth of brick manholes, and the depth of the foul water drop where required. The plans also show the number and type of manhole frames and covers required.
- 4-09.9 PRECAST CONCRETE DROP INLETS.** Precast concrete drop inlets are specified in the plans unless special conditions require cast in place concrete drop inlets. When precast drop inlets are specified in the contract, the contractor will be permitted to substitute cast in place drop inlets to the dimensions required for precast drop inlets. Details for each type are shown in the standard plans.
- 4-09.9 (1) MEASUREMENT FOR PAYMENT.** Measurement of precast concrete drop inlets, complete in place, will be measured to the nearest 1 ft. [0.5 m] for the depth of the drop inlet, measurement being the vertical distance from the top of the inlet as shown on the standard drawing. Grates and bearing plates are paid for as a separate item.
- 4-09.9 (2) TYPE T DROP INLETS.** Where two or more units of Type T drop inlets are required, measurement for payment will be the number of units times the depth, i.e., three units at 6 ft. [1.5 m] depth, the pay quantity being 18 ft. [4.5 m].

4-09.9 (3) 2B SHEET PROCEDURE (COLUMN HEADINGS). The suggested column headings for the accepted arrangement on the 2B Sheet is as follows:

- Col. 1 Station
- Col. 2 Location
- Col. 3 Type - A, B, C, etc.
- Col. 4 ENGLISH Depth "D" - As detailed in culvert sections. Depth is rounded to the nearest foot for each inlet for payment listed under appropriate size, i.e., "D" of 3.5' would be 4.0' "D" of 3.3' would be 3.0'
METRIC Depth "D" - In 100 mm increments as detailed in culvert sections. Depth is rounded to the nearest 0.5 m for each inlet for payment listed under appropriate size
- Col. 5 Grates and Bearing Plates Weight from Standard 614.10 by size of opening.
- Col. 6 Curb Inlet – Number required
- Col. 7 Class 3 Excavation
- Col. 8 Remarks - Number and size of pipe openings required, etc.

4-09.10 PIPELINES. Methods of handling pipeline items and other utility items are given in Chapter VII. The plans show pipeline owner, location, elevation, and disposition. Plan details are developed to minimize pipeline adjustment. Grades and location can sometimes be changed to avoid pipeline adjustment without materially affecting roadway costs. This particularly applies to low type roads.

4-09.11 PRIVATE UNDERPASSES. Private underpasses such as cattle passes are considered only when they can be economically justified by their service and use. Cattle passes are built without bends if possible and so that the outlet can be seen from the inlet end. Such structures are, in effect, always paid for by the property owners they serve, or others. Where the right of way is being purchased, the difference in cost between the underpass structure and a structure required to handle the runoff from the drainage area is deducted from the damages to the property. Where the right of way is being furnished by others without cost to the department, the difference in cost is paid by the property owner or others. In all cases when private underpasses are provided, the files include a record of the economic justification.

4-09.11 (1) RELATED TO ACCESS CONTROL. When a highway project severs a property, access under the structure will be allowed the landowner. Plan design is not to be altered to accommodate owner needs unless justified by appraisal. This item is further discussed in [Section 4-02](#).

4-09.11 (2) TYPES. Bridges, concrete box structures, or large pipes may be used for underpass structures. For cattle passes, a pipe 66 in. [1650 mm] in diameter or a box culvert 6 ft. [1.8 m] in height may be used. Pipe structures may be specified with paved inverts to increase their utility for use as underpass structures. Vehicular underpasses may be of any reasonable size and are usually box culverts.

4-09.11 (3) PLANS. The following note is placed on the plans for each appropriate structure "Access Is allowed under the bridge (or through the culvert)". In addition to the regular note for culverts, the culvert note on plans includes a note "Cattle Pass", "Vehicular Underpass", or "Private Underpass", so that the plans will be a record of the agreement with the property owner to construct underpass structures.

4-09.12 JOB NUMBERS. Improvements are identified by job numbers in the following manner: J7P0414. The first character is always the letter "J". The second character is the district number with zero used for District 10. The third character is the system (I, P, S, U, or X). The fourth through seventh characters are a unique four-digit number assigned by the Office of Transportation Program Management in the Highway Right of Way and Construction Program Book. The eighth character, if there is one, is a letter of the alphabet which designates a different stage of the same basic job number.

4-09.13 RAILROADS. Methods of handling railroad items are in Chapter VII.

4-09.13 (1) TIES TO RAILROADS. The plans show ties between the intersection of the survey centerline and railroad stationing at the centerline of the track. When two railroads are involved ties are shown for each intersection.

The railroad alignment, right of way, and topography are shown for a minimum distance of 500 ft. [150 m] each side of survey centerline. Particular railroad facilities to be shown on the plans include signal and communication poles, signal boxes, signals, and buildings. Where improvements parallel railroads, the plans include ties to all railroad stationing and to track curve points, the railroad curve data, and railroad right of way limits.

- 4-09.13 (2) ENCROACHMENTS ON RAILROAD RIGHT OF WAY.** Improvements paralleling railroads are located if possible to eliminate encroachments on the railroad right of way. Such improvements are located to at least minimize the number of encroachments on the railroad right of way. The railroad right of way is clearly shown on the plans and encroachments are indicated on the plans as construction easements. On highway improvements with access control, the appropriate legend denoting the access control is placed on the common highway-railroad right of way line between the improvement and the railroad. This also requires the purchase of abutters rights from property owners on the opposite side of the railroad right of way. Access to railroad right of way for the purpose of obtaining soil borings is often necessary. In most cases, the railroad requires those who desire to enter their right of way to "Hold Harmless" the railroad. This assumption of liability by the Missouri Highway and Transportation Commission is not acceptable. If it is not possible to obtain the necessary soil borings from just off the railroad right of way, the use of consultants to obtain these borings should be arranged. An "on-call" hourly rate agreement with these consultants should be used. See [Subsection 1-03.4](#) for guidelines and additional information regarding the hiring of consultants. The Geotechnical Section of the Construction and Materials unit should be contacted to arrange for the service. These borings should be obtained as directed by MoDOT staff.
- 4-09.13 (3) SIGHT DISTANCE AT HIGHWAY-RAILROAD GRADE CROSSINGS.** A triangle of right of way or sight distance and unobstructed area easements are obtained in each quadrant at all highway-railroad grade crossings not to be protected with flashing lights, to the extent that a vehicle approaching the grade crossing is able to see a train approaching the crossing in time to stop prior to reaching the crossing. The limits of the additional right of way or sight distance and unobstructed area easement triangles are defined by connecting a point on the highway at a distance from the crossing, based on the stopping sight distance for the highway design speed, and a point on the railroad at a distance from the crossing, based on train speed. The stopping sight distance and factors for various train speeds are tabulated in [Figure 4-09.5](#). If these are not practicable, due to physical obstruction such as buildings, flashing light signal installations may be required. These installations are approved by the Multimodal Operations Division prior to right of way negotiations. Where the railroad or highway is in a cut, the additional area is graded (based on 4 ft. to 4 ft [1.2 m to 1.2 m] height of eye to height of object) as required to obtain sight distances in accordance with [Figure 4-09.5](#). Grading in these areas requires additional right of way or easements beyond the limits normally required. Where grade crossings are to be protected with flashing lights, the additional right of way or easements are not required. In such cases the grades adjacent to the grade crossings are established so that the driver of a vehicle approaching the crossing can see the flashing lights at a distance from the crossing at least equal to the stopping sight distance tabulated in [Figure 4-09.5](#). The determination for installation of flashing lights requires negotiation with various agencies and is handled by the Multimodal Operations Division. Additional right of way is used in lieu of sight distance and unobstructed easements where fences, vegetation, crops, etc., will obstruct the sight distance. This restricts the use of easements to locations where both the railroad and the highway are on fill heights above such features.
- 4-09.13 (4) PLANS.** The plans show complete details of all encroachments upon railroad right of way, and additional right of way or sight distance and unobstructed area easements where required at all highway-railroad grade crossings. If the additional right of way or sight distance and unobstructed area easements are not in accordance with [Figure 4-09.5](#), the letter of transmittal explains the reasons for not following these criteria. If a reduced design speed is used to establish the easement limits, the reduced design speed is furnished in the letter of transmittal.
- 4-09.14 CLEAR ZONES.** Appropriate typical sections are selected for a project using [Figure 4-04.1](#) and recommendations from the location study report.
- 4-09.14 (1) DEFINITION.** The clear zone is defined as the roadside border area measured from the edge of the pavement that is available for the safe use by errant vehicles as determined in accordance with Chapter 3 of the AASHTO

Roadside Design Guide.

4-09.14 (2) USE OF CLEAR ZONES. Clear zones are provided where the design speed of the roadway is 50 mph [80 km/h] or more. For less than 50 mph [80 km/h], clear zones should be considered if economically feasible. Non-traversable slopes or fixed objects should be removed, relocated, or shielded by a barrier if they are within the indicated minimum clear zone width and if it is cost effective to do so. Higher speeds will result in vehicles traveling further before recovery. Horizontal curvature will increase the likelihood of a vehicle leaving the traveled way and will increase the distance it will travel. The designer may choose to modify the clear zone distance obtained from the Roadside Design Guide's Figure 3.1 or Table 3.1 for horizontal curvature by using Table 3.2. These modifications are normally only considered where accident histories indicate a need, or a specific site investigation shows a definitive accident potential which could be significantly lessened by increasing the clear zone width, and such increases are cost-effective. Steeper fill slopes will also increase the distance the vehicle travels off the traveled way. It is important in the implementation of the clear zone concept that the clear zone distances should not be used as boundaries for introducing roadside hazards such as bridge piers or trees. These should be far from the traveled way as is practical. The clear zone width should be applied with good judgment. If an obstacle lies just beyond the clear zone, it should be removed or shielded if costs are reasonable. Conversely the clear zone should not be obtained at all costs. Limited right of way or high construction costs may lead to the installation of a barrier or possibly no protection at all. As may be noted, roadside slopes apply an important part in the clear zone width determination. Fill slopes of 1:6/1:3 are standard, i.e., a 1:6 fill slope extending from the shoulder line out for a distance necessary to obtain the clear zone then break the fill slope to 1:3 or flatter. If feasible, the flattening of slopes is preferable to installation of guardrail. In cut sections, the roadside ditch is likely to be located within the clear zone. Therefore, the configuration of the ditch and the type of erosion control treatment used in the ditch (see [Section 9-04](#)) must be viewed with respect to clear zone requirements. Namely, side slopes of the ditch and the method of erosion control used in the ditch must be traversable by vehicles that leave the roadway. Figure 3.6 in the Roadside Design Guide should be checked for preferred ditch cross sections. Ditch sections must be within the shaded portions of the guides for use with clear zones. Background for this procedure is contained in Appendix A of the Roadside Design Guide. Any deviation from the standard slope will be considered special conditions and should be justified by costs or other considerations.

4-09.14 (2) (a) FOR BRIDGES AND CULVERTS. Clear zones, when used, shall be carried full width to bridge ends. Where the existing roadway is to be incorporated into the completed facility as part of the main roadway, the use of clear zones will be considered on an individual project basis.

The use of the clear zone typical sections is not applicable for small culvert replacement projects where the intent is to continue the service of the road without upgrading it. In this case, the typical sections used in the original construction should be used except that the roadbed width should not be less than 24 ft. [7.2 m].

In shallow fills and in cuts where box or pipe culvert normally require a head wall to be located in the clear zone, the structure should be extended to place the head wall at the outer edge of the clear zone. The slope of the clear zone will then require modification to provide cover over the entire surface.

4-09.14 (2) (b) RAMPS. Flattened slopes or clear zones should be used on ramps to eliminate the use of guardrail. It is the intention to use guardrail only to protect bridge ends within the interchange area.

4-09.14 (2) (c) UNUSUAL CONDITIONS. Where steep sidehill conditions exist and standard clear zone slopes will not catch the ground, steeper slopes must be used. In these cases, the clear zone may be omitted and guardrail used at the shoulder line. Desirable minimum length for elimination of clear zone is 500 ft. [150 m] but no case less than 250 ft. [75 m].

For long fill sections through a reservoir project, clear zones can be eliminated and guardrail used at the shoulder lines.

Speed change lanes adjacent to main roadways are to be placed within main roadway clear zone with no further widening of clear zone. The clear zone is always located adjacent to and measured from the normal

edge of the pavement of the main roadway including climbing or continuous auxiliary lanes.

4-09.15 TEMPORARY CONNECTIONS. Temporary connections are provided on the plans as required to connect improvements to existing surfaces, and to connect lanes at the termini of divided lane facilities. Temporary connections will usually be used by traffic longer than such items as bypasses and are therefore designed to a higher standard.

4-09.15 (1) SURFACING. Temporary connections are usually surfaced with the same surface type as that used on the improvement being planned. An exception is that, where concrete pavement is used, reinforcement and base may be omitted. Temporary connections constructed with concrete pavement are jointed along the edges of main traffic lanes in such manner that the ultimate removal of the connection will be simplified and can be accomplished without disturbing the through pavement.

4-09.15 (2) ALIGNMENT. Temporary connections are usually constructed using a maximum degree of curvature of 3 degrees [minimum radius of 585 m]. Specific conditions may merit the use of flatter or sharper curves. Temporary connections used at the terminus of divided lane facilities are constructed using reversed curves with a maximum degree of curvature of 3 degrees [minimum radius of 585 m], as illustrated on [Figure 4-09.4](#). Temporary connections may be designed with or without superelevation.

4-09.15 (3) LOCATION. Temporary connections are located in such manner that will provide good sight distance for traffic approaching the connection and in such manner that drainage structures required for the connections are held to a minimum. The required sight distance for traffic approaching temporary connections is twice the stopping sight distance based on design speed. These sight distance requirements are the same as those tabulated in [Table 4-05.4](#).

4-09.16 UTILITIES. Policies and methods of handling utility matters are given in Chapter VII.

All existing utilities within right of way limits are shown by proper legend on the plans. In addition, the owners of all utilities are shown and the disposition of the utility by an appropriate note such as "Leave in Place", "Remove", "Abandon", or "Relocate". The plans show the elevation of all underground utilities, and the approximate clearance for overhead utilities. The plans show the location of all new or relocated utilities within right of way limits and their owners. On plans for other than the interstate system, the new or relocated utilities can be shown by legend or with an appropriate note such as "Power line owned by the Able Power Company is to be relocated by owner along left right of way line between _____ and _____".

4-09.17 TEMPORARY U-TURN MEDIAN OPENINGS ON FREEWAYS. U-turn median openings for use by the general public are not provided on freeways.

Temporary U-turn median openings for contractors to haul materials are permitted only at locations indicated in the traffic control plan. Median openings shall be signed in accordance with the traffic control plan.

4-09.17 (1) RURAL. Where the spacing of interchanges is greater than approximately 3 miles [5 km], a U-turn median opening may be provided at a favorable location about halfway between interchanges. Where the spacing of interchanges is greater than about 6 miles [10 km] U-turn median openings may be provided so that the distance between such openings or between a U-turn median opening and an interchange is not greater than about 3 miles [5 km].

U-turn median openings should be located only where there is open, well-above-minimum stopping sight distance along the freeway. They should be at least 1 mile [1.5 km] from any ramp terminal or other access connection such as a safety rest area.

4-09.17 (2) URBAN. Due to the close spacing of interchanges on urban freeways, U-turn median openings are not needed for the operation of official vehicles and in general they should not be provided.

4-09.18 WEIGH STATIONS AND REST AREAS. The general locations for truck-weigh stations and rest areas are designated by the Maintenance Division, in advance of the development of plans for highway improvements.

Weigh stations and rest areas on interstate routes are located not less than 1 mile [1.5 km] from interchanges and on all other routes at locations that provide good sight distance for traffic approaching the weigh station or rest area. Upon completing preliminary surveys and determining tentative grades, a conceptual plan is reviewed by the district for determining the location of the weigh station or rest area, with concurrence of the Maintenance Division and the Traffic Division. Weigh station and rest area locations are finalized prior to completing the preliminary plan. Their locations are indicated on the preliminary plan, and the Maintenance Division and the Traffic Division are furnished with a print of the plan prior to preliminary plan approval.

4-09.18 (1) DESIGN DETAILS. Design details for weigh stations and rest areas are provided by the Traffic Division.

4-09.18 (2) PLANS. The plans provide for the complete installation of the weigh station or rest area. The district is responsible for the satisfactory completion of plans to construct the entire facility. An engineering consultant should be selected to perform the following items: geometric layout, grading, drainage, paving quantities including parking areas, and all other roadway items, including all plans and specifications for the scale, scale pits, the weigh station building or rest area and its appurtenances. The design team for the weigh station or rest area must include representatives of the Highway Patrol. Representatives from the Traffic, General Services, Maintenance (Permit Section) and Design Divisions should serve as resources to the team. Federal funds can be provided for all construction items. Separate bid items will be provided for the scale and pit, generally financed from highway planning funds. Non-highway items such as the building, space heater, air conditioner, cabinets, wells, etc., are financed from Operation or Highway Patrol funds. All building plans including wiring, plumbing, heating, air conditioning, and sewage, along with their special provisions, are to be reviewed and approved by an architect registered in Missouri. Special provisions and drawings are available from the Traffic and General Services Divisions and should be requested by the design team for plan preparation on projects involving a weigh station. The special provisions or drawings may be modified when necessary to meet special conditions. Where entrances are specified from outer roadways to weigh stations located on limited-access highways, the type of entrance is indicated by including the notation "Gate Entrance - For Official Use of Weigh Station Only" on the plans. These entrances may be located within the limits of the no right-of-access line; however, the no-right-of-access line is not broken or terminated at the entrance. Other data is listed on the 2B sheet under entrances and approaches.

4-09.19 WORK BY MAINTENANCE. MoDOT maintenance forces should not perform any work on contracted projects regardless of the funding source (i.e., construction, maintenance or "innovative" funds). Exceptions to this policy must be approved by the Director of Operations and the Director of Project Development prior to plan development. Any approved MoDOT work associated with non-contractual items is considered non-contractual labor. For additional information about non-contractual items, see [Subsection 4-03.14 \(4\)](#). All approved work is shown on the estimate and tabulation of quantities as a non-contractual item to be financed from the district's operating budget and coded to the appropriate project number.

4-09.20 JUNKYARD CONTROL. Each fiscal year, the Highway Right of Way and Construction Program includes certain junkyards to be screened, if feasible or possible. If screening is not possible or economically feasible, junkyards will be acquired as a LAST RESORT, and a permanent restrictive easement will be obtained preventing any further activity resulting in an unsightly view to the traveling public. When feasible, junkyards may be screened either by chain link fence, or by appropriate vegetation and/or earthen berms.

The department can acquire easements for screening purposes either by negotiation or condemnation.

A reasonable height for man-made screening is approximately 8 ft. [2.4 m]. Vegetation must be of such density as to screen the junkyard from sight of the traveling public within a three year period after initial planting and be of a variety that will screen the junkyard from view the year round. The department agronomist should be consulted concerning vegetative screening. Earthen berms may be used for screen or to increase the vertical height of vegetation or fence.

The department will design and contract to build the screen either on existing right of way or a permanent easement outside the right of way. The screen will be maintained by the department whether it is placed on right of way or on a permanent easement. It is not feasible to construct a screening fence to a height greater than 8 ft. [2.4 m].

When developing plans, develop the plan sheets to show complete ownership, 1000 ft. [300 m] line, land ties, all necessary dimensions, bearings, junkyard license number, and area under permit with relation to highway, and identify elevation needed to screen. Include general location of junk and any buildings, structures, or improvements involved and suggested method of screening.

4-09.21 PERMITS. Bridge and roadway construction in a floodplain, wetland, or over a defined waterway will require one or more of the following permits:

4-09.21 (1) SECTION 404 PERMITS. The Corps of Engineers (COE) has jurisdiction over wetlands and waters of the United States and more specifically, any stream meander shown as a blue line on a USGS quadrangle map. An application for a Section 404 Permit is to be submitted for construction or maintenance activities within jurisdictional waters of the United States. Section 404 Permits are also required if material is placed or removed in a wetland even if no stream is crossed. Authorization in the form of a permit from the COE must be received prior to the commencement of any such activities. If it cannot be reasonably determined by the district whether a Section 404 Permit will be required for the construction or maintenance activities for any project, the Design Division or the environmental studies coordinator should be contacted for assistance.

Requirements for Section 404 Permits are set by the COE and are changed frequently. The most current forms and instructions should be used.

There are several nationwide permits (NWP) which adequately cover most construction and maintenance activities. These NWP's are issued for specific activities, such as maintenance, survey activities, bank stabilization, road crossings, United States Coast Guard approved bridges, minor discharges, minor dredging, approved categorical exclusions, headwater and isolated water discharges and temporary construction, access and dewatering. In many instances, the COE may determine that proposed construction and maintenance activities are not covered by any of the nationwide permits. They may then issue an individual permit which is project specific and requires many more months to process. Individual permits will include conditions which must be followed during the construction and maintenance activities.

All NWP's are governed by the Nationwide Permit General Conditions and Section 404 Only Conditions. Specific additional conditions may also be associated with each permit. Section 401 Water Quality Certification (see [Subsection 4-09.21 \(2\)](#)) must also be obtained as a condition of obtaining the Section 404 permit. All applicable permits, conditions and water quality certification are to be included in the construction project proposal. All permits require compliance certification upon completion of construction or maintenance activities. The conditions of the permit must also be followed for maintenance activities.

Special care should be used to properly establish the COE ordinary high water elevation. This elevation is determined by a line on the bank established by the fluctuations of water and indicated by the clear natural line impressed on the bank or by the limit of vegetation growth. This elevation in almost every case will cause the elevation to be well down in the channel below the top of the bank.

The completed application with original sketches and additional information sheet should be submitted to the environmental studies coordinator after the preliminary bridge layout is completed. The State Bridge Engineer will provide the environmental studies coordinator with quantities of material to be placed below the ordinary high water at this time. Copies of letters from the Missouri Department of Conservation (MDC) which document our coordination of the project with the MDC should be attached when available. The application for construction or maintenance activities requiring an individual permit or for high profile projects that have significant environmental concerns should be submitted at least 12 months prior to plan completion. For projects governed by NWP's, the application should be submitted at least nine (9) months prior to plan completion.

The following procedure should be used to ensure timely submission and receipt of all Section 404 Permits and the Section 401 Water Quality Certification:

- The district project team submits basic application data to the environmental studies coordinator requesting environmental services for Section 404 Wetland Determination and Permit Application. The necessary

application data is detailed in [Figure 4-09.10](#). This data should be submitted as early in the project as possible. A form for this use can be found in the Bridge category of the Design forms on the computer system.

- The basic application data should include a copy of a USGS map showing the limits of the project, a project title sheet, plan sheets, culvert sheets and the first sheet of the bridge plans. This data should indicate the streams, shown as a blue line on USGS maps, wetlands, temporary crossings (including pipes), workpads and other construction requirements necessary to complete the project. It is important to also include this information on the plans and in a job special provision. This will provide the contractor necessary information with which to prepare their bid.
- After a field review, as necessary, conducted by personnel from the environmental section of the Design Division, the district project manager and the COE, a determination is made if the project will qualify for a NWP or require an individual permit.

The following procedure should be used if it has been determined a NWP for the project will be required. Adherence to this procedure will ensure timely submission and receipt of the Section 404 Nationwide Permit and the Section 401 Water Quality Certification.

- The environmental studies coordinator prepares draft applications to the COE and Missouri Department of Natural Resources (MDNR) with all attached exhibits. They will provide a copy to the district project manager and the Design Division for review and comment.
- Through communication between these three groups, a consensus is reached regarding project information contained in the application. It is important this consensus is formed as quickly as possible so the project completion schedule can be maintained.
- A final version of the application to the COE (with a copy to the MDNR) is prepared by the environmental studies coordinator. The environmental studies coordinator will sign the application and send it to the appropriate COE office and MDNR. A copy of this signed version is also provided to the district project manager and to the Design Division.
- The COE will provide the environmental studies coordinator with the necessary permit(s) to accomplish the project. Once received, a copy of the permit(s) must be provided to the Design Division and the district project manager. These three groups will reach a consensus concerning the acceptability of COE special conditions as required in the permit.
- The district project manager must indicate in the transmittal letter of contract plans to the Design Division the date the COE 404 Permit and the MDNR Section 401 Water Quality Certification was received. The Design Division will ensure these documents are included in the bid proposal.
- During construction of the project, the environmental studies coordinator will coordinate activities with the Resident Engineer or Area Engineer to ensure adherence to the permit conditions and to assist in the resolution of questions raised by regulatory agencies.
- The COE permit requires a certification be signed by a MoDOT official stating the project was constructed in accordance with the permit conditions. It is suggested the Resident Engineer or the Area Engineer discuss compliance with these permit conditions with the environmental studies coordinator prior to signing this certification and then submit it to the COE upon project completion.

If an individual permit has been determined to be required following field review, the project manager should submit a completed COE form (ENG FORM 4345) with the necessary sketches to the environmental section of the Design Division. Once this has been accomplished, the following steps should be followed:

- The environmental studies coordinator prepares a draft application with attached exhibits to the COE with a copy to the district project manager and the Design Division for review and comment.
- After communication between each of these three groups, a consensus is reached regarding the project information contained in the application. It is important this consensus be reached as quickly as possible so the project completion schedule can be maintained.
- A final version of the application to the COE is prepared by the environmental studies coordinator. It will be necessary the Chief Engineer sign this application and submit it to the appropriate COE office. A copy of this signed application will be provided to the environmental studies coordinator, the Design Division and the district project manager.
- After consideration, the COE will provide an unsigned copy of the individual permit to the Chief Engineer

for signature. This permit will most likely contain special conditions which must be followed during construction and maintenance of the project. These conditions will be reviewed by the district project manager, the Design Division and the environmental studies coordinator.

- Once consensus is reached concerning the constructability of these conditions, the permit document will be provided to the Chief Engineer for signature.
- Once signed by the Chief Engineer, the individual permit will be transmitted to the COE office for their signature.
- Following signature of the individual permit by the COE, the permit will be returned to the Chief Engineer and will be included in the bid proposal.
- During construction of the project, the environmental studies coordinator will coordinate activities with the Resident Engineer or Area Engineer to ensure adherence to the permit conditions and to assist in the resolution of questions raised by regulatory agencies.
- This COE permit will require a certification be signed by a MoDOT official that the project was constructed in accordance with the permit conditions. It is suggested the Resident Engineer or the Area Engineer discuss compliance with these permit conditions with the environmental studies coordinator prior to signing this certification and then submit it to the appropriate COE office.

It is important to note that adherence to the conditions established in either the nationwide permit or the individual permit issued by the COE is critical. These conditions are included in the bid proposal and therefore must be followed during construction.

4-09.21 (2) SECTION 401 CERTIFICATION. Section 401 Water Quality Certification must be obtained from the Water Pollution Control Program of the Department of Natural Resources in order to obtain any Section 404 Permit. (See application process described in [Subsection 4-09.21\(1\)](#)) A copy of the Corps of Engineers Section 404 permit application and supporting data is submitted to the Department of Natural Resources to request water quality certification for the construction or maintenance activity simultaneously with submission of the Section 404 permit application to the Corps of Engineers.

The State of Missouri has promulgated an antidegradation requirement in the Water Quality Standard regulations (10 CSR 20-7.031). This policy coincides with the purposes of the Clean Water Act to maintain and restore the biological, chemical and physical integrity of the waters of the United States. As such, three outstanding national resource waters, the Current, Jacks Fork and Eleven Point Rivers, are protected by exceptionally restrictive water quality criteria. Additionally, thirty-four other streams and wetlands have been identified as outstanding state resource waters ([Figure 4-09.7](#)). These state resource waters are also recognized as having special importance, and may also require stringent water quality management. Therefore, all nationwide permit applications within the watershed of waters designated as outstanding national resource waters or within the designated segments of outstanding state resource waters require a preconstruction notification (PCN) to the Corps of Engineers and Department of Natural Resources.

4-09.21 (3) COAST GUARD PERMIT - NAVIGABLE WATERWAYS. Permits for construction of bridges over the Missouri or Mississippi Rivers will be obtained by the Bridge Office from the United States Coast Guard.

4-09.21 (4) FLOODPLAIN DEVELOPMENT PERMITS. Communities (cities, counties or states) participating in the National Flood Insurance Program (NFIP) are required to regulate construction in the floodplain. Communities accomplish this by requiring permits for development in the floodplain. The State Emergency Management Agency (SEMA) has been granted authority to regulate floodplain development by state agencies and to issue floodplain development permits for their projects.

The Central office will obtain the necessary floodplain development permit(s) from SEMA for construction in a regulated floodplain. The Bridge Division will obtain permits for projects which include structures in a regulated floodplain and the Design Division will obtain permits for other projects involving roadway fill in a regulated floodplain. The district will be responsible for determining whether a floodplain development permit is required on the project, and for providing to the appropriate Central Office any project information necessary to obtain the permit.

4-09.21 (4) (a) FLOODPLAIN AND SPECIAL FLOOD HAZARD AREA. The floodplain is defined by the Federal

Emergency Management Agency (FEMA) as any land area susceptible to being inundated by water. The 100-year flood, or a flood with a one percent annual chance of being equaled or exceeded, has been adopted by FEMA as the base flood for the NFIP. The water surface elevation of the base flood is known as the base flood elevation (BFE). A special flood hazard area is land in the floodplain inundated by the 100-year flood and is commonly referred to as the "100-year floodplain." A floodplain development permit is required for any construction in a special flood hazard area. Special flood hazard areas are typically shown as "A" zones on flood insurance maps.

4-09.21 (4) (b) FLOODWAY. Encroachment on the floodplain, such as roadway fill, reduces the flood-carrying capacity, increases the flood heights of streams and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For the purposes of the NFIP, the floodway concept is used as a tool to assist in this aspect of floodplain management. The 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of the stream plus the portions of the adjacent overbanks which must be kept free of encroachment in order to pass the base flood. The floodway fringe is the area between the floodway and floodplain boundaries (see [Figure 4-09.8](#)).

Construction in the floodway which causes any increase in the BFE is prohibited. In order to issue a floodplain development permit for construction in the floodway, the community must receive a "No-Rise Certification," signed and sealed by a registered professional engineer, which certifies that the proposed construction will cause no increase in the BFE.

Where construction in an existing floodway is absolutely necessary, and such construction will cause an increase in the BFE, the floodway must be revised so that the proposed construction no longer causes an increase in the BFE or is no longer in the floodway. Flood insurance map revisions are obtained from FEMA through the community(ies) with jurisdiction. The map revision process requires a detailed hydraulic analysis and the cooperation and approval of all communities involved. In general, obtaining a map revision is a difficult and time-consuming process and should be avoided if at all possible.

4-09.21 (4) (c) REVIEW OF FLOOD INSURANCE MAPS. The Design Division receives two copies of the Flood Insurance Study and associated maps from FEMA for streams subject to the National Flood Insurance Program. One copy is sent to the Bridge Division and one copy is sent to the appropriate District Office. The maps may be one of three types: Flood Insurance Rate Maps (FIRMs), Flood Boundary and Floodway Maps (FBFMs), or Flood Hazard Boundary Maps (FHBMs). FHBMs are used when detailed studies have not been performed, no floodway has been developed, and floodplain boundaries are approximate. FIRMs and FBFMs are used when a detailed study has been performed and a floodway has been developed and show the boundaries of both the floodplain and the floodway. Special flood hazard areas are shown as Zone A on FHBMs and as Zone A or Zones A1 through A30 on FIRMs and FBFMs.

A current list of communities participating in the NFIP is available on the Internet at www.fema.gov/home/fema/csb.htm. This list should be consulted to determine if any communities within the project limits are participating in the NFIP. For all participating communities, the maps which include a portion of the project should be checked to determine if the project is within a special flood hazard area. If so, a floodplain development permit is required.

If any portion of the project is to be constructed within the regulatory floodway, the construction cannot cause an increase in the BFE and a No-Rise Certification will be required by SEMA. the Bridge Division will insure that structures to be constructed in a regulatory floodway comply with NFIP regulations. They will advise the district at the bridge memo stage if the construction is in a NFIP regulated floodway. It is the district's responsibility to insure that roadway fills to be constructed in a regulatory floodway comply with the NFIP regulations. the Bridge Division may be contacted for assistance in making this determination and in performing any necessary hydraulic analysis.

The process for reviewing floodway maps is summarized below:

- Check all communities within project limits to see if participating in NFIP.
- If participating, check maps (FIRMs, FBFMs, FHBMs).

- If in special flood hazard area, floodplain development permit is required.
- If in regulatory floodway, can cause no increase in BFE. No-Rise Certification is required. Floodway revision may be required.

4-09.22 DISTRIBUTION POLICY. The Design Division will maintain a list of all parties receiving documents in accordance with this policy. The maintenance of this list and the issuance of documents, including future updates to them, will be the responsibility of the Design Division. Updates to Standard Plans will only be provided as 8 1/2" x 11" sheets regardless of the size obtained under this policy.

4-09.22 (1) PROJECT DEVELOPMENT MANUAL, STANDARD SPECIFICATIONS, AND STANDARD PLANS.

4-09.22 (1) (a) CONSULTING ENGINEERING FIRMS CURRENTLY PERFORMING SERVICES FOR MoDOT. One copy each of the Project Development Manual, Standard Specifications book (with 8-1/2" x 11" revisions if applicable) and Standard Plans (8-1/2" x 11" sheets) along with subsequent updates will be provided free of charge to each of the consulting engineering firm's offices performing services for MoDOT. (One per firm per office location with an active contract.) Either a Metric or English version of the documents will be provided depending on the type of deliverables specified in the scope of services.

If an engineering firm requests multiple copies of these documents (more than one per firm per office location with an active contract), they will be charged the normal rate for these additional copies. Once additional copies are purchased, updates will be provided free of charge.

If an engineering firm requests additional copies of specific sheets or sections from any of these documents, they will be furnished, but charged for copies at the normal rate.

Once a copy of any of these documents is obtained by the consulting engineering firm, either free or purchased, MoDOT will provide subsequent updates for each copy of each document free of charge.

4-09.22 (1) (b) CONSULTING ENGINEERING FIRMS NOT CURRENTLY PERFORMING SERVICES FOR MoDOT. Consulting engineering firms who have previously performed services for MoDOT, and have retained copies of the Project Development Manual, Standard Specifications book (with 8-1/2" x 11" revisions if applicable), or Standard Plans (8-1/2" x 11" sheets), will be provided future updates free of charge, provided that the copies have been maintained and kept up to date by the consultant. Only English or Metric versions of the updates will be provided free of charge, depending on the version of the documents retained by the consultant.

Consulting engineering firms who have not performed services for MoDOT or who have not maintained the copy of documents they retained from a previous contract, may purchase any number of copies of the Project Development Manual, Standard Specifications book (with 8-1/2" x 11" revisions if applicable), or Standard Plans in either version at the normal rate. Once documents are purchased, updates for each copy of each document will be provided free of charge.

If an engineering firm requests multiple copies of specific sheets or sections from any of these documents, they will be furnished, but charged for copies at the normal rate.

4-09.22 (1) (c) COUNTIES AND CITIES. One copy of the Project Development Manual, Standard Specifications book (with 8-1/2" x 11" revisions if applicable), and Standard Plans (8-1/2" x 11" sheets) along with subsequent updates, will be made available to counties and cities upon written request free of charge. The availability of these documents can be communicated verbally through our District Liaison Engineers. The cost of the documents including handling and mailing, will be provided through the T² Program.

If a city or county requests multiple copies of any of these documents, they will be charged the normal rate for the additional copies. Once additional copies are purchased, updates for each copy of each document will be provided free of charge.

If a county or city requests additional copies of specific sheets or sections from any of these documents,

they will be furnished, but charged for copies at the normal rate.

- 4-09.22 (1) (d) OTHER GOVERNMENTAL AGENCIES (FHWA, transportation departments from other states, AGC, CECMo and other affiliated agencies).** One copy of the Project Development Manual, Standard Specifications book (with 8-1/2" x 11" revisions if applicable) and Standard Plans (8-1/2" x 11" sheets) and subsequent updates, will be furnished to these groups or agencies free of charge upon written request. The State Design Engineer shall have the final decision with regard to which affiliated or governmental agencies will receive copies of these documents free of charge.

If any of these agencies request multiple copies of any of these documents, they will be charged the normal rate for the additional copies. Once additional copies are purchased, updates for each copy of each document will be provided free of charge.

If any of these agencies requests additional copies of specific sheets or sections from any of these documents, they will be furnished, but charged for copies at the normal rate.

- 4-09.22 (1) (e) OTHERS.** Any group or individual not listed above, who requests copies of the Project Development Manual, Standard Specifications book (with 8-1/2" x 11" revisions if applicable), or Standard Plans will be furnished the requested number of copies and charged the normal rate for each document. Once copies of these documents are purchased, updates for each copy of each document will be provided free of charge if requested at the time of purchase.

Complete new versions of any of these documents will not be considered as updates to existing copies previously purchased under this policy. The decision with regard to who receives new versions of documents free of charge and who must purchase them, will be made by the State Design Engineer at the time the new versions are issued.

If additional copies of specific sheets or sections from any of these documents are requested, they will be furnished, but charged for copies at the normal rate.

Construction contractors who obtain copies of the Standard Specifications book or Standard Plans will not be mailed updates to these two publications. Their updates will be included with each bid proposal they obtain for the department's construction projects.

4-09.22 (2) LOCAL PUBLIC AGENCY MANUAL (LPA).

- 4-09.22 (2) (a) CONSULTING ENGINEERING FIRMS.** Any number of copies of the LPA Manual will be distributed to consulting engineering firms upon request. The consulting engineering firm will be required to pay the normal rate for each copy of the LPA Manual. Once copies are purchased, updates for each copy of the manual will be provided free of charge.

If a consulting engineering firm requests additional copies of specific sheets or sections from the LPA Manual, they will be furnished, but charged for copies at the normal rate.

- 4-09.22 (2) (b) COUNTIES AND CITIES.** One copy of the LPA Manual and subsequent updates will be made available to counties and cities free of charge upon written request. The availability of manuals can be communicated verbally through our District Liaison Engineers. The cost of the manuals, including handling and mailing, will be provided through the T²Program.

If a city or county requests multiple copies of the LPA Manual, they will be charged the normal rate for the additional copies. Once additional copies are purchased, updates for each copy of the manual will be provided free of charge.

If a county or city requests additional copies of specific sheets or sections from the LPA Manual, they will be furnished, but charged for copies at the normal rate.

- 4-09.22 (2) (c) OTHER GOVERNMENTAL AGENCIES (FHWA, transportation departments from other states, AGC, CECMo and other affiliated agencies).** One copy of the LPA Manual and subsequent updates, will be furnished to these groups or agencies free of charge upon written request. The State Design Engineer shall have the final decision with regard to which affiliated or governmental agencies will receive copies of these documents free of charge.

If any of these agencies request multiple copies of the LPA Manual, they will be charged the normal rate for the additional copies. Once additional copies are purchased, updates for each copy of the manual will be provided free of charge.

If any of these agencies requests additional copies of specific sheets or sections from the LPA Manual, they will be furnished, but charged for copies at the normal rate.

- 4-09.22 (2) (d) OTHERS.** Any group or individual not listed above, who requests copies of the LPA Manual will be furnished the requested number of copies and charged the normal rate for each document. Once copies of the LPA Manual are purchased, updates for each copy of the manual will be provided free of charge if requested at the time of purchase.

Complete new versions of the LPA Manual will not be considered as an update to existing copies previously purchased under this policy. The decision with regard to who receives new versions of the manual free of charge and who must purchase them, will be made by the State Design Engineer at the time the new version is issued.

If additional copies of specific sheets or sections from the LPA Manual are requested, they will be furnished, but charged for copies at the normal rate.

- 4-09.22 (3) JOB SPECIAL PROVISIONS.** Consulting engineering firms currently performing services for MoDOT, either as a prime consultant or as a subconsultant, may receive one set of Job Special Provisions, along with subsequent updates, free of charge to each of the consulting engineer's offices performing services for MoDOT upon written request. (One per firm per office location with an active contract.) Either a Metric or English Version of the set of provisions will be provided depending on the type of deliverables specified in the scope of services.

If an engineering firm requests multiple copies of these provisions (more than one per firm per office location with an active contract), they will be charged the normal rate for these additional copies. Once additional copies are purchased, updates will be provided free of charge.

- 4-09.22 (4) MICROSTATION "FORMATS/SPECIAL SHEETS".** Consulting engineering firms currently performing services for MoDOT, either as a prime consultant or as a subconsultant, may receive vellum reproducibles of any Microstation file in the "Format & Special Sheets" directory free of charge to each of the consulting engineer's offices performing services for MoDOT upon written request. (One vellum of each file requested per firm per office location with an active contract.) Either Metric or English version of the files will be provided depending on the type of deliverables specified in the scope of services.

- 4-09.22 (5) FINAL PLANS.** Prints of plan sheets from the final plans, which have been microfilmed, will be furnished to anyone who requests them. The duplication charges for final plan sheets will be in accordance with establish pricing information. There is no charge for a reasonable number of prints for use by official government agencies.

The reference datum used on the furnished final plan sheets, such as bench marks, may not be appropriate for the public's intended use. Therefore, individuals should be reminded that MoDOT does not warrant existing vertical bench mark data. Individuals needing information to establish vertical datum should be encouraged to contact the Missouri Department of Natural Resources.

- 4-09.23 PROPRIETARY ITEMS.** A patented material, specification, or process that can only be obtained from one manufacturer is known as a proprietary item. Such Items can generally be identified by use of a trade name. In the

interest of promoting competition and allowing for the development of new products, neither the FHWA nor MoDOT will participate in payment for any proprietary item, except in the following cases:

- The state certifies that the proprietary item is essential for synchronization with the existing highway facilities and that no equally suitable alternative exists. (Requires a letter of public interest finding to the Central Office).
- The proprietary item is used for research or for a special type of construction on relatively short sections of road. (Requires a letter of public interest finding to the Central Office).
- Only proprietary items are acceptable, and at least three or more other proprietary items are offered as alternatives. (Does not require a letter of public interest finding to the Central Office).
- The proprietary item is offered as an alternative to an equally suitable non-proprietary item. (Does not require a letter of public interest finding to the Central Office).
- The FHWA finds that the utilization of the proprietary item is in the public interest.

Use of the term “or equal” following the name of a proprietary item is permitted under terms of Missouri Standard Specifications for Highway Construction. However, use of the term “or equal” with a proprietary product name does not supersede the need to obtain a “public interest finding”. It is not necessary to obtain a “public interest finding” when three or more proprietary product names are listed in the proposal as possible sources for a specific item necessary to construct the proposed improvement. If less than three proprietary product names are mentioned in the job special provision, the term “or equal” is to be used. Additionally, the specific characteristics of the proprietary product that is mentioned are to be included in the job special provision. Construction personnel can use this information to determine if the substitute product is indeed “equal”. Examples of specific characteristics are the reflective properties of pavement marking tape, width and length of crashworthy end treatments, signal controller units that are compatible with existing units in the field or other applications in which the design team can specifically name product characteristics. When requested by a contractor to approve the use of a substitute product based upon the “or equal” provisions contained in the JSP, construction field personnel are to coordinate their response to this request with the district project manager. Approval by the Construction and Materials Division is to be obtained prior to use of the substitute product.

[Section 106.14](#) of the Standard Specifications outlines a procedure to follow in the event a proprietary item included in a project becomes unavailable during construction. The resident engineer is to share the contractor’s request to use an alternative product with the district project manager (information is also to be shared with the originating functional unit who requested the proprietary item be used) and by working together determine if it is acceptable. The contract unit price for this replacement item will need to be negotiated between MoDOT and the contractor. This unit price is to be based upon market conditions. Cost for this item on previous MoDOT projects can be helpful in arriving at an appropriate “negotiated” unit price. In most cases the use of a nonproprietary item as a substitute for a proprietary item will result in a lower unit cost. However, in a few instances this might not be the case. Should the cost of a substitute for a proprietary item be higher than the unit bid price for the proprietary item the additional cost of the item is not eligible for federal participation (23 CFR 635.411). Therefore, this higher cost will be the responsibility of the local (city, county, developer, etc.) entity, which requested the item be included in the project or MoDOT itself. Should additional state funds be required to pay for the “substitute” item, an adjustment to future funding allocations to the District will be necessary.

4-09.24 PUBLIC INTEREST FINDINGS. In order to demonstrate to the FHWA and the Design Division that the utilization of a proprietary item is in the public interest, the district must submit a letter of public interest finding to the Design Division.

Any use of a proprietary item in a full oversight project as defined in [Subsection 1-04.2\(1\)](#) will require FHWA approval of the Public Interest Finding. The Design Division will submit the finding to FHWA. Use of a proprietary item on any other project will require approval from the Design Division.

To gain approval, the letter must include the brand name and manufacturer of the item in question as well as a detailed discussion of the factors that necessitate the item's use (synchronization with existing facilities, no equally suitable alternative available, substantial cost savings, benefit/cost analysis when more than one proprietary item is available, etc.). This discussion should be supported by any relevant figures and documentation, and should be as complete and detailed as possible. In order to expedite the processing of the request, the bid opening date should be included. A sample letter for submittal to the Design Division is shown in [Figure 4-09.9](#).

The district will be notified of the decision of the FHWA or the Design Division.

4-09.25 BICYCLE/PEDESTRIAN FACILITIES.

4-09.25 (1) POLICY. The district is encouraged to consider and to provide bicycle/pedestrian facilities when deemed appropriate. Consideration should be given to the provision of pedestrian and/or bicycle accommodations on improvement projects during preliminary studies, design and construction when any of the following exist:

- The local jurisdiction has adopted a bicycle/pedestrian policy or facilities plan or otherwise requested by the local jurisdiction.
- Bicycle/pedestrian traffic generators are near MoDOT transportation projects (generators include residential neighborhoods, employment centers, shopping centers, schools, parks, etc.).
- There is evidence of pedestrian and/or bicycle traffic and the local community supports the incorporation of facilities.
- The route provides access across a natural or man-made barrier, i.e., bridges over rivers, roadways or railroads or under access-controlled facilities and roadways.
- There is public support through local planning organizations for these facilities.

The design and installation of pedestrian and bicycle facilities is at the sole discretion of the director or their designee. Documentation should be developed on all projects to support the decision to provide or not provide pedestrian and/or bicycle accommodations.

Additional costs for new pedestrian and bicycle facilities, including right of way and construction and maintenance, may be funded by local jurisdictions, by Enhancement funds, other non-department sources, the department itself and/or a combination of these. State road funding shall only be provided for those projects located on MHTC right of way. Funding arrangements and agreements will be handled on a case by case basis.

The department will include in normal right of way and construction costs the cost of restoration of existing bicycle/pedestrian facilities that are disturbed by a proposed improvement.

Agreements with local jurisdictions and/or others should be used to address maintenance issues for separate bicycle and/or pedestrian facilities constructed on or off of MoDOT right of way. The agency responsible for maintenance shall be established prior to construction. MoDOT assumes legal liability for bicycle/pedestrian facilities on MHTC right of way. This responsibility should be addressed by agreement, with MoDOT personnel performing regular inspections to ensure proper maintenance is performed as provided under terms of the agreement. Should maintenance not be performed as required by agreement, MoDOT should take necessary steps to ensure proper maintenance is provided.

4-09.25 (2) DESIGN CRITERIA. Numerous strategies are available to provide improved operating facilities for non-motorized travelers. These include sidewalks, pedestrian paths, bicycle paths, shared-use paths, bicycle lanes, and wide shared lanes any of which may be on the shoulder or separated from the travelway. Typical roadway sections should be developed based on the typical roadway sections and information shown on [Figure 4-09.12](#). The AASHTO publications "*Guide for the Development of Bicycle Facilities*" and "*Guide For The Planning Design and Operation of Pedestrian Facilities*" along with FHWA-RD-92-073 "*Selecting Roadway Design Treatments to Accommodate Bicycles*" provide guidance for pedestrian, bicycle and shared-use facilities. Design and Transportation Planning Division personnel can assist with further information. [Table 4-09.3](#) provides guidance on the application of bicycle facilities with respect to roadway classification.

**TABLE 4-09.3
BICYCLE FACILITIES**

	Bicycle Path	Bicycle Lane	Wide Shared Lane	Bicycle Lane on, or Bicycle Usage of, Shoulder
Interstate	Permitted	Not Permitted	Not Permitted	Possible Solution*
Urban Freeway	Permitted	Not Permitted	Not Permitted	Possible Solution*
Principal Arterial	Permitted	Possible Solution	Possible Solution	Possible Solution
Urban Principal Arterial	Permitted	Possible Solution	Possible Solution	Possible Solution
Minor Arterial	Permitted	Permitted	Permitted	Permitted
Urban Minor Arterial	Permitted	Permitted	Permitted	Permitted
Collector	Permitted	Permitted	Permitted	Permitted
Local	Permitted	Permitted	Permitted	Permitted

Definitions:

Permitted: This design is allowed with this functional class.

Not Permitted: This design is not allowed with this functional class.

Possible Solution: This design may be considered but requires further analysis of geometrics and traffic characteristics to determine proper design for given conditions.

* This solution should only be considered when all other reasonable alternatives are not practical and this routing is needed to provide continuity of local and cross country bicycle routes.

4-09.25 (2) (a) SIDEWALKS. Sidewalks are constructed where existing sidewalks are disturbed by highway construction and may also be provided based on a needs assessment. Along arterial streets where outer roadways are to be constructed to connect local streets that would otherwise dead-end, and where such intersecting streets have sidewalks that formerly connected to cross streets with sidewalks, it is proper to consider sidewalk construction along the outer roadways on a needs basis as a replacement of existing facilities. In addition, where sidewalks are warranted:

- Sidewalks provided in developed areas should be separated from the travelway by a barrier curb (see [Figure 4-07.2](#)).
- In rural or low density developed areas (ADT > 1700), off road pedestrian paths separated from the roadbed by a green area, ditch or swale may be appropriate.
- In rural areas (ADT < 1700) where it is necessary to accommodate pedestrian access along the roadway shoulder a minimum shoulder width of 6 ft. (1.8m) should be provided.

It is important to remember that any designated sidewalk or pedestrian path must be accessible according to ADA guidelines.

Where the curb is separated from the parallel sidewalk by a parkway (border), all house walks shall be extended across the parkway (see [Standard Plan 608.10](#)). When provided, sidewalks should have a minimum width of 5 ft. [1.5 m] and thickness of 4 in. [100 mm]. Exceptions are as follows:

- If a 5 ft [1.5 m] sidewalk would be geometrically constrained or would produce excessive costs, a narrower width may be used. For sidewalk widths less than 5 ft [1.5 m], a 5 ft by 5 ft [1.5 m by 1.5 m] passing space is to be provided at intervals no greater than 200 ft [61 m]. Such features as driveways, building entrances and sidewalk intersections are considered acceptable intersections. The absolute minimum sidewalk width allowed by ADA guidelines is 4 ft [1.2 m].
- Sidewalks across private approaches, street, sideroads, alleys or commercial approaches should be the same thickness as the paved approach.
- Housewalks shall be 4 in. [100 mm] thick and a minimum of 3 ft. [1.0 m] wide. Steps to house shall be a minimum of 3 ft. [1.0 m] wide. Steps and housewalks shall be a width to match the existing width. Steps other than house steps shall be a width to fit a particular condition.
- A sidewalk proposed within 2 ft. [0.6 m] of a curb should be adjacent to the curb, a minimum of 6 ft. [1.8 m] wide and located behind a barrier curb.
- A clear airspace of 7 ft [2.1 m] above the sidewalk should be maintained free of tree limbs, signs,

fountains, poles or planters. Protrusions into the area of the sidewalk must not exceed 4 in. [100 mm].

4-09.25 (2) (b) CURB AND SIDEWALK RAMPS. Curb and sidewalk ramps shall be designed in accordance with the standard plans, or varied to fit the needs at a particular location. If a particular curb ramp differs from the standard plans, the ramp shall be detailed on the plans. The following criteria apply to all curb ramp situations:

- A pay item is included for curb ramps. The designer should estimate the square yardage [m²] for each curb ramp and show the quantity on the 2B sheet(s).
- Curb ramps shall have a clear width of 5 ft. [1.5 m], exclusive of flared sides.
- If a sidewalk ramp has a rise greater than 6 in. [150 mm] or a horizontal length greater than 6 ft. [1.8 m], handrails shall be provided on both sides. The maximum rise for any ramp shall be 30 in. [750 mm]. See [Figure 4-07.5](#). Handrails are not required on curb ramps.
- The least possible slope shall be used for any ramp. The maximum slope of a ramp in new construction shall be 12:1 [1:12].
- Ramps shall have a level landing at the top of each run. The landing shall have the same width as the ramp and a minimum length of 5 ft. [1.5 m].
- Transitions from curb ramps to sidewalks, gutters or streets shall be flush and free of abrupt changes. Maximum slopes adjoining a curb ramp shall not exceed 20:1 [1:20].
- Raised islands in crosswalks shall be cut through level with the street or have curb ramps at both sides and a level area at least 4 ft. [1.2 m] long between the curb ramps.
- Sidewalk ramps should be provided at locations where steps occur, such as at the ends of bridges having sidewalks across the bridge or at pedestrian grade separations.
- In the case of retrofitting a curb ramp where pedestrians must walk across the ramp, the ramp shall have flared sides sloped at a maximum of 10:1 [1:10]. If a level landing cannot be constructed in a retrofit situation, then the flared sides shall have a 12:1 [1:12] maximum slope.

4-09.25 (2) (c) MID-BLOCK PEDESTRIAN CROSSING. The potential for pedestrians needs to cross multilane facilities with lengthy distances between signalized intersections should be considered in design. For instance, near schools, parks, hospitals, public buildings, or shopping centers, there may be high demand for pedestrians to cross a roadway between signalized intersections. A raised median, with curb cuts, might be the preferred approach to provide a safer crossing for pedestrians. A pedestrian underpass or overpass may also be considered.

4-09.25 (2) (d) BICYCLE PATH. A bicycle path is a bikeway, usually beyond the clear zone, physically separated from motorized vehicular traffic by an open space or barrier. It may be within the highway right of way or on an independent right of way. A bicycle path is appropriate in corridors not served directly by streets and highways, such as along rivers, lakes, abandoned utility or railroad right of way, parks, etc. Cross movement by motor vehicle traffic should be minimal. Sometimes, due to the multiple user types (e.g., walkers, rollerbladers, wheelchair users, etc.), they are referred to as multi-use paths. If pedestrian use is intended, a bicycle path in the public right of way should generally comply with ADA requirements for public sidewalks. Minimum bicycle path design criteria is given in [Figure 4-09.11](#). A typical bicycle path section should be developed based on Form D-49.

4-09.25 (2) (e) BICYCLE LANES. A bicycle lane is a portion of a roadway which has been designated by striping, signing and pavement markings for the preferential or exclusive use of bicyclists. Bicycle lanes are appropriate where bicycle travel and demand is substantial and/or traffic volumes and speeds are relatively high. They are commonly located on urban collector and arterial routes.

4-09.25 (2) (f) WIDE SHARED LANES. A right through lane wider than the standard 12 ft. [3.6 m] width can better accommodate both bicycles and motorists in the same lane and thus is beneficial to both. This accommodation is most suited to urban and suburban roads. This treatment works best with low traffic volumes and low truck volumes and can be used in other situations where bike lanes are not feasible. A 14 ft. [4.2 m] lane is desired for shared use. This width generally will allow a motor vehicle and bicycle to be operated comfortably side by side within the lane. A traveled way less than 14 ft. [4.2 m] will require a design exception (see [Subsection 2-01.8](#)). Widths greater than 14 ft. [4.2 m] may encourage the

undesirable operation of two motor vehicles in one lane.

4-09.25 (2) (g) BICYCLE LANE ON SHOULDER. Paved shoulders can serve the needs of bicyclists. This treatment is more suitable for rural design. When paved shoulders are signed and marked for use by bicyclists, a minimum 4 ft. [1.2 m] operating width should be provided.

4-09.25 (2) (h) PEDESTRIAN GRADE SEPARATIONS. It is not practical to develop warrants governing the construction of pedestrian grade separation facilities. Each situation must be considered on its own merits. Such facilities are generally warranted only at locations where exceedingly heavy volumes of pedestrian traffic must cross a heavy vehicular flow. When the construction of a pedestrian grade separation is considered, an investigation is to be made including studies of pedestrian crossing volumes, type of highway to be crossed, location of adjacent crossing facilities, the predominant type and age of persons who will use the facility, and the cost of constructing the pedestrian grade separation. A pedestrian grade separation should only be constructed when the need for the safe movement of pedestrians cannot be solved in some simpler and more economical manner. Experience has shown that in many instances, facilities of this type are not used by pedestrians. Where the facility offers a more convenient path than a crossing at street grade, the likelihood of general use by pedestrians is good. If the situation requires descending to a different level and then ascending to the original level, or ascending to a different level and then returning to the original level, the chance of general use is not good unless barriers are erected to force pedestrians to use the facility. Additional guidance concerning pedestrian grade separations can be found in an AASHTO publication entitled. "*Guide Specifications for Design of Pedestrian Bridges*".

4-09.26 MOWING. Mowing should be specified on projects, which require significant mowing during construction. The project core team, with significant input from district Maintenance, should determine which projects will require mowing during construction. The district should include in the proposal the special provision titled "Mowing", DSP-00-11. This special provision specifies mowing the entire project limits, but if only specific areas are to be mowed, the designer needs to specify those locations in the special provision. Specific locations to be mowed and approximate number of mowings should be coordinated with district maintenance.

4-09.27 CONTRACT LEVELING COURSE PROJECTS. In order to coordinate and expedite the preparation of projects for the contract leveling course program, plans shall be prepared in English units and submitted to the Design Division by August 1 of the program year. This will enable the bidding and contract services section to adjust the groupings, if necessary, and to appropriately schedule the bid opening dates.

The contract leveling course program is intended for use on roadways with less than 3500 ADT, and on which a BP-1, Type C, Type IC or superpave mixture has not been previously placed. Superpave resurfacing is viewed as more involved work, and should be programmed as a thin lift overlay project outside of the contract leveling course program.

To shorten the processing time, improve the quality of plans and to standardize procedures across the state, the following should be used when preparing plans in English units:

- Each project should have, as a minimum, the following plan sheets:
 1. Title Sheet, with north arrow pointing to the top of the sheet, if possible.
 2. Length of Project Sheet - should include "exceptions."
 3. Typical Section Sheet - should include "estimate factors."
- The plans are placed in a proposal that contains a vertical format, and plans should read accordingly when possible. Original plans should be submitted using the format shown on [Figure 6-05.1](#) with pages numbered by the district. To improve the quality of printing, originals should be submitted, not copies.
- Leveling course projects must have logical termini. Do not break projects at district, county or city limit lines (short projects which abut should not be shown as separate projects). Coordination with adjoining districts should be done when a project abuts a district boundary.

- [Figure 4-09.13](#) provides sample templates for the location sketch, project length and typical sections and are available electronically in Microstation format on district servers.
- the Bridge Division will analyze all bridges within the project limits to determine which bridges can be overlaid based on bridge rail height and load rating. With supporting information from District Operations and/or Design, the Bridge Division will verify the load ratings for each bridge and verify that any standard rail will not be made substandard by the Contract Leveling Course operations. Bridges should be excepted unless prior written approval is obtained from the Bridge Division and submitted with the transmittal package.
- Districts need to supply at time of submittal conflict of interest documentation (see [Subsection 4-03.17\(1\)\(f\)](#)) and core team certification.
- Use of district forces for any operation, such as milling, that may affect the progression of the contractor operation, shall be approved in accordance with [Subsection 4-09.19](#).

Tack quantities are based on tacking the entire roadway surface at an estimated rate of 0.05 gallons/square yard. The asphalt binder for the contract leveling course mixture (surface leveling) should typically be PG 64-22. Quantities for asphalt binder and mineral aggregate for individual projects will vary and should be shown, along with the estimate factors used for calculating quantities on the typical section sheets for the project. Minimum thicknesses are 1 inch for Plant Mix Bituminous Surface mixtures, 1 ¼ inches for BP-2 mixtures and 1 ¾ inches for BP-1 mixtures.

[Table 4-09.5](#) is a guide for selecting bituminous mixtures for contract leveling course projects. If the district elects to use a mixture other than what is specified, the project manager should submit by letter to the Design Division the justification for specifying a different mixture or thickness than given in [Table 4-09.5](#). In addition, at the bottom of the letter an approval signature block similar to that on the Design Exception Information Form (see [Figure 2-01.9](#)) should be provided for the State Design Engineer.

**TABLE 4-09.5
BITUMINOUS MIXTURES CRITERIA
FOR CONTRACT LEVELING COURSE PROJECTS**

Corridor Designation	Traffic	Recommended Mix and Thickness
Light Duty	ADT < 1750	1" Sec 402 Mixture
Light Duty	1750 < ADT < 3500	1 ¼" BP-2 * (Sec 401)

*If the district feels warranted, a 1 ¾" BP-1 (Sec 401) mixture may be substituted for this application.

If special situations require limiting loads on a given route, a "Haul Road Restriction" special provision will be considered on a project-by-project basis. Otherwise, the only load restrictions, other than the 80,000-pound legal load limit, will be any posted bridge load limits.

Traffic control plans and job special provisions should be prepared and submitted by the districts. Traffic control plan templates are available on district servers. Sample job special provisions are also available from the Design Division Review Section. The quantity of "No Center Stripe" Signs should be included as necessary to sign the entire project. On contract leveling jobs, final pavement marking may be required in the contract, included in a district wide pavement marking contract, or done by district forces. [Subsection 8-05](#) and [Figure 8-05.1](#) provide guidance for selection of pavement marking material. Temporary raised pavement markers are included in the resurfacing contract at no direct pay to the contractor, regardless of method of pavement marking.