

GUIDE FOR

Non-NHS STATE Highways

4R-3R-2R-1R Criteria

WYDOT Design Guides



2000

WYOMING
Department of Transportation

Note: This guide is presented herein in the original 8 1/2" x 11" format as it appeared prior to reformatting to the 5 1/2" x 8 1/2" published booklet. The information is the same.

GUIDE FOR Non-NHS STATE HIGHWAYS 4R-3R-2R-1R CRITERIA

INTRODUCTION

This Guide is directed to developing transportation projects on the Wyoming State Highway System, Non-NHS roadways, functionally classified as Principal and Minor Arterials, Collector Roads and Streets, and Local Roads and Streets (this System will be referred as Non-NHS State Highways). The Guide uses the generally accepted 4R-3R-2R-1R project-type definitions, extended from the traditional highway pavement improvement types to also address geometric design, bridge design, safety design/hardware, capacity considerations and other highway elements.

The criteria presented in this Guide have been developed as recommended practice, and their use should become standard practice to best meet the Department's direction for project designs/contract documents. These criteria may be modified, if needed, to meet an individual project or location-specific situation. As a result, the use of words such as 'may or should' versus 'shall, will, or must' is intended to support presentation of the criteria, and is not intended to present a permissive condition versus a required condition.

The Criteria presented in this Guide were developed consistent with the WYDOT Mission "To provide a safe, high quality, and efficient transportation system" and related Goal to "Enhance safety on the transportation system." Management systems for safety, pavements, and bridges are used to provide systems-level data supporting project-level decisions. Project -level safety evaluations provide for a systematic approach to the collection of relevant data including crash history, predominant crash type, traffic volumes and vehicle classifications. Safety improvements, to be incorporated into the project design and construction, are evaluated to both improve an existing safety element or address a project purpose of lowering the potential for an identified crash type. Upgrading safety hardware to current safety design standards, constructing clear recovery areas, improved signing and pavement markings, correcting geometric deficiencies, and providing pavement/bridge deck skid resistance, are all considered during the process to develop project scopes that address identified needs and budget funds to construct highway system improvements.

These criteria should guide the initial scope/description of 4R-3R-2R-1R type projects. Changes to the project scope during plan development, to add additional work elements or use design values higher than initially selected, will be evaluated by Project Development for added cost and overall benefit to the project design. Documentation of the evaluation and resultant change will be included within an amended Project Reconnaissance Report.

GENERAL DEFINITIONS

1) Functional Classification: Classification of the system of highways by the character of service they provide. The Non-NHS State Highways include highways with functional classifications as Principal and Minor Arterials, Collector Roads and Streets, and Local Roads and Streets. These highways are designed to provide 1) trip lengths to accommodate regional and intra county travel, 2) connected travel movements between urban areas and other traffic generators, and 3) access from adjacent land use.

2) Controlling Design Criteria: Controlling design criteria are Minimum Design Speed (MDS), Lane Width, Shoulder Width, Bridge Structure Width, Horizontal Alignment, Cross-Slope, Super-elevation, Vertical Alignment, Grades, Stopping Sight Distance, Horizontal Clearance to Obstructions (Lateral Offset), Vertical Clearance, and Structure Capacity (loading), from the WYDOT *Road Design Manual*. Horizontal Clearance to Obstructions may also be referred to as Lateral Offset, but its definition is not synonymous with the definition of clear recovery area/clear zone, although the design values for Horizontal Clearance to Obstructions may be based on the same computations as used to compute clear recovery areas/clear zones. Design exceptions may be processed for 4R type projects where it is not reasonable to achieve full compliance with WYDOT design values for any of the controlling design criteria. For 3R type projects design exceptions may be processed where it is not reasonable to achieve full compliance with the tolerable controls. The process for evaluating, justifying, and documenting (including signature authority) the need for a design exception is outlined in WYDOT *Road Design Manual*.

3) Design, Safety, and Bridge Standards: The standards current with development of this Guide are listed in Table 1 through Table 4 and supplemented with References. The use of design standards, in this Guide, refers to the most current adopted version of the identified or referenced standards.

4) Highway Capacity Analysis: This analysis will be completed for the selected design year using procedures in the TRB *Highway Capacity Manual* or an adopted State analysis method. Interim years, such as 10 years from the year open to traffic, should be analyzed as a basis for decisions required for implementing the criteria in this Guide. For purposes of this Guide, the terms ‘design year’ and ‘design life’ represent the same future year, with that year selected from the anticipated year of project construction. A Level-of-Service (LOS) D has been chosen as the appropriate LOS to warrant capacity improvements for Non-NHS State Highways within an urban area. Capacity improvements for Non-NHS State Highways in rural areas will be warranted based on a LOS C for the selected design year.

5) Rural and Urban Sections: Rural section refers to a typical section providing for shoulders and graded ditches based on a set of geometric design standards or practices. An urban section refers to a typical section providing a curb and gutter system based on a set of geometric design standards or practices. These terms should, but may not, coincide with the above designation for Non-NHS State Highways within an urban area or Non-NHS State Highways in rural areas. For example, a Non-NHS State Highway within an urban area may be constructed using a rural typical section.

6) Project Scope and Funding: Project scopes will be determined at an early planning stage using established management systems for pavement, bridge, safety, and asset management. Early project scoping or the Reconnaissance Phase will develop a consensus on the project purpose, project type, limits, and all location-specific major elements. Projects meeting the 4R-3R-2R-1R criteria presented in this Guide are eligible for State and Federal funding categories.

7) 4R: New construction or reconstruction to provide for the full range of pavement design strategies for plant-mix asphalt pavements to include removal and replacement of a portion or all of the existing pavement structure and base materials. 4R includes the construction of portland cement concrete pavements. This type of project will include improvements to address the need for additional continuous travel lanes for added capacity, auxiliary lanes, safety clear recovery areas, new or reconstructed bridge structures, and upgrade geometric and other highway elements to design standards. Project designs will meet a minimum 20-year design life.

8) 3R: Restoration or rehabilitation of an existing pavement structure using a full range of pavement design strategies. This project type may include widening to provide for standard shoulder widths or auxiliary lanes, safety improvements, reconstructed bridge structures, and upgrading geometric and other highway elements, below tolerable controls, to meet design standards. Project designs will meet a selected design life up to 20 years.

9) 2R: Resurfacing with additional pavement structure to extend serviceability of the roadway pavement. This project type may include minor widening to maintain the existing roadway width (combined travel lane plus shoulder widths), shoulder widening, minor safety, bridge, or geometric improvements, and other highway elements to address identified needs for a selected design life up to 15 years.

10) 1R: Preservation of existing pavement structure to extend the service life pending future pavement construction, and reactionary efforts to keep the highway system open to traffic. This type of project will provide a maximum 2" pavement thickness (including leveling thickness), and will not require the selection of a design life.

APPLICATION CRITERIA—Non-NHS STATE HIGHWAY 4R PROJECTS

Pavement Design Process:

Non-NHS State Highway 4R projects provide for the full range of pavement design strategies for plant-mix asphalt pavements to include removal and replacement of a portion or all of the existing pavement structure and base materials. 4R includes the construction of portland cement concrete pavements. All 4R designs will provide a minimum 20-year design life. The pavement type determination will meet the procedures of WYDOT *Operating Policy 38-2, Pavement Type Determination*.

Non-NHS State Highways will be designed to meet the following criteria for the paved width of travel lanes, shoulders, and auxiliary lanes.

Travel Lanes: For Arterials and Collector Roads and Streets, travel lanes will be designed to a full-depth pavement structure for the full width. For Local Roads and Streets, travel lanes will typically be designed to a full-depth pavement structure for the full width, but a gravel surface can be constructed rather than a paved surface.

Auxiliary Lanes: All auxiliary lanes, including passing, turning, climbing, parking, and bicycle lanes, will be evaluated for a reduced-depth pavement structure as they carry a differing volume and mix of traffic.

Shoulders: For Non-NHS State Highways functionally classified as Arterials, shoulders will be evaluated for a reduced-depth pavement structure, typically a minimum 2-inch depth plant-mix surface for the full width. For Non-NHS State Highways functionally classified as Collector Roads and Streets, shoulders will be evaluated for a reduced-depth pavement structure, typically a minimum 2-inch depth plant-mix surface for the inside 2-feet, with the remainder of the shoulder width extending either the 2-inch depth plant-mix surface or constructed with a consolidated and drain-able material. For Non-NHS State Highways functionally classified as Local Roads and Streets, shoulders will be evaluated for a reduced-depth plant-mix pavement structure or constructed with a consolidated and drain-able material.

Geometric Design Process and Standards:

Design Process: Non-NHS State Highway 4R projects will be designed to meet WYDOT design standards for controlling design criteria and best practice for non-controlling geometric elements as presented in Tables 1 through 4 and related text.

The selection of minimum design speed (MDS), from Tables 1, 2, or 3, will first consider the functional classification of the roadway. A MDS design value from a differing Table may be selected due to traffic/truck volumes, trip lengths, or access to adjacent land use; a map has been developed to identify those roadways where a differing MDS may be selected.

WYDOT design procedures have been developed, with this Guide, to establish a relationship between the selected minimum design speeds, by functional classification, and the posted speed limit for Non-NHS State Highways. These procedures will assure that the posted speed limit does not exceed 10 MPH over the MDS and the related design values. These procedures are further developed in 4R and 3R applications for Collector Roads and Streets and Local Roads and Streets.

Design Standards: Design standards presented in Table 1 through Table 4 of this Guide have been developed consistently with Wyoming laws, regulations and procedures. Supplemental geometric design information can be found in AASHTO *A Policy on Geometric Design of Highways and Streets*, and WYDOT *Road Design Manual*. For the limited number of multi-lane Non-NHS State Highways, supplemental geometric design standards for rural sections are presented in WYDOT *Standards for Multi-Lane Rural Roadway* and the Operating Policy for non-Interstate multi-lane highways. WYDOT

design values for Arterials, Collector Roads and Streets, and Local Roads and Streets, are presented in Tables 1, 2, and 3 for the ten Controlling Design Criteria relating to roadway design. WYDOT design values for the three Controlling Design Criteria relating to bridges are presented in Table 4 located in a following section, Bridge Design Process and Standards. These design values are applicable to mainline sections and are not intended to guide the design of auxiliary lanes.

Except as footnoted, 4R projects will meet Wyoming design values, and as a minimum, will maintain existing travel lane and shoulder widths, and geometric design elements for both horizontal and vertical alignment for the non-NHS State Highway system.

Table 1. Arterials, 4R Roadway Geometric Controlling Design Criteria			
Controlling Design Criteria	Foot Note	Wyoming Standard Rural Section	Wyoming Standard Urban Section
Design Speed (MDS)	1	65 MPH MDS	45-30 MPH MDS
Lane Widths		12 Feet	12 Feet
Shoulder Widths 2-Lane or Undivided Roadway Vehicles/day, under 400 Vehicles/day, 400-2000 Vehicles/day, over 2000 Multi-Lane Divided Roadway Outside Shoulder Inside Shoulder	2	4 Feet 6 Feet 8 Feet 8 Feet 4 Feet	Minimum: Gutter Pan Widths Desirable: Rural Section Widths for Outside Shldr. Minimum: Gutter Pan Widths Desirable: Rural Section Widths for Outside Shldr.
Horizontal Alignment	1,3	65 MPH MDS	45-30 MPH MDS
Cross-Slope		1.5-2.0%	1.5-3.0%
Superelevation	5	Superelevation Tables, emax = 8%	Superelevation Tables, emax = 8%
Vertical Alignment	1,4	65 MPH MDS	45-30 MPH MDS
Grades-Maximum (Ranges) Level Terrain Rolling Terrain Mountainous Terrain		3-5% (65-40 MPH MDS) 4-6% (65-40 MPH MDS) 5-8% (65-40 MPH MDS)	6-8% (45-30 MPH MDS) 7-9% (45-30 MPH MDS) 9-11% (45-30 MPH MDS)
Sight Distance (Ranges)		645 Feet (65 MPH MDS) 305 Feet (40 MPH MDS)	360 Feet (45 MPH MDS) 200 Feet (30 MPH MDS)
Horizontal Clearance to Obstruction		Roadside Design Guide	2.0 Feet (From Curb Face)

Footnotes:

1--The Design Speed for rural sections may be lowered, by 5 MPH increments up to 25 MPH, based on terrain type. Design values for Controlling Design Criteria should match selected MDS and are taken from AASHTO *A Policy on Geometric Design of Highways and Streets, 2004*.

2--For rural sections, wider shoulder widths may be selected in consideration of WYDOT *Operating Policy 7-4, Bicycle Accommodation and Multiple-Use Transportation Facilities*. For urban sections, the shoulder width may be increased to provide for parking lanes, bicycle lanes, and/or turn lanes; selected shoulder widths include the gutter pan width, measured to curb face.

3--Isolated horizontal curves can be considered to remain in-place when the combination of design elements--curve radius, super elevation, and stopping sight distance--meets a minimum 55-MPH design speed for a rural section, lowered to 40-MPH MDS for terrain type. A Design Exception, justifying the action to leave a horizontal curve in-place, will be processed when this action is not consistent with the selected Design Speed.

4--Isolated vertical curves can be considered to remain in-place when the combination of design elements--vertical curve length, grades, and stopping sight distance--meets a minimum 55-MPH design speed for a rural section, lowered to 40-MPH MDS for terrain type. A Design Exception, justifying the action to leave a vertical curve in-place, will be processed when this action is not consistent with the selected Design Speed.

5--The 6% Table may be used in mountainous terrain. The 4% Table may be used in urban areas. Tables from AASHTO, *A Policy on Geometric Design of Highways and Streets, 2004*.

Fore-slope rates, the width of clear recovery areas, and median widths are non-controlling geometric elements for which best practice design values have been established. Fore-slopes are measured laterally from the outside edge of shoulder to ditch bottom or to a point of slope selection for cut sections, and to a point of slope selection for fill sections. The WYDOT minimum fore-slope rate established for Arterial reconstruction projects is 1V:4H, with a WYDOT recommended rate of 1V:6H. The first four feet, including the surfacing taper, will be constructed at a minimum 1V:8H using plant-mix or other consolidated and drain-able materials.

The clear recovery area (clear zone) is measured beyond the edge of the travel lane. Arterial 4R projects will provide for safety grading to meet a project-selected clear recovery area. The minimum width of the clear recovery area is the same as the Wyoming Standard for Horizontal Clearance to Obstructions, presented above for both rural and urban sections. 4R projects on rural sections of Arterials, previously constructed with a clear recovery area, will not require grading to further widen the clear recovery area. Beyond the clear recovery area, selection of slope-rates will be based on fill-height tables.

Median widths are measured between the edges of travel lanes and include the left shoulder widths. 4R projects should maintain the existing median width or construct a selected width from WYDOT *Standards for Multi-Lane Rural Roadway* and the Operating Policy for non-Interstate multi-lane highways. Based on the safety evaluation and resultant crash types required in the Highway Safety Improvement section, existing medians should be considered for protection with a longitudinal guardrail barrier.

Table 2. Collector Roads and Streets, 4R Roadway Geometric Controlling Design Criteria

Controlling Design Criteria	Foot Note	Wyoming Standard Rural Section	Wyoming Standard Urban Section
Design Speed (MDS)	1,6	55 MPH MDS	40-30 MPH MDS
Lane Widths		12 Feet	12 Feet
Shoulder Widths 2-Lane or Undivided Roadway Vehicles/day, under 400 Vehicles/day, 400-2000 Vehicles/day, over 2000 Multi-Lane Divided Roadway Outside Shoulder Inside Shoulder	2	2 Feet 4 Feet 6 Feet 6 Feet 2 Feet	Minimum: Gutter Pan Widths Desirable: Rural Section Widths for Outside Shldr. Minimum: Gutter Pan Widths Desirable: Rural Section Widths for Outside Shldr.
Horizontal Alignment	1,3	55 MPH MDS	40-30 MPH MDS
Cross-Slope		1.5-2.0%	1.5-3.0%
Superelevation	5	Superelevation Tables, $e_{max} = 8\%$	Superelevation Tables, $e_{max} = 8\%$
Vertical Alignment	1,4	55 MPH MDS	40-30 MPH MDS
Grades-Maximum (Ranges) Level Terrain Rolling Terrain Mountainous Terrain		6-7% (55-30 MPH MDS) 7-9% (55-30 MPH MDS) 9-10% (55-30 MPH MDS)	9% (40-30 MPH MDS) 10-11% (40-30 MPH MDS) 12% (40-30 MPH MDS)
Sight Distance (Ranges)		495 Feet (55 MPH MDS) 200 Feet (30 MPH MDS)	305 Feet (40 MPH MDS) 200 Feet (30 MPH MDS)
Horizontal Clearance to Obstructions		Roadside Design Guide	2.0 Feet (From Curb Face)

Footnotes:

1--The Design Speed for rural sections may be lowered, by 5 MPH increments up to 25 MPH, based on terrain type. Design values for Controlling Design Criteria should match selected MDS and are taken from AASHTO *A Policy on Geometric Design of Highways and Streets, 2004*.

2--For rural sections, wider shoulder widths may be selected in consideration of WYDOT *Operating Policy 7-4 Bicycle Accommodation and Multiple-Use Transportation Facilities*. For urban sections, the shoulder width may be increased to provide for parking lanes, bicycle lanes, and/or turn lanes. Selected shoulder widths include the gutter pan width, measured to curb face.

3--Isolated horizontal curves can be considered to remain in-place when the combination of design elements--curve radius, super elevation, and stopping sight distance--meets a minimum 45-MPH design speed for a rural section, lowered to 30-MPH MDS for terrain type. A Design Exception, justifying the action to leave a horizontal curve in-place, will be processed when this action is not consistent with the selected Design Speed.

4--Isolated vertical curves can be considered to remain in-place when the combination of design elements--curve length, grades, and stopping sight distance--meets a minimum 45-MPH design speed for a rural section, lowered to 30-MPH MDS for terrain type. A Design Exception, justifying the action to leave a vertical curve in-place, will be processed when this action is not consistent with the selected Design Speed.

5--The 6% Table may be used in mountainous terrain; the 4% Table may be used in urban areas. Tables from AASHTO *A Policy on Geometric Design of Highways and Streets*, 2004.

6--Rural projects with a selected posted speed limit that exceeds the Design Speed (MDS) will include a correction to design elements for both horizontal and vertical alignment to assure that all design values are within 10 MPH of the posted speed limit. For these projects, the MDS and related design values will remain at 55 MPH but the design values in footnotes 3 and 4 must be raised, as needed, to remain within 10 MPH of the selected posted speed limit.

Fore-slope rates, the width of clear recovery areas, and median widths are non-controlling geometric elements for which best practice design values have been established. Fore-slopes are measured laterally from the outside edge of shoulder to ditch bottom or to a point of slope selection for cut sections, and to a point of slope selection for fill sections. The WYDOT minimum fore-slope rate established for Collector reconstruction projects is 1V:4H, with a WYDOT recommended rate of 1V:6H. The first four feet, including the surfacing taper, will be constructed at a minimum 1V:6H using plant-mix or other consolidated and drain-able materials.

The clear recovery area (clear zone) is measured beyond the edge of the travel lane. Collector 4R projects will provide for safety grading to meet a project-selected clear recovery area; the minimum width of the clear recovery area is the same as the Wyoming Standard for Horizontal Clearance to Obstructions, presented above for both rural and urban sections. 4R projects on rural sections of Collectors, previously constructed with a clear recovery area, will not require grading to further widen the clear recovery area. Beyond the clear recovery area, selection of slope-rates will be based on fill-height tables.

Median widths are measured between the edges of travel lanes and include the left shoulder widths. 4R projects for Collector Roads and Streets, with urban sections, should maintain the existing median width.

Table 3. Local Roads and Streets, 4R Roadway Geometric Controlling Design Criteria			
Controlling Design Criteria	Foot Note	Wyoming Standard Rural Section	Wyoming Standard Urban Section
Design Speed (MDS)	1,6	45 MPH MDS	30 MPH MDS
Lane Widths		12 Feet	12 Feet
Shoulder Widths 2-Lane or Undivided Roadway Vehicles/day, under 400 Vehicles/day, 400-2000 Vehicles/day, over 2000	2	0 Feet 2 Feet 4 Feet	Gutter Pan Width
Horizontal Alignment	1,3	45 MPH MDS	30 MPH MDS
Cross-Slope		1.5-2.0%	1.5-3.0%
Superelevation	5	Superelevation Tables, emax = 8%	Superelevation Tables, emax = 8%
Vertical Alignment	1,4	45 MPH MDS	30 MPH MDS
Grades-Maximum (Ranges) Level Terrain Rolling Terrain Mountainous Terrain		7-8% (45-20 MPH MDS) 9-11% (45-20 MPH MDS) 12-16% (45-20 MPH MDS)	7% 10% 14%
Sight Distance (Ranges)		360 Feet (45 MPH MDS) 115 Feet (20 MPH MDS)	200 Feet
Horizontal Clearance to Obstructions		10 Feet	2.0 Feet (From Curb Face)

Footnotes:

1--The Design Speed for rural sections may be lowered, by 5 MPH increments up to 25 MPH, based on terrain type. Design values for Controlling Design Criteria should match selected MDS and are taken from AASHTO *A Policy on Geometric Design of Highways and Streets, 2004*.

2--For rural sections, wider shoulder widths may be selected in consideration of WYDOT *Operating Policy 7-4 Bicycle Accommodation and Multiple-Use Transportation Facilities*. For urban sections, the shoulder width may be increased to provide for parking lanes, bicycle lanes, and/or turn lanes; selected shoulder widths include the gutter pan width, measured to curb face.

3--Isolated horizontal curves can be considered to remain in-place when the combination of design elements--curve radius, super elevation, and stopping sight distance--meets a minimum 35-MPH design speed for a rural section, lowered to 20-MPH MDS for terrain type. A Design Exception, justifying the action to leave a horizontal curve in-place, will be processed when this action is not consistent with the selected Design Speed.

4--Isolated vertical curves can be considered to remain in-place when the combination of design elements--curve length, grades, and stopping sight distance--meets a minimum 35-MPH design speed for a rural section, lowered to 20-MPH MDS for terrain type. A Design Exception, justifying the action to leave a vertical curve in-place, will be processed when this action is not consistent with the selected Design Speed.

5--The 6% Table may be used in mountainous terrain; the 4% Table may be used in urban areas. Tables from *AASHTO A Policy on Geometric Design of Highways and Streets, 2004*.

6--Rural projects with a selected posted speed limit that exceeds the Design Speed (MDS) will include a correction to design elements for both horizontal and vertical alignment to assure that all design values are within 10MPH of the posted speed limit. For these projects, the MDS and related design values, to include design values in footnotes 3 and 4, must be raised, as needed, to remain within 10MPH of the selected posted speed limit.

Fore-slope rates, and the width of clear recovery areas are non-controlling geometric elements for which best practice design values have been established. Fore-slopes are measured laterally from the outside edge of shoulder to ditch bottom or to a point of slope selection for cut sections, and to a point of slope selection for fill sections. The WYDOT minimum and recommended fore-slope rate established for Local reconstruction projects is 1V:4H. The first four feet, including the surfacing taper, will be constructed at a minimum 1V:4H using plant-mix or other consolidated and drain-able materials.

The clear recovery area (clear zone) is measured beyond the edge of the travel lane. Local 4R projects will provide for safety grading to meet a clear recovery area; the minimum width of the clear recovery area is the same as the Wyoming Standard for Horizontal Clearance to Obstructions, presented above for both rural and urban sections. 4R projects on rural sections of Local Roads and Streets, previously constructed with a clear recovery area, will not require grading to further widen the clear recovery area. Beyond the clear recovery area, selection of slope-rates will be based on fill-height tables.

Bridge Design Process and Standards:

Non-NHS State Highway 4R projects will provide for bridge structure replacement or reconstruction of any element that does not meet design standards. Design standards presented in this Guide have been developed consistently with Wyoming laws, regulations and procedures. Supplemental geometric design information can be found in *AASHTO A Policy on Geometric Design of Highways and Streets*, and *WYDOT Road Design Manual*. WYDOT design values for State Highways (SH) classified as Arterials, Collector Roads and

Streets, and Local Roads and Streets, are presented in Table 4 for the three Controlling Design Criteria relating to bridge design.

Except as footnoted, all 4R projects will be designed to meet Wyoming design values, and as a minimum, will maintain existing travel lane and shoulder widths, and geometric design elements for both horizontal and vertical alignment for the Non-NHS State Highway system.

Table 4. Non-NHS State Highways, 4R Bridge Geometric Controlling Design Criteria				
Controlling Design Criteria	Foot Note	Wyoming Standards	Wyoming Standards	Wyoming Standards
		Arterials	Collector Roads	Local Roads
Bridge Roadway Width		Approach Roadway Width, Minimum 26 Feet Width	Approach Roadway Width, Minimum 26 Feet Width	Approach Roadway Width, Minimum 26 Feet Width
Vertical Clearance Over State Highway	1,2	16 Feet	14 Feet	14 Feet
SH Over Interstate		16 Feet	16 Feet	16 Feet
SH Over NHS Arterial		16 Feet	16 Feet	16 Feet
Structural Capacity		HL 93	HL 93	HL 93

Footnotes:

1--The determination to replace an existing bridge overpass to meet vertical clearance will consider the functional and structural evaluation of the bridge. Bridge replacement to meet Vertical Clearance is not required; a Design Exception justifying the action to leave the bridge in-place will be processed.

2--An additional 0.5 feet of vertical clearance is recommended to allow for future surfacing.

Any bridge structure replaced or proposed for reconstruction of major elements will be evaluated for structure type including location of abutments and piers, and length and width requirements. This evaluation will address future capacity needs of the roadway system, using a highway capacity analysis based on a minimum 20-year design life. The location of abutments and piers will consider design values for Horizontal Clearance to Obstructions, which vary by highway system crossed (Interstate, NHS Arterial, Non-NHS State Highways).

Highway Safety Improvements:

Early project planning for Non-NHS State Highway 4R projects will include an evaluation of the safety elements of the roadway and roadside. Crash history, predominant crash types, traffic volumes and vehicle classifications, and project scope and budget will all be evaluated

to determine the extent of safety improvements needed to improve the existing safety elements or address a project purpose of lowering the potential for a certain crash type. All roadside safety hardware within the clear recovery area, including bridge curb and railing, guardrail barriers and terminals, bridge-rail to guardrail connections, and sign support breakaway hardware, will be upgraded to meet safety design standards, NCHRP *Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features*.

Highway Capacity Improvements:

Non-NHS State Highway 4R projects, based on a highway capacity analysis, will provide for additional continuous travel lanes needed to meet a 20 year projected travel demand. Auxiliary lanes, such as turn lanes and truck climbing lanes, will be included, as justified.

Interchanges and Intersections:

4R projects can include the evaluation of geometric design, capacity and safety needs for interchange ramp connections to the NHS Interstate or NHS Arterial System. All improvements, based on a highway capacity analysis to meet a 20 year projected travel demand and design and safety design standards, can be included in the project plan. Improvements to the Interstate and NHS Arterial ramps may be delayed and programmed with a future Interstate or NHS Arterial project.

4R Non-NHS State Highway projects will evaluate the geometric design, capacity and safety needs for major intersections, including the intersecting road. All improvements, based on a highway capacity analysis to meet 20-year projected travel demand and design and safety design standards, can be included in the project plan. Capacity improvements to the intersection and/or the intersecting road may be delayed, if not warranted within the first ten years of the selected project design life, and can be programmed for a future stand-alone project. As an alternative, the initially proposed 4R project, to include intersection capacity improvements, may be delayed and a different project type, such as a 2R, may be selected to extend the project life until the capacity improvements are warranted and programmed as a 4R project.

Special Studies:

Innovative contracting including Cost plus Time, Lane Rental, and Incentive/ Disincentive provisions should be evaluated for 4R projects.

APPLICATION CRITERIA—Non-NHS STATE HIGHWAY 3R PROJECTS

Pavement Design Process:

Non-NHS State Highway 3R projects will be designed to restore or rehabilitate the existing pavements using a full range of pavement design strategies, to a selected design life up to 20 years. The pavement type determination will meet the procedures of WYDOT *Operating Policy 38-2*.

Non-NHS State Highways will be designed to meet the following criteria for the paved width of travel lanes, shoulders, and auxiliary lanes.

Travel Lanes: All travel lanes will be designed to a full-depth pavement structure for the full width, for all functional classifications.

Auxiliary Lanes: All auxiliary lanes, including passing, turning, climbing, parking, and bicycle lanes, will be evaluated for a reduced-depth pavement structure as they carry a differing volume and mix of traffic.

Shoulders: For Non-NHS State Highways functionally classified as Arterials, shoulders will be evaluated for a reduced-depth pavement structure, typically a minimum 2-inch depth plant-mix surface for the full width. For Non-NHS State Highways functionally classified as Collector Road and Streets, shoulders will be evaluated for a reduced-depth pavement structure, typically a minimum 2-inch depth plant-mix surface for the inside 2-feet, with the remainder of the shoulder width extending either the 2-inch depth plant-mix surface or constructed with a consolidated and drain-able material. For Non-NHS State Highways functionally classified as Local Roads and Streets, shoulders will be evaluated for a reduced-depth plant-mix pavement structure or constructed with a consolidated and drain-able material.

Geometric Design Process and Standards:

Design Process: Early project planning for Non-NHS State Highway 3R projects will include an evaluation of the existing highway elements against design values, for both controlling design criteria and other major criteria such as fore-slope rates. 3R projects will improve those highway elements related to controlling design criteria that are below tolerable controls, consistent with WYDOT *Operating Policy 7-1 Design Standards and Tolerable Controls*. Improvements will be designed to meet design standards for controlling design criteria and best practice for non-controlling geometric elements.

Design Standards: WYDOT design standards are presented in the preceding Table 1 through Table 4. Tolerable controls, relative to those highway elements which can remain in-place for a 3R project, are generally defined as the design values that were in effect at the time of original construction of the Non-NHS State Highway section proposed for improvement, or the design values for existing highway elements, related to controlling design criteria, if the roadway has been improved since original construction. These tolerable controls will be maintained during project design or improved as needed. Tolerable controls, applicable to mainline sections, are as follows in Table 5 for roadways.

Table 5. Non-NHS State Highways, WYDOT 3R Roadway Tolerable Controls				
Controlling Design Criteria	Foot Note	Tolerable Controls		
		Arterial	Collector	Local
Design Speed (MDS) Rural Section Urban Section	1,6	55MPH Existing Posted Speed	45 MPH Existing Posted Speed	35 MPH Existing Posted Speed
Lane Widths Rural Section Urban Section		12 Feet 11 Feet	11 Feet 11 Feet	11 Feet 10 Feet
Shoulder Widths Rural Section Urban Section	2	Existing, Min.2' Existing Widths	Existing Widths Existing Widths	Existing Widths Existing Widths
Horizontal Alignment Rural Section Urban Section	1,3	55 MPH MDS Existing Posted Speed	45 MPH MDS Existing Posted Speed	35 MPH MDS Existing Posted Speed
Cross-Slope		1.5%	1.5%	1.5%
Superelevation	5	Consistent with Horizontal Alignment	Consistent with Horizontal Alignment	Consistent with Horizontal Alignment
Vertical Alignment Rural Section Urban Section	1,4	55 MPH MDS Existing Posted Speed	45 MPH MDS Existing Posted Speed	35 MPH MDS Existing Posted Speed
Grades-Maximum All Terrains		Existing Grades	Existing Grades	Existing Grades
Sight Distance Rural Section Urban Section		495 Feet Existing	360 Feet Existing	250 Feet Existing
Horizontal Clearance Rural Section Urban Section		Existing Shoulder 2 Feet From Curb Face	Existing Shoulder 2 Feet From Curb Face	Existing Shoulder 2 Feet From Curb Face

Footnotes:

1--On rural sections, the tolerable control for minimum design speed and the related highway elements which can remain-in-place can be lowered, by 5 MPH increments up to 15 MPH, due to terrain type.

2--For rural sections, wider shoulder widths may be selected in consideration of *WYDOT Operating Policy 7-4 Bicycle Accommodation And Multiple-Use Transportation Facilities*. For urban sections, the shoulder width may be contained within a gutter section, parking lane, turn lane, or bicycle lane. Selected shoulder widths include the gutter pan width, measured to curb face.

3--The use of minimum values for design elements of horizontal alignment--curve radius, super elevation, and stopping sight distance (these values taken from current design standards)--should be avoided.

4--The use of minimum values for design elements of vertical alignment--vertical curve lengths, grade differences, and stopping sight distance (these values taken from current design standards)--should be avoided.

5--Design values from Superelevation Tables for $e_{\text{max}} = 8\%$, AASHTO *A Policy on Geometric Design of Highways and Streets, 2004*. The 6% Table may be used in mountainous terrain; the 4% Table may be used in urban areas.

6--For Collector and Local Roads and Streets, projects developed as rural sections with a selected posted speed limit that exceeds the Design Speed (MDS) will include a correction to the MDS and related design values to assure that all design values are within 10MPH of the posted speed limit.

Fore-slope rates, the width of clear recovery areas, and median widths are non-controlling geometric elements for which best practice design values have been established. Fore-slopes are measured laterally from the outside edge of shoulder to bottom of ditch or to a point of slope selection for cut sections, and to a point of slope selection for fill sections. The WYDOT minimum fore-slope rate and tolerable control is 1V:4H. The WYDOT recommended rate of 1V:6H is established for Arterials and Collector Roads and Streets. A rate of 1V:4H is established for Local Roads and Streets. The first four feet, including the surfacing taper, will be constructed using plant-mix or a consolidated and drain-able material at a minimum rate of 1V:8H on Arterials, a minimum rate of 1V:6H on Collector Roads and Streets, and a minimum rate of 1V:4H for Local Roads and Streets. Design exceptions are not required, but project records should document when it is not reasonable to achieve full compliance with WYDOT minimum design values for this non-controlling design element.

The width for Horizontal Clearance to Obstructions is determined through application of the procedures for establishing the clear recovery area from the AASHTO *Roadside Design Guide, 2002*. For a 3R project, the tolerable control for horizontal clearance will be the paved shoulder width for a rural section and 2.0 feet beyond the curb face for an urban section, as presented in Table 5. When this tolerable control width is selected on a rural section that has not been safety-graded, all fixed objects outside of the shoulder width but inside a calculated design value for horizontal clearance, will be removed, made breakaway or shielded by crashworthy guardrail. The clear recovery area (clear zone) is measured beyond the edge of the travel lane. The design value and tolerable control widths of the clear recovery area, for Non-NHS State Highway 3R projects, are the same values as presented for Horizontal Clearance to Obstructions. Beyond the clear recovery area, selection of slope-rates will be based on fill-height tables.

There are a limited number of miles of 4-lane divided Non-NHS State Highways. Design standards for median widths, from 8 feet paved to 76 feet depressed, are presented in the WYDOT *Standards for Multi-Lane Rural Roadways* and the Operating Policy for non-Interstate

multi-lane highways. Existing median widths are acceptable as the tolerable control. Based on the safety evaluation and resultant crash types, required in the Highway Safety Improvement section, existing medians should be considered for protection with a longitudinal guardrail barrier.

Bridge Design Process and Standards:

Design Process: Non-NHS State Highway 3R projects will evaluate bridge structures to determine elements in an advanced state of deterioration. The evaluation will review the roadway width (combined travel lane plus shoulder widths) for improvements to ensure that the bridge width is consistent with the width of the approach roadway. Work needed to extend the functional life of the structure, including structure replacement, widening, or reconstruction of any element, will be addressed with a 3R project and meet design standards. Any bridge structure replaced or proposed for reconstruction of major elements will be evaluated for structure type, length and width requirements, with a capacity analysis based on a minimum 20-year design life. The location of abutments and piers will consider design values for Horizontal Clearance to Obstructions, which vary by highway system crossed (Interstate, NHS Arterial, Non-NHS State Highways).

Design Standards: WYDOT design standards are presented in the preceding Table 1 through Table 4. Tolerable controls, relative to those highway elements which can remain in place for a 3R project, are generally defined as the design values that were in effect at the time of original construction of the Non-NHS State Highway section proposed for improvement, or the design values for existing highway elements related to controlling design criteria, if the roadway has been improved since original construction. These tolerable controls will be maintained during project design or improved as needed; tolerable controls are as follows in Table 6 for bridges.

Table 6. Non-NHS State Highways, WYDOT 3R Bridge Tolerable Controls			
Controlling Design Criteria	Tolerable Control	Tolerable Control	Tolerable Control
	Arterials	Collector Roads	Local Roads
Bridge Roadway Width	Approach Roadway Width, Minimum 26 Feet Width	Approach Roadway Width, Minimum 26 Feet Width	Approach Roadway Width, Minimum 26 Feet Width
Vertical Clearance Over State Highway (SH) SH over Interstate SH over NHS Arterial	Existing Clearance, Minimum@14 Feet Existing Clearance Existing Clearance	Existing Clearance Existing Clearance Existing Clearance	Existing Clearance Existing Clearance Existing Clearance
Structural Capacity	Inventory Rating 0.8 or greater	Inventory Rating 0.8 or greater	Inventory Rating 0.8 or greater

Highway Safety Improvements:

Early project planning for 3R projects will include an evaluation of the safety elements of the roadway and roadside, including the clear recovery area, median widths, existing fore-slope rates, and all existing roadside safety hardware. Crash history, predominant crash types, traffic volumes and vehicle classifications, and project scope and budget will all be evaluated to determine the extent of safety improvements needed to improve the existing safety elements or address a project purpose of lowering the potential for a certain crash type. All roadside safety hardware within the clear recovery area, including bridge curb and railing, guardrail barriers and terminals to include length-of-need, bridge-rail to guardrail connections, and breakaway hardware will be evaluated. Upgrading roadside safety hardware to current safety design standards, NCHRP *Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features*, may be included in the project plan or, consistent with the Safety Management System, be phased as a future programmed project or stand-alone safety project. As presented in an earlier section on Horizontal Clearance to Obstructions, a 3-R project design that uses the shoulder width for horizontal clearance on a highway section that has not been previously constructed with a clear recovery area must upgrade safety hardware to safety design standards.

Highway Capacity Improvements:

3R projects are not intended to provide for additional continuous travel lanes. Future year capacity needs on Non-NHS State Highways would typically be evaluated as part of a 4R Reconstruction.

Interchanges and Intersections:

3R projects are not intended to include improvements to interchange ramp connections to the NHS Interstate or Arterial System; a 3R project may include resurfacing of ramps and crossroads, maintaining existing widths.

3R projects will evaluate the geometric design, capacity and safety needs for major intersections, including the intersecting road. Improvements, based on a highway capacity analysis to meet 20-year projected travel demand and design and safety design standards, can be included in the project plan. Capacity improvements to the intersection and/or the intersecting road may be delayed, if not warranted within the first ten years of the selected project design life, and can be programmed for a future stand-alone project. As an alternative, the initially proposed 3R project, to include intersection capacity improvements, may be delayed and a different project type, such as a 2R, may be selected to extend the project life until the capacity improvements are warranted and programmed as a 4R Reconstruction.

APPLICATION CRITERIA—Non-NHS STATE HIGHWAY 2R PROJECTS**Pavement Design Process:**

Non-NHS State Highway projects will be designed to resurface the existing pavement structure to a selected design life up to 15 years. Project types include level/mill and overlay, concrete pavement restoration and dowel bar retrofits.

Geometric Design Process and Standards:

Design Process: Early project planning for 2R projects will include an evaluation of the horizontal alignment for existing curve radius and super-elevation, and the resultant design speed. The evaluation will determine if either of those highway elements is below tolerable controls defined in the above Application Criteria—Non-NHS State Highway 3R Projects. If the horizontal alignment warrants improvement, the selected improvements will meet the Wyoming Standards in Table 1, Table 2, or Table 3. 2R projects are not intended to improve all highway elements that do not meet tolerable controls. Project records such as a Project Evaluation Report will document the evaluation results and justify delaying the improvement of highway elements that do not meet tolerable controls; the formal Design Exception process is not applicable to 2R projects.

Design Standards: 2R projects will maintain the existing roadway width. For those highway segments where the existing roadway width exceeds the design values presented in Table 1, Table 2, or Table 3, the roadway width may be reduced to meet those design values, consistent with the functional classification of the road.

Bridge Design Process and Standards:

Bridge structures will be evaluated to determine elements in an advanced state of deterioration. Work, generally defined as bridge preservation to extend the functional life of the structure, may be included with a 2R project, to include bridge deck repairs and overlays.

Highway Safety Improvements:

2-R projects are not intended to improve all roadside features. Early project planning for 2R projects will include an evaluation of all existing roadside safety hardware. Upgrading roadside safety hardware to safety design standards, *NCHRP Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features*, may be included in the project plans or, consistent with the Safety Management System, be phased as a future programmed project or safety project.

Pavement edge drop-offs, that result from the constructed project, will be corrected on a 1V:4H or flatter.

Highway Capacity Improvements:

2R projects are not intended to provide for additional continuous travel lanes or auxiliary lanes. Future year capacity needs would typically be evaluated as part of a 4R Reconstruction.

Interchanges and Intersections:

2R projects are not intended to include improvements to interchange ramp connections to the NHS Interstate or NHS Arterial System. A 2R project may include resurfacing of ramps and crossroads, while maintaining existing widths.

Modifications to intersections, including turn lanes, should be evaluated and included in the project plan, if justified.

APPLICATION CRITERIA—Non-NHS STATE HIGHWAY 1R PROJECTS

Pavement Design Process:

Non-NHS State Highway 1R projects are defined as those pavement preservation strategies and reactionary efforts designed for a maximum 2" pavement thickness (including leveling thickness). Project types include overlays, partial width mill/fills, chip seals, micro-surfacing, crack seals, wearing courses, grind and reseals, and slab repairs.

Geometric Design Process and Standards:

Design Process: 1R projects, structured to solely address mainline pavement preservation needs, are not intended to improve the existing mainline geometric elements.

Design Standards: 1R projects will maintain the existing roadway width. For those highway segments where the existing roadway width exceeds the design values presented in Table 1, Table 2, or Table 3, the roadway width may be reduced to meet those design values, consistent with the functional classification of the road.

Bridge Design Process and Standards:

Work, generally defined as bridge preservation to extend the functional life of the structure, may be included with a 1R project, to include bridge deck repairs and overlays.

Highway Safety Improvements:

1R projects are not intended to improve roadside safety features.

Pavement edge drop-offs, that result from the constructed project, will be corrected on a 1V:4H or flatter.

Highway Capacity Improvements:

1R projects are not intended to provide for additional continuous travel lanes, or auxiliary lanes. Future year capacity needs would typically be evaluated as part of a 4R Reconstruction.

Interchanges and Intersections:

Non-NHS State Highway 1R projects are not intended to include improvements to interchange ramp connections to the NHS Interstate or NHS Arterial System. Modifications to intersections, including turn lanes, should be evaluated and included in the project plan, if justified.

REFERENCES

The References presented in this Guide are current and adopted editions. As these references are revised and new editions adopted, all references in this Guide are intended to refer to the most current and adopted edition. For example, NCHRP Report 350, when updated, may be renamed or have a different sponsoring agency, but when adopted, will be the edition required for use by this Guide.

AASHTO: *A Policy on Geometric Design of Highways and Streets, 2004.*

AASHTO: *Roadside Design Guide, 2002.*

AASHTO: *Highway Safety Design and Operations Guide, 1997.*

TRB: *Highway Capacity Manual Special Report 209, 2000*

NCHRP: *Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features*

WYDOT: *Road Design Manual & Road Design Manual Memorandums (RDMM)*

WYDOT: *Operating Policy*

Policy Number 38-2 Pavement Type Determination

Policy Number 7-1 Design Standards and Tolerable Controls

Policy Number 25-1 Traffic Control and Roadway Lighting Devices

Policy Number 7-4 Bicycle Accommodation and Multiple-Use Transportation Facilities

WYDOT: *Standards for Multi-Lane Rural Roadways and the Operating Policy for non-Interstate multi-lane highways.*