# Kansas Low-Volume Roads Handbook: Just Another Manual?

Eugene R. Russell, Sr., and Bob L. Smith, *Kansas State University*

The Kansas handbook on low-volume roads (LVR) is more than a stripped-down version of the *Manual on Uniform Traffic Control Devices*. It is a guide to good signing practice aimed specifically at low-volume rural roads. Its objective is to assist local government agencies by providing guidance for making safe local roads for the traveling public within their jurisdictions. It is specifically intended for county and small-town engineers, county road supervisors, township boards, and other local officials with responsibility for road and street safety. The history and development of the LVR handbook are discussed, stressing that the handbook's acceptance by local officials and personnel came from involving them in the process. An undertaking such as the LVR handbook should have local input from the start. The more local input, the more likely that such a handbook will be accepted and used. The Intermodal Surface Transportation Efficiency Act of 1991 mandated several management systems, including a highway safety management system (HSMS), which both state and local governments are struggling to define and implement. The LVR handbook actually advocates a process that is essentially a basic HSMS for local government agencies. The process and the connection are explained and illustrated with examples. The principles of good operating practice, which are based on the principles of driver expectancy, positive guidance, and consistency, are defined and explained. Examples of these principles are the basis for several sections of the LVR handbook in which guidance on typical problems encountered on low-volume roads is provided. A commentary driving procedure was developed as a supplement to the handbook. Commentary driving is a simple, cost-effective technique to evaluate consistency—or to find inconsistencies that put drivers at risk for having an accident—that is described in the paper. A feature unique to Kansas and to the LVR handbook is the ABC road classification system. A driver's expectancy is influenced by the type of road being traveled and how the driver perceives the road. A prudent driver receives information from a road and will set his or her driving speed accordingly. That information will also govern the degree to which he or she is attentive to the driving task. How this relates to proper signing by road classification is discussed.

As stated in the *Manual on Uniform Traffic Control Devices* (MUTCD) (*1*), "The responsibility for the design, placement, operation and maintenance of traffic control devices rests with the governmental body or official having jurisdiction." In 1966 Congress gave the Secretary of Transportation authority to require traffic control devices on all streets and highways in each state. The Uniform Vehicle Code, Section 15-104, also specifies that each state highway agency adopt a manual and specification for a uniform system of traffic control devices that correlates with and conforms as much as possible to the most recent edition of the MUTCD.

Almost all states have statutes that require traffic control devices to conform to a state manual that, in turn, substantially conforms to the MUTCD. The majority of states have adopted the MUTCD as their state manual; some have developed their own, which is generally the same. Kansas has adopted the MUTCD. In Kansas, it is a standard that must be followed.

The MUTCD states (*1*): "The decision to use a particular device at a particular location should be made on the basis of an engineering study." The manual is intended to provide standards for design and application, but it is not intended to substitute for engineering judgment. The MUTCD further states (*1*): "It is the intent that the provisions of this Manual be standards for traffic control devices installation, but not a legal requirement for installation." However, in practice in today's climate of rampant litigation, public officials and personnel with traffic control responsibilities face a potential tort liability suit each time they make a decision that does not follow the manual exactly.

Tort liability is an issue that is beyond the scope of this paper. However, it concerns many local agencies, many of which have no professional or trained traffic engineers or, in some cases, trained technical personnel. A survey currently being conducted in Kansas has revealed that some counties rely on the risk manager of their insurance company to make decisions on highway signing. Clearly, local government units need help in the proper application of the principles of the MUTCD.

The MUTCD presents traffic control device standards for all classes of public streets and highways under all government agencies having jurisdiction. The manual specifies restrictions on a few signs with limited application. For example, certain sections on expressways and freeways are not applicable to local roads and streets under the jurisdiction of counties, small towns, and so on. Many other sections are seldom used on low-volume roads (LVRs) under county jurisdiction (e.g., motorist service signing, signing for civil defense). Finally, in a handbook guiding counties on LVRs, there is little or no need for the section on signals.

The first obvious step in developing an LVR handbook is to remove all sections on signs, signals, and markings that are not commonly used on LVRs. Such a "stripped-down" MUTCD has some advantages. If it contains only signs and markings important to local government, it should be easier to use and, in theory, could promote greater use. Nevertheless, a stripped-down version of the MUTCD is probably a waste of resources to produce. What most local government agencies (those without professional, engineering expertise) need is guidance. As a book of standards, the MUTCD is a valuable document; however, it is short on guidance.

The purpose of the *Handbook of Traffic Control Practices for Low-Volume Roads* (LVR handbook), developed by the Kansas State University (KSU) Traffic Assistance Services for Kansas (TASK) project, is to assist local government agencies by providing guidance on providing safe local roads for the traveling public within their jurisdictions (*2,3*). It is specifically intended for county and small-town engineers, county road supervisors, township boards, and other local officials with road and street safety responsibilities.

Statewide use of the LVR handbook will lead to more consistent signing and marking of local roads, roads that meet drivers' expectancy and are safer (i.e., the driver is not surprised or confused and put at risk of an accident by unexpected situations). The consistent use of the guidelines should also decrease the legal liability of local governments in lawsuits arising from roadway accidents. Finally, recognizing that the funds available to local government agencies for construction, maintenance, and operation of their road system are limited, the LVR handbook aims at a rational balance between maximum safety (or zero risk) and minimum cost.

The LVR handbook does not differ from the MUTCD—no such handbook should conflict with the MUTCD on any point—but is meant to supplement it. The MUTCD is a standard that must be followed; the LVR handbook provides completely compatible, supplementary material. It provides guidance, but is not a standard.

The LVR handbook is based on the principles of good operating practice, including driver expectancy, positive guidance, and consistency. These principles will be discussed below. The relationship between the LVR handbook and the current mandate to develop highway safety management systems (HSMSs) at all levels is also discussed below.

## Early History of LVR Handbook

The development of the LVR handbook began in about 1979 when Bob L. Smith suggested to the Kansas Department of Transportation (KDOT) Bureau of Local Projects that the Kansas counties and townships needed some guidance, probably in handbook form, that would supplement the MUTCD for traffic control practices on their low-volume roads. In 1979 KDOT and KSU entered into a contract for the development of the handbook. The original KSU development project was directed by Smith.

One of the concerns of the Project Director was that the county personnel (the handbook's intended audience) would perceive the developed handbook as being KDOT's, KSU's, or Smith's rather than a county-township document. Thus, shortly after the project

started, a 17-member technical advisory committee (TAC) was formed. The TAC comprised 1 engineer from FHWA, 3 engineers from KDOT, 1 county commissioner, and 12 county engineers or road supervisors. The TAC did, in fact, function as its name implies. It is very important for anyone considering the development of a local manual to have local input from the start. The more local input, the more likely it is that such a handbook will be accepted and used.

The development team in its early conceptual work adopted the elements of driver expectancy, positive guidance, and consistency as basic principles of good operating practice. Tapering, a special application of positive guidance, was developed. Tapering is a simple technique in which the traveled way (the maintained part of the road) is gradually narrowed some distance ahead of an impediment (e.g., a narrow culvert). The driver simply follows the edge of the roadway—the usual tendency—and is thus guided away from the roadside obstacle. This innovation appealed to Kansas county engineers. The details and design principles of tapering are contained in the LVR handbook and are summarized below.

The handbook development team searched for a context in which to implement the basic operating principles (driver expectancy, positive guidance, and consistency). The search resulted in a road classification system unique to Kansas and the LVR handbook. A driver's expectancy is influenced by the type of road being traveled and how he or she perceives the road while driving it. The concept of using driver expectancy, positive guidance, and consistency in conjunction with the road classification system was agreed upon in the project by the TAC. Details of classification system, excerpted from the LVR handbook, are presented in a later section.

The first handbook draft was very rough: a conglomeration of hand-drawn sketches, pasted-up hand-lettered sections, and typed sections. At this stage, the county TAC members knew for sure they would have ample opportunity to question, offer suggestions, and discuss the handbook content and format. (Again, promotion of a cooperative attitude and open discussions with county personnel were very important.) Many subsequent TAC meetings resulted in modifications, additions, and deletions but, quite often, consensus on items when first suggested for the handbook. A final draft was completed and reviewed by TAC. The KDOT Bureau of Local Projects agreed to publish the handbook. Full acceptance of the final document was clearly shown when the TAC county members expressed impatience about printing delays.

The first edition was printed and distributed in late 1981 (2). A course on the use of the LVR handbook was given for county and township personnel early in 1982. The handbook has been used for several years as a text for the TASK course on low-volume road problems and as supplementary material for many other TASK courses. It was also used for several years in a required course for students in civil engineering at KSU. Thus, if it had no other value, it has been an effective teaching tool for dozens of KSU courses for local government personnel on proper local road signing as part of the TASK project.

The LVR handbook was updated in 1990 to conform to the 1988 MUTCD, and the second edition was published in 1991 (3). The same process was used. Over a 2-year period, each section of the handbook was critically reviewed. Several sections were rewritten; a few sections were added. Whenever a controversy arose, the TAC representatives from local governments were given priority. Before publication, a final draft was reviewed by a committee of the Kansas County Highway Association, which gave its endorsement. In Kansas, endorsement of any project by this association generally ensures acceptance.

## Relationship to Local Highway Safety Management Systems

The Intermodal Surface Transportation Efficiency Act of 1991 mandates several management systems. Pavement management systems, maintenance management systems, and bridge management systems are common and well established. Highway safety management systems (HSMS) are more elusive. State and local government agencies are currently struggling to put these together. As of February 1994, neither KDOT nor any of the local government agencies have plans on how they will proceed to meet the HSMS mandate.

County and township roads carrying less than 400 vehicles per day are classified as low-volume rural roads. They make up a large percentage of the total rural road mileage in the United States. The extensiveness of low-volume rural roads presents counties and townships with serious financial problems. They are hard-pressed to provide construction and maintenance dollars to improve existing roads or to simply maintain them at their current condition; to replace or upgrade substandard bridges; and to install or maintain necessary traffic signs and pavement markings. The problem is to provide a reasonably safe roadway system at reasonable cost.

A desirable goal for local government is a roadway system in which a reasonably prudent driver, even a stranger to the area, will be able to travel safely. This goal is the underlying principle of the LVR handbook and is consistent with the goal of any HSMS, which is simply to reduce accidents.

The LVR handbook suggests procedures that, when followed, contain the basic components of a local HSMS. A suggested LVR handbook procedure would include the following actions essential to an HSMS:

- Classify roads according to type,
- Identify problem areas and safety deficiencies using commentary driving,
- Institute a citizen complaint system,
- Prioritize safety deficiencies and develop and document a plan of action,
- Locate information in the LVR handbook that addresses the problem,
- Institute a sign inventory and maintenance program, and
- Take action, according to established and documented priorities.

The LVR handbook, along with the supplementary commentary driving procedure, gives guidance on all of the actions above.

The authors strongly recommend the commentary driving technique to identify safety deficiencies. This technique is based on principles of driver expectancy, positive guidance, and consistency. It is a natural companion to the LVR handbook, which is based on the same princples. A procedure manual was written and distributed as a supplement to the LVR handbook (*4*). Recently, a self-taught, interactive video-workbook on the use of the commentary driving technique was developed and distributed to all counties in Kansas (*5*).

Citizen involvement in government decisions is very desirable, particularly at the local level. The LVR handbook suggests a citizen complaint system, which is described in the following paragraphs. Such a system can be a valuable supplement to whatever primary system is used to identify problem areas and safety deficiencies.

All complaints should be made to one office. The office should be available to receive complaints or notices of problems concerning roadways and traffic control devices. The following actions are suggested:

1. Record date and time of complaint;
2. Record name, address, and telephone number of complainant;
3. Record location and description of problem;
4. Prioritize the problem according to an established system based upon potential criticality of having an accident;
5. Investigate, if necessary, to determine corrective action;
6. Contact maintenance personnel and instruct them to take appropriate action immediately in case of a high-priority ranking;
7. Record time, date, and to whom the corrective action instruction was assigned;
8. Ask for local law enforcement support at location, if necessary, until action can be taken;
9. Record date and time that corrective action was completed;
10. Upon completion of action, notify complainant about corrective action taken, and express appreciation for assistance;
11. Maintain a record system of all complaints and file according to location; and
12. Review records periodically, noting recurring problems that may need special attention.

Guidelines are also given for setting up a complaint office or contact point to receive and record the complaints, and the factors that should be considered in developing a priority system for selecting the order for responding to citizen complaints are included. In addition to helping keep track of safety deficiencies, a citizen complaint system has considerable public relations value by promoting goodwill. Evidence of seeking out safety deficiencies and a program to prioritize and correct them help in defending tort liability cases.

To summarize the HSMS connection, the process set forth in the LVR handbook, both explicitly and implicitly, supplemented by the commentary driving procedure, provides the basis for a simple, usable HSMS for local government agencies.

## Principles Related to Good Operating Practice

The LVR handbook is based on principles of good operating practice. Included in these principles are driver expectancy, positive guidance, and consistency. The following discussion of these principles comes from the LVR handbook (*3*).

### Driver Expectancy

Drivers, and people in general, expect things to operate in certain ways. When entering a dark room, one expects to find an on-off toggle switch for the lights. One also expects to switch up for *on* and down for *off*. When the switch works in reverse, or when there is a rheostat knob, it takes one a bit longer to respond. The same situation occurs with drivers. When a driver's expectancy is incorrect, he or she either takes longer to respond properly or, worse, responds poorly or wrongly. If, for example, a curve sign indicates a curve to the right when the road actually curves left, one can imagine the difficulty a driver has in negotiating the curve properly—especially a stranger to the area at night. This example may seem to be extreme; however,

such difficulty has been observed rather frequently with winding-road sign when the bottom or beginning curve points in the wrong direction.

What the driver expects on a road is greatly influenced by what was experienced on the previous section of road. Studies have shown that what a driver has seen—presence or absence of traffic control devices, road surface type, condition and width, narrow bridges or culverts, and so on (what might be called the "roadway environment")—is what the driver expects for the next 1/2 to 1 mi.

Driver expectancy is affected not only by very recent experiences but also by what drivers have learned through past experiences (e.g., advance railroad crossing signs are at all railroad grade crossings; stop signs are red; curve warning signs are yellow and diamond shaped). It follows that the consistent use and placement of traffic control devices can do a great deal toward ensuring that the driver's expectancy is correct.

Driver expectancies are also affected by the type of road (i.e., Interstate highway, state highway, county or township road). The driver expects to use a different level of caution on each road type.

## Positive Guidance

Positive guidance is the concept of a driver being given sufficient information where he needs it and in a form he can best use to safely avoid a hazard. Positive guidance can be given to the driver through combinations of signs, object markers, safe advisory speed signs, and, probably most important of all, the view of the road ahead. If drivers could see the curves far enough ahead to judge their sharpness and adjust to a safe speed or see approaching cars on cross roads because the intersections were clear of sight obstructions, if there were no intersections hidden by the crest of a hill, or if all narrow bridges and culverts were visible to drivers from both directions, there would be little need for anything more than an occasional stop or yield sign to assign the right-of-way at the intersection of low-volume roads with higher-volume roads. The condition just described might be called "roadway positive guidance." Studies have shown that the edge of the roadway ahead is among the most important guidance information the driver uses. Using the edge of the roadway in this manner provides an easy and effective way of providing positive guidance at narrow bridges and culverts or other roadside obstacles. (Examples are presented in a following section.)

## Consistency

Consistency relates to the sameness of the nature of a road from one section to another. Inconsistencies are sudden changes in the nature of a road. Inconsistencies violate a driver's expectancy; thus, either the road should be made consistent, which is usually impractical, or the driver's expectancy should be corrected (i.e., the driver's expectancy should be restructured). In the case of a hidden curve in a nearly straight roadway, the use of a curve warning sign with, perhaps, an advisory speed plate will correctly restructure the driver's expectancy. After seeing the curve sign, the driver expects the curve, knows whether the road curves left or right, and knows the speed at which the curve can be comfortably and safely driven. Commentary driving is a simple, cost-effective technique to evaluate consistency—or to find inconsistencies.

## Commentary Driving

The commentary driving technique has been recommended, promoted, and taught to local personnel in Kansas for several years. The technique brings together the principles of driver expectancy, positive guidance, and consistency. The technique is believed to be the most cost-effective technique available for identifying problem areas and high accident risk locations, particularly on low-volume roads and streets. It was developed specifically as a supplement to the LVR handbook; details have been published in supplementary materials (*4*,*5*). The following paragraphs are based on that section of the LVR handbook that is used to acquaint LVR officials with the process, the principles, and the availability (*3*) of the commentary driving technique.

The information that a driver derives from the road should be correct, pertinent, concise, and presented in such a way that it is readily understood and usable. If this information is inconsistent with what drivers expect to receive or should receive, the result violates a driver's expectancy of the roadway environment and could result in increased reaction time and possible driver error.

The commentary driving procedure is highly useful in safety evaluations of low-volume rural roads. It is a simple technique that requires no special equipment and from which information is gathered concerning the roadway environment to help rid the roadway environment of all information-deficient locations. (Information-deficient locations are specific sites on the roadway where the information received by the driver from the roadway is insufficient to ensure that he or she can safely traverse the roadway.) The commentary driving procedure requires a driver-evaluator to travel the section of road to be evaluated. As the road is driven, the driver-evaluator records his or her expectancies of the road and comments on locations and conditions that violate these expectancies. After completing the commentary on a section of road, the evaluator returns

at a later date and conducts a more detailed study of the problem locations perceived.

The detailed study may result in specific recommendations (e.g., changes in signs or pavement markings, clearing of weeds or brush that obstruct signs). The purpose of the changes is to correct any information deficiencies as noted in the detailed study (i.e., locations that violate a driver's expectancy, provide insufficient guidance, and/or are inconsistent and thus increase the driver's risk of an accident). To assist in the evaluation, deficiency check sheets have been developed. Through a series of questions, the user is guided to the proper countermeasure or solution to the problem that is being investigated. The LVR handbook provides guidance to mitigate the problem, thereby, reducing the accident risk. The next section presents an example.

## "Applied" Positive Guidance

One unique and very useful procedure developed at KSU for the first edition of the LVR handbook is "tapering," which is a simple technique in which the traveled way (maintained part of the road) is gradually narrowed (tapered) some distance ahead of an obstacle, say, a narrow culvert. Since drivers usually follow the edge of roadway, they are automatically guided away from the roadside obstacle. If tapering is not used, the driver may not see the end of the culvert, and if he or she continues to follow the edge of roadway (faulty guidance), he or she may drop a wheel off the end of the culvert. (See Figure 1.) When the road is tapered by proper blading with a road grader, the roadway edge is gradually brought in to the culvert ends as shown in Figure 2. Thus, the driver is guided away from a path that would lead to a collision within the culvert end.

The LVR handbook contains tables of values for proper tapering and considerable direction (with examples, diagrams, etc.) on how to provide positive guidance at narrow-bridge locations, which are quite common on LVRs.

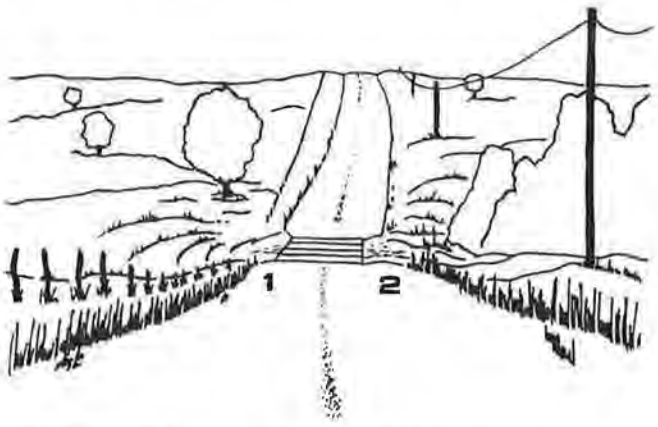


FIGURE 1 Before tapering of road (*3*).

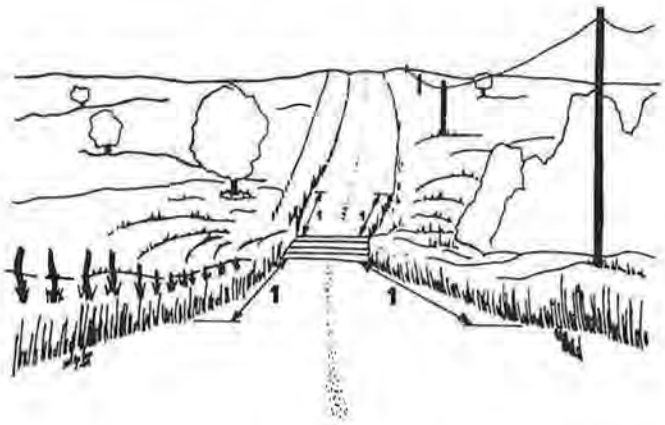


FIGURE 2 After tapering of road (*3*).

## LVR Classification

Another feature unique to the Kansas handbook is an LVR classification system developed specifically for Kansas roads by the KSU project staff that developed the first edition of the Handbook. As noted earlier, the driver's expectancy is influenced by the type of road being traveled and how the driver perceives the road. Traditionally, highways have been classified by administrative jurisdiction, such as state, county, or township; by volume; and most frequently according to function, such as arterial, collector, or local service. It is impossible for a driver to perceive the administrative classification of roads without state, county, or township route markers. It is difficult, if not impossible, for the driver to judge the function of the road or its volume without special training. What the driver does observe are the physical roadway characteristics, such as width and kind of surface, riding quality, road surface drainage, the presence or absence of traffic control devices, hills and sharp curves. The road classifications—Type A, Type B, and Type C—used in the LVR handbook are based on roadway characteristics that drivers readily perceive. These characteristics, in turn, influence the driver's expectancies. On the basis of this information, a prudent driver will set his or her driving speed accordingly. It will also govern the degree to which he or she is attentive or inattentive to the driving task, whether consciously or subconsciously.

Figures 3 through 6 are examples of Kansas roads typical of each classification system. The physical characteristics of each type of road are summarized in Table 1. Upon entering a road, the driver sees physical char-

FIGURE 3 Type A aggregate-surfaced road (*3*).

FIGURE 5 Type C road (*3*).

acteristics, except operating speed and drainage, almost immediately. After a short distance, the width of the road, type of surface, and riding quality will suggest an appropriate safe speed to a reasonably prudent driver. After a little rain, the effects of a well-drained versus a poorly drained road will become apparent to the driver.

Once the driver has decided on (perceived) the kind of road, he or she will choose how to drive it. Table 2 summarizes some of the expectancies related to the classification of rural roads. Through knowledge of what a driver expects, inconsistencies can be identified and appropriate actions can be taken to lessen or remedy the problem.

Table 3 gives the proper handling of some selected inconsistencies for the three types of roads. Just as driver expectancies are different for each type of road (drivers expect a lower level of signing and maintenance on Type C than on Type B or A), inconsistencies are also different. For example, what may be an inconsistency on a Type A road is often a consistency on a Type C road and consequently may require no positive guidance or signing.

In summary, the LVR handbook road classification system is a good example of local government agencies treating all roads in a consistent fashion relative to meeting a driver's expectancy. This is important in providing a reasonably safe roadway system at a reasonable cost.

Throughout, the handbook offers guidance to local officials on providing safer roads based on the principles of expectancy, positive guidance, and consistency, considering road type (classification). Among other topics, it contains sections on the following:

- Narrow bridges, culverts, and roadside obstacles;
- Low-water stream crossing;
- Cattle crossings; and
- Construction and maintenance signing.

In addition, several appendixes give instructional material on common operations not already discussed, including the following:

- Tapering techniques,
- Sign inventory and maintenance checks,
- Ball bank indicator use,
- Sight distance at intersections,

FIGURE 4 Type B road (*3*).

FIGURE 6 Type C (primitive) road (*3*).

**TABLE 1 Classification of Low-Volume Roads by Typical Physical Characteristics (3)**

| Characteristic | Road Type | | |
|---|---|---|---|
| | Type A See Figure 3 | Type B See Figure 4 | Type C Primitive See Figure 6 |
| Typical Width of Traveled Way and number of visible wheel paths | 22' or greater, 3 or 4 visible wheel paths (if gravel) | 16'-24', 2 or 3 visible wheel paths | 2 or no visible wheel paths |
| Prudent Operating Speed | 40 mph or greater | 25-45 mph | 40 mph or less |
| Surface Material | paved or aggregate | aggregate | natural surface may have some aggregate |
| Riding Quality | No adverse effect | may cause reduction in operating speed | typically poor; may be impassable due to poor weather |
| Drainage | All-weather road - good surface drainage; water carried to ditches | All weather road - some surface ponding; water carried in ditches | Fair weather road - ditches are narrow or nonexistent; surface ponding likely to affect driveability |

**TABLE 2 Some Driver Expectancies by Roadway Type (3)**

| Conditions | Road Type | | |
|---|---|---|---|
| | Type A | Type B | Type C |
| Roadside Obstacles Vertical Alignment | Some consistent with previous 1/2 to 1 mile | Some consistent with previous 1/2 to 1 mile | Many may be consistent with previous 1/2 to 1 mile |
| Horizontal Alignment | consistent with previous 1/2 to 1 mile | consistent with previous 1/2 to 1 mile | consistent with previous 1/2 to 1 mile |
| Vehicle Right of Way at Intersection | expects to have right of way | prepared to yield right of way | expects to yield right of way |
| Safe Stopping Sight Distance | adequate for usual operating speed | adequate for usual operating speed | adequate for usual operating speed |
| Influence of Opposing Traffic | None | slow down to pass opposing vehicle | difficult to pass opposing vehicle |

**TABLE 3 Handling of Selected Inconsistencies (3)**

| Road Type Inconsistency Discussion | Road Type | | | |
|---|---|---|---|---|
| | Type A | Type B | Type C | Detailed Discussion |
| T or Y Intersection | should be signed unless adequate sight distance is provided | should be signed unless adequate sight distance is provided | should be signed unless adequate sight distance is provided | pages 23, 24[a] |
| Railroad Crossing | shall have advance sign and crossbucks | shall have advance sign and crossbucks | shall have advance sign and crossbucks | pages 46-52[a] |
| Narrow Bridge or Culvert | all shall be signed | all shall have positive guidance - some should be signed | all shall have positive guidance (few should be signed) | pages 53-56[a] |
| Low Water Stream Crossing | should be signed | may be signed | may be signed | pages 66-71[a] |
| Dead End | not applicable | not applicable | should be signed | |

[a] Pages in the handbook

- Tort liability,
- Chevron alignment signs at curves, and
- Commentary driving procedures.

## Summary

It should be clear that the LVR handbook is not just another manual—not just a stripped-down version of the MUTCD. It is a guide to good signing practice aimed specifically at low-volume rural roads, with the objective of reducing accidents.

The LVR handbook is based on principles of driver expectancy, positive guidance, and consistency. It not only explains these principles, it integrates them throughout. The concept of tapering is one example.

Another example is the ABC classification system, which is tied to driver expectancy. Drivers have higher expectations of road maintenance and signing on better roads and drive them accordingly (i.e., with higher speeds and less caution). They need and expect guidance consistent with their speed and relaxed attentiveness. Thus, these roads should receive a higher priority for funds available for signing and maintenance. On a "primitive" C (wheelpaths with grass in the center, for example), a prudent driver's expectancy is low (i.e., he or she drives slower with more attentiveness and caution and does not need or expect much guidance). These roads can be given a lower priority for available resources for signing and maintenance.

The authors believe that the greatest value of the LVR handbook, and its supplement on commentary driving, is as a basis for a local HSMS. The LVR handbook and supplementary commentary driving procedure provide guidance for the following suggested procedure:

- Classify roads according to type,
- Identify problem areas and safety deficiencies using commentary driving,
- Institute a citizen complaint system,
- Prioritize safety deficiencies and develop and document a plan of action,
- Locate information in the LVR handbook that addresses the problem,
- Institute a sign inventory and maintenance program, and
- Take action according to established and documented priorities.

This process is basically an elementary HSMS. It could be the foundation for an expanded, more inclusive, more sophisticated HSMS. It is probably the level at which most local governments should start the HSMS process.

## References

1. *Manual on Uniform Traffic Control Devices for Streets and Highways*, 1988 ed. FHWA, U.S. Department of Transportation, 1988.
2. Smith, B. L., ed. *Handbook of Traffic Control Practices for Low Volume Roads*, 1st ed. Kansas Department of Transportation, Topeka, 1981.
3. Russell, E. R., ed. *Handbook of Traffic Control Practices for Low Volume Roads*, 2nd ed. Kansas Department of Transportation, Topeka, 1991.
4. Smith, B. L. *Commentary Driving Procedure: A Supplement to the LVR Handbook*. Kansas State University, Manhattan, 1988.
5. Russell, E. R. *Instruction Manual for Commentary Driving: A Self Taught, Interactive Video/Workbook*. Center for Transportation Research & Training, Kansas State University, Manhattan, 1993.