Transportation Systems and Utility Infrastructure

Audience

- Local and regional units of government,
- Landowners and developers,
- Community and citizen organizations, and
- Transportation / utility planners and engineers.

Overview

Transportation systems and utilities are major components of urban development. For instance, the old cliché "Build a _____ and the people will come!" certainly typifies the results of building transportation facilities through undeveloped land. Transportation systems and utilities also play a major role in the loss of trees and woodlands. The impact of transportation systems and utility infrastructure should be considered at all three levels.

Transportation systems

■ Types of transportation systems

Transportation facilities may include interstate highways, state trunk highways, county state-aid highways, municipal state-aid routes, county roads, municipal roads, township roads, railways, transit ways, airports, and bike and pedestrian ways. Construction of each type of transportation system results in varying degrees of

impact on wooded areas and other natural resources depending upon land use, zoning, and projected traffic volume and speed.

■ Planners of transportation systems

The Minnesota statewide transportation plan is required by state and federal regulations, as are transportation plans for each of the seven Minnesota Metropolitan Planning Organizations (MPOs). Minnesota Department of Transportation (Mn/DOT) districts are developing district long-range plans intended to complement the statewide planning process. Copies of district plans may be obtained by contacting the local Mn/DOT district office (Appendix 1, page 91).

Planning for transportation systems involves many different players, including:

- Mn/DOT—seven districts and the metro division,
- MPOs—seven in Minnesota,
- Regional Development Commissions (RDCs),
- local county and city road authorities, and
- Federal Highway Administration.

■ Funding for transportation systems

Funding for transportation improvement projects for all state trunk highway projects and all federally funded local highway and transit projects are listed in the Minnesota State Transportation Improvement Program

(STIP). The STIP is required by federal regulations, as are Transportation Improvement Programs (TIPs) from each of the seven MPOs.

The STIP is developed through a local decision-making process using Area Transportation Partnerships (ATPs) to generate lists of local projects based on local transportation needs, planning decisions, and regional funding targets. These lists are called Area Transportation Improvement Programs (ATIPs). The membership of ATPs includes traditional and nontraditional stakeholders and can include MPOs, RDCs, cities, counties, townships, transit providers, tribal governments, other interests, and Mn/DOT. The ATIPs and the MPO TIPs are developed and ultimately incorporated into the STIP through a process outlined in *Guidance for the Development of the State Transportation Improvement Program*.A copy can be obtained by contacting Mn/DOT Office of Investment Management (see Appendix 1, page 91).

■ State road and highway design standards

Safety is a primary concern in state road design. Trees over 4 inches in diameter within the clear zone pose a safety hazard to motorists that leave the highway. Factors influencing the clear-zone distance (Figure 25, page 80) include design speed, average daily traffic, and degree of curve (sharp curves require a wide clear zone), and cut or fill section.

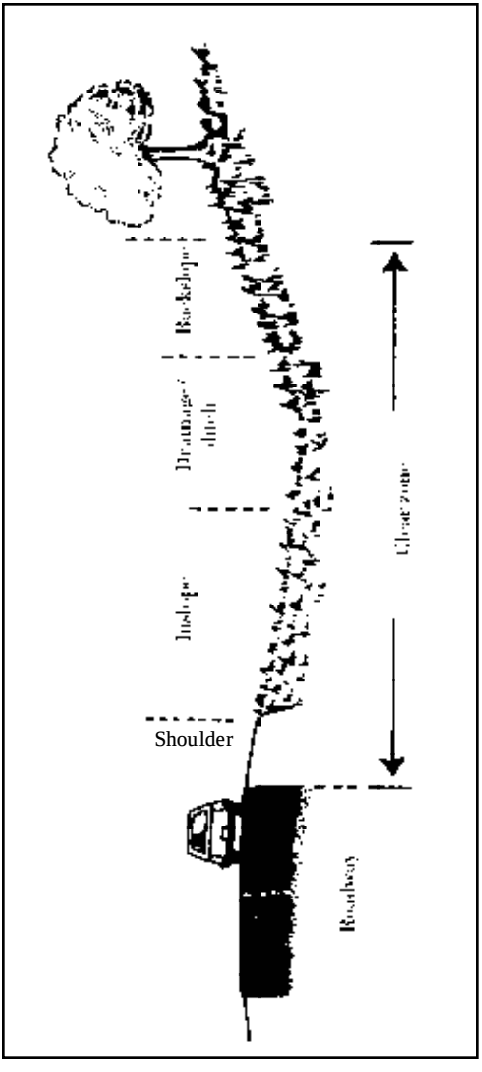


Figure 25. A roadway clear zone is a wooded area specifies standards for conserving trees and providing safe travel.

Mn/DOT's *Road Design Manual* addresses clear-zone design requirements. Valuable trees or forest communities may be preserved by shifting the road alignment, steepening cut or fill slopes, constructing retaining walls, and installing guardrails. To purchase a copy of the *Road Design Manual*, contact Mn/DOT's Map and Manual sales office (see address in Appendix 1, page 93). To read the manual or make copies of selected portion(s), contact the Mn/DOT Library (see phone number and e-mail address in Appendix 1, page 93).

■ Natural preservation routes

Transportation agencies are exploring "context-sensitive" design principles to preserve important natural plant communities during planning and construction of transportation facilities. Natural preservation routes provide one example.

◆ Definition

Natural preservation routes are designated roadways that possess sensitive or unique scenic, environmental, or historical characteristics. Examples may include roads along lakes, rivers, wetlands, or flood plains, or through forests or hilly, rocky, or bluff terrain.

◆ Classification process

Any county state-aid highway may be classified as a natural preservation route if it satisfies the definition criteria. Any person may make a written request to the

county board to have a route declared a natural preservation route. The county board asks the local advisory committee* to carefully consider all the information available and make a recommendation to the commissioner of transportation to either designate the route or reject the petition.

Roadways designated as natural preservation routes are constructed using standards designed to reduce environmental impacts through reduced design speeds; narrower lanes, shoulders, and recovery areas; steeper slopes; fewer cuts and fills; and less contractor working space (Figure 26, page 84). There are three levels of natural preservation routes:

Type I—Very low traffic volumes and few accidents—30 mph design speed. Type I is best characterized as one in which the natural surroundings convey a feeling of intimacy with nature.

Surface type	Design speed (mph)	Lane width (feet)	Shoulder width (feet)	In slope (rise: run)	Recovery area (feet)	Design strength (tons)	Bridge to remain (feet)
Aggregate	30	11	1	1:3	3	-	22
Paved	30	11	1.5	1:3	10	9	22

*Each district of the Mn/DOT has a local advisory committee consisting of three members of the general public, one representative from a recognized environmental organization, one representative from the DNR, the county highway engineer, and the county commissioner.

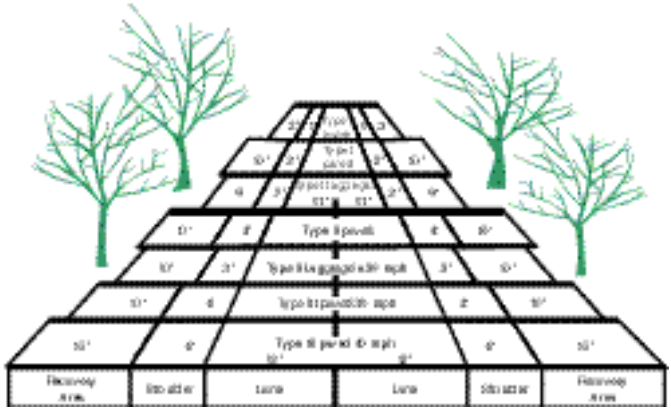
Type II—Generally low traffic volumes less than 300 vehicles per day—30–40 mph design speed. Type II routes are similar to type I, except that the surroundings and vistas may be more distant.

Surface type	Design speed (mph)	Lane width (feet)	Shoulder width (feet)	Inslope (rise: run)	Recovery area (feet)	Design strength (tons)	Bridge to remain (feet)
Aggregate	30	11	2	1:3	10	-	24
Paved	40	11	4	1:4	10	9	24

Type III—Traffic volumes generally less than 750 vehicles per day—30–40 mph design speed. Type III routes are more like type I and type II, except that the scenery is even more distant.

Surface type	Design speed (mph)	Lane width (feet)	Shoulder width (feet)	Inslope (rise: run)	Recovery area (feet)	Design strength (tons)	Bridge to remain (feet)
Aggregate	30	12	3	1:4	10	-	24
Paved	30	12	4	1:4	10	9	24
Paved	40	12	4	1:4	16	9	24

STANDARDS FOR
NATURAL PRESERVATION ROUTES



Note: For more details on Natural Preservation Route standards, see the Minnesota Department of Transportation, Division of State Aid, Operations Rules chapter 8820.

Figure 26. Construction standards for natural preservation routes are used to preserve wooded areas and trees during road construction.

■ Reduce tree damage through subdivision transportation planning

Planning for transportation systems within a development should include temporary protection fencing, clean root cutting, watering, topsoil fill (type and placement), utility construction, tree pruning, assessing damage to trees, oak wilt prevention, and other vegetation protection measures (Mn/DOT Standard Specifications 2572, *Protection and Restoration of Vegetation*). A copy of this document can be obtained by contacting any Mn/DOT district office, the Mn/DOT Library (see Appendix 1, page 93, for telephone number and e-mail address), or the County Auditor's Office. Tree Protection Details (Mn/DOT Sheet C) illustrates temporary fence placement, root protection and trenching, sandy loam fill placement, and slope rounding.

Utility infrastructure

■ Types of utility infrastructure

Utilities include water, storm water systems, irrigation lines, gas, sanitary sewer, power, cable television, and fiber optics for communication. Major concerns utilities have in development are to maximize customer connections to utilities, minimize the installed infrastructure and impact on the environment, and minimize the visual impact where practical by burying the facilities underground in dedicated utility easements, usually located adjacent to the street or backyard lot lines.

■ Reduce tree damage through utility planning

Regional and local planners, developers, and builders must plan the utility infrastructure before construction begins so that connection and installation can be accomplished efficiently. Before trenching for utilities or septic systems, make sure that wooded areas and trees to conserve have been identified, protection measures have been installed, and the final grade is complete. On larger new developments try to install utilities two to three years before construction begins and to evaluate the tree protection plan.

◆ Utilize joint utility trench

Utilities can often share the same trench (Figure 27). A common utility trench within the same easement may be cost effective, reduce the size of area disturbed, and save trees. The size of underground structures ranges from 2 to 8 feet wide and 2 to 5 feet deep, and so the trench may require extensive excavation (Matheny and Clark, 1998). One of the few exceptions to joint utility trenches is that water and sewer utilities may be required to be in separate trenches. Other utilities, including electric, gas, fiber optic, and cable television, can be installed in the same trench. The North Oaks development in Minnesota has been using a joint utility trench. When considering a joint utility trench, the landowner, developer, and utility companies must coordinate the schedule and activities. Also, utilities must abide by certain specifications and rules within the trench (e.g., National Electric Safety Code).

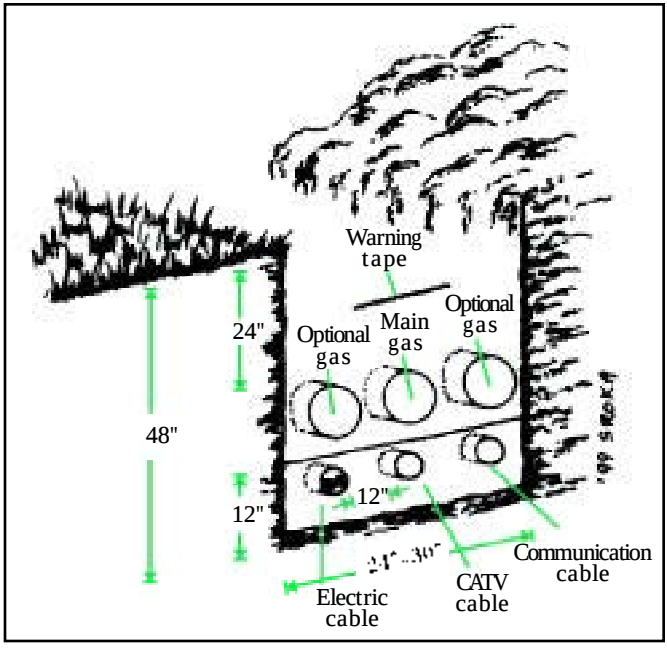


Figure 27. A joint underground utility trench for electrical, gas, fiber optic, and cable television infrastructure is encouraged in wooded areas to minimize utility easements and enhance the conservation effort.

◆ **Use tunneling rather than open trenching**

Vegetation is discouraged in dedicated utility easements because of the potential for conflict with utilities. To protect wooded areas and trees on utility easements, consider tunneling for utility installation as an alternative to open trenching and tree removal.

Tunnel at least 2 feet below the soil surface to minimize impacts on roots (Figure 28). Tunneling is very effective to protect trees when done appropriately.

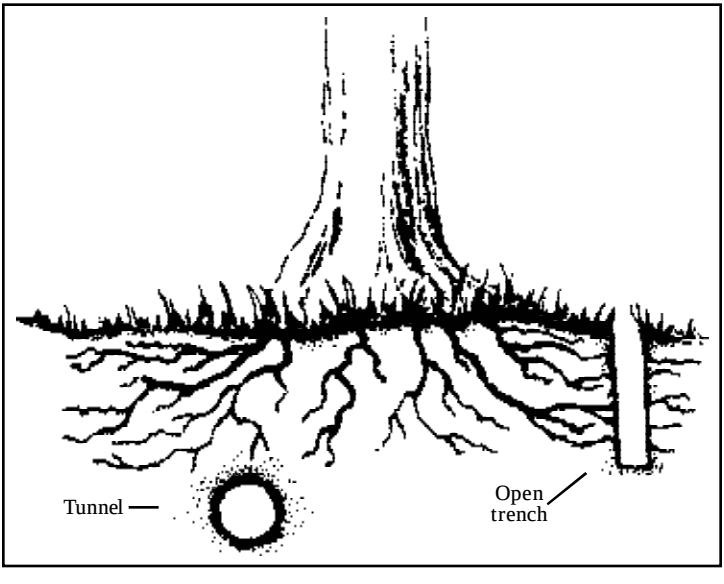


Figure 28. Tunneling below the root system is preferred over open trenching (on right) when installing the utility infrastructure near the protected root zone because tunneling impacts fewer roots and thereby increases tree survival.

Mn/DOT Standard Specifications 2572 *(Protection and Restoration of Vegetation)*provides information about tunneling considerations related to timing and distance of tunneling in relation to trees.

◆ Consider other soil excavation methods

Manual or hydraulic excavation with water pressure may be a cost-effective alternative to tunneling (Figure 29). They cause less damage to roots than mechanized trenching. When trenching manually, avoid physical damage to roots greater than 2 inches in diameter. Hydraulic excavation requires knowledge of soils, roots, hydraulics, and use of proper specialty equipment. Water pressurized at 60 to 80 pounds per square inch at the nozzle will be effective and efficient (Gross, 1995).

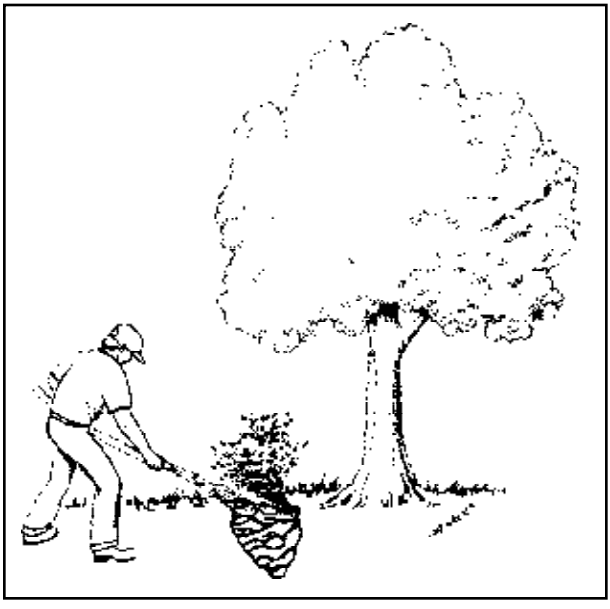


Figure 29. Water under pressure can be used as an alternative method to remove soil near the protected root zone and prevent cutting roots.

■ Site readiness summary for utilities

- ☐ Site is within 4 inches of final grade (installation area and cable route)
- ☐ Block numbers and lot corners are identified and staked
- ☐ Curbs are installed and the first layer of blacktop completed (if required by ordinance)
- ☐ Curbs are back-filled for utility trucks to access
- ☐ Utility conduits crossing under roadways are installed and ends are marked
- ☐ Protected wooded areas and trees are identified
- ☐ Tree protection measures are installed (e.g., fence, signs, wood chips, crossing bridge)
- ☐ Sites for storing soil and other excavation materials are identified
- ☐ A travel route for utility equipment is available (8 foot-wide clearance is adequate)
- ☐ When using a joint trench for utilities, the landowner, homeowner, or developer coordinates the work schedule with all utility companies