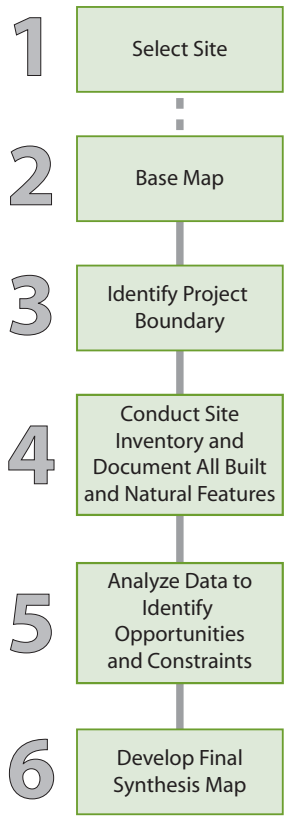
Chapter 3
Site Inventory and Analysis

Proper planning prevents wasted dollars. For example, if the wrong species of tree is chosen for use under power lines, money will be lost every year to tree trimming or repair of damaged lines from fallen branches. Likewise, the selection of the wrong tree in a downtown streetscape leads to roots that spread beneath sidewalks, causing them to buckle and resulting in hazardous conditions or high maintenance and repair costs. These costs can be prevented or mitigated if a thorough site inventory and analysis is conducted and proper material selections are made.

A site inventory documents a site's natural and built environment and, for the purpose of this manual, the safety and design policies established by AASHTO and TDOT. Once these conditions have been documented, an analysis of all the site's features can then be developed to identify opportunities and constraints. These include the areas of the roadside environment in which to plant and the vegetation that is best suited to a particular site. A site analysis can also determine areas that may require drainage structures or erosion prevention measures.

The following process and associated checklist will aid in the development of a detailed site inventory and analysis and will lead to a more successful roadside enhancement project. Chapter 4, *Design Development*, provides a more detailed approach to selecting plant materials based on these conditions, while Chapter 6 presents a variety of sample design solutions that respond to the opportunities and constraints determined by the site analysis.

Figure 3.1: Site Inventory and Analysis Process



BASE MAPS

When conducting a site inventory, it is helpful to have an aerial photograph or a site survey to assist in the documentation of existing conditions. If the roadside enhancement project is part of a new roadway project, the roadway construction plans can be used. For projects on existing roadways, maps can be found from a variety of sources, including a local government's GIS data, engineering or planning departments, online GIS and aerial photograph viewers and databases, and roadway construction plan archives (TDOT or local government), to name a few.

SITE INVENTORY: IDENTIFYING DESIGN PARAMETERS

After selecting a site and gathering the necessary base maps, the next step is to identify the project boundaries, which will vary depending on the type and location of the project. The boundary can be a right-of-way line, property line, median or any other defined area. After the boundary has been identified, use the *Existing Conditions Checklist* and a base map to record the existing site conditions. The physical features listed in the checklist are typical to the roadside environment and will require a site visit or a thorough land survey in order to be documented. Other items, including the utility information and clear zones, may require some research and coordination with local governments or TDOT.

The following outline helps explain what to look for when conducting a site inventory and the depth of information to be recorded. Figures 3.10 through 3.16 provide examples for documenting a site's existing conditions. When all the conditions are recorded, an analysis can be developed, as illustrated in Figure 3.17.

Environmental Conditions

Region of the State

The State of Tennessee is divided into three grand divisions: East, Middle and West. These divisions each have distinct environmental and land form characteristics. In this manual, the purpose of identifying the regions is to help determine native plant species. Native plants are adapted to particular environmental conditions and will perform better if matched to the proper region. The plant lists, found in the Appendix, indicate whether the species is native to one of these three regions.

USDA Hardiness Zone

These zones, developed by the US Department of Agriculture, represent areas in which plants will most successfully grow based on temperature. While the zones are developed based on minimum temperatures, heat can also impact a plant's survival. The zones are also divided into subzones (a and b) to cover microclimates. Tennessee is comprised of Zones 6a, 6b, 7a and 7b.

Figure 3.2: Grand Divisions

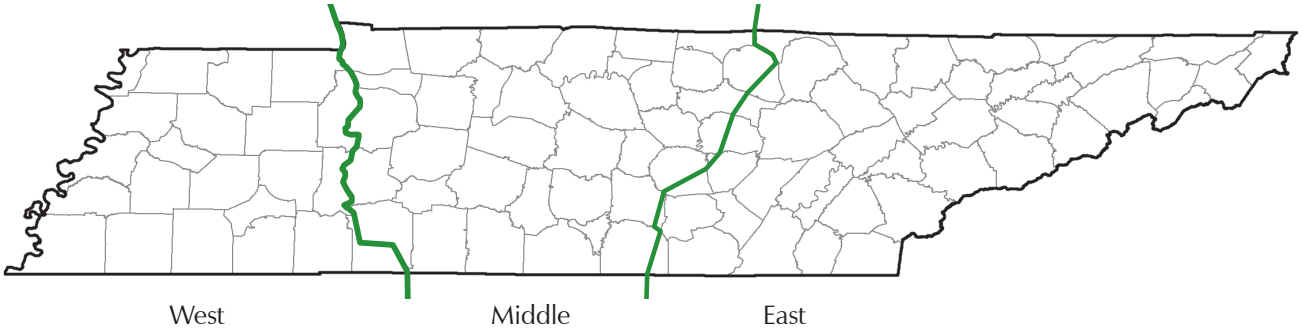
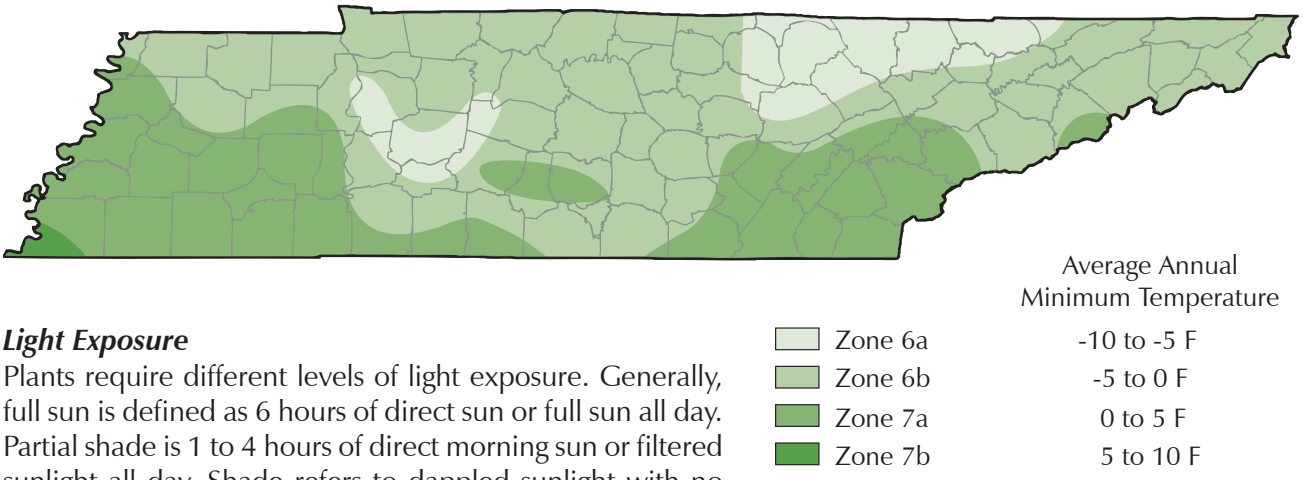


Figure 3.3: USDA Hardiness Zone Map



Light Exposure

Plants require different levels of light exposure. Generally, full sun is defined as 6 hours of direct sun or full sun all day. Partial shade is 1 to 4 hours of direct morning sun or filtered sunlight all day. Shade refers to dappled sunlight with no direct sun (Wasowski, 29). Existing vegetation, fences, walls, buildings and slope can all affect light exposure and should be noted.

Soil Moisture

There are four classifications of soil moisture: wet, moist, moist to dry and dry. Soil moisture can vary on a site, so make note of different areas. Also, one must take into consideration recent rain events or dry periods. Wet refers to soil that is consistently or frequently inundated with water. This includes wetland areas but not areas that hold water for a brief period of time after a rainfall. Moist soil is defined as soil that retains moisture year-round. This soil type is ideal for most plants. Moist to dry soil is seasonally moist but is also periodically dry. Dry soil has very little to no moisture and is typically found in sandy soils (*Landscaping with Native Plants in Tennessee*, TN-EPPC) (Wasowski, 29).

Slope

If a topographical survey is not available, slope can be difficult to determine by a site visit alone. Slopes less than 10% (10H:1V) are generally flatter and may have areas that hold water. Slopes 10–25% (10H:1V to 4H:1V) are moderate and more prone to erosion. Slopes greater than 25% (4H:1V) are steep and pose a greater risk of erosion and may require stabilization. If slopes vary throughout the site, indicate the different areas on a map. Note any areas that require erosion prevention measures.

Waterways

These include any streams, creeks, rivers, lakes and other bodies of water. Make note of these features even if they are intermittent or ephemeral.

Existing Plant Species

Make note of the site's existing vegetation and its condition. Existing vegetation is a good indicator of a site's relative health and ability to sustain future landscaping enhancements. Note the existing vegetation characteristics, such as mature forest, transition vegetation, turf, flowering, fruit-bearing, evergreen, deciduous, invasive, etc. Record any specimens that are to remain.

Structures

Drainage Structures

These include built structures for the purpose of collecting and/or conveying water. Document all drainage structures, including inlets, headwalls, culverts, swales, and detention and retention ponds. Note features about each structure, including sizes and materials.

Utilities

All existing overhead and underground utilities should be documented. If a survey of underground utilities is not available, contact local utility companies to locate all underground gas, water, electrical, sewer and storm water lines. Indicate other utilities that will require access, such as control boxes and manholes. Prior to construction, contact Tennessee One Call System, Inc. (1-800-351-1111 or 811) to assist in locating underground utilities.

Other Structures

Document all other built features, including poles, guardrails, fences, noise barriers/sound walls, bridges, signs and billboards. Include relevant information such as their size, quantity and material.

QUICK FACTS

The colors of the paint and flags used by the Tennessee One Call System to indicate buried utilities are:

Red: Electric
Orange: Communications, Phone/ CATV
Blue: Potable Water
Green: Sewer/Drainage
Yellow: Gas/Petroleum Pipe Line
Purple: Reclaimed Water
White: Premark site of intended excavation

Source: Call 811 (www.call811.com)

Safety and Design Requirements

Clear Zones

Note the required clear zone(s). The desirable clear zone varies depending on roadside geometry (side slopes), speed and traffic volume, as well as the presence of guardrails and other barriers (Figure 1.2). Consult AASHTO's *Roadside Design Guide* (Chapter 3) and the TDOT Design Division for clear zone requirements.

Sight Distance

Note approaches and intersections that will require open sight lines (Figures 1.3 through 1.6). Record the types of roads, (major, minor, etc.) the speed limits on all roadways, and consult AASHTO's *Guide for Geometric Design* and the TDOT Design Division's Roadway Standard Drawings for sight distances and requirements.

Special Conditions

Viewsheds

Views can be something to screen or to open. Record any undesirable views that should be blocked from the roadway. Likewise, document areas that want views *to* the roadway blocked (e.g., neighborhoods). Note any views that should be opened or maintained. These could be scenic overlooks or views into a downtown area.

Views, like this one from Highway 421 in Shady Valley, Tennessee, should be preserved

Cultural and Historical Features

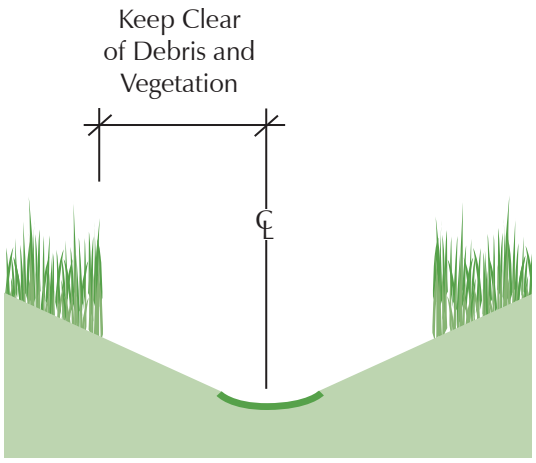
Record any features of cultural or historical importance, including items that may be on the National Register of Historic Places. State parks, monuments, cemeteries and historic homes are all examples of features that should be noted.

Historic structures, such as Two Rivers Mansion in Nashville, Tennessee, should be noted in the site inventory

SITE ANALYSIS: IDENTIFYING OPPORTUNITIES AND CONSTRAINTS

Now that all of the site features have been documented and the information has been gathered, it is time to analyze the findings. This analysis does not create a design, but it does guide it. The guidelines below, which are based on AASHTO and TDOT's design, safety and maintenance policies, will help identify opportunities and constraints that may exist on any given site.

Figure 3.4: Concrete or Grass Swale



- Drainage structures must be kept clear of debris and vegetation to allow for water flow and access. Swales should be cleared or mowed a minimum of 3 feet from the centerline (Figure 3.4). All drainage structures must be kept easily accessible for maintenance.
- Certain types of vegetation, particularly trees with extensive root systems, should not be planted over underground utilities. In the roadside environment, underground drainage lines are often present and should be avoided.
- Do not plant vegetation that will interfere with overhead utilities. Only small trees or shrubs that will not exceed 25 feet at maturity should be planted under overhead utilities to prevent future interference. Consider the spread of the tree, as well, when planting adjacent to overhead utilities. Limbs that get too close to overhead lines will be trimmed.

Figure 3.5: Mature Size of Tree at Power Lines

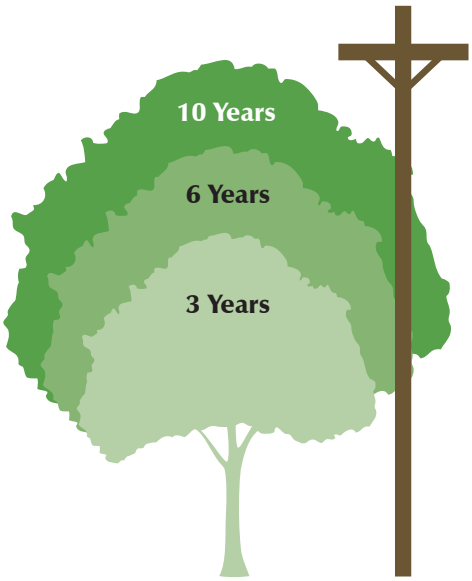


Figure 3.6: Spread of Tree at Power Lines

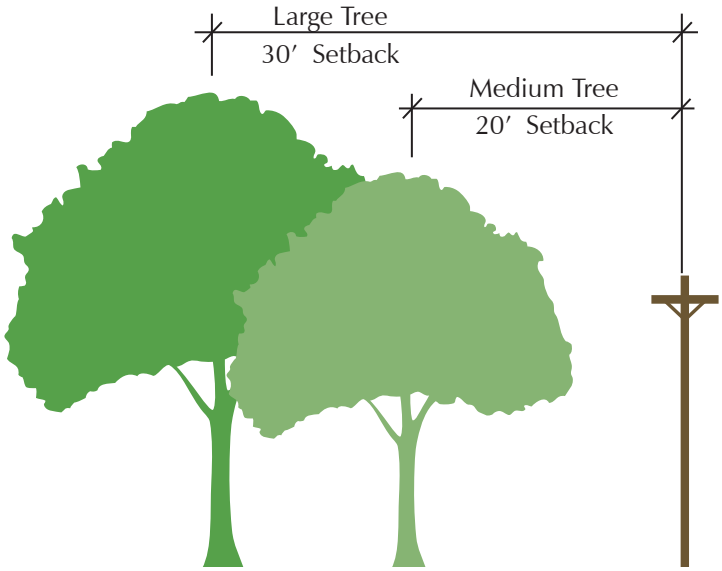
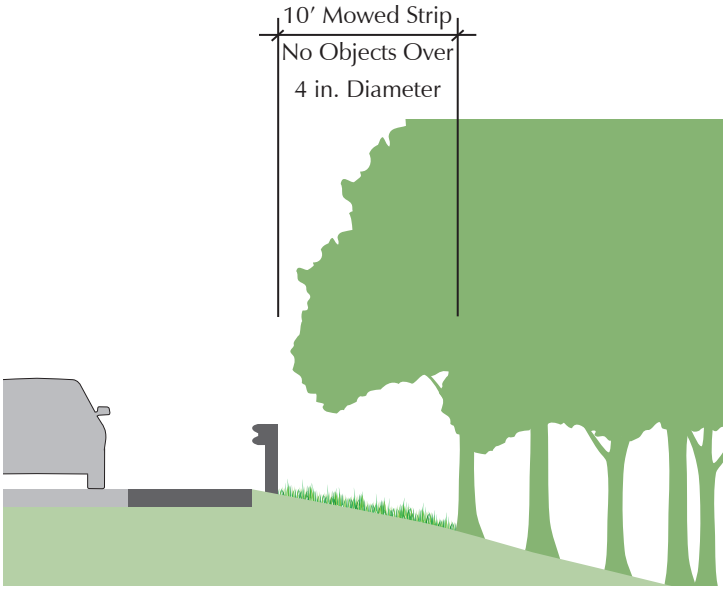


Figure 3.7: Clear Area Behind Guardrails



- There are limitations for planting behind guardrails due to safety requirements, the ability of plants to thrive and maintenance needs. If a guardrail is impacted, it deflects. This deflection distance varies depending on the guardrail system. Due to this deflection, objects over 4 inches in diameter should be kept a certain distance behind guardrails (see AASHTO's *Roadside Design Guide* for deflection distances). In addition, the soils adjacent to guardrails typically have high gravel content from construction and are not optimum for tree growth. Therefore, trees should be planted a minimum of 10 feet from the back of guardrails. Another consideration is maintenance. A 10-foot mowed strip should be maintained behind guardrails in order to keep them functioning properly and to prevent vegetation from growing in guardrail posts.
- In medians, consider the available width for plantings and choose plants that will not overhang the roadway shoulder. In some cases, medians may be too narrow for trees, and only shrubs, grasses or flowers should be used.
- Cultural and historic resources may be something that should be protected and restricted from access (e.g., burial grounds), or something to be preserved, enhanced, viewed and/or open to the public (e.g., parks, historic homes).
- In areas where sight distances must be preserved, leave a clear sight window from 3.5 feet to 8.5 feet above grade (Figure 1.3).

- Vegetation should not interfere with lighting, which is necessary for night visibility.
- Views can be screened from or to the roadway with vegetation, earthen berms, fences, walls, or a combination of these items. Conversely, views can be opened or preserved with removal and regular maintenance of vegetation.
- Vegetation cannot obstruct views to signs and billboards. On high-speed roads, such as interstates and highways, signs require a minimum clear area of 500 feet for visibility (TCA §54-21-119). On lower speed roadways, any vegetation that obstructs signs should be cleared from the motorists' line of sight (e.g., tall grasses or shrubs, low-hanging tree branches). Billboards require the right-of-way to be clear of vegetation that obstructs views to the sign, but only up to 500 feet within the area of general visibility. However, this only applies to new vegetation or vegetation that has grown since the installation of the billboard. In other words, existing vegetation cannot be removed after the installation of a billboard.

Figure 3.8: Clear Area at Signs

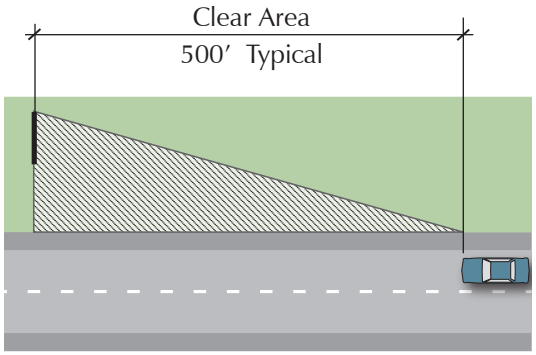
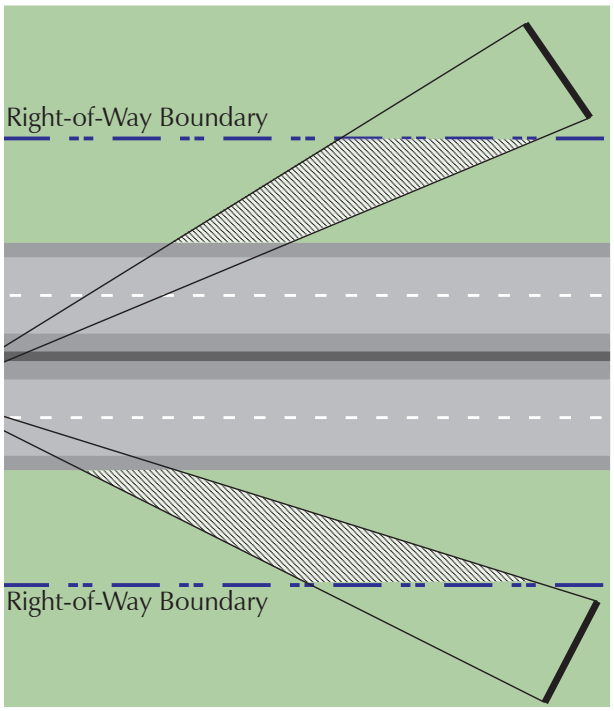


Figure 3.9: Clear Area at Billboards



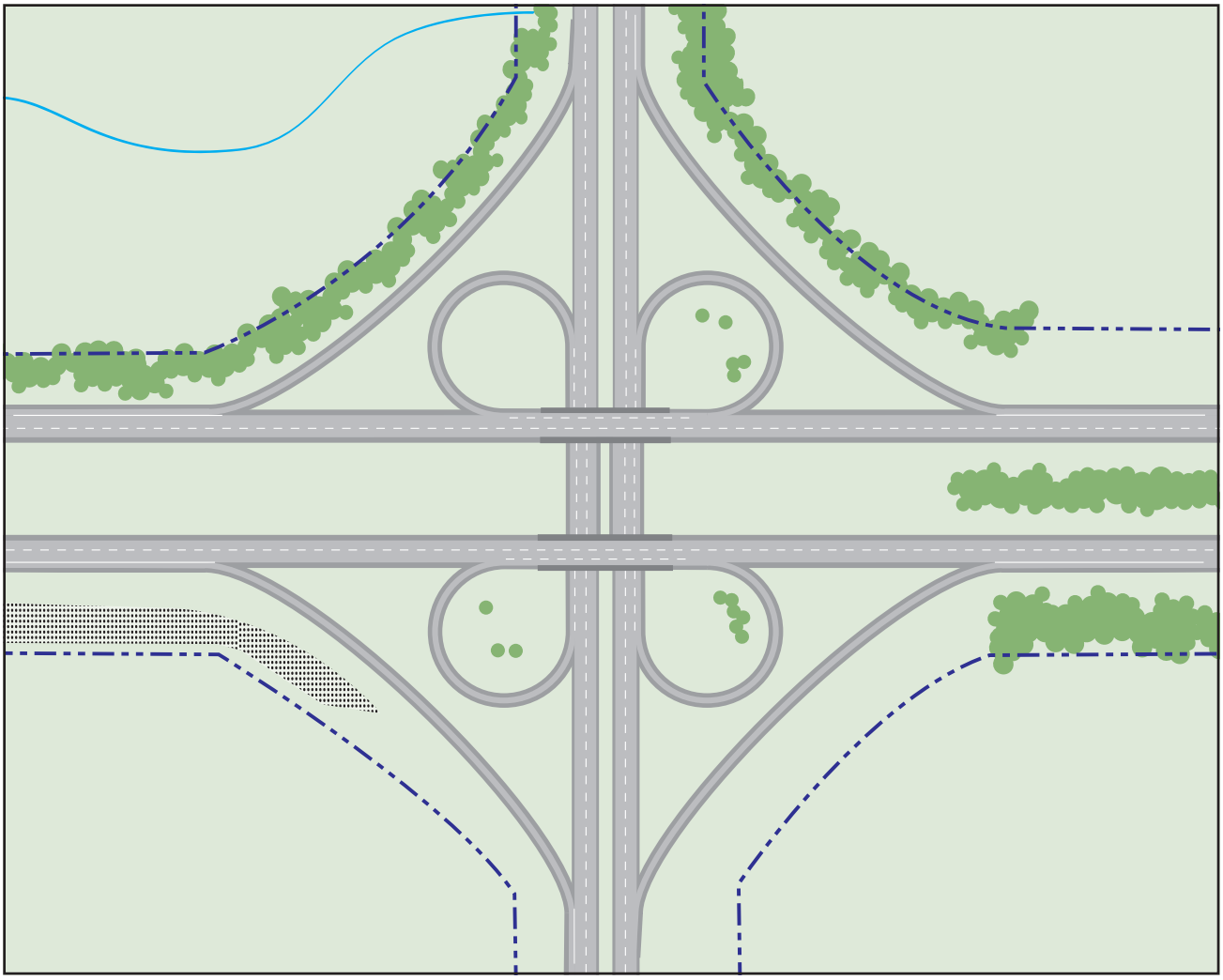
SITE INVENTORY AND ANALYSIS EXAMPLE

As the pieces come together, opportunities and constraints are revealed. Areas in which to plant or not to plant, the type of vegetation and materials to use, and views to be screened or preserved are all identified. Figure 3.17 illustrates the end product of a thorough site inventory and analysis.

Existing Environmental Conditions

In this sample project site, there are several large stands of existing vegetation within the right-of-way. The design speed for both roadways is greater than 45 mph. A creek runs through a field in an adjacent property to the northwest before it enters a headwall and is channeled under the roadway. Steep slopes to the southwest of the interchange present a challenge for mowing equipment and some erosion is apparent. Otherwise, the overall landform in the medians and interchange is flat to moderate with slopes up to 15%.

Figure 3.10: Existing Environmental Conditions



Legend

Right-of-Way Boundary

Stream

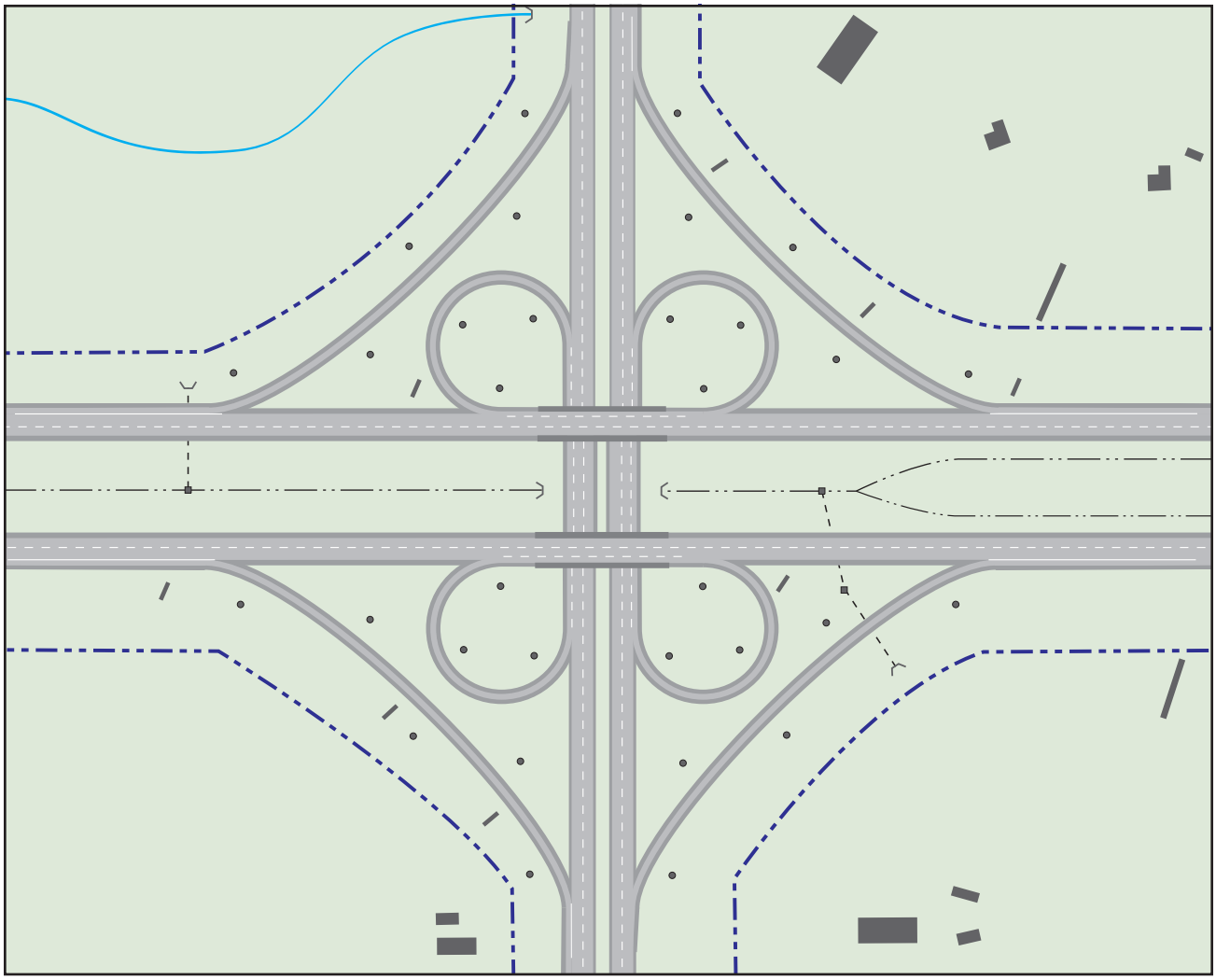
Existing Vegetation

Steep/Eroding Slope

Existing Structures

Several light posts, signs and drainage structures are present throughout the interchange. The drainage structures include inlets, headwalls and underground pipes. Two billboards are also present on adjacent properties to the northeast and southeast of the interchange.

Figure 3.11: Existing Structures



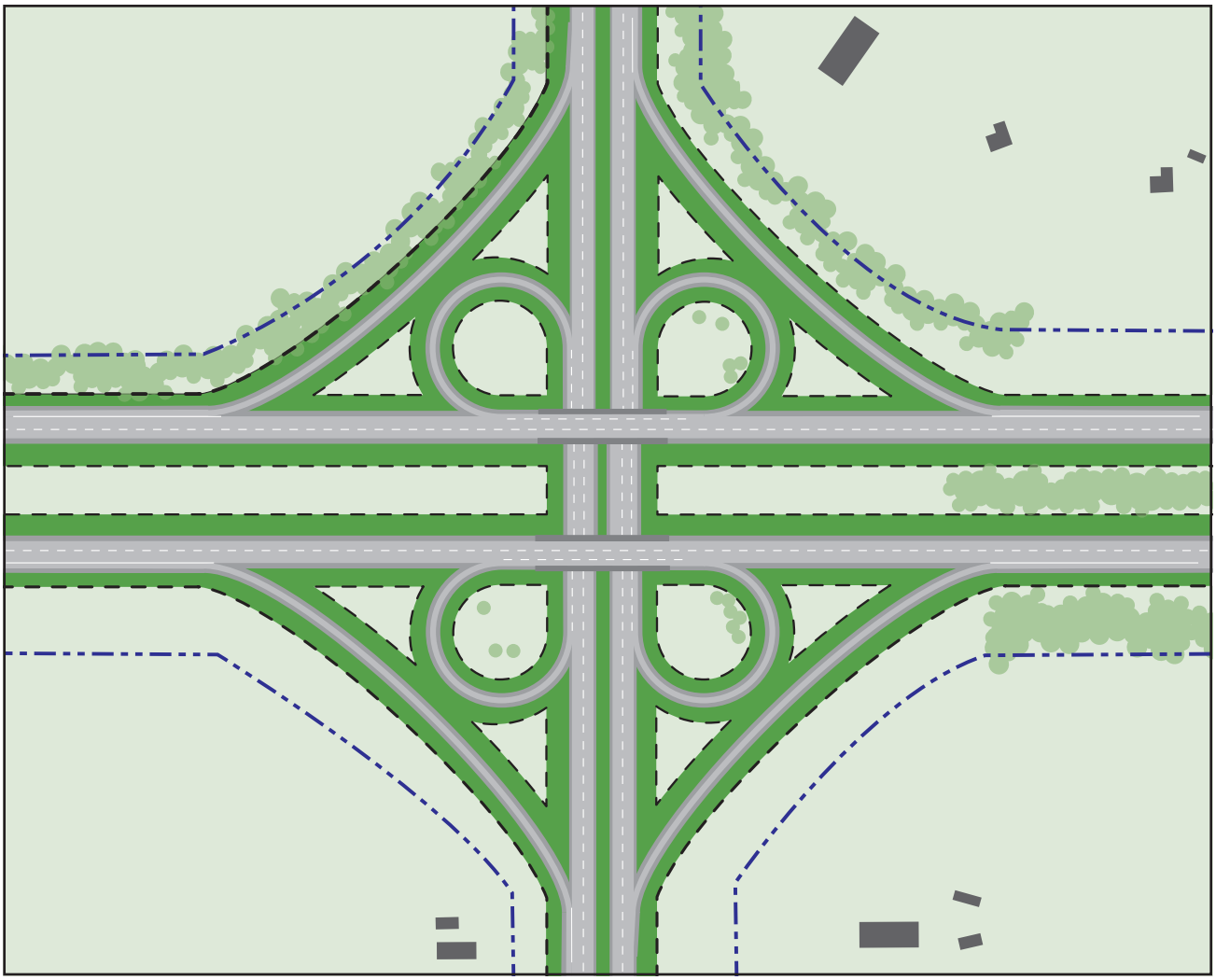
Legend

- Right-of-Way Boundary
- Swale
- Sign
- Stream
- Underground Drainage Line
- Building
- Drain Inlet
- Light Pole
- Headwall
- Billboard

Clear Zone

The desirable clear zone is illustrated (refer to Figure 1.2). This area must be kept unobstructed in order to allow a driver to stop safely or regain control of a vehicle that leaves the traveled way. On roadways with design speeds less than 45 mph, consult the TDOT Design Division for engineering guidance of site-specific clear zone requirements. On roadways with design speeds of 45 mph or greater, only turf, native and ornamental grasses, and flowers are appropriate vegetation choices for the clear zone.

Figure 3.12: Clear Zone



Legend

Right-of-Way Boundary

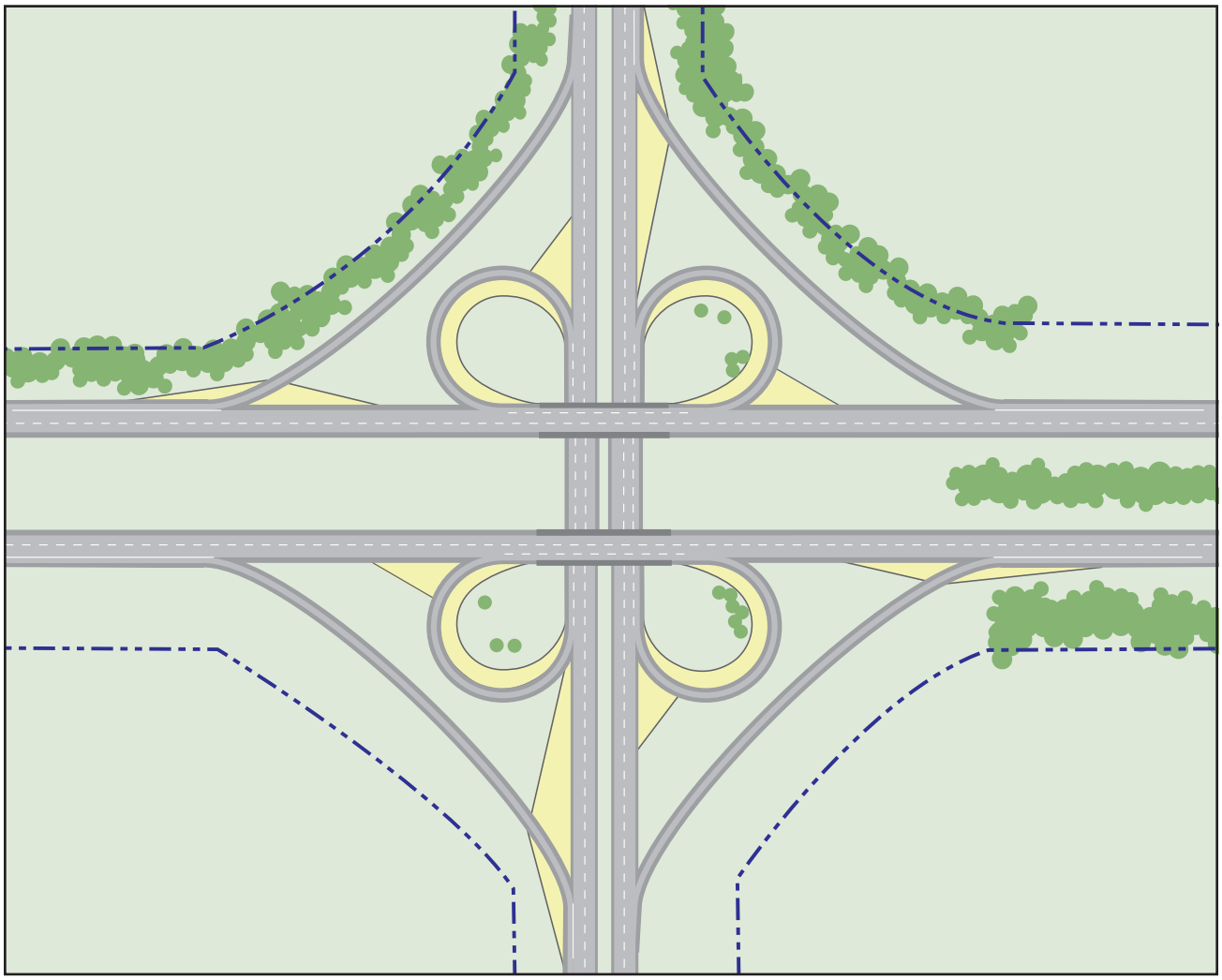
Clear Zone

Existing Vegetation

Sight Distance

The desirable sight distances are shown at intersections and areas where vehicles must merge into traffic lanes. These areas must be kept clear of sight obstructions (refer to Figures 1.3 through 1.6).

Figure 3.13: Sight Distance



Legend

Right-of-Way Boundary

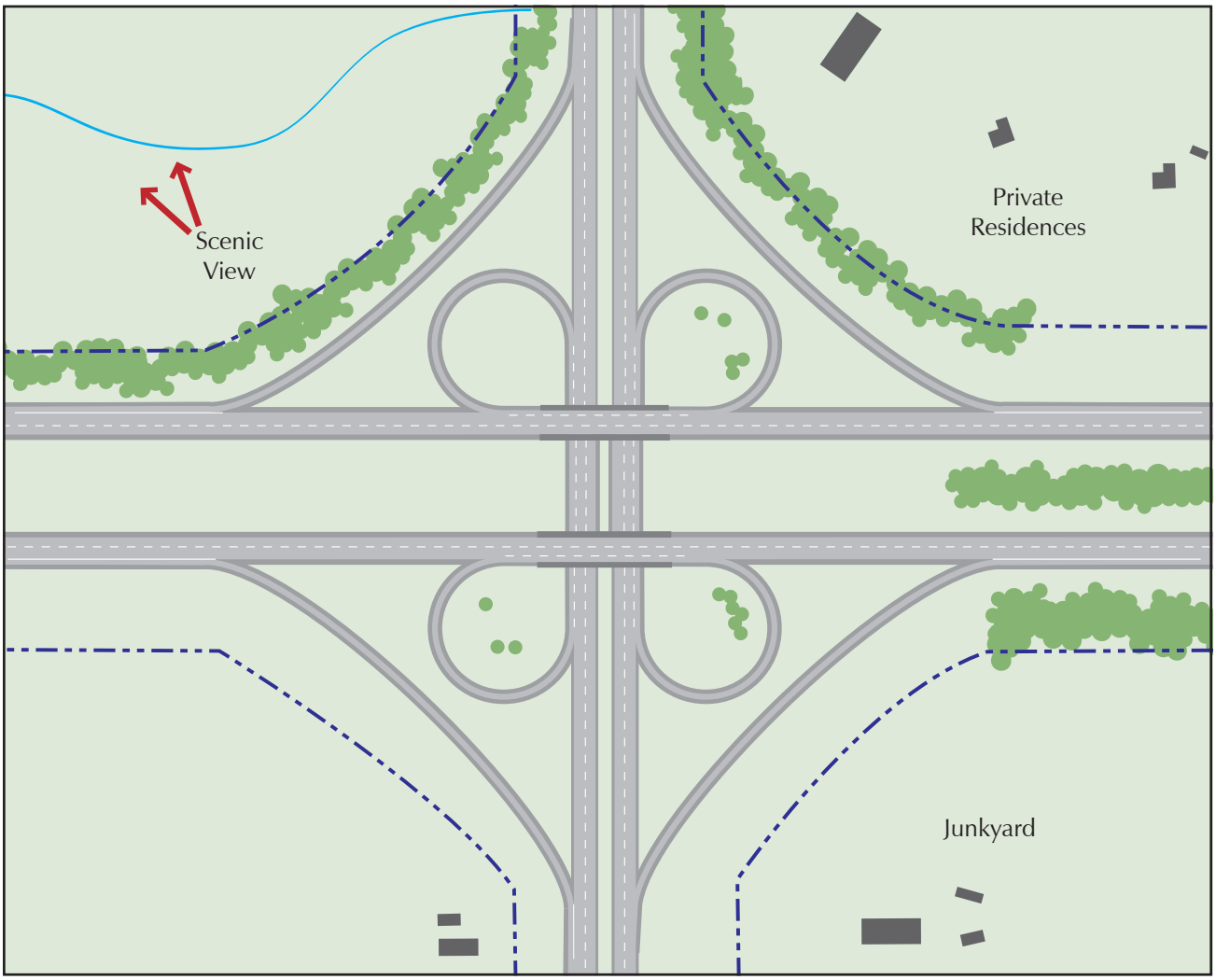
Areas Free of Sight Obstructions

Existing Vegetation

Special Conditions

A mountainous area to the northwest offers a spectacular scenic vista, but existing vegetation blocks the view. Residences on adjacent properties to the northeast wish to preserve privacy and want views to the roadway blocked. A junkyard on the property to the southeast is unsightly and should be blocked from view.

Figure 3.14: Special Conditions



Legend

Right-of-Way Boundary

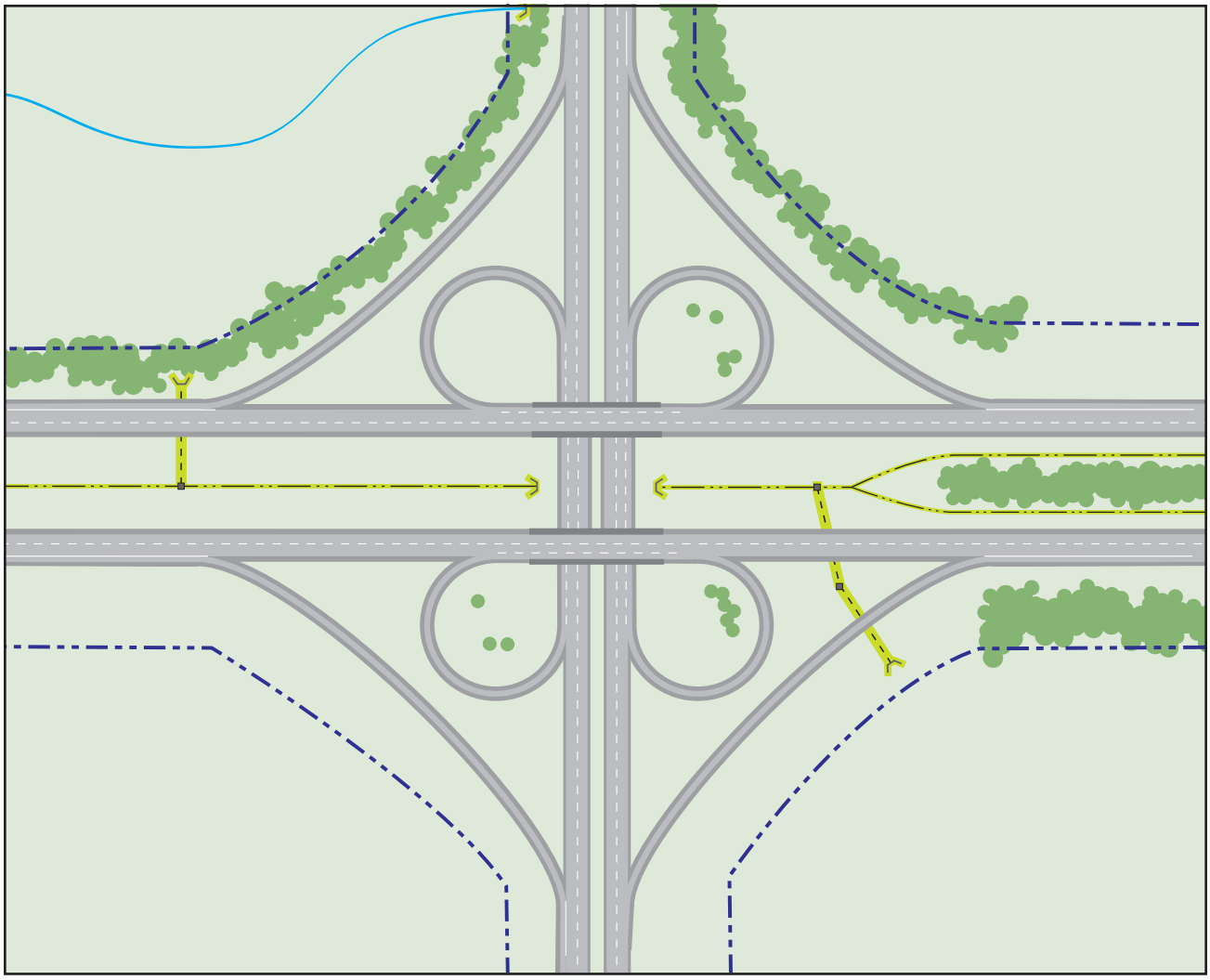
Building

Existing Vegetation

Drainage Structures

Vegetation should not be planted within drainage swales, and trees should not be planted over underground drainage lines. Swales and the areas around inlets and headwalls should be mowed and kept clear of debris.

Figure 3.15: Drainage Structures



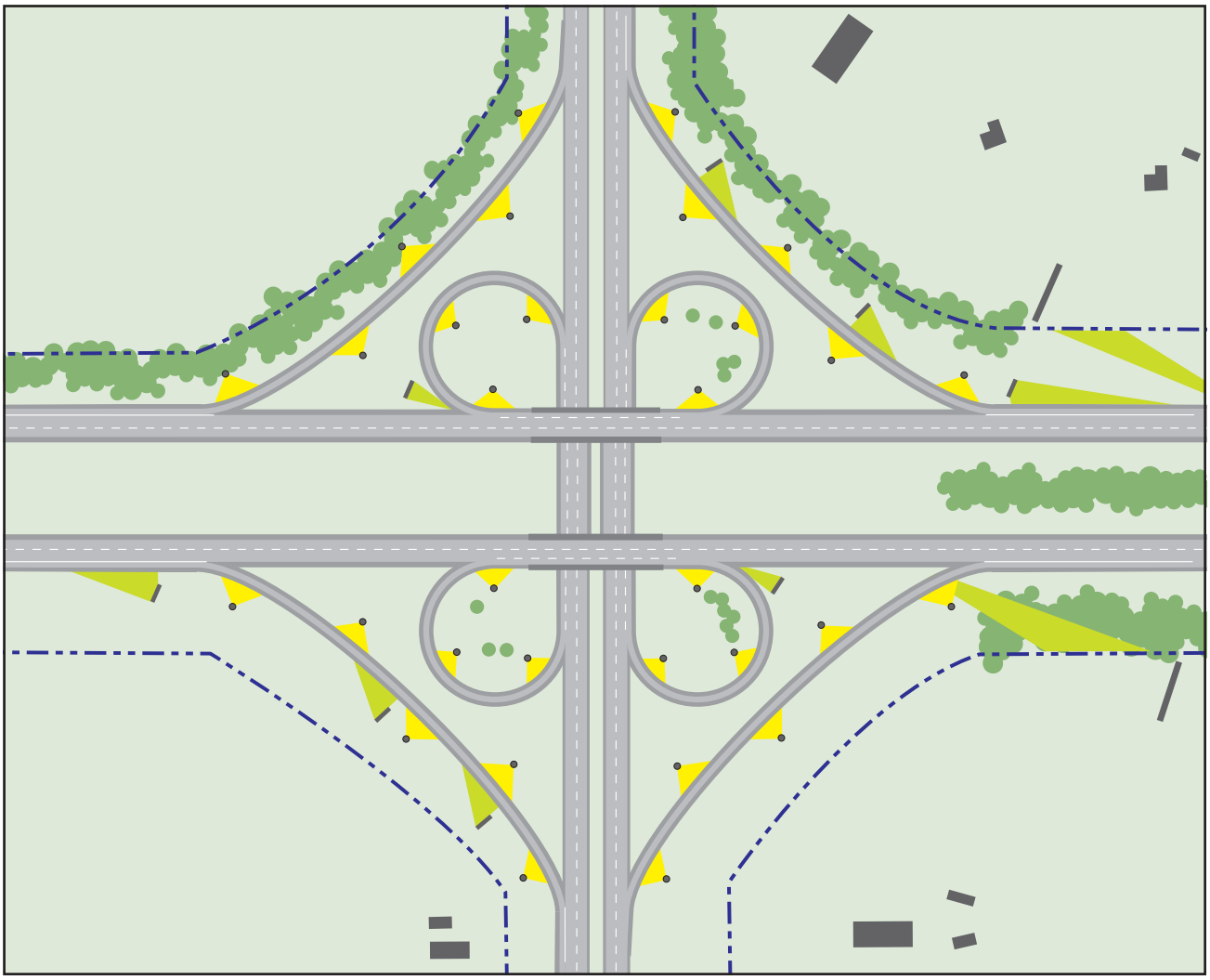
Legend

- Right-of-Way Boundary
- Existing Vegetation
- Stream
- Clear Area at Drain Inlet
- Clear Area at Headwall
- Clear Area at Swale
- No Trees over Underground Drainage Lines

Lighting and Signage

Avoid planting tall vegetation in areas where it will interfere with light from the light poles. Apply the rules for visibility to signage and do not plant vegetation that will grow to obstruct visibility to existing billboards.

Figure 3.16: Lighting and Signage



Legend

Right-of-Way Boundary

Existing Vegetation

No Obstructions at Signs and Billboards

No Obstructions at Light Poles

Final Site Synthesis

As the pieces come together, opportunities and constraints are revealed. Areas in which to plant or not to plant, the type of vegetation and materials to use, and views to be screened or preserved are all identified. Figure 3.17 illustrates the end product of a thorough site inventory and analysis.

The areas shown in yellow indicate should be free from sight obstructions. This includes views to existing signs and required sight distances. Vegetation that is 2 feet tall or less, such as low growing shrubs, grasses or ground covers are appropriate for these areas.

The areas shown in blue indicate views to existing billboards. When selecting vegetation for these areas, do not use plants that will grow to obstruct the view of the billboard.

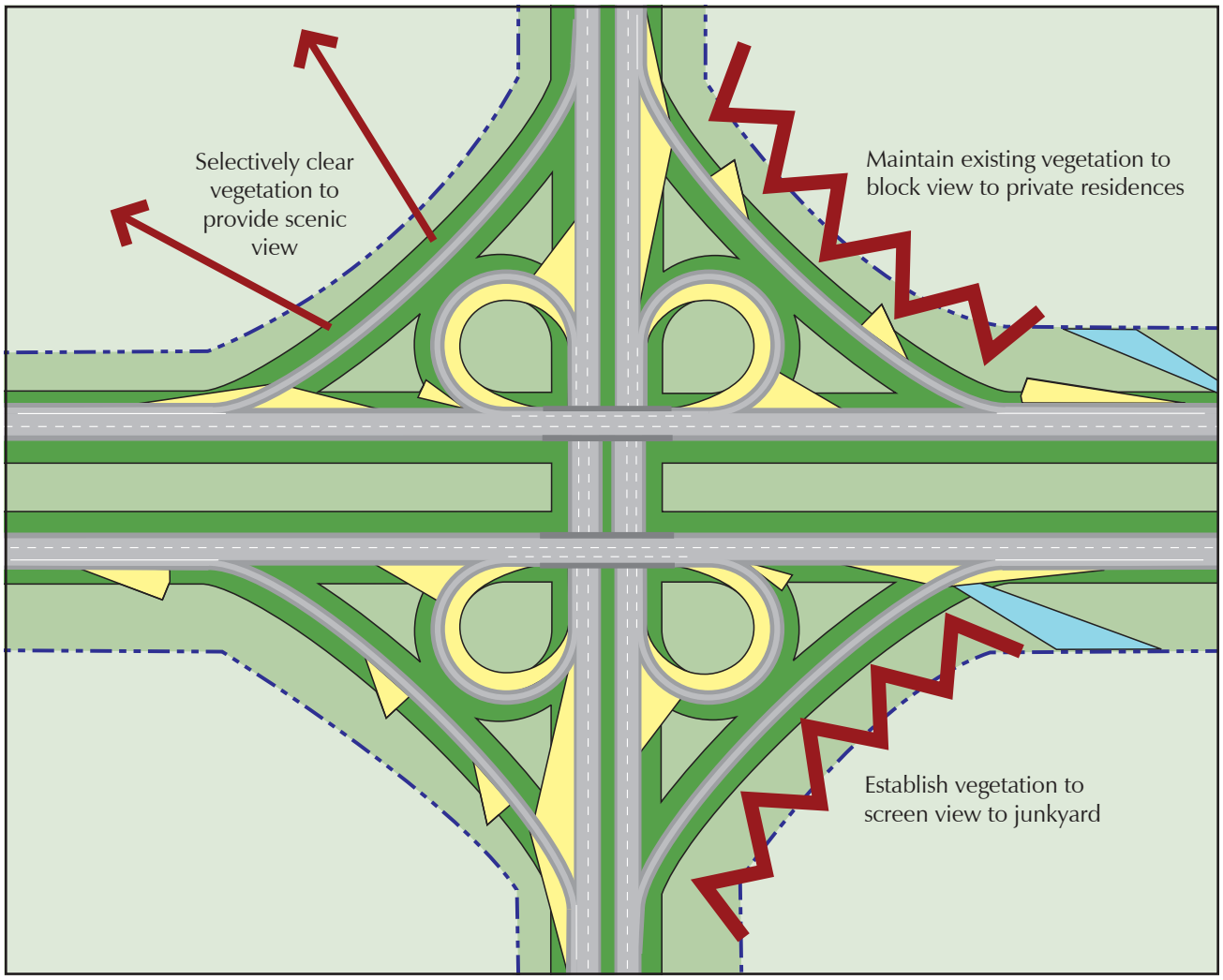
The clear zone is indicated by dark green. In this scenario, turf, native and/or ornamental grasses, or flowers are appropriate vegetation choices for the clear zone. In areas where the sight line triangles (shown in yellow) overlap the clear zone, the clear zone criteria still apply.

The steep, eroded slope requiring stabilization is shown in brown. There are a variety of methods for stabilizing a steep slope (e.g., terraces, erosion control blankets, riprap, vegetation). In this scenario, selecting a low growing shrub or ground cover (e.g., creeping juniper, cotoneaster) may help stabilize the slope. Since this particular sample project site notes that mowing the slope is a challenge, grasses should be avoided.

The views to the private residences and the junkyard should be screened by either maintaining existing vegetation or establishing a new vegetative buffer. The view to the mountains should be opened by selectively removing vegetation.

The areas shown in light green present the most opportunities. The existing drainage structures must be avoided, but the type and size of vegetation used in these areas is less restricted.

Figure 3.17: Final Site Synthesis



Legend

- Right-of-Way Boundary
- Vegetation 2 ft. tall or less
- Vegetation that will not grow to obstruct billboard
- Any vegetation (avoid drainage structures)
- Turf, native and/or ornamental grasses, and/or flowers
- Slope stabilization needed
- Block/Screen View
- Open/Preserve View

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