APPENDIX 48.23

175 Power to recover for damage by wilful or negligent behaviour

A person who wilfully or negligently destroys, damages, stops, obstructs, or otherwise interferes with any works or property owned, constructed, acquired, or used by a local authority is liable for, as the case may be,—

(a) the amount of the destruction or damage; or

(b) the cost incurred by the local authority in removing the stoppage or obstruction; or

(c) any loss or expenses incurred by the local authority by the stoppage or obstruction or interference.

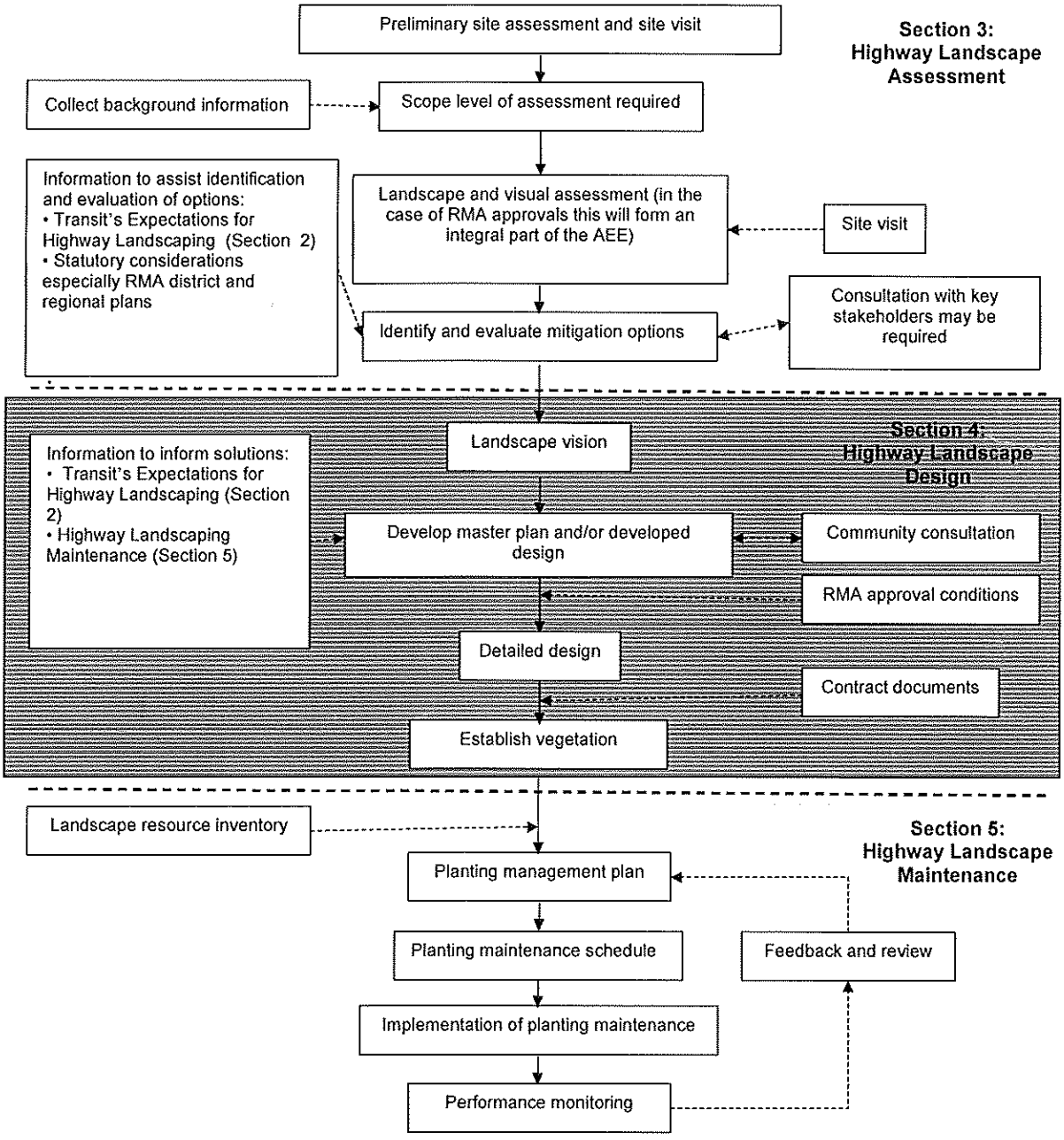
Compare: 1974 No 66 s 695

APPENDIX 48.24

4. Highway Landscaping Design

4.1 Introduction

This section sets out a comprehensive design process to achieve Transit's expectations for highway landscaping outlined in Section 2 Transit's Expectations for Highway Landscaping in a way that suits the specific qualities and context of the site, as assessed in Section 3 Highway Landscaping Assessment.



4.2 Design checklist

Design checklist

This checklist summarises the landscape design process for a works project within the state highway network. This stage responds to the evaluation, mitigation and treatment options identified at the assessment stage and ensures the maintenance implications of the design are considered.
At the end of the design process, a detailed design scheme will be prepared and implemented, and a landscape management plan prepared.

Landscape vision and goals

1 Take account of the outcomes of the assessment stage ☐

2 Inform solutions by consulting relevant authorities and stakeholders ☐

3 Consider ongoing maintenance implications ☐

4 Prepare a landscape vision that addresses Transit's expectations for highway landscaping ☐

Design

1 Assess the level of design required ☐

2 If consistent with the project plan, consult with stakeholders once the developed design is prepared ☐

3 Prepare detailed design and seek consideration of maintenance implications in conjunction with the Transit asset manager ☐

Site assessment

1 Identify the environmental context(s) of the highway route ☐

2 Identify the site attributes and constraints ☐

Design considerations

Ensure the design outputs have taken account of:

- road safety requirements ☐
- maintenance considerations ☐
- plant selection ☐
- plant types ☐
- plant establishment ☐
- planting design ☐
- cost considerations ☐
- using earthworks ☐

Specific highway situations	Consider the implications of landscaping in specific highway situations	☐
Implementation	1 Analyse and evaluate how all of these factors can inform the design and maximise opportunities to meet Transit's expectations	☐
	2 Co-ordinate establishment of vegetation within project schedule	☐
	3 Prepare landscape management plan for asset manager	☐

4.3 Landscape vision and goals

Introduction

Design decisions need to be based on an integrated and methodical approach that avoids arbitrary decisions. The insights, evaluations and mitigation opportunities identified during the landscape assessment stage form the basis for design decisions.

The design of highway landscaping should:

- be responsive to the surrounding landscape, the site, and the needs of highway users and local communities
- meet Transit's Expectations for Highway Landscaping as set out in Section 2 of the *Guidelines*.

Informing solutions

Highway landscaping design and management solutions need to be developed with consideration of the ongoing operational needs of the highway. To ensure safety and maintenance considerations are adequately identified and taken account of, landscaping design and maintenance programmes need to be developed collaboratively with input from relevant Transit experts, in particular:

- planners
- project engineers
- safety engineers
- asset managers.

In addition, solutions should also be informed by the:

- results of consultation with stakeholders including community groups, iwi and adjacent landowners
- contents of any relevant district or regional planning instruments prepared under the RMA and the outcomes of discussions with relevant local authorities.

Landscape vision

The landscape vision is a statement of broad intent, which should convey the overall desired outcomes and the general manner in which the highway landscape will be treated. Depending on the landscape and environmental context, the vision for an overall landscape treatment may be quite general, for example:

> *To establish highway landscaping that reflects the local landscape character.*

Or the vision may be quite specific in seeking a particular outcome:

- for a corridor with high ecological values it may provide a linkage for flora and fauna between different areas
- for a feature landscape it may mean establishing visual features, distinct theme(s), or contrast with the surrounding area
- for a gateway it may mean providing a sense of arrival or entry point into a town, city or region
- for a scenic route it may mean emphasising and enhancing views of natural scenic areas, cultural features or landscapes.

4.4 Design

Level of design

The "Level of Design" table below can be used to determine whether master plans and/or developed designs are required. In general, master plans are only required for significant highway projects involving new highways, corridor strategies or major landscape upgrades.

Level of design table

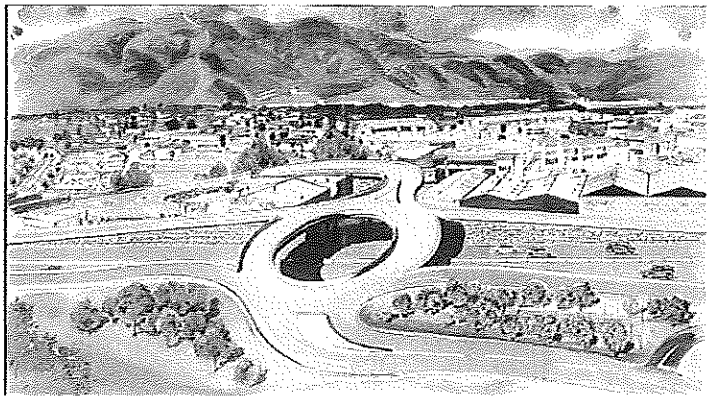
	Master Planning	Developed Design	Detailed Design
Major projects • Urban motorways and expressways • Multi-lane highways • Highways in sensitive areas • Urban main roads	• Design report • Vision statement • Conceptual coloured plans • Sketches, and/or elevations, computer simulations or photomontages	• A number of coloured detailed concept plans min scale 1:1000 • Design statement • Sketches and/or elevations, computer simulations or photomontages • Preliminary costings	• Detailed landscape/ planting plans min scale 1:500 (preferably in CAD) • Site preparation and layout plans • Grading and drainage details • Schedule of materials and costings • Plant supply contract • Landscape specification
Medium projects • Interchanges • Realignments • Large bridges • Bypasses	Not generally required	• A number of coloured detailed concept plans min scale 1:500 • Design statement • Sketches and/or elevations, computer simulations or photomontages • Preliminary costings	• Detailed landscape/ planting plans min scale 1:500 (preferably in CAD) • Site preparation and layout plans • Grading and drainage details • Schedule of materials and costings • Plant supply contract • Landscape specification
Minor projects • Minor landscape upgrades • Minor realignments • Intersection • Roundabouts	Not generally required	• One coloured detailed concept plan (min scale 1:500) • Brief design statement • A sketch or cross section illustrating details	• Detailed landscape/ planting plans min scale 1:500 (preferably in CAD) • Planting schedule • Project estimates • Landscape specification

Master plans

The master plan conveys the overall vision for a section of highway in graphic terms. A master plan will describe the overall conceptual layout and landscape treatment, including interactions with adjacent landscapes or wider urban context , and will show staging and priorities.

Outputs for this stage should include:

- a design statement outlining the design themes and vision for the highway and identifying how Transit's expectations have been achieved
- coloured plan(s) to a suitable scale that depict the broad-scale landscape layout and treatment
- sketches, elevations, sections, photo-montages, or images to clearly depict the design intent.



A coloured plan shows the broad-scale landscape layout and treatment in a master plan

Developed design

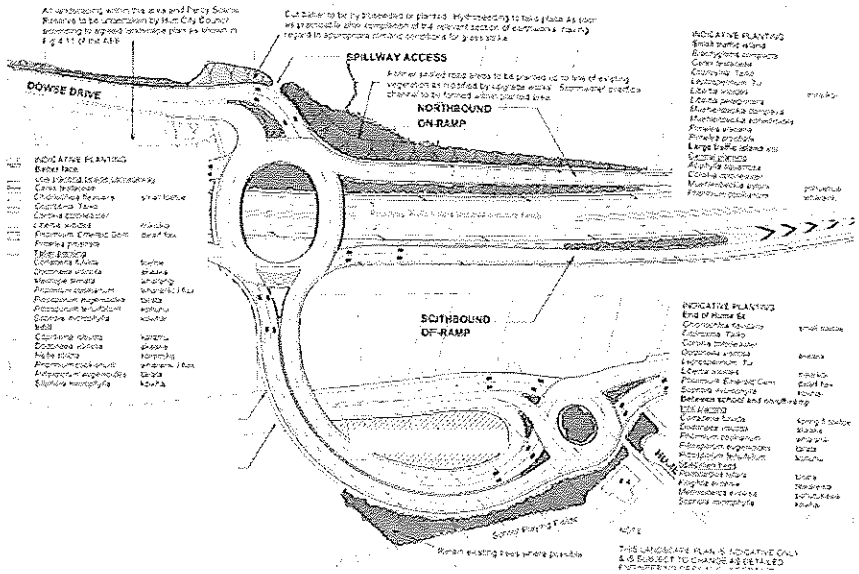
The purpose of the developed design is to present and/or clarify the overall design intent before the final design details are prepared. Developed designs should depict the specific treatment and layout of detailed areas, including:

- town entrances
- gateways
- intersections
- interchanges
- roundabouts
- medians
- rest areas.

Unlike master plans, developed designs will be required on almost *all* types of highway landscape developments, whatever their size.

Outputs at this stage will depend on the complexity of the project, but may include:

- coloured detailed design plans, depicting landscape layout, materials and plant varieties and adjacent building footprints in urban situations (appropriate scales are 1:250-1:1000)
- a design statement and summary of issues
- sketches, elevations, sections, photo-montages, images or computer simulations to clearly depict the design intent, and showing the proposal in its natural, rural or urban context.
- preliminary cost estimates.



Developed design plans depict landscape layout, materials and plant varieties

Consultation

Once a developed design has been prepared, it can be provided to stakeholders and interested members of the community for their comments and recommendation.

Highway landscaping schemes can benefit from local knowledge and input to ensure the final landscaping treatment incorporates local values, promotes local features and history and represents the reasonable aspirations of local communities.

Community consultation should be undertaken in accordance with Transit's consultation guidelines. This consultation will need to be aligned with the highway project plan and consultation on wider project issues.

Detailed design

The detailed design stage is the realisation of the mitigation opportunities, landscape vision, and decisions made during the preceding design process. Detailed design will be required on *all* highway landscape projects, as this forms part of the implementation documentation for the landscape design.

The maintenance implications of the proposed design must be considered at this stage, in conjunction with the appropriate Transit asset manager.

Drawings should be prepared using CAD as this allows efficient exchange of information with other professionals on the highway project.

Depending on the project size and complexity, outputs at this stage may include:

- site preparation plans (scale 1:200-500) showing the location of appropriate storage and stockpiling areas, trees to be removed or pruned, tree-protection zones, site access, and parking.
- layout and materials plans (scale 1:200-500) with the layout of the landscape works superimposed over the highway layout plan.
- grading and drainage plan (scale 1:200-500) – some landscape input may be required for final earthshaping and drainage, particularly for plant establishment.
- planting plans (scale 1:200-500) which must show the accurate location of existing and proposed planting. The planting schedules should clearly differentiate and notate each type of planting using a simple labelling system based on botanical names.
- detail plans (scales 1:10-1:50) illustrate the methods of construction or how the planting will be implemented
- schedule of material sources, itemised costing of the materials and tasks or actions for completing the landscape works, including a programme of phased plantings.

(**Note:** for smaller and less complex projects, much of the plan information may be incorporated on composite drawings.)

4.5 Informing design

Introduction

Site assessment and consideration of site attributes are necessary steps in the design process to ensure detailed site-specific conditions are factored into the final design proposal.

Site assessment at design stage

Site assessment for landscape design is used to:

- determine the site conditions to assist in landscape design
- apply, analyse and interpret various design considerations in relation to the physical site.

Site assessment at this stage involves the analysis of the biophysical, climatic and physical attributes of the environment and area to determine which factors will influence the long-term success of the landscape design.

Site assessment considerations

Geology/soil

Origins, type, depth, original or fill, compaction, suitability for plant growth (nutrients, structure, Ph), nature of seed bank.

Water

Existing water bodies, water table position and fluctuation, surface and sub-soil drainage patterns and rates. Opportunities to achieve stormwater management objectives through highway landscaping.

Climate

Regional and local microclimate, air temperature, precipitation, potential evaporation, sun, wind, shade.

Built features/structures and patterns

Context and character, heritage and cultural values, use and location, access and circulation, connection, services

Ecology

Existing plant and animal communities, location, cover values. Diversity, stability in response to landscape works, significance, relationship to other physical or biotic factors.

Topography

Landform type, contour, slope, impact on drainage.

Road users and local residents

Characteristics and behavioural patterns, local identity, pedestrian routes, likely conflicts (eg vandalism).

Site constraints

Ownership and management responsibilities, legislation and planning provisions

Site attributes and constraints

The landscape and visual assessments undertaken at the assessment stage of a landscaping project (Section 3 Highway Landscaping Assessment) will have determined the environmental setting of the highway corridor. The three broad environmental settings are:

- urban
- rural
- natural areas including National Parks.

The design of highway landscaping should respond to the characteristics of this environmental setting. The way in which vegetation and earthworks are used, for instance, will differ in an urban situation compared to a National Park setting.

Appropriate responses to any environmental setting should take into account the matters raised as part of the landscape and visual assessments, as well as site-specific considerations.

Urban setting

Urban settings are determined by the nature of surrounding land uses and activities such as commercial and residential land uses, the presence of pedestrians and cyclists or frequent interactions with local traffic. Urban settings occur alongside highways with a range of posted speed limits.

Urban highways contribute to an adjacent community's identity and sense of place.

Urban highway landscape design solutions tend to be more demanding because of the complex nature of urban environments and the space constraints. Specific considerations for urban areas include:

- planting can be more formal and distinctive compared with rural or natural setting to provide a strong sense of place or a specific theme
- plantings can provide visual relief, contrast, or complement the built urban landscape to enhance the experience of all highway users
- continuous planting may be appropriate to provide visual separation and screening
- the establishment of feature planting, gateways, boulevards and avenues may be appropriate
- constraints of space often dictate a lineal approach to planting and structural solutions instead of earthworks. These need to integrate with the surrounding urban environment
- integrating planting edges where highway landscaping meets local council planting schemes
- the needs of cyclists and pedestrians
- blending landscaping and engineered forms to take account of different speeds and potential close interaction of the viewing audience.

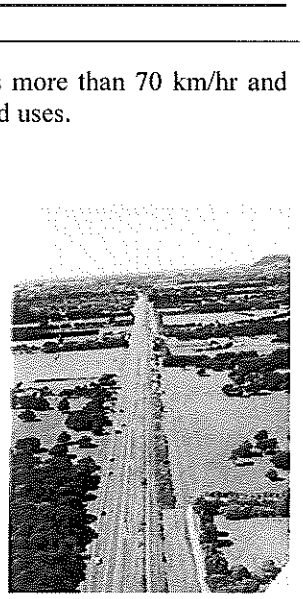
Native plantings in this urban setting meet visual amenity, safety and maintenance goals for the site.

Rural setting

Rural areas are those where the posted speed limit is more than 70 km/hr and can be characterised by predominantly agricultural land uses.

The specific considerations for rural areas are:

- roadside earthworks should relate to the surrounding landform
- earthworks and slope retention should, where appropriate, rely on vegetation for reinforcement and visual integration
- planting should relate to the existing pattern and geometry of the dominant land use
- large-scale tree and shrub planting may not be appropriate in this setting (where screening is usually not an issue), rather the natural rural scenery should be allowed to prevail



Rural settings have unique characteristics

- continuous planting should be avoided unless it is an existing feature of the local area or is used to unite fragmented areas of ecological significance
- a naturalistic, informal approach to planting is preferred except when the landscape character is dominated by vegetation such as shelterbelts and woodlots
- too great a variety of plants should be avoided in favour of using commonly occurring local species, both naturally occurring and planted. Exceptions to this are where planting is of an ecological restoration nature such as to provide a corridor between ecologically significant sites. In such cases the number of plant species used should reflect the local biodiversity.

Natural areas

Examples of natural areas include riparian and lake margins, coastal areas, the high country, areas of native forest and areas provided for in section 6 of the RMA, where relevant. Such areas are often sensitive to the effects of highway developments.

The main considerations for natural areas are:

- roadside earthworks should relate to the surrounding landform
- earthworks and slope retention should, wherever possible, rely on vegetation for reinforcement and visual integration
- attempts should be made to merge the highway with the surroundings. Depending on the setting, this may involve substantial or minimal intervention
- the natural scenic qualities of the surroundings should prevail where landscaping meets either functional requirements (restoration planting, erosion control, directing views, and screening) or visual amenity requirements, it should be in keeping with the surrounding context
- generally only naturalistic layouts and associations of native plants should be established and these should be blended in as much as possible with existing vegetation rather than set out in fragmented, discrete groupings
- native plants should be sourced from the same region to preserve local genetic variation and be best suited to the site conditions.

Natural areas are often sensitive to the effects of highway developments

National Parks

The state highway system links and passes through many of New Zealand's National Parks. Transit and the Department of Conservation have developed protocols and procedures for works on state highways that pass through or adjoin National Parks and conservation areas. These are summarised below:

- work must be carried out in consultation and agreement with the administering bodies of National Parks and allied reserves
- landscape and visual assessments will be required as part of a statement of environmental effects
- landscape design should be in harmony with the landscape and other National Park values and should not adversely affect flora, fauna, or the ecology of the area
- a very high standard of vegetative restoration will be required
- special attention must be given to the effect of the highway on the landscape and also to the highway's visual appearance
- particular attention must be paid to reducing the extent of excavations and preserving as much native vegetation as possible
- any restoration planting that may be necessary must be done using native species found in the area, preferably raised from seed taken from the reserve or National Park involved.

Management plans for National Parks contain provisions for planting and road restoration, and should be consulted during the development of both highway and landscaping project design.

Landscape design in National Parks should be in harmony with National Park values

4.6 Highway landscape design considerations

Specific considerations

Highway landscaping has specific requirements that require careful consideration at design. The following considerations are discussed in the following subsections:

- 4.6.1 Road safety requirements
- 4.6.2 Maintenance considerations
- 4.6.3 Plant selection
- 4.6.4 Plant types
- 4.6.5 Plant establishment
- 4.6.6 Planting design
- 4.6.7 Cost considerations
- 4.6.8 Using earthworks

4.6.1 Road safety requirements

Introduction

This section discusses the role of vegetation in maintaining and improving highway safety and in particular safety considerations that need to be taken into account when undertaking highway landscaping.

Clear zone functions

Establishing and maintaining clear zones alongside highways is an effective way of reducing the severity of accidents.

The main functions of clear zones are to:

- provide a safe run-off area or clear recovery zone free from hazards; and
- maintain sight lines and continuous visibility along the highway for the motorist.

Where icing of roads occur, vegetation should be treated for consistency with clear zone requirements.

Clear zone vegetation

Clear zone should be kept free of solid obstacles such as large trees and should be traversable by a vehicle. Detailed requirements for clear zones are provided in Section 6.5 of the *State Highway Geometric Design Manual.* However, as a rule of thumb, on a straight section of state highway with a design speed over 70 km/hr a clear zone of at least 9 metres from the edge of the traffic lane is desirable.

Within the clear zone only *frangible* vegetation should be planted. Any plant with a stem equal to or greater than 100 mm in diameter at maturity, measured at 400 mm above the ground, is considered to be non-frangible.

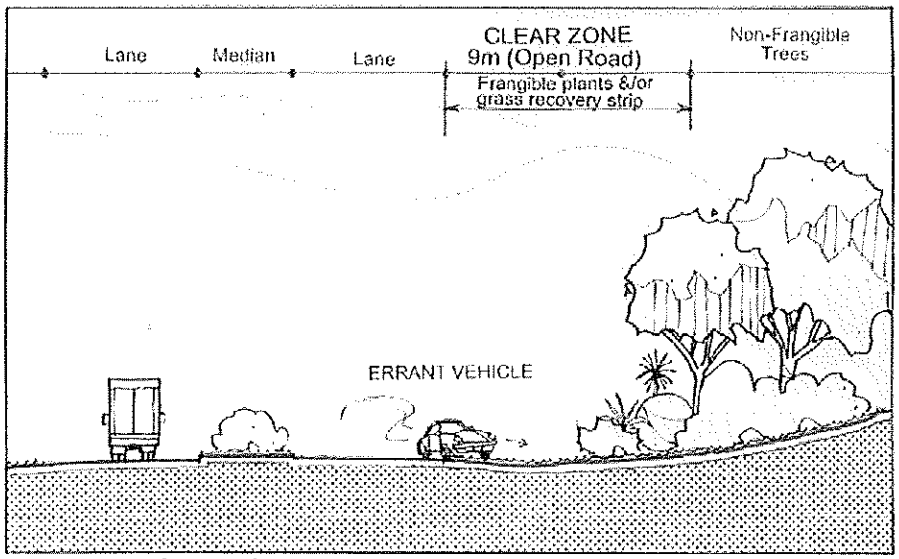
Where frangible vegetation is planted close together (less than 2100mm apart) then it is considered non-frangible unless vegetation density is established so as not to create an overturning hazard for errant vehicles (see Appendix 1 for an indication of the frangibility of indigenous species).

Where the terrain next to the highway is relatively flat, a strip of grass or low-growing vegetation can provide a run-out zone for drivers to regain control of their vehicles or as an emergency stopping area.

Non-frangible vegetation may be planted closer to the highway where it is shielded by a road safety barrier.

In areas such as the outside of horizontal curves, at congestion points, or where evasive manoeuvres may occur, a clear zone of greater than 9m may be required. In forestry areas or where there is fire-prone vegetation, a vegetation-free zone of a minimum of 20 metres (including the highway) can be used as a firebreak. If vegetation is required in this area, fire-resistant native broadleaf plants may be used.

Non-frangible vegetation such as large trees and some shrubs (see Appendix 1) should not be established within clear zones.



Cross-section showing clear zone

Sight lines

Clear zones are important for the maintenance of sight lines for:

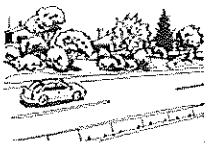
- intersections, including access roads and driveways
- signs, barriers and roadside markers
- pedestrian crossings
- rail crossings
- passing areas
- medians.

The likely extent of plant growth should not encroach into sight-lines at a later date. For vegetation control requirements to protect sight lines refer to Transit's *SOMAC Specification for Vegetation Control* (SM032 VC 09).

Particular attention should be given to planting and earthworks on the inside of curves, in interchange loops, medians, ends of ramps and on cut slopes to ensure forward visibility for drivers is maintained.

Refer to the Land Transport Safety Authority and Transit New Zealand joint publication, *Guidelines for Planting for Road Safety* 1991, for further information on safety considerations for planting.

Creating visual interest



In areas lacking natural visual interest, landscape design should create regular areas of interest to alleviate boredom and help maintain driver concentration.

Where there are few existing landmarks or landscape features, creating features as milestones helps drivers determine their progress on a journey and relieves visual monotony.

Visual interest can be created by:

- clearing vegetation and creating view corridors
- enhancing views and vistas by framing and orientating views
- providing contrast between open and closed views
- varying planting composition and setback
- establishing feature planting.

A mixture of fleeting and panoramic views should be provided.

At highway speeds, distant views are more important than near views as features close to the road pass by very quickly and are difficult to focus on. Therefore, roadsides should provide a simple, non-distracting foreground to distant views.

There should be a point of interest or view at least once every 5–10 minutes to avoid driver weariness. The speed of travel is an important factor when designing for view appreciation. As little as 1 second may be enough for a fleeting view, but 5 seconds is required to appreciate a view or landscape feature.

Panoramic views take longer to assimilate and warrant more time to allow for appreciation. Generally, 15 seconds should be enough viewing time for a panoramic view in any one viewing event. The distances required for different time periods and different speeds are:

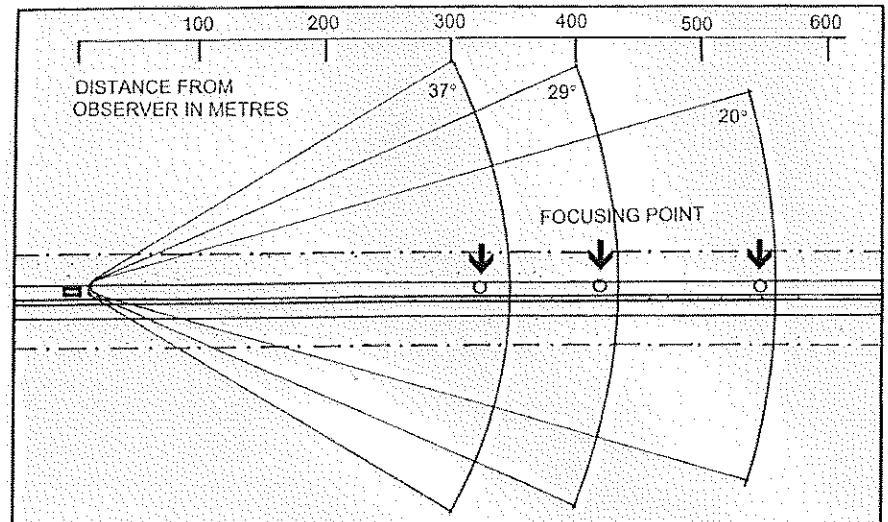
Speed	Distance	
	5 sec	*15 sec*
50 km/hr	69 m	207 m
80 km/hr	112 m	336 m
100 km/hr	138 m	416 m

Too much time exposure can reduce the impact of a view. The landscape should be revealed in a series of views to provide contrast and a sense of anticipation.

Cone of vision

Screening should be used to conceal distracting and confusing views such as adjacent and parallel road alignments (excluding areas where they converge), or to delineate curves.

Use the area of effective cone of vision (set out below) to decide where the framing and screening of views will be most effective.



Relationship between focusing distances, angle of vision & distance of foreground detail at the speeds of 64, 80, 100kph. To be used to assist in design to screen/frame views.

(Source: Landarc 1991)

Reading the road and other safety considerations

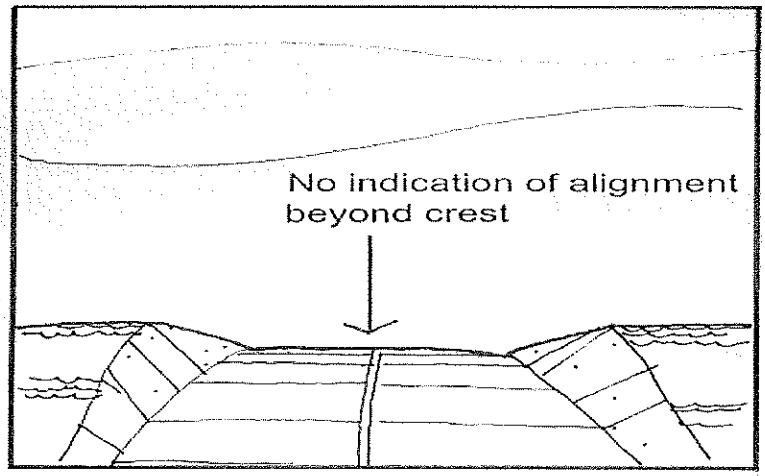
Highway planting can help drivers 'read' the road and react appropriately to their driving environment by providing:

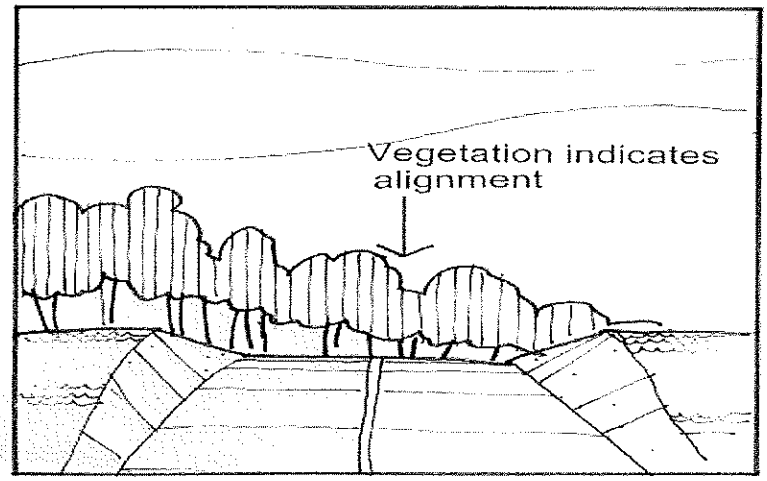
- curve delineation
- headlight glare reduction
- visual containment
- speed awareness and stimulation.

Planting can also be an important safety consideration particularly in relation to ice and strobing and wind reduction.

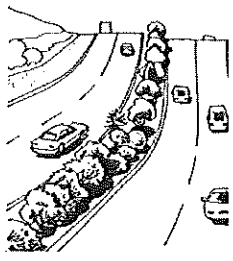
Curve delineation

Planting can be used to emphasise road curvature, giving road users early warning of changes in direction. This is particularly useful where curves are unexpected or difficult to ascertain eg when they coincide with crests. Plants should be of a suitable size and density to warn of road curvature.





Headlight glare reduction



Planting will also reduce the effects of sun glare around curves or when there is late or early sun. Planting can be used on divided roads as a means of reducing headlight glare, especially around bends. Similar methods are also useful for screening headlight glare from local residents who live close to highways. Most medians have road safety barriers installed on them and any vegetation should not interfere with the performance of the barrier.

The height of headlight beams above the road range from 500 mm for cars up to 1300 mm for trucks and buses. The most effective method for reducing glare is through planting a mixture of groundcovers and shrubs (with a dense compact form) that will reach the desired heights. (Note: planting should not be located where it impairs the visibility or sight lines of drivers.)

Visual containment

Landscape treatment can reduce distraction for road users from nearby land activities (including lighting) or opposing traffic by screening and filtering views. Plants should be of sufficient size and density to achieve this satisfactorily.

Speed awareness/ stimulation

Continuous lineal/parallel roadside planting should be avoided as it is monotonous and can impair driver speed awareness over longer distances. Undulating or intermittent planting is better as it provides more contrast and visual stimulus, and a better reference point for determining speed.

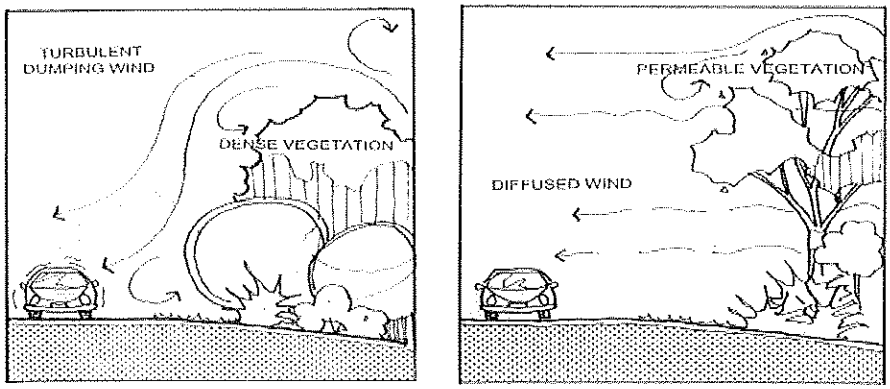
Ice and strobing

In areas prone to frosts, avoid planting tall vegetation close to the roadway on the northern side of roads as it may prevent ice thaw. (Note: Transit's *Planning Policy Manual* (SP/M/001) contains policies on this issue.)

Also avoid planting tall, closely spaced trees without an under storey, as a strobe effect may result from rapid movement through areas of contrasting sunlight and shadow. This can be distracting and potentially dangerous for motorists.

Wind reduction

Use planted windbreaks to alleviate cross winds in areas with frequent, severe wind gusts. Windbreaks should be used to diffuse winds, particularly where the local topography channels winds at the end of gullies or batters. They should be porous enough to prevent wind dumping on to the road.



Role of vegetation in wind reduction

4.6.2 Maintenance considerations

Introduction

The maintenance implications of highway landscape designs are an important factor in achieving a successful and sustainable landscape scheme. Planting that is appropriate to surrounding areas, low maintenance and easy to access offers significant efficiency gains.

Maintenance considerations

Ongoing maintenance implications include:

- plant life span (and the need for replacement planting) and whether the planting is likely to become self-sustaining (including self seeding) in the long-term
- whether the mature form of landscaping will meet Transit's safety objectives
- the required frequency of maintenance such as mowing, pruning, trimming
- traffic management requirements and costs in areas of the highway where maintenance disrupts traffic (as required by Transit's *Code of Practice for Temporary Traffic Management* (SP/M/010))
- if the maintenance required to keep planted areas healthy and attractive is appropriate to the site
- access requirements of maintenance crews and equipment for vegetation control and maintenance of road and drainage structures.

Key questions to ask during design to ensure maintenance requirements are accommodated might include:

- will mower tractors be able to fit between trees to maintain undergrowth?
- how will the margin between grassed areas and bark bed be maintained?
- what weed control measures are in place to control native weeds in the ground from emerging e.g. cooch?
- are groupings of trees so close to the side of the road that they will act as a catchment for litter?
- have we done everything possible to minimise the need for agrichemical sprays?

Section 5 Highway Landscaping Maintenance provides guidance on the maintenance tasks required to provide ongoing care and protection of highway vegetation.

4.6.3 Plant selection

Introduction

The main factors to consider in plant selection are:

- suitability and establishment
- ecology and biodiversity
- implications for stormwater management
- aesthetics
- cultural factors
- surrounding land use and environment.

Suitability and establishment

Plant suitability for the particular environment is the main consideration in plant selection, and should be selected to suit the biophysical conditions of the site as identified in the site assessment. Considerations include:

- moisture requirements
- sun/shade requirements
- nutrient requirements
- drainage requirements
- typical growth pattern
- tolerance to wind exposure
- tolerance to coastal conditions.

Other conditions that plants will need to respond to include:

- pollution resistance
- ability to associate and compete with other plants
- maintenance requirements, such as height limitations beneath power lines
- cost effectiveness
- lifespan.

Once these conditions are known, only plants that can establish and survive within the defined environment should be considered.

Ecology

Plants must be appropriate to the ecology of the site and the local area. Consider whether the plants will:

- support local fauna (mindful of potential safety implications for fauna and road users)
- enhance local biodiversity, habitat values or specific types of habitat
- reinforce local vegetation types
- restore conservation values.

Species vary in their tolerance and ability to adapt to different situations. For highway landscaping, plants with wide tolerances should generally be selected.

Natural successional characteristics of plant communities can be used to reduce ongoing costs such as replanting and weed control by promoting self-sustaining plant communities. This can be achieved by considering:

- recruitment of replacement plants – trees and shrubs with fruit/berries that attract birds encourage the dispersal of seeds
- longevity – relatively long-lived species with high levels of biomass production and litter accumulation are desirable.

Pioneering species are interplanted with successional plants to achieve a self-sustaining plant community

Stormwater management

Roadside vegetation can provide a cheap and effective method of filtering road run-off. For example, vegetated swales can provide protection against erosion, while removing sediment and pollutants from stormwater.

Where large areas are available for planting, wetlands and riparian species are highly efficient in removing pollutants from road run-off. Wetlands collect, detain and adsorb materials in run-off, and when used in conjunction with other stormwater management techniques, achieve maximum pollutant removal.

Site-specific landscape and stormwater management objectives should be developed together. Doing so will allow multi-purpose responses that enhance biodiversity, improve visual quality and manage stormwater.

Biodiversity

Biodiversity is essential for maintaining ecologically sustainable plant communities and wildlife habitats. To maximise the biodiversity of the highway, a landscape design should:

- use locally sourced native plant material
- preserve existing vegetation, habitat and ecological values
- encourage biodiversity by manipulating the topography and ground conditions to create variable microclimates and by using a diverse range of naturally associated vegetation
- protect existing habitat and ecological values.

Genetic variability arises between plants of the same species as an adaptive response to specific local conditions. Introducing plants from the same species that were obtained from outside the local population risks tainting the genetic make-up of specimens peculiar to the local area (refer Appendix 2: Native Plant Selection).

To avoid genetic pollution when using indigenous species, seeds should be sourced as close as possible to the planting site. Seed collection should be from a wide variety of individual plants within a population to ensure some genetic variability (refer Appendix 3: Native Seed Collection).

Aesthetics

Aesthetics is the contribution plants make to the character, quality and visual appreciation of an area. For example, the use of a continuous planting theme can assist drivers in identifying a state highway from a local road.

Both the point of view of local communities and the highway user should be taken into account in plant selection.

Specific attributes of plants –such as growth habit/form, seasonal effects, texture and colour – need to be considered in the context of the overall effect required. The length of time required for plants to establish and reach the desired aesthetic impact should be considered during species selection.

Plant 'attractiveness' is an important consideration in urban areas.

Cultural factors

Plant selection that reflects aspects of the local heritage and cultural overlay will integrate better with the local landscape.

Surrounding land use and environment

Compatibility with the surrounding land use and environment needs to be considered in the plant selection process. Possible impacts are:

- the accidental introduction of invasive plants that will spread to adjacent pasture (eg some wildflower varieties)
- plants that may be toxic to livestock (eg Ngaio, Oleander)
- plants that may attract undesirable animals (eg possums) or insects that predate desirable insects and disrupt pollination.

4.6.4 Plant types

Introduction

This section discusses the attributes of different plant types. The specific site context will determine which plant types will be most effective in meeting Transit's expectations for highway landscaping.

Native or exotic

Both native and exotic plants are appropriate for use in the highway landscape. The decision to use either native or exotic plants is dependent on the biophysical site conditions and character of the surrounding land use and environment.

The use of native species is preferred to reflect Transit's commitment to biodiversity, however there is a place for exotic plants in modified environments such as urban and some rural settings. The site assessment process outlined in Section 4.5 Informing design will help identify the plant type most suitable for the project context.

Native vegetation

Native vegetation includes any species that are naturally occurring in New Zealand. Native vegetation can be used:

- for ecological restoration
- for erosion control, where steep slopes and batters provide optimal growing conditions for some native species
- in rural and natural areas to assist in integration with the surrounding landscape
- as a contrast in urban areas or as a reminder of what would have grown in the area before urbanisation.

In rural and natural areas, native species should be planted in associations and configurations that replicate how they would appear naturally. Acceptable approaches are to:

- use a range of pioneering native species to replicate the preliminary stages of natural regeneration
- where conditions permit, plant a more diverse mixture of shrub and tree species that reflect a more advanced successional stage.

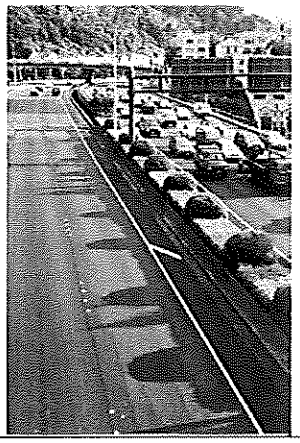
Native plants should be carefully selected to suit site conditions. Once established, they should require relatively low levels of long-term maintenance, particularly if adequate weed control techniques have been established.

Note: Many native tree species are unsuitable for planting in roadside environments as specimens unless they have associated shrub plantings to provide initial protection. To achieve a native landscaping scheme that functions well when mature, pioneering species must be interplanted with successional species.

Refer Appendix 1 for a list of suitable indigenous species for different parts of the country.

Exotic vegetation

Exotic vegetation includes plants that are indigenous to other countries. A range of exotic species have adapted to New Zealand conditions and are now a part of the wider landscape and may be appropriate to use in highway planting.



Exotic vegetation should be used in urban and rural situations where it is already an integral part of the landscape character. Care should be taken to ensure that the species used are not invasive or likely to become a maintenance problem. Maintenance levels for vegetation often increase with the degree of formality of the layout.

Plant types

In addition to considering whether to use native or exotic plants (or both), it is important to consider the type of plants appropriate to the situation.

The main plant types used in highway situations are:

- mown grass, including low growth grass species
- groundcovers
- riparian plants
- shrubs and trees
- vines or climbers

Applications for each of these plant types are discussed below. Guidance on specific landscape treatments and highway situations is included later in this section.

Mown grass

Grass can be appropriate for particular applications, eg:

16 months growth of a low growth grass species

- rural areas where pasture or grassland is a significant element in the landscape and surrounding environment
- erosion control on steep slopes and batters
- safety clear-zones along the shoulder of the highway (refer to the discussion of clear zones in Section 4.6.1 Road safety requirements)

Grass is relatively cheap to establish and achieves almost instantaneous results. It is, however, expensive to maintain because of the need for regular mowing. In high trafficked situations the cost of mowing is exacerbated by the additional traffic management cost required to close lanes or shoulders, which is far greater than the actual mowing cost. Apart from where grass is used for erosion control, it should generally be established only where the grades are mowable (3:1 or flatter).

Low growth exotic grass species can provide a cost-effective alternative to regular grass species on new highway berms and verges and sections of the existing state highway network. Low growth grasses require less frequent mowing and can reduce maintenance costs compared to regular grass species. Appendix 5 outlines the guideline for use of low growth vegetation.

Site preparation for low growth species should ensure the site is:

- free of any residual herbicides
- weed free
- lightly scarified

Maintenance schedules for low growth grass species should allow at least 150mm growth before the first mow, and active weed control to prevent infestations.

In many cases massed vegetation of small trees, shrubs and ground cover is more appropriate than grass. Planting may also be cheaper than conventional grass species as planting requires less regular maintenance and thus less traffic control. Guidance on cost comparisons is included later in this section.

Wildflowers may also be considered as a viable alternative to large grassed areas. Appendix 3 outlines the criteria for use of wildflowers.

Groundcover

Groundcovers include grasses, such as tussock or *Carex* species, and small low growing plants that over time cover the ground surface to reduce weeding and maintenance costs.

They are ideal in many highway situations, especially in medians, traffic islands and other such areas where plants must be low to the ground and require little maintenance for safety and traffic management reasons.

Groundcovers are appropriate for particular applications, including:

- mass planting of roundabouts, central medians and other traffic islands
- underplanting to larger trees and shrubs to achieve ground coverage and minimise weed growth
- an alternative to grass on medium grade batters and embankments.

Riparian plants

Riparian vegetation consists of wetland plants, grasses, sedges, shrubs and trees commonly found at the margins of water bodies. Wetland species can cope with intermittent wet and dry periods, and are tolerant to saltwater or brackish conditions if near the coast.

Riparian plantings associated with highway corridors should generally be native species from the local area. Care should ensure riparian plants are not invasive as they can be easily spread through waterways.

Riparian planting can be used for ecological restoration along highway corridors that are in close proximity to lakes and wetlands, or that traverse rivers and streams.

Appropriate riparian planting can also be used in drainage channels and stormwater treatment features associated with highway corridors provided the planting will not impair the drainage function of these areas.

Wetland species should be considered for roadside drains and channels to assist in soil-stabilisation and filtration of stormwater. These plants can assist filtration of contaminants from runoff water, reduce runoff speed and encourage local infiltration.

A roadside stormwater retention pond presents an opportunity for ecological restoration

Shrubs and trees

Shrubs and trees are larger plants with woody stems. Shrubs are smaller than trees, with stems or branches usually well branched from or near the ground, while trees have a well-defined trunk with a head of branches above.

Trees and shrubs are ideal in highway situations where they can grow without obstructing the road and impacting on safety and visibility for highway users.

Shrubs can serve a number of purposes including:

- coverage of large areas such as batters, embankments and extensive verges
- minimising weed growth
- providing screening
- providing visual relief.

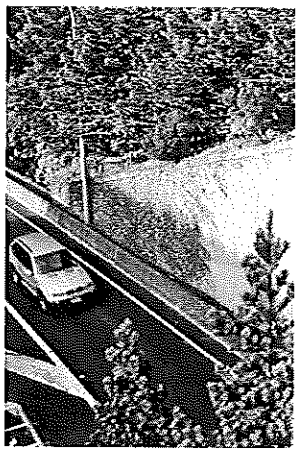
Trees can serve a number of purposes including:

- screening the highway from surrounding land uses and properties
- adding height and variety to lower shrub planting to enhance visual quality
- assisting with the integration of the highway with the surrounding landscape
- defining the highway corridor, including avenues, boulevards and gateway/intersection markers in urban areas.

Vines and climbers

Vines and climbers are plants that grow using other plants or objects as support. Planted to cover large expanses of concrete or segmental block walls they can achieve the following purposes:

- integrating structural solutions for the highway interface with the surrounding landscape
- providing visual relief to large expanses of unbroken concrete or other built material
- growing in situations where there is little room for establishing bulkier trees and shrubs.



Vines and climbers should not be allowed to interfere with the structural integrity of supporting structures.

4.6.5 Plant establishment

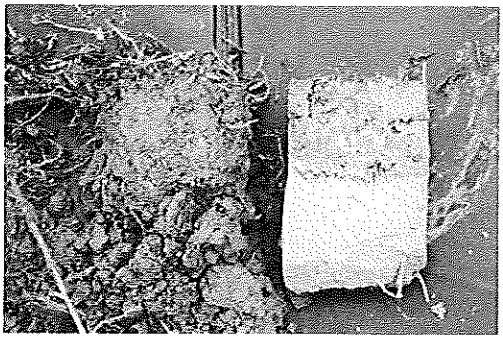
Introduction

Successful plant establishment depends on site preparation and establishment techniques.

Site preparation

Site preparation involves:

- identifying and protecting existing vegetation
- clearing unwanted vegetation (consideration should be given to the impact of clearance on local landscape character, ecology, biodiversity, water quality and soil erosion)
- controlling weeds (often weed control is essential to eliminate competition)
- managing topsoil (including the stripping and respreading of topsoil). Soil improvement may be required and should be considered where soil is:
  - heavily compacted
  - coarse textured with a low ability to hold water and nutrients.



(L) Adequate topsoil

(R) Inadequate topsoil over anaerobic subsoil

(Source: Landcare)

Plant establishment techniques

There are two main techniques:

- planting of nursery raised plants
- direct seeding.

Nursery-raised plants

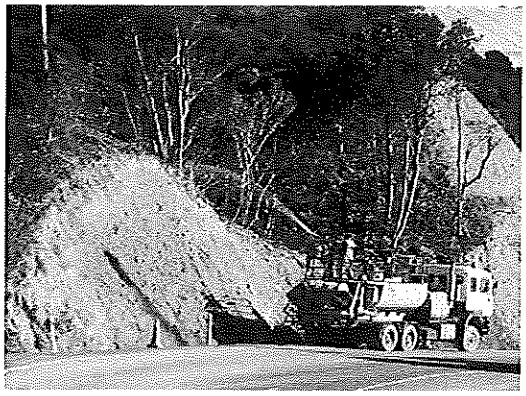
The use of nursery-raised plants is the most commonly used technique as it gives rapid results. Considerations include:

- planting size (the size of plants chosen depends on potential competition, type and location of planting, desired appearance, likely maintenance required and the growth characteristics of plants)
- planting techniques
- timing of planting
- watering requirements
- mulching (mulches improve conditions by suppressing weed competition, reducing moisture loss, adding nutrients to the soil and maintaining an even soil temperature).

Direct seeding

Direct seeding sows the seeds onto a prepared planting surface. For native plants this method is only suitable for pioneering shrubs and early successional species on relatively low fertility sites where they will not be initially out-competed by weed species. This technique is not usually appropriate for steep sites.

A local seed source is preferred to ensure genetic purity (Appendix 2 provides the timing schedule for native seed collection). Success of this technique depends largely on:



Hydroseeding at Kaitoke, State Highway 2

- relatively large amounts of viable seeds (large losses due to predation)
- timing that coincides with optimal seed viability and germination periods
- a suitable microclimate
- favourable climatic and soil conditions during germination
- control of competition from weed species.

4.6.6 Planting design

Introduction

The main considerations when developing a planting design (particularly for native vegetation) are:

- plant densities and spacings
- planting approach
- plant composition
- plant layering
- plant size
- retaining existing vegetation
- edge effects.

Densities/ spacings/ distribution

Planting of shrubs should be at higher densities initially to allow for natural attrition and to provide rapid canopy cover.

Spacings between large trees should reflect their eventual dimensions – but generally they should be a minimum of 10-12 metres apart. If large trees are used in urban areas, spacings should not exceed 10-12 metres to preserve a pedestrian-scale feel and avoid creating an impression of long walking distances.

The distribution of species needs to be considered, particularly for trees and enrichment planting.

Planting approach

For increased biodiversity and long-term success of areas of native planting, a wide range of species should be established. However, because of the difficult nature of many highway environments, it is often not possible to establish long-term species from the outset.

Growing conditions can be vastly improved by planting a nurse crop of fast-growing pioneering species. These plants will improve the conditions for establishing longer-term *successional* species by suppressing weed competition and improving the local microclimate.

Increased species diversity, which results from succession, can be hastened by enrichment planting. Once a nurse crop has formed a reasonable degree of canopy closure (2 to 4 years), enrichment planting of successional shrub and tree species can be carried out. This will involve minor clearance, and some thinning and interplanting into the protective canopy of the nurse crop.

The enrichment species should be grouped in clusters and in locations where they would occur naturally, rather than being dispersed evenly throughout the planting area. Species enrichment can also be enhanced by selecting a nurse crop of mixed species which will attract birds to the area, and by hand spreading seed to augment the planting.

Plant composition

For *native* planting the mix of vegetation should be influenced primarily by:

- the compositional structure of the surrounding native vegetation
- the establishment requirements of the plants and the long-term vision for the area.

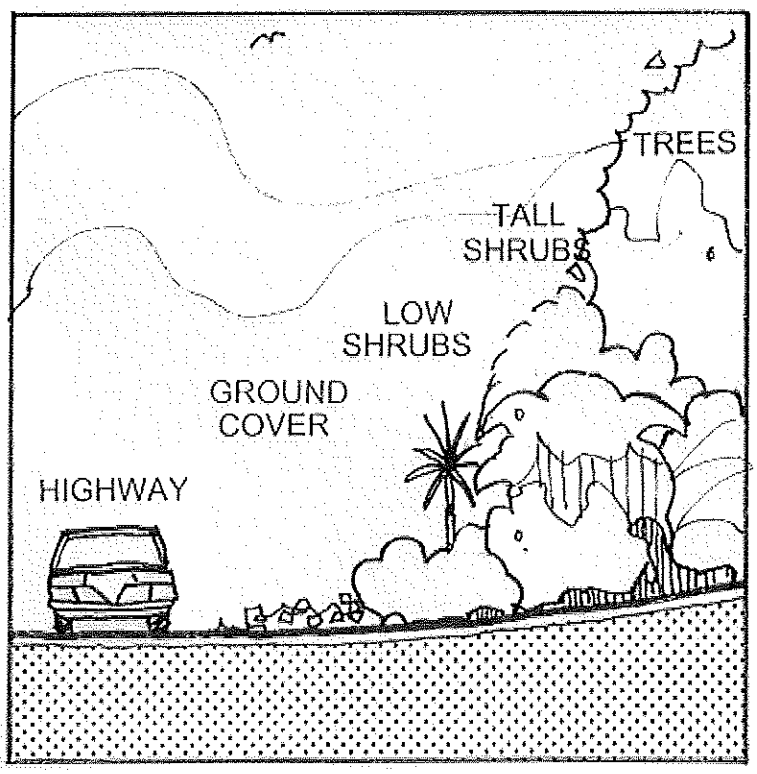
When *exotic* species are used, planting compositions can be more contrived and ornamental, particularly in urban situations. Provided functional and aesthetic considerations are met, the compositions are limited only by the design intent.

Plant layering

Plant layering involves grouping plants in relation to their height. Lower growing shrubs and ground covers immediately next to the highway corridor gradually merge into taller shrubs and trees furthest away from the highway. Plant layering is an effective technique to use in roadside environments as it:

- allows for clear zones
- allows for the inclusion and benefits of large trees but with safe clearance of the highway
- avoids overhanging vegetation growth into the highway, reducing maintenance requirements
- avoids enclosure and visual constriction of the road
- provides visually appealing plant compositions
- mimics the edges of stands of naturally occurring vegetation
- provides good weed control and a suitable microclimate for natural regeneration.

Example of plant layering



Plant layering in a motorway environment, Auckland Southern Motorway, State Highway 1

Retaining existing vegetation

Every effort should be made to retain existing vegetation identified in the landscape assessment (see Section **Error! Reference source not found. Error! Reference source not found.**) as having landscape qualities such as physical values, ecological integrity, rarity, aesthetic values or heritage and community values. Existing vegetation provides:

- a sense of continuity and maturity within the landscape (including landmarks and prominent features)
- a more rapid visual integration of the highway development with the surrounding area
- protection for newly planted vegetation.

An assessment will be required as to whether retained species will be healthy and viable in modified conditions.

The benefits of retaining vegetation or relocating significant specimens should always be balanced against relative costs, life expectancy and regrading or replanting options.

Example of existing vegetation retained and replanted

Plant size

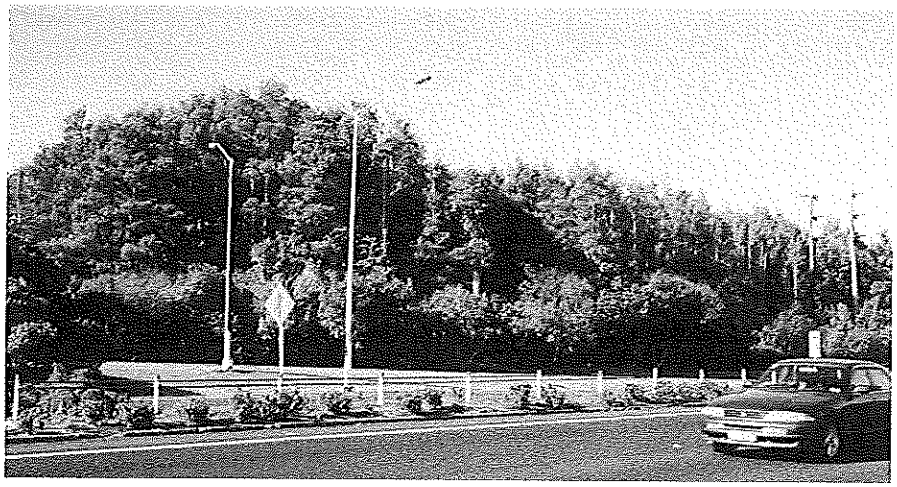
There is often public pressure to see instant landscape, but this is expensive and rarely successful in the long-term. The best approach is to use smaller well-hardened plants that will establish more readily and adapt to local conditions.

Edge effects

The edges of natural stands of vegetation are important in providing a buffer zone to the interior of the stand. Removal of this buffer zone can result in major changes to the microclimate within the sub-canopy and diminish species composition. These events can then have significant implications for the health and structure of existing stands.

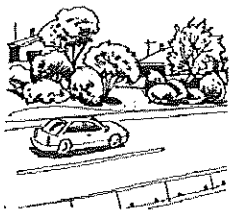
To reduce the effects of the removal of the bush edge the following approaches can be adopted:

- thinning in advance of road construction can stimulate regrowth and create a natural looking protective buffer for when the edge of stands of vegetation are exposed
- once the edge of the vegetation has been removed, plant a nurse crop of fast-growing native pioneer species to quickly re-establish a buffer zone.



Example of a buffer strip

Screening



Visual screening may be used to mitigate adverse visual effects of the highway or to integrate structures associated with the highway such as acoustic barriers. Earthworks, planting or a combination can be used to do this.

Any screening should retain good views, reflect local landscape character and not intrude on the landscape and surrounding environment. In some cases, visual integration through partial screening may achieve the desired results more sensitively than through full screening.

For screening the following points should be considered:

- the most effective screens are usually those closest to the viewer rather than the object or area that is to be screened
- for the screening of vehicles from surrounding areas, vegetation must eventually exceed 4 metres in height to conceal trucks and buses
- vegetation has little appreciable effect on noise levels. Vegetative screens may, however positively affect people's perception of noise levels, as noise often appears less if the source is concealed
- the branching habit and density of the vegetation will affect its ability to conceal views or objects. Where integration rather than concealment is desired, it may be desirable to filter views by selecting plants with less dense foliage
- screen planting should vary in form and size to replicate existing vegetation patterns
- screen planting in open and/or flat landscapes should be integrated with existing vegetation and other features, otherwise it may appear out of place and simply direct attention toward the highway.

Screening should avoid creating concealment areas that may threaten pedestrians' perception of personal safety.

4.6.7 Cost considerations

Introduction

If the conditions of the project site allow a range of planting options to be considered, the costs of stock purchase, installation and ongoing maintenance will be important factors in determining what form of planting will be selected for the site.

This section highlights the need to consider the cost implications of traffic management when developing highway landscape designs.

Traffic management costs

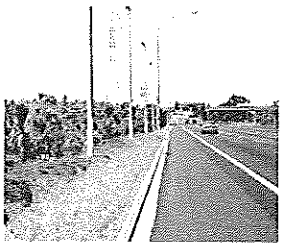
Transit's *Code of Practice for Temporary Traffic Management* (CoPTTM) determines the levels of traffic management required when undertaking roadside maintenance, such as vegetation control. The key determinants of the level of traffic management required are the impact of the maintenance activity being undertaken, traffic volumes and speed limits.

Traffic management costs significantly influence the cost of roadside vegetation management. Where traffic management is not required, the cost of vegetation maintenance drops significantly and the comparative cost of mowing grass (based on 8 to 12 cuts per year) are reasonably similar to the cost of planting (based on 4 maintenance visits per year).

Two places where traffic management is not required are:

- behind road safety barriers, safety rails or ropes, or
- 5m or more from the edge white line.

However, the procedures and requirements of CoPTTM must be followed at all times and should be referred to if there are any doubts as to its requirements.



An option that gives the attractive appearance achieved with planting but also minimises traffic maintenance costs is to establish grass from the road edge (mown with mobile closure) and planting beyond this (no traffic management required).

Comparative estimates of costs to maintain grass and plantings have been calculated in Appendix 4 Landscape Maintenance Costs and are shown as net-present-value (NPV) figures.

For example:

- On a Level 3 road with static lane closure during maintenance visits, the cost of maintaining Type 1 (frequently mown) grass ($47.93/m^2) is much higher than the cost of maintaining planting ($26.67/m^2)

4.6.8 Using earthworks

Introduction

Earthworks can be used to provide:

- screening
- visual variety
- points of interest
- a means of marking gateways and the like.

For successful visual integration of the highway, any associated earthworks should be natural looking and responsive to:

- the wider topography
- any smaller scale local landforms
- geologically significant features.

In some situations, such as urban areas, earth forms can be designed that have obvious sculptural qualities or contrast with the surrounding landform to provide distinct landscape features.

Erosion control

Combining earthworks with planting is a useful method of minimising erosion. Engineering solutions centre on reducing slope angles, providing terraces and incorporating benches and interceptor/ cut-off drains. Early establishment of vegetation cover will assist in controlling wind and water erosion on exposed surfaces.

Vegetative and bioengineering techniques can be employed to control erosion during earthworks and to provide permanent solutions to slope stability issues. Suitable techniques include:

- grassing
- mulching
- hydro-seeding
- mulch-seeding
- textiles and mats
- brush layering (bundles of saplings layered into batter slopes)
- pole planting (deep rooting trees and shrubs).

Successful use of vegetation to control erosion requires:

- site assessment: to identify site conditions such as soil type, soil water levels, and risk of movement
- appropriate species selection: to ensure species selected meet engineering requirements and are in keeping with the form and shape of surrounding vegetation
- forward planning: to ensure seed stock and plants suited for site conditions are available on-schedule
- contingency planning: to determine what extent of soil movement is expected before alternative solutions should be investigated
- ongoing monitoring: to ensure plant establishment is at the projected rate.

Slopes, cuttings and embankments

Where possible, earthworks should be graded out to integrate with the surrounding landscape. This involves reducing the steepness of earthworks and blending them with the natural landform alongside the highway corridor.

Grading out of large cut-an-fill batters is often not practicable because of the cost and the fact that it usually incolces extending the earthworks well out of the designation area into adjacent land.

The appearance and integration of cuttings and emabankments can be improved by:

- blending and feathering of the ends of slopes
- rounding the top and toe of slopes and blending them with the slope of adjacent ground
- ensuring the length of the slope matches the scale and angle of the surrounding topography by varying the angle of slopes along their length with gentle transitions between slope angles
- avoiding the appearance of unnatural steepness over short lengths of slope
- incorporating naturally occurring landforms and features within the earthworks that are immediately visible from the highway including ridgelines, natural drainage channels and features such as rock outcrops

- avoiding disturbance to water bodies by providing transitional bell-mouthed swales and gentle transitions at the point where slopes intersect with water courses
- using locally sourced rock typical in scale and formation to that occurring naturally if 'rip-rap' is required for erosion protection.

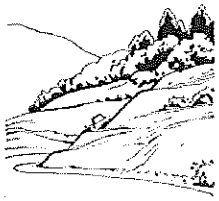
For detailed specifications relating to slope gradients and batter treatment, refer to Section 11.7 of the Austroads Rural Road Design: A Guide to the Geometric Design of Rural Roads.

Terracing and benching

Where a steep cutting is necessary, terracing should be used to break up the faces to reduce visual dominance. Terraces therefore should be irregular, responding to the natural bedding planes of the base material. Terracing is also an opportunity to further integrate the cutting by establishing vegetation. Often the best approach is to create terraces that will accumulate material and support natural revegetation rather than planting them which can look unnatural.

For detailed specifications on benches, refer to Section 11.7.1 of the Austroads Rural Road Design: A Guide to the Geometric Design of Rural Roads.

Rock cuttings



Different rock types give rise to variations in natural slope. Any cutting should reflect this and be blended sensitively into the surroundings.

When exposing rock on stable slopes, a random cutting/blasting method should be employed to ensure the rock face resembles natural fractures. Pre-split blast line should be avoided.

In areas where slope stability is a concern, irregular staggered bench sections should be used with risers that resemble natural rock strata lines. Benches should be random with a minimum width of 1 metre so revegetation can soften and naturalise their appearance.

Rock faces should be treated to match naturally occurring ones by:

- scarifying rock faces to mask residual drill lines
- spraying scarified rock faces with liquid fertiliser to encourage rapid revegetation.

Drainage

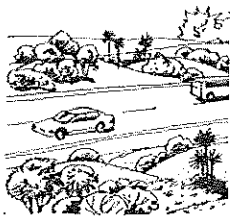
The following are suggested ways to integrate drainage features successfully into the surrounding landscape and environment:

- integrating drains with the natural drainage of adjacent land
- limiting the depth of drains to the minimum required by geotechnical and stormwater disposal needs
- minimising the gradient of side slopes (particularly in gentle terrain) and blending them into surrounding ground levels
- using vegetated swales where practical
- rounding the bottoms of drains
- varying the distance (where space allows) between the drain and the edge of the road in accordance with the nearby terrain
- providing gradual variations in slope gradients
- constructing wide transition areas where the drains intersect with a natural drainage gully.

For detailed specifications on drains, refer to Section 6.11 of Transit's *State Highway Geometric Design Manual* (SP/M/024).

Vegetated swales should be used, where possible, to assist in the management of stormwater quality and enhance biodiversity

Berms (including mounds)



Mounds can help screen the highway and reduce noise. Their screening function and visual integration can be greatly improved when combined with planting. Designing mounds for effective noise reduction needs to be carried out in consultation with an acoustic expert to ensure berm design mitigates noise. Gaps between berms can accentuate noise if not designed and located appropriately.

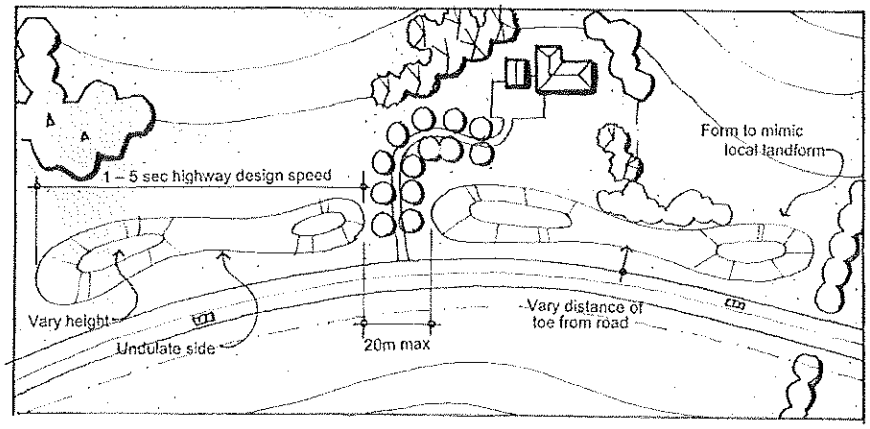
Mounds should be designed to appear natural. This can be done by varying their height, length and alignment to avoid visual monotony, and by avoiding sharp profiles when blending them in with the surrounding landform. Mounding may be inappropriate on flat terrain, as it may appear unnatural.

Following the points below is likely to lead to successful berm design by achieving a 'better fit' with the scale and form of the landscape:

- mounds should be a minimum length of 0.5 seconds of highway-designed speed and a maximum length of 5 seconds. At 100 km/hr this ranges between approximately 15 metres and 140 metres. Ideally, their lengths should vary in size and be toward the middle of the specified range. The scale of the surrounding landscape should be used to guide final design length

- gaps between mounds should not exceed 20 metres, so they retain a strong visual relationship between one another and do not appear to 'float' in the landscape
- berm side slopes should not exceed 3:1, to allow for mowing if required
- the height of mounds will depend on their function. If they are required to screen most vehicles (excluding trucks and buses) they will need to be at least 1.8 metres in height above the highway
- the distance of the toe of the mound to the highway should be varied if possible.

Note: Mounds can be an overturning hazard for vehicles and should be designed in accordance with the clear zone requirements speficied in Transit's *State Highway Geometric Design Manual* (SP/M/024).



Example of roadside mound design

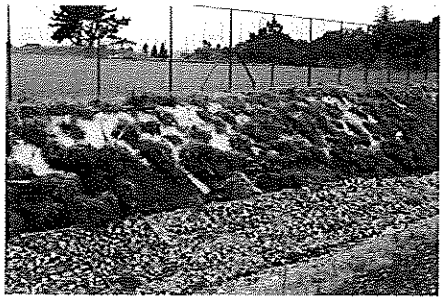
control

Erosion once earthworks are completed can remove valuable topsoil and result in the sedimentation of drains and natural water bodies. The nature and degree of erosion is determined by the slope steepness, the frequency and intensity of rain events and the local soil conditions and geology.

Earthworks designed in combination with various planting techniques provide the best methods to minimise erosion. Engineering solutions centre on reducing slope angles, providing terraces and incorporating benches and interceptor/ cut-off drains.

Early intervention is needed to assist in stabilising areas disturbed by earthworks, particularly cut/fill batters. The following are suitable vegetative and bioengineering erosion-control methods that can be employed for erosion:

- grassing
- mulching
- hydro-seeding
- mulch-seeding
- textiles and mats
- brush layering (bundles of saplings)
- pole planting (deep rooting trees and shrubs).



4.7 Landscaping for specific highway situations

Introduction

This section provides guidance on how to meet Transit's expectations for highway landscaping in specific highway situations and types of non-pavement structures including:

- rest areas
- highway junctions
- vegetation adjacent to services
- medians
- traffic islands
- swales
- planter boxes
- batters and embankments
- verges
- urban highways.

The following highway situations and non-pavement structures may occur together. For example, verges often contain batters and embankments, swales may be located within verges, and medians may merge into traffic islands at highway intersections.

Completing a comprehensive landscape assessment and design process should ensure a site-specific response that is appropriate for site conditions and meets Transit's expectations for highway landscaping.

4.7.1 Rest areas

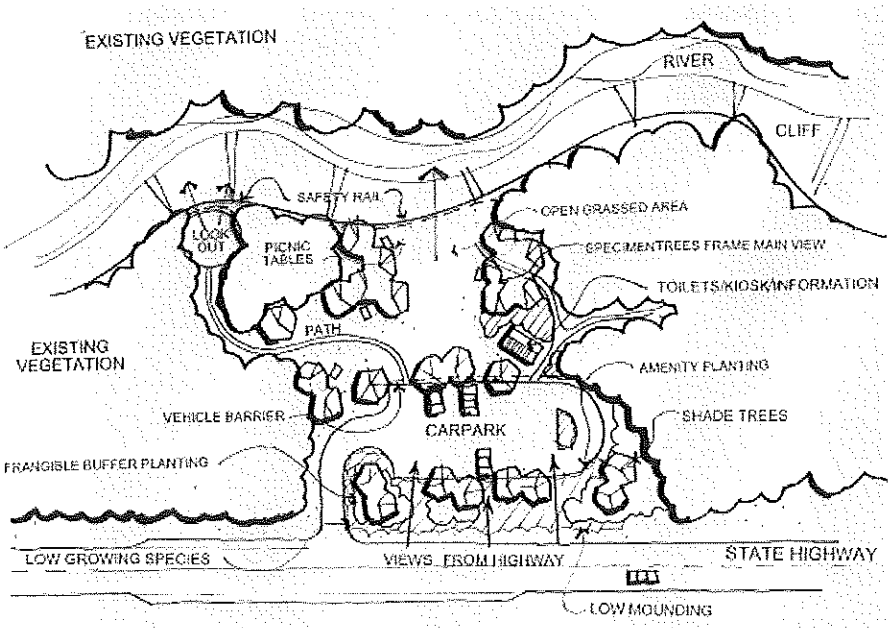
Rest areas are found throughout the state highway network. Stopping places provide road users with safe, pleasant places to take a break and reduce driving fatigue.

The use of plants in and around rest areas should achieve a range of design objectives:

- screening of noise, traffic, buildings and car parking can be managed through planting. Some gaps should be left in the vegetation along the road boundary as this provides a sense of safety for rest-area users by allowing the passive observation of rest areas by passing motorists
- setbacks can be used to maintain sight lines and visibility, particularly at the point of entry and exit from rest areas
- safety can be enhanced by planting soft frangible plants next to the highway, to create buffer zones between the highway and rest areas
- using locally-sourced native plant species can emphasise the indigenous character of an area while reinforcing the ecological value of rest area planting
- retention and enhancement of views can add to the aesthetic pleasure of the rest area
- planting can provide shelter, shade and visual enhancement. The use of colourful and/or textured planting adds to the pleasurable experience of a rest area
- maintenance costs can be reduced by careful plant selection and design
- separation and safety is assisted by installing robust barriers or earthworks to prevent vehicles leaving the car park and entering open grassed areas.

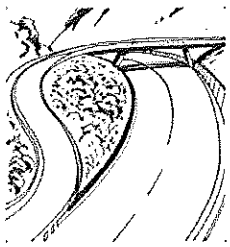
Earthworks may be used to enhance rest areas through:

- visual and physical separation from the highway
- the deflection of road noise from the highway
- the manipulation of vehicular traffic and reduced tracking over grassed areas
- the direction of drainage flows by way of swales, that can be incorporated into appropriate planting, especially on wet sites.



NOTE
Access should be designed in accordance with *TNZ Access Standards*

4.7.2 Highway junctions



Highway junctions include interchanges, intersections and roundabouts associated with a highway. Planting can be used as an effective means of indicating a junction.

Large junctions including interchanges should be well integrated into their surroundings with extensive planting.
Sight lines and visibility are vital at junctions and must be maintained by the use of either low planting or taller shrubs and trees with clear lower limbs (refer *State Highway Geometric Design Guidelines* SP/M/024).

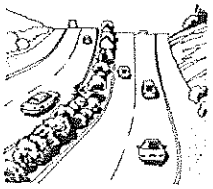
Where practicable, medians and roundabouts associated with junctions should be planted or paved in preference to grass. This reduces the need for expensive, and potentially dangerous, frequent maintenance of these areas.

4.7.3 Services

When services need to be located in the road reserve, their placement should be co-ordinated with the landscape design to avoid potential conflicts. For safety reasons and to reduce maintenance, the following general clearances from services for plants with stems greater than 100 mm are recommended:

- lamp posts – 10 metres
- power poles – 10 metres
- underground services – 4 metres. Most modern plastic pipes resist roots, but when service maintenance is required root damage to the tree can result
- drainage sump – 6 metres
- overhead power lines – avoid planting trees or any large shrubs underneath or close by that will require trimming.

4.7.4 Medians



Medians vary in size according to the site context and function. Narrow medians are often located in low speed environments, whereas wide medians are usually found only on high volume, multi-lane highways in New Zealand.

Medians wider than 1 metre can provide enough space for plants to grow and to allow maintenance access. Medians narrower than 1 metre can still allow for planting, although low maintenance treatments should be considered.

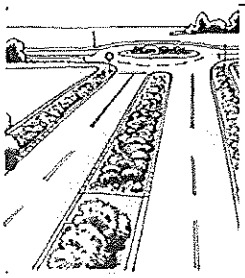
Planting within medians can serve a variety of functions:

- vegetation helps emphasise the visual separation of the roadways
- vegetation reduces the scale of the road and provides visual relief to the wide expanse of sealed area
- vegetation reduces the effects of oncoming headlight glare. Where visibility is important, this can still be achieved through the use of low-growing shrubs (refer Section 4.6.1 Road safety requirements)
- depressed medians (which serve a drainage function) can be planted with wetland species to reduce maintenance, improve aesthetic and ecological values, and assist in the treatment of road run-off
- plantings can reduce on-going maintenance costs of mowing of grassed medians.

Grassed areas within medians should be replaced with planting that requires less long-term maintenance where opportunities are available. In some situations, wildflowers may be appropriate (refer Appendix 3). Care must be taken that only frangible plants (such as small shrubs and ground cover) are used if they are not shielded by safety barriers. Where there is limited room for vehicle recovery, grassed areas should be retained.

Regionally appropriate ground cover, grass and shrub species should be considered for medians where growth patterns will not extend beyond the median.

4.7.5 Traffic islands



Traffic islands are common elements within the highway corridor, especially in urban areas. Traffic islands include:

- roundabouts
- traffic islands at intersections
- traffic islands at entries to towns and urban areas.

Planting within traffic islands can serve a variety of functions:

- helping drivers 'read the road' by marking an intersection and distinguishing between different sections of road
- vegetation can provide visual cues to assist drivers in reducing speed at the entry to towns and other urban areas
- vegetation increases the visual quality of the highway and helps to integrate the highway with local roads and surrounding uses and environments
- vegetation can reduce on-going costs and potentially dangerous or disruptive maintenance associated with regular mowing of grassed areas at highway junctions and intersections.

When planting within traffic islands the following matters should be considered:

- that clear zones and setbacks are maintained for the maintenance of sight lines (refer to Section 4.6.1 Road safety requirements)
- that vegetation once mature will not obstruct roadside furniture in traffic islands such as signs, marker posts, guardrails etc
- that vegetation will not obstruct visibility.

Sight lines and visibility are vital at intersections and must be maintained by the use of either low planting or taller shrubs and trees with clear lower limbs (refer *State Highway Geometric Design Guidelines*).

Where practicable, medians and roundabouts associated with intersections should be planted or paved in preference to grass. This reduces the need for expensive, and potentially dangerous, frequent maintenance of these areas.

4.7.6 Swales

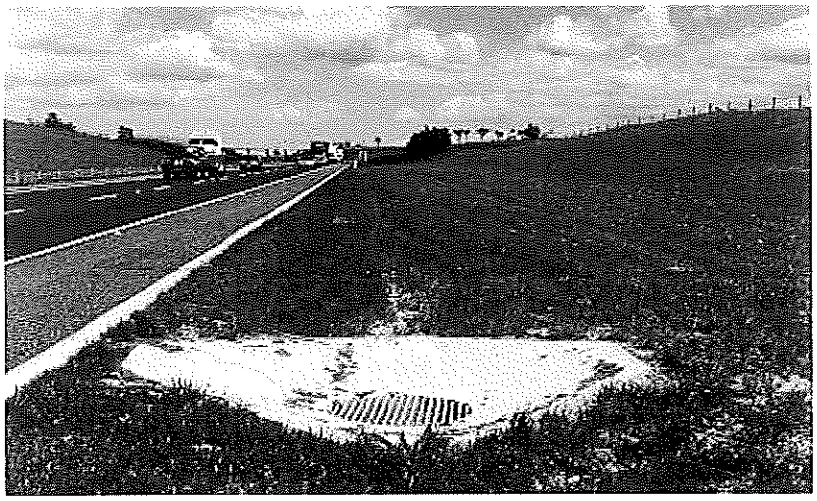
Grassed or vegetated swales are an alternative to conventional engineered solutions for stormwater management within the highway corridor.

They can be integrated into the overall landscaping scheme and can serve a variety of functions in achieving biodiversity, visual quality and stormwater runoff objectives:

- swales (especially vegetated swales) can slow the rate of stormwater runoff, encourage infiltration and improve quality of runoff entering waterways
- vegetated swales can improve biodiversity by enhancing aquatic and wetland habitats and attract invertebrate and avian fauna, especially if combined with detention ponds and wetland planting
- swales can improve visual quality of the highway landscape by introducing forms that integrate with natural environmental settings.

When considering using swales in highway landscaping the following matters should be considered:

- whether to use a grassed or vegetated swale. Vegetated swales are preferable, but may not always be appropriate, especially in narrow sites where space is constricted between the swale and road shoulder
- the natural alignment of watercourses should be retained wherever possible
- varying the width and grade of swales to create organic forms that integrate with natural environmental settings
- whether the swales can be integrated with detention basins and stormwater ponds as part of a more comprehensive stormwater management system
- whether the swales can be integrated both visually and physically with landscape developments on neighbouring reserve land or open space.



A vegetated swale on this site, Auckland South Western Motorway, State Highway 20 is consistent with a number of Transit's expectations for highway landscaping

4.7.7 Planter boxes

Planter boxes may be used in highway situations where there is limited room between the shoulder and the designation boundary, such as in some highly built up urban areas.

In these situations, planter boxes have the advantage of being easily fitted into the urban landscape, especially where extensive planted areas are not a characteristic of the surroundings.

Planter boxes can serve a number of functions:

- integrate the highway with the surrounding built urban environment, and contribute to urban amenity through screening, shade and improved appearance
- allow the establishment of trees and larger shrubs in areas where in ground planting is not possible due to space constraints or underground services.

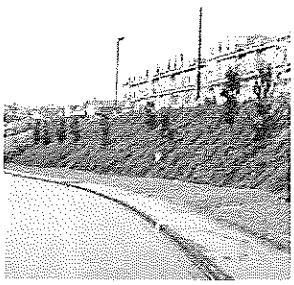
When using planter boxes in highway landscaping design, the following matters should be considered:

- road safety
- drainage
- space available for planter within road corridor
- volume of soil for achieving the plant growth intended
- design and detailing of materials to fit with surrounding urban landscape
- any council-led theme for street furniture or urban design.

4.7.8 Batters and embankments

Batters (including cut and fill batters) and embankments are a common element in highway landscaping, especially in hilly topography. Planting on batters and embankments can serve a variety of purposes:

- assist in erosion control and slope stabilisation
- assist in visually integrating cut batters with the surrounding landscape
- ameliorate adverse effects of earthworks on existing areas of vegetation by reducing weed invasion and controlling dust drift.



Careful site preparation, selection of plant species and planting formations are fundamental to creating planted batters that establish well and lessen maintenance requirements.

The decisions made at the engineering design phase of a project determine the grade of batters and embankments. The grade of batters affects the ability to plant these areas – for example, a grade of 1:2.5 or less is optimum for soil preparation and plant establishment. A slope between 30° and 40° will require the use of ladders, and slopes steeper than 45° will require ropes, making planting difficult.

Often on these steep slopes hydro-seeding is seen as an easier option, being far simpler to implement. Hydro-seeding can quickly revert to weeds and gorse, meaning long-term maintenance will be more onerous than a well planted bank.

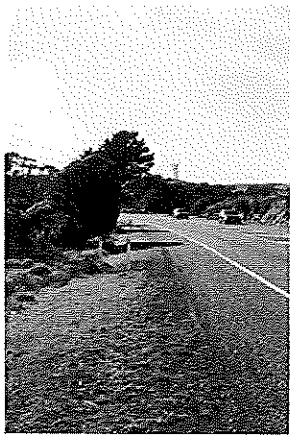
The nature of the surrounding land use and environment will influence the decision to plant or hydro-seed. For example: if the surrounding land use is farming, then it will be more appropriate to hydro-seed than to plant.

In planting batters and embankments, other matters to be considered include:

- the grade of the batter, the depth of soil and the implications these have for effective plant establishment
- the mature size of plants, and whether species selected are appropriate for the scale of the bank and the distance to the road shoulder
- whether plant densities are sufficient to quickly cover the bank surface and thus minimise weed growth and maintenance costs
- consistency with Section 4.6.8 Using earthworks
- long-term maintenance implications of planting, as discussed in Section 4.6.2 Maintenance considerations, and in Section 5 Highway Landscaping Maintenance of these Guidelines.

4.7.9 Verges

Verges include all side slopes (including batters and embankments) between the shoulder and the edge of the designation. Batters and embankments have been dealt with separately in this section, so the following refers to flat or gently sloping verges and artificial mounding created as a result of earthworks.



Transit's *SOMAC Specification for Vegetation Control* (SM032 VC 09) sets out the required height for verge vegetation and vegetation around edge marker posts.

Verges are often grassed beyond the edge marker post, especially in rural areas where the surrounding environmental setting is pastoral grazing land.

There are circumstances however, where it may be desirable to plant beyond the edge marker post. In natural or National Park settings where the state highway is bounded by native vegetation cover, planted verges will assist in integrating the highway with the surrounding landscape.

Similarly, in urban areas it may be appropriate to plant the verge to integrate with or screen the highway from the surrounding built urban landscape, or to mark the entry to towns. What is appropriate depends upon the matters raised during the assessment stage of the project.

Where verges are grass the length to which it is mown is another matter to be considered, in terms of both long-term maintenance and what treatment will best integrate with the surroundings. For example, longer grass may be more appropriate in rural situations, reducing maintenance costs. In an urban area, more tightly mown grass may be needed to integrate with the level of amenity in the urban landscape.

In considering how best to treat highway verges the following matters should be considered:

- what landscape treatment (eg grass or planting) will best integrate with the surrounding environment
- safety requirements for sightlines, recovery zones, and vegetation on inside curves
- the degree of maintenance work (eg standard of mowing or vegetation trimming) that is most appropriate
- opportunities to integrate stormwater runoff into the design of planted verges through swales etc.

4.7.10 Urban highways

Where highways pass through urban areas, landscape quality influences the character of the surrounding area.

In addition to providing for through traffic, highways in urban areas also function as streets where people live, work, walk and cycle. Highway landscape design should support these activities.

When considering the landscape treatment of highways through urban areas, the following matters should be considered:

- consistency with established patterns of landscaping. Urban highway landscaping should be coordinated with local authority landscaping strategies and plans
- ornamental planting may be appropriate if consistent with local character, and if access to the site facilitates the regular maintenance required
- planting in urban areas is more likely to be ordered rather than naturalistic. An ordered line of street trees can provide a unifying theme where buildings and activity at the edges are highly diverse
- greater frequency of vegetation and finer level of landscaping detail to provide visual interest to slower moving traffic, cyclists and pedestrians
- using closely spaced trees to provide shade for pedestrians, define street spaces and provide character
- landscape treatments can calm driver behaviour where interactions between vehicles and pedestrians occurs
- planting adjacent to footpaths should allow clear views between pedestrians and drivers
- careful landscape design should eliminate opportunities for concealment close to footpaths.

4.8 Analysis and implementation

Analysis

Once the environmental setting and site attributes have been assessed, and design considerations relevant to the site have been identified, careful analysis of this information should inform the landscape design to ensure the landscaping proposed meets the site vision and achieves Transit's expectations for highway landscaping.

Implementation

The implementation of landscape works should be co-ordinated with the staging of works for the project as a whole.

In doing so the following matters should be considered:

- co-ordinating earthworks, grading and soil preparation with the contract works as a whole
- ensuring earthworks are in place in time for planting. Typically,