

University of Southern Queensland
Faculty of Engineering and Surveying

Development of an Asset Maintenance Program for Darwin City Council

A dissertation submitted by

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ABSTRACT

Darwin city is a small tropical city situated in the Northern Territory. The City Council population is 75852 covering approximately 70 square kilometres. Within this area there is an extensive network of civil infrastructure.

One major task of Council is to maintain these assets at a service level satisfactory to the community. To do this there needs to be understanding of what the assets are, the service levels they are required to meet and their current condition. This project explores the ways to optimise the current processes and to create more efficient programs that integrate multiple assets where possible. The assets to be focussed on are road surface and pavement, kerb and gutter, footpaths and driveways.

There are many opportunities to optimise the way in which surveys are carried out and programs created for infrastructure assets at DCC. Surveys are carried out every four years on roads, driveways and footpaths, with kerb and gutter not being inspected. Currently only road surface and footpaths are programmed with the program duration being four years for footpaths and ten years for road surfaces, which is updated with new data input.

There are three outcomes to be addressed in this project, they are;

- Develop existing asset maintenance plans for roads, kerb & gutter, footpaths and driveways,
- Investigate and comment on the current levels of service , and
- Improve the condition survey programs to ensure all relevant information is collected on all asset.

The programs for all assets have been developed for the 2009/10 financial year works as much as possible. The recommendations and processes discussed will be used to further optimise the programs at Darwin City Council.

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CANDIDATES CERTIFICATION

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I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

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Contents

ABSTRACT	i
LIMITATIONS OF USE.....	ii
CANDIDATES CERTIFICATION	iii
ACKNOWLEDGEMENTS	iv
LIST OF FIGURES	vii
LIST OF TABLES	viii
GLOSSARY	ix
1 INTRODUCTION.....	1
1.1 Outline	1
1.2 Background.....	2
1.3 Objectives	4
1.4 Consequences and Risks.....	6
1.4.1 Consequences	6
1.4.2 Risks.....	6
1.5 Summary.....	7
2 LITERATURE REVIEW	9
2.1 Introduction.....	9
2.2 Review	9
2.2.1 Asset Management	10
2.2.2 Asset Maintenance.....	11
2.2.3 Condition Surveys	13
2.2.4 Service Levels	17
2.2.5 Policies and Regulation	25
2.3 Summary.....	33
2.4 Outline	34
2.5 Resources	35
3 ASSET OVERVIEW	36
3.1 Summary.....	36
3.2 Technical Information	37

3.2.1	Road Surface	37
3.2.2	Road Pavement	39
3.2.3	Kerb and Gutter.....	40
3.2.4	Footpaths	41
3.2.5	Driveways	42
3.3	Existing Data	44
3.3.1	Road Surface	44
3.3.2	Road Pavement	45
3.3.3	Kerb and Gutter.....	46
3.3.4	Footpaths and Driveways.....	46
4	SURVEYS.....	47
4.1	Summary.....	47
4.2	Roads and Kerb & Gutter	49
4.3	Footpaths and Driveways	52
5	PROGRAM DEVELOPMENT	55
5.1	Summary.....	55
5.2	Service Levels.....	55
5.3	Roads and Kerb & Gutter	57
5.3.1	Current Programs	57
5.3.2	New Programs (2009/10).....	58
5.4	Footpaths and Driveways	61
5.4.1	Current Programs	61
5.4.2	New Programs (2009/10).....	62
5.5	Future Programs.....	62
6	RECOMMENDATIONS	64
7	CONCLUSION.....	65
8	REFERENCES.....	66
	Appendix A – Project Specification	68
	Appendix B – 10 Year Works Plan	69
	Appendix C – DCC Budget Extract	71
	Appendix D – Service Level Legislative Requirements.....	74

Appendix E – Driveways Policy	80
Appendix F – Road Standards Policy	81
Appendix G – Footpath Construction and Reconstruction Policy	82
Appendix H – Footpath Maintenance Policy	87
Appendix I – DCC Data Collection Manual	88
Appendix J – Road Resurfacing Program 2009/10	98
Appendix K – Footpath Program 2009/10	100

LIST OF FIGURES

Figure 1 - Program Development and Implementation Process	12
Figure 2 - Flushing Example.....	17
Figure 3 - Shire of Busselton Draft Community Levels of Service.....	24
Figure 4 - Shire of Busselton Draft Operational Levels of Service	24
Figure 5 - ACEAM Maintenance Surface Patching Service Level Template	25
Figure 6 - Brisbane City Council - Guidelines for Footpath Width Selection	29
Figure 7 - Road Asset Hierarchy	36
Figure 8 - DCC Typical Cross Section	38
Figure 9 - Typical Kerb and Gutter Design	40
Figure 10 - Typical Layback Kerb Design	41
Figure 11 - Typical Semi-Mountable Kerb Only Design.....	41
Figure 12 - Standard Footpath Cross Section.....	41
Figure 13 - Standard Residential Driveway Plan Design	43
Figure 14 - Driveway Cross-Section Standard	44
Figure 15 - MapInfo Road Survey.....	45
Figure 16 - MapInfo image Footpath Types.....	47
Figure 17 - GBM Mobile Process.....	48
Figure 18 - Reseal Program Roads	59

LIST OF TABLES

Table 1 - Asset Survey and Program Summary	2
Table 2 - Civil Asset Budget Summary.....	4
Table 3 – Consequences/Probability Matrix.....	6
Table 4 - Project Risk Matrix and Summary	7
Table 5 - Footpath and Driveway Survey	14
Table 6 - Road Survey	16
Table 7 - Annual Plan Program Summary	20
Table 8 - Pathways Service Levels	21
Table 9 - Road Service Levels	22
Table 10 - Chip Seal and Asphalt Descriptions	39
Table 11 - Road Data Summary from 2006 Summary	45
Table 12 - Footpath and Driveway Data from 2006 Survey.....	46
Table 13 - Road Condition Survey Form.....	50
Table 14 - Road Treatments	51
Table 15 - Kerb Details	51
Table 16 - Kerb and Gutter Condition Rating.....	52
Table 17 - Footpath Condition Data.....	53
Table 18 - Pathways Service Levels for Programming	56
Table 19 - 2009/10 Road Surfacing Program	60
Table 20 - Road Surface Program Treatment.....	60

GLOSSARY

Asphalt	Road surface type of pre-mixed bitumen and aggregate that is layed and compacted whilst hot.
Chip-Seal	Road surface type made of sprayed hot bitumen with aggregate spread and rolled into the bitumen.
Council	The municipality, in this project it is Darwin City Council
Crossover	Paved/formalised link between road surface and property boundary allowing access to property for residents, also known as a driveway
DCC	Darwin City Council
Driveway	Paved/formalised link between road surface and property boundary allowing access to property for residents, also known as a crossover
dTIMS	Computer program used to model road deterioration over time.
Kerb	A concrete separation between road surface and verge.
Kerb and Gutter	A combined kerb with gutter which are generally constructed together. The kerb prevents separates the road from the verge and the gutter controls the flow of stormwater.
Levels of Service	The legislative requirements and customer expectations of the condition of an asset, includes intervention levels and is monitored by performance indicators.
Municipality	Elected local government for a city area, in this project it is Darwin City Council, other municipalities are referred to throughout the project.
Policy	A Council approved document that forms a controlled guideline on the maintenance of an asset.
Road Pavement	The constructed section of road reserve intended for vehicular use, the pavement includes the sub-grade, sub-base and basecourse. It doesn't include the wearing surface (road surface).

Road Reserve	The area between property boundaries that is controlled by Council or other Government body.
Road Surface	Wearing surface of the road, constructed on the pavement. Usually is asphalt or chip-seal.
Reseal	The resurfacing of a road surface using chip-seal.
Resurface	The placement of a new surface (chip-seal or asphalt) over the existing surface.
Verge	The area within the road reserve that exists from behind the kerb to the property line

1 INTRODUCTION

1.1 Outline

AIM: Develop an Asset Maintenance Program for the Darwin City Council.

Darwin City Council is the largest city council in the Northern Territory. The city is the northern-most city within Australia and has a typical tropical climate with two distinct seasons, the wet and the dry. The municipality covers approximately 70 square kilometres with a population of 75852 (ABS, 2006). There are approximately 420 kilometres (kms) of Council controlled roads, 330 kms of stormwater pipe network, 9,700 stormwater pits, 360 kms of footpaths and 18,000 driveways all owned and maintained by Council.

All of the assets are required to meet service levels. These are largely derived from community expectations, particularly in regards to safety. The Lord Mayor represents the community as a whole and there are three aldermen in each of the four wards. As the community is the largest stakeholder for Council, their satisfaction with the services provided is a priority. To ensure that their changing needs are met surveys regarding the infrastructure are conducted annually.

Maintaining the infrastructure assets to their respective service levels is a difficult and expensive task. The service levels currently used at Council are largely rated by the assets overall condition rating and customer satisfaction. How these service levels affect asset surveys and programs will be investigated in this project.

Plans and programs for assets can be developed once an understanding of what the asset is and to what level it is to be maintained. An important part of planning is having an understanding of how the assets work together or how a program can be optimised when assets are maintained in conjunction with one another.

This project looks into all aspects of programming the maintenance of several infrastructure assets and provides recommendations on how to transfer the process to the remaining assets. The assets to be focussed on and programmed are road surface and pavement, kerb & gutter, driveways and footpaths.

1.2 Background

Darwin City Council (DCC) has an asset management plan that has been continually developed, particularly since 2004. Through its development most of DCC's assets have been identified and their condition recorded. The information collected has been stored in a variety of programs such as Authority, MapInfo, dTIMS and spreadsheets. These programs will be explained further when the specific assets are discussed.

The asset management plan DCC has produced is a document (currently in draft format) that covers all aspects of managing Darwin City Council's assets with particular focus on valuations and service levels. The document doesn't explore how the asset is to be maintained (such as type of resurfacing), the specific maintenance programs are determined from the data recorded and the condition of the asset.

Darwin City Council has also adopted a strategic plan called Evolving Darwin; Strategic Directions: Towards 2020 and beyond. Within this are several strategic items that relate to the maintenance and management of Council's assets. These items must be met to ensure the Darwin City Council strategies are being achieved and will be addressed as the programs are developed. The asset management plan is the next 'step' in managing the assets, with the specific maintenance programs being the final 'step'.

A ten year plan also currently exists that gives a guide to what the Council budget is going to be used for over the next 10 years. It covers large capital works and general maintenance of all assets. The level of detail to what assets are maintained to vary greatly but generally it is just a snapshot of the money budgeted on each asset class. Appendix B has an extract from the document. This document will not be used as part of this project due to it currently being reviewed.

The current maintenance programs have been developed in conjunction with the asset management plan. The table below indicates the assets within the Council owned road reserve that DCC has collected data on, whether regular condition surveys are carried out and the status of current programs.

Table 1 - Asset Survey and Program Summary

Asset	Condition Survey	Program
Roads - surface	Yes – visual, 4 years	Yes – 10 years
Roads - pavement	Yes – visual, 4 years	No – reactive works

Kerb & Gutter	No – beginning in 2010	No – reactive works
Driveways	Yes – visual, 4 years	No – reactive works
Footpaths	Yes – visual, 4 years	Yes – 4 years
Signs	No	No
Linemarking	No	Yes – 5 years
Walkways	Yes – visual, 4 years	Yes - annual
Stormwater system	Yes – visual and camera, as required	No

As mentioned previously only road surface and pavement, kerb & gutter, driveways and footpaths will be analysed in this project. The following is a summary on the surveys and programs of these assets.

- Roads, footpaths and driveways are all surveyed every four years with maintenance programs developed for up to 10 years.
- Road pavements are surveyed in conjunction with the road surface condition but maintenance is only undertaken as required, it isn't programmed over the next 10 years like the surface.
- Kerb and gutter maintenance is carried out as required, condition surveys and maintenance programs do not currently exist.
- Driveways and footpaths are surveyed together with each lot frontage having a single driveway and footpath segment as an asset. The condition of the footpaths is used to determine the next 4-5 years maintenance program.
- The driveway condition data is used as a guide for when maintenance is requested from residents or internal staff.

The programs that are currently in place focus on individual assets, such as a segment of road surface or a stretch of footpath. Each asset is essentially treated as an individual item with its own attributes and value. For example, roads are separated into segments between intersections, and footpaths are listed per lot frontage. By integrating the programs both between and within the asset classes the maintenance of the assets can be optimised from both time and budget perspectives.

The maintenance programs at DCC have been developed for a group of assets to be maintained within a set budget. The road surface program has been developed over the last few years and the budget has been adapted (increased) to ensure the road condition meets service levels and also doesn't depreciate to an un-manageable level. The other programs are generally programmed to fit within the budget and monitored to ensure the required level of service is met. Some budgets also need to allow for

reactive works, such as road pavement failures and driveway replacement requests from residents.

The following table summarises the 2008/09 budget for road, footpath, kerb and gutter and driveway maintenance. The summary from the adopted budget for infrastructure projects is included in Appendix C.

Table 2 - Civil Asset Budget Summary

Item	Budget	Description
Road Construction and Traffic Management	\$995,000	New capital works
Pathways – Capital Refurbishment	\$960,000	Footpath, cyclepath and walkway reconstruction
Pathways – Capital New	\$310,000	New pathways works
Roads – Capital Refurbishment	\$1,225,000	Includes driveway replacement (\$200,000), kerbs, traffic signals, road resealing and rehab (\$850,000), carparking and streetlighting
Roads – Capital New	\$143,000	New disability access, shoulders and lighting projects

In summary, Darwin City Council has developed basic service levels, an asset management plan and procedures for programming maintenance of most assets. A selection of these assets will be investigated and their maintenance programs revised in order for them to be more cohesive and efficient.

1.3 Objectives

The main objective of this project is to create cohesive maintenance programs for the following assets;

- Road surface,
- Road pavement,
- Kerb and Gutter,
- Footpaths, and
- Driveways

The final product (and main objective) of the project will be five asset maintenance programs that will be used to maintain the listed assets in the most effective way. The programs are intended to be implemented for works in the 2009/10 financial year as much as possible. From this initial implementation the recommendations

identified for the surveys and programs will be used for future programs, with the next survey being scheduled to occur in 2010/11.

In order to get the programs working cohesively, the program development must ensure that where-ever possible the assets are maintained in the most efficient way. This means that the current programs need to be understood and developed to work with each other and not as though each asset is independent of all others. For example, damaged driveways can be programmed to be replaced when the footpath is programmed for maintenance, or non-conforming kerb and gutter can be replaced when a road is resurfaced. The methodology chapter further describes how the programs will be developed.

In order to achieve the main objective there will be two minor objectives achieved, the first being to understand the current service level requirements and determining whether they require revision and the second objective is to improve the current condition surveys.

The current service levels are very general and do not indicate specific performance criteria for the assets. How the service levels actually affect the maintenance programs and whether they need to be more specific will be investigated in this project, with the aim of recommending several improvements to make them more accessible and clearer.

The final objective is to improve the current condition surveys. The way in which the surveys are carried out can greatly impact on the final maintenance program. Currently condition surveys are carried out on most assets on a four-yearly cycle, but there are some assets not surveyed and also the information gathered not utilised in the most effective way. By reviewing and improving the surveys the data collected can be used more effectively in creating the maintenance programs.

To summarise, the main objective of this project is to develop existing asset maintenance plans for roads, kerb & gutter, footpaths and driveways. The secondary objectives are to review the service levels and also to improve the survey programs to ensure all relevant information is collected on all assets. By combining these objectives the programs will be developed to meet required levels of service, DCC's strategic aims, be within budget constraints and be integrated and optimised as much as possible.

1.4 Consequences and Risks

1.4.1 Consequences

There are not any significant consequential effects expected with this project as the project is intended to improve the current programs. Most of the effects are likely to be positive as the current programs will be streamlined and more efficient.

There is the possibility of some negative effects such as the program developed being implemented and then not able to be followed through within the time or budget available. This would have the following possible impacts;

- Required level of service not met
- Budget being over-spent in order to complete works
- Delays caused by confusion of integrating the plans

These impacts can be avoided by being aware of the possible consequential effects and ensuring the plans are developed with them in mind.

The beneficial effects include budget and time savings through optimised programs.

1.4.2 Risks

There are few risks to health and safety associated with this project. There are some risks involved with the survey of the assets and associated site inspections. There are also some risks to the community if the assets are not maintained to safe levels, this should be covered by the existing service levels, but through investigation and revising programs there is the risk that the asset condition will be, or fall below safe service levels.

Table 4 summarises the risks associated with this project. The total risk is determined using the risk matrix definition from Wikipedia as shown in table 3. The consequences of negligible, marginal, critical and catastrophic are rated against the type of injury, with negligible being minor injury and catastrophic being multiple deaths.

Table 3 – Consequences/Probability Matrix

	Negligible	Marginal	Critical	Catastrophic
Certain	High	High	Extreme	Extreme

Likely	Moderate	High	High	Extreme
Possible	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	Extreme
Rare	Low	Low	Moderate	High

Table 4 - Project Risk Matrix and Summary

Hazard	Consequence	Probability	Total Risk
Field inspection – accident in car	Negligible	Possible	Low
Field inspection – accident on foot	Marginal	Unlikely	Low
Road asset not meeting service level causing traffic accident	Negligible	Rare	Low
Footpath/driveway asset not meeting service level causing pedestrian accident	Marginal	Unlikely	Low
Footpath/driveway asset not meeting service level causing traffic accident	Marginal	Rare	Low

As shown in table 4, all of the hazards are given a low risk rating. Throughout the project the risks will be monitored to minimise the probability of any accident. The asset condition is monitored as it always has been so the risk remains the same as long as the condition doesn't fall below the required service level, assuming the current service level is considered suitable. The field inspection risks are minimised by ensuring all work is carried out to relevant occupational health and safety standards as required by Darwin City Council.

1.5 Summary

This project has the aim of developing an Asset Maintenance Program for the Darwin City Council. One of the main objectives is to integrate the assets as much as possible to optimise the maintenance of the assets. Optimising the programs will allow for budgets to be monitored and work schedules created more effectively. The assets being focussed on are road surface, road pavement, kerb & gutter, footpaths and driveways.

Darwin City Council currently has programs in place for maintaining most of the assets in line with its Asset Management Plan. This project will develop these programs to work alongside each other rather than independently. Reviewing the current survey practices will also be done to ensure all information coming in is relevant and able to be used to create the best maintenance plans.

The end result will be a more developed, efficient and cohesive asset maintenance program for several of Council's assets with recommendations on how to apply the same processes to optimise the maintenance of all Darwin City Council's assets.

2 LITERATURE REVIEW

2.1 Introduction

This chapter summarises the literature reviewed in order to understand the project and how the asset maintenance plans are to be developed.

The following types of documentation were used in the review

- Industry standard manuals and guidelines that are used across Australia to develop asset management plans
- Other local council's asset management plans and programs (to understand how the industry applies the standards)
- Previous projects and theses on asset management
- Darwin City Council documents (strategic plan, asset management plan, policies etc)

The entire literature review is divided roughly into the main topics that follow the initial summary; asset management and asset maintenance and also the areas to be investigated as the programs are developed; service levels, condition surveys and policies and regulations. The technical aspects of the assets were not researched as the current standards are considered adequate for Darwin City Council.

2.2 Review

In terms of Council infrastructure, an asset can be considered to be any physical item that is owned or controlled by Council; it has a value, useful life and contributes to the community as a service. A typical example is a road, it is essential to the community for transport and has an expected life and value that depreciates as the road reaches the end of its useful life. Developing asset management and maintenance plans is essential to ensure that the life of the asset is optimised and the community expectations of the service level are met.

The Merriam-Webster online dictionary defines a program as being "a plan or system under which action may be taken toward a goal" (<http://www.merriam-webster.com/dictionary/program>, accessed 24 May 2009). If the goal is clearly defined then the plan to reach that goal can be developed. For this project the goal is

to have more integration between assets, so the plan is to undertake this literature review and develop the existing programs to reach the final asset maintenance program.

Darwin City Councils Evolving Darwin document clearly defines seven strategies that are linked to all of Council's programs. The seven main strategies are;

- Collaborative Relationships
- Lifestyle
- Connectivity
- Environmental Sustainability
- Cohesive Community
- Branding Darwin
- Governance

These strategies have been developed further into specific goals and outcomes that can be monitored and performance judged against. The strategies are tied to service levels which are then linked to policies that relate to each of the assets. This chapter looks at most aspects of asset management and maintenance, it provides the information that the asset maintenance programs will be developed by. Levels of service, condition surveys and policies provide all of the information required to develop the current maintenance programs at Darwin City Council.

2.2.1 Asset Management

There are many definitions of asset management but for infrastructure it essentially is the management of physical assets to keep them at a required service level. This chapter looks at how the assets are managed from how the asset is defined to its value.

The International Infrastructure Management Manual, 2006 defines asset management as;

"The combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner"

The definition from the Austroads 1997 Strategy for Improving Asset Management Practice (page 4) is;

“Asset management may be defined as a comprehensive and structured approach to the long term management of assets as tools for the efficient and effective delivery of community benefits. The emphasis is on the assets being a means to an end, not an end in themselves.”

Darwin City Council has a comprehensive Asset Management Plan (AMP) that provides a whole-Council approach to managing all of DCCs assets. This project focuses on the civil infrastructure and in particular the roads, kerb & gutter, footpaths and driveways.

In summary, asset management plans are essential for Councils to understand their assets and to be able to ensure they are kept at the required service level and meet the needs of the community.

2.2.2 Asset Maintenance

An asset maintenance plan is essential for being able to control budgets and work schedules. The International Infrastructure Management Manual, 2006 defines a maintenance plan as;

“Collated information, policies and procedures for the optimum maintenance of an asset, or group of assets.”

So in regards to developing an asset maintenance at Darwin City Council, all of the information and policies on assets at DCC will be used to create an asset maintenance program.

At DCC there are policies on footpath and cycleway maintenance that ensures maintenance on the assets are to the communities standards. The footpath construction and reconstruction policy defines when and why a footpath will be constructed, maintained or reconstructed. When maintenance programs are developed the policies currently in place must be conformed to, as these are the service levels the community expects.

Australian standards must also be complied with when maintenance occurs; when an asset is replaced it must be to current standards regardless of its previous construction.

The Program Development and Implementation document which is Part 4 in Austroads Guide to Asset Management considers there to be three types of maintenance activities.

- Routine maintenance – reactive works and secondary maintenance such as road sweeping
- Preventative periodic maintenance – activities to improve/preserve the infrastructure such as road resealing
- Rehabilitation – works to improve the structural integrity of the asset, such as pavement reconstruction

This project will be dealing largely with the second and third types of maintenance, particularly with roads as most pavement works will be rehabilitation and reseal works will be periodic maintenance. The figure below is from the Austroads guide that can be used as a process for program development.

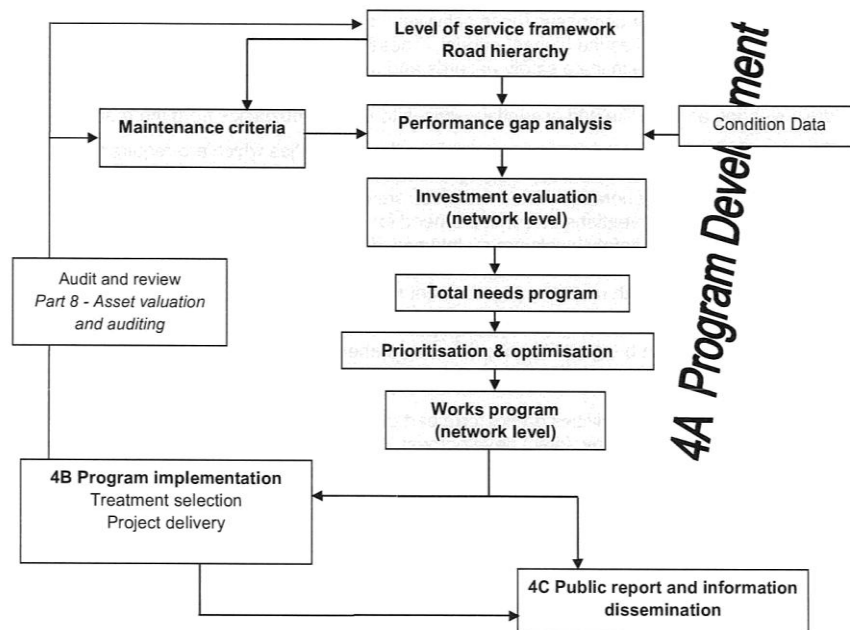


Figure 2.1: Program development and implementation process

Figure 1 - Program Development and Implementation Process

Previous maintenance programs developed at Darwin City Council have been through these stages of development. This project will look at how to develop the programs further, particularly in regards to determining maintenance criteria, prioritisation and optimisation and the final works program.

2.2.3 Condition Surveys

The International Infrastructure Maintenance Manual (IIMM) has a section on Condition Assessment and Performance Monitoring (Section 3.3). It summarises the importance of condition assessment and performance monitoring as;

“Condition and performance information supports decision making and is critical to the management of risks and performance in achieving service standards.”

This section focuses on the collection of condition data which IIMM considers to be essential in determining the need and timing of preventative and remedial maintenance for both service and financial reasons. There are two approaches, core and advanced. The core approach focuses on data collection to manage risks, basic rating systems are used such as the 1-5 system which is discussed further in this chapter. At DCC most assets are rated and managed using the core approach at this stage. The only exception is the road survey which collects data for predictive modelling using dTIMS and is hence the advanced approach.

Section 4.3 of the IIMM, Data Collection/Management looks at the process required to undertake a successful data collection program. It considers there to be 5 levels required to be considered for implementing data capture, they are;

1. Scope – define objectives, confirm asset identification
2. Research – identify data needs, identify existing data, identify collection opportunities and methods
3. Analyse – identify data collection and entry options, assess optimal programme and methods, assess resources
4. Trial – set up and run trial programme, validate and verify, confirm option or review, confirm budget and programmes
5. Implement – document data collection, secure budgets, allocate responsibilities, train staff, collect and enter data, audit process continually

The system at Darwin City Council is currently in the implementation phase but continues with ongoing improvement through research, such as this project, and analysis.

In 2007 IPWEA (Institute of Public Works Engineering Australia) began releasing practice notes to guide Councils with surveying their infrastructure assets. So far there are Practice Notes 1: Footpaths and Cycleways, and Practice Notes 2: Kerb and Channel (Gutter). These practice notes cover level of service requirements, policies, inspections, damage factors, risk assessment and condition rating guidance.

The guidelines recommend different rating systems for each type of asset. The footpaths are recommended to have three levels;

- as new
- some wear and defects, and
- severe defects requiring maintenance

The condition ratings for kerb and gutters are

- as new
- some wear and tear
- some isolated defects that may require minor maintenance
- extensive wear and defects require some replacement
- significant defects over more than 50% of length requiring full replacement of the kerb

Within both practice notes there are several images and specific criteria for each rating of the assets which allows for consistent assessments.

Currently these are the only two practice notes with stormwater, buildings and water & sewerage infrastructure guidelines currently in development. By using these guidelines there can be consistent surveys of assets which are critical for managing the assets successfully. The practice notes available will be used in the development of the survey program and how the information is then used in preparing the maintenance programs.

For the previous surveys of footpaths and driveways a guideline was produced in-house to assist the surveyors in collecting consistent data. The guideline indicated how the asset is recognised per segment and then how and what conditions to be recorded. The following table indicate the options used in the software program to record the condition and information on the asset.

Table 5 - Footpath and Driveway Survey

Footpath	Description
Type	
Width	Metres
Length	Metres
Crossfall	Percentage
Cracking	Metres
Damage	Rating (1-5)
Steplift	Rating (1-5)
Steplift	Millimetres

Edgedrop	Metres
Root Damage	
Urgent Works	Comment
Pram Crossing (1)	Percentage
Pram Crossing (2)	Percentage
Pit Present	Yes/No
Pit Type	Type Selection
Pit Hazard	Comment
Driveway	
Type	
Width	Metres
Length	Metres
Crossfall	Percentage
Cracking	Metres
Damage	Percentage
Steplift	Rating (1-5)
Steplift	Millimetres
Edgedrop	Metres

The footpath condition survey will be updated to be consistent with the IPWEA Practice Notes for Footpaths and Cycleways. The driveway survey will likely remain the same, with some of the footpath practice note details being used as required.

For road surveys a data collection manual was created in 2004 for Darwin City Council by an external company. The manual outlines the fields that are updated for road data, including sealed width, construction ID and materials, segment ID number and the condition data. Some of the principles of the methodology of the type of data collected are;

- The rater collects information, making as few judgements on the road as possible
- The sections are 'short', usually 20-50m long
- The information for the segments will be aggregated by dTIMS, the location referenced pavement modelling system
- Information falls into the categories;
 - Surface defects
 - Pavement defects
 - Riding quality
 - Inventory and condition

The defects, and associated information, recorded on the software in the field surveys are summarised in the table below;

Table 6 - Road Survey

Street	
Surface Type	
Surface Year	
Cracks Present	
Longitudinal Cracking	Extent, Severity, Pumping, Density
Transverse Cracking	Extent, Severity, Pumping, Density
Block Cracking	Extent, Severity, Pumping, Density
Crocodile Cracking	Extent, Severity, Pumping
Crack Patch	Yes/No
Patch	
Pothole	Quantity
Isolated Defect	Type, Urgency
Ravelling	Extent, Severity
Stripping	Extent, Severity
Flushing	Extent, Severity
Proposed Treatment	Year, Type
Road Comments	
Kerb Left Type	
Kerb Left Height	
Kerb Left Condition	
Kerb Right Type	
Kerb Right Height	
Kerb Right Condition	
Kerb Comments	

The technical aspects of determining what these defects are through the use of the Data Collection Manual and also other relevant literature on road defects. For example flushing (a surface defect) is defined in the Data Collection Manual as;

“Flushing is the occurrence of excessive bitumen at the surface of either a spray bituminous chip seal(CS), Asphalt Concrete/Slurry(AC), resulting in a smooth bitumen rich surface”

The Curtin University course handbook for Pavement Design describes flushing as;

“Immersion, partially or completely, of the aggregate into the bituminous binder causing low texture depth and inadequate tyre-to-stone contact.

And finally, the Catalogue of Road Defects from the Research and Development Division of Highways Department (USA) definition;

“Immersion, partially or completely, of the aggregate into the bituminous binder resulting in a black and brilliant aspect”

The following image showing a flushed surface is from the Seal Coat and Surface Treatments, Inspector's Training Manual (USA).



Figure 2 - Flushing Example

So to summarise, flushing is a surface defect that can be described in numerous ways. This applies to all of the defects where the detailed definition of the defect can vary slightly across texts but in the end it's still that particular defect. Where there is any uncertainty the Data Collection Manual compiled for DCC should take precedence as this is the 'base' set of information that all surveyors will use and will ensure consistency across the network for all surveyors.

The condition surveys at Darwin City Council are programmed and organised using the International Infrastructure Manual, and in particular sections 3.3 and 4.3. The newly released Condition Assessment and Asset Performance Guidelines for Footpaths and Cycleways and Kerb and Channel will be used to improve the current surveys, along with revising the existing road survey.

2.2.4 Service Levels

Levels of service, or service levels in regards to infrastructure assets, are the expected standards and condition levels of the particular assets. The IIMM defines Level of Service as;

“The defined service quality for a particular activity (i.e. roading) or service area (i.e. streetlighting) against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability and cost.”

The process of creating levels of service is covered in depth in the Developing Levels of Service and Performance Measures (2007) guidelines. The objectives of the guidelines are to assist organisations in delivering customer value by developing performance measurement framework that has clear service levels linked to the strategic goals of the company. In very broad terms it assists developing exactly what the levels of service for an organisation are.

The guidelines outline the process recommended in achieving the agreed outcome for the organisation, the process steps are;

1. Getting started – understand service level / consultation processes across the organisations, develop a project plan
2. Understand your customers – understand the variety of ways people communicate and different values
3. Document current service levels and performance measures – confirm performance framework, benchmark levels with industry standards
4. Debate options and decide the right service level – develop options that address customer concern or value- add, assess cost impacts
5. Deliver the agreed outcome – adopt levels of service, monitor against performance targets

As part of this process the customers need to be consulted to determine what it is they expect from each asset, this is done in conjunction with steps 2, 3 and 4. The largest part of determining levels of service is understanding the regulations and customer expectations and how they can be applied to the asset. The DCC Corporate Asset Management Plan identifies the need of define the level of service for Council’s assets. The asset management plan intends to match the level of service provided with the expectations of the community, and if they are not met calculate the cost to close the gap. The plan identifies four uses of defined levels of service;

1. Inform the community of the standards they can expect
2. Develop optimised asset management practices
3. Measure performance of practices
4. Identify the costs of performing services

The customer is considered to be all community members including residents, ratepayers, tourists, user groups and other government agencies. As the levels of

service are still currently being developed and the system is still the 'basic' approach (rather than the 'advanced'), the standards are currently based on customer satisfaction and current Council operations.

Section B4 of the Developing Levels of Service and Performance Measures guidelines explores levels of service and performance measures for transportation and pedestrian facilities. It outlines what the customers may be thinking about the asset and how to develop service levels to achieve them. The customer groups are;

- The community
- Road users
- Road occupiers
- Affecting parties
- Internal customers
- Key stakeholder groups

The main groups for DCC are the community and the elected members that represent the community. There are also core customer values that the guidelines consider;

1. Accessibility
2. Affordability
3. Community involvement
4. Customer service
5. Efficiency
6. Fairness/consistency
7. Flexibility
8. Health and safety
9. Integration
10. Quality
11. Reliability
12. Responsiveness
13. Sustainability
14. Whole community benefits

These core values are used to develop the levels of service for a particular asset. The draft levels of service developed by DCC use key performance indicators rather than these core values, the reason is that they are able to be linked to the Council's strategic goals.

There are three drivers recognised in the DCC Asset Management plan;

1. Legislative requirements
2. Strategic and corporate goals

3. Customer requirements

The legislative requirements are included in Appendix D. The strategic goals are those identified in the Evolving Darwin; Strategic Directions: Towards 2020 and beyond. The main item relating to assets is Goal 3: Assist Individuals and the Community Stay Connected with the Darwin Region. Goal 2 has 3 outcomes;

3.1 Promote the use of public spaces

3.2 Enhance transport systems

3.3 Implement and promote use of technology

The outcome relevant to this project and all of the levels of service is outcome 3.2: Enhance transport systems, which has 3 key strategies;

1. Review transport and parking needs
2. Manage and improve the road network and infrastructure to a standard that meets the needs of the community
3. Provide parking facilities and management systems which meet the needs of the community

Finally the customer requirements are not currently defined beyond the complaint records, so feedback is only recorded as it is received; the intention is for extensive consultation to determine the appropriate levels of service.

The 2009/10 city of Darwin Municipal plan has a summary of each program and outlines the basic service levels and key performance indicators for each program. The table below summarises these.

Table 7 - Annual Plan Program Summary

Program Profile	Description	Outputs/ Service Levels	Key Performance Indicators
Roads Maintenance	To manage and maintain road infrastructure to provide an efficient, safe and affordable asset in accordance with Council's provisions and maintenance policies	• Monitor roads for maintenance needs, including preventative maintenance • Overlay, reseal and repair roads • Monitor and replace signage along roadways – Regulatory within 24 hours, Other – within one month • Potholes – Urgent – 24 hours, Other – within one month • Linemarking – refreshment intervals outlined from 2 years to 5 years dependant on hierarchy of road	Community satisfaction rating with the standard of road maintenance > 4

Pathways	The provision and maintenance of safe and adequate footpaths, walkways and cycleways that are affordable and satisfy the needs of the community including those with disabilities. To provide equal access /to all Council facilities for all of the community.	• Monitor the condition of footpaths, driveways, cyclepaths and walkways throughout the municipality • Construct, reconstruct and maintain these pathways as required • Cyclepath sweeping – fortnightly cycle walkway patrols 8-12 week cycle • High pressure cleaning of footpath to remove mould – on complaint basis • Reactive repairs to damage primarily caused by tree roots • Reactive repairs to cyclepaths, driveways and walkways • Response times – make safe – 24 hours (safety), make good – 1 week (urgent), make good – 1 month (non urgent)	Community satisfaction rating with the standard of footpaths/cycle paths > 4
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These service levels are not very specific to the individual assets, such as what exactly constitutes a safety issue. DCC has other service levels but they are not complete at this point in time. The tables below are the draft service levels.

Table 8 - Pathways Service Levels

Key Performance Indicator	Level Of Service	Specific Performance Measure	Performance Measurement Process
<i>Safety / Legislative Requirement</i>	To ensure the network complies with relevant standards	<=5 complaints / asset / quarter	Customer service centre reports (CAR)
<i>Cost Effectiveness</i>	To provide the required services in the most cost effective manner	Maintenance costs as a percentage of replacement value (to be determined once maintenance history is available)	Annual summary of work order data
		Maintenance cost per Km (to be determined once maintenance history is available)	Annual summary of work order data
<i>Customer Satisfaction</i>	To ensure the services provided meet user requirements	85% customer satisfaction	Conduct annual customer surveys

<i>Physical Condition</i>	The network will meet a prescribed condition	Intervention level not to exceed 4 (poor) (on a scale from 1 to 5. 1 being new 5 being inoperable). This score is the average for the single asset, however if any individual components score 4 it defaults this score to the individual asset.	Condition assessment of pathway network
<i>Response Time</i>	To provide repairs which meet user requirements in terms of responsiveness	Response 1 hour Make good - 1 day (safety) Make good - 1 week (urgent) Make good - 1 month (non urgent)	Customer service center reports (CAR)
<i>Functional Suitability</i>	To provide infrastructure that is constructed to suit the local environment including dimensions	Cycleways are constructed from concrete if trees are not in the immediate area. If trees are obstructive then construction is asphalt Footpaths are constructed from concrete. If trees are an obstruction then root barriers are utilised	Pre budget / planning meeting report

Table 9 - Road Service Levels

Key Performance Indicator	Level Of Service	Specific Performance Measure	Performance Measurement Process
<i>Safety / Legislative Requirement</i>	To ensure the road network complies with relevant standards(as per street classifications)	<= 3 accidents in 3 years at the same location	Yearly accident statistics (NT government) and local knowledge
		<=15 complaints / year / road	Customer service centre reports (CAR)
<i>Cost Effectiveness</i>	To provide the required services in the most cost effective manner	Maintenance costs as a percentage of replacement value (to be determined once maintenance history is available)	Annual summary of work order data
		Maintenance cost per Km (to be determined once maintenance history is available)	Annual summary of work order data
<i>Customer Satisfaction</i>	To ensure the services provided meet Road user requirements	85% customer satisfaction	Conduct annual customer surveys

<i>Physical Condition</i>	The road network will meet a prescribed condition	Intervention level not to exceed 4 (poor) (on a scale from 1 to 5. 1 being new 5 being inoperable). This score is the average for the single asset, however if any individual components score 4 it defaults this score to the individual asset.	Condition assessment of road network
		Other surface (eg manhole) to seal difference shall not exceed 20mm.	Visual inspection upon request / complaint
		Line marking / reflectors (minimum standards for types of roads (access, collection, etc) see separate road design guidelines	Visual inspection upon request / complaint
<i>Response Time</i>	To provide repairs which meet user requirements in terms of responsiveness	Response 1 hour (taken from when the responsible officer receives notification) Make good - 1 day (safety) Make good - 1 week (urgent) Make good - 1 month (non urgent)	Customer service centre reports (CAR)
<i>Capacity / Demand</i>	To ensure road intersections provide for minimum traffic delays	<3 complaints / year	Customer service centre reports (CAR)

These levels of service are not currently in use for performance monitoring but the basics that they work off are in place, as shown in the annual plan previously. There are few other materials available on service levels as each community has its own expectations. The Shire of Busselton in Western Australia also has draft levels of service. They have two levels of service tables for each of the paths and roads assets, they cover community and technical/operational levels of service. The following are images from the Path Asset Management Plan and Road Asset Management Plan for community levels of service for paths and operational levels for roads.

Key Performance Indicator	Level of Service	Performance Measurement Process	Target Performance	Current Performance	Actions to meet performance target	Resources Required
Connection	Limit number of dead end paths	Qty of paths with no connection	5% reduction per year	Not measured	Develop strategic plan	Not measured
Condition	Removal of overhanging trees and shrubs, rubbish and graffiti	Quantity of complaints received	5% reduction per year	Not measured	Reduce by regular inspections	Not measured
Width	Width is suitable for volume and type of users	Quantity of complaints received	Not measured	Not measured		
Safety	Average Number of accidents per kilometre of path over 5 year period	Insurance claims received by the Shire	Not measured	Not measured	Reduce trip hazards by regular inspections.	Not measured

Figure 3 - Shire of Busselton Draft Community Levels of Service

Key Performance Indicator	Level of Service	Performance Measurement Process	Target Performance	Current Performance	Actions to meet performance target	Resources Required
Condition	Surface Roughness (NAASRA Counts)	Condition Survey every 4 years	Primary - <200 District - <220 Local - <230	0.00 Kms 0.30 Kms 1.63 kms	Target rough roads in annual works program	Allocation in Road Program
Responsiveness	Compliance with target response times	% of requests addressed within timeframes	90% within 7 days	Not measured	Not measured	Not measured
Performance	Inspections to locate faults	Frequency of program	Primary - Weekly District - Monthly Local - Annually	Not measured	Not measured	Not measured
Design and Capacity	Width of Road surface	% of network meeting requirement	Primary - Dual Carriageway District - 7.2m Local Sealed- 5.9m Local Gravel- Traffic <100 AADT	0.00 Kms 0.20 Kms 1.34 Kms 2.60 Kms	Not measured	Not measured

Figure 4 - Shire of Busselton Draft Operational Levels of Service

The Shire of Busselton levels of service are similar to the Darwin City Council draft ones. Neither levels of service look at the specific condition of the individual asset, such as what constitutes a trip hazard. A service level manual template has been developed by ACEAM (asset management practitioners). The manual illustrates technical levels of service to a higher level of detail. The figure below is taken from the surface patching section of the manual.

This project does not focus on developing the levels of service but recommendations will be made on improving them so that they are reflected in the maintenance programs developed.

SERVICE ACTIVITY - Maintenance Surface Patching of sealed roads to keep safe**ROADS**

Sub-Activities	Intervention Level *	Repair Activities	Response Times	
Hot-mix surface patch	Failed area exhibiting minor deformation (level 1 or 2) and moderate severity crocodile cracking (level 3). Area <100 sqm in an asset segment.	Patch existing surface with hot-mix. (ACEAM #)	Arterials	7d
			Collectors	10d
			Locals	20d
Pot-hole patch	Failed surface pot-hole, isolated in location, >300mm diameter / 50mm deep.	Patch existing surface with hot-mix. (ACEAM #)	Mini-locals	30d

Figure 5 - ACEAM Maintenance Surface Patching Service Level Template

2.2.5 Policies and Regulation

Darwin City Council has several policies that relate to the assets being researched in this project. They are;

- Driveways (policy number 133)
- Road Standards (policy number 277)
- Footpath Construction and Reconstruction (policy number 154)
- Footpath Maintenance (policy number 157)

These policies are included in appendices E, F, G and H respectively.

The other city councils within the Northern Territory do not have policies on driveways, footpaths or roads. For comparison some policies from Queensland and Western Australia were used where appropriate. These states were focussed on due to their close proximity to the Northern Territory; the northern areas of the states were used where possible. Asset management policies from other councils were also researched and are discussed in the relevant section.

The Darwin City Council Subdivisional Guidelines (2005) are used for the technical standards for all new developments; the specific details are explored further in the relevant chapters. The sections used from the guidelines will be Part 3: Design

Requirements. The new draft subdivisional guidelines will also be referred to as required to ensure that programs meet the future guideline standards.

Territory and state regulations also play a part in governing how assets are maintained, as it is the relevant Minister that has the overall control of the roads. In the Northern Territory the Local Government Act and Control of Roads Act are relevant to infrastructure and there are similar acts and regulations in other states and territories.

The policies and regulations (where necessary) for each of the assets to be researched in the project are outlined in the following sections.

2.2.5.1 Roads

The Local Government Act (NT), part 12.3, defines a road as;

“(a) land vested in a council at the commencement of this Act as a road or a road reserve; and

(b) land vested in, or placed under the care control and management of, a council as a road or a road reserve, after the commencement of this Act, under this or some other Act; and

(c) land reserved, dedicated or resumed, with the council's agreement, as a public street, road or thoroughfare; and Chapter 12 Council property Part 12.3 Roads Local Government Act 93

(d) land transferred to the council in fee simple, and accepted by the council, as a public road; and

(e) land declared by the council, by Gazette notice, to be a road with the consent of the owner of the land; and

(f) land vested in the council, with the council's agreement, by notice under subsection (2).”

This can be summarised as meaning that a road is any portion of land that is under the care or control of Council as a road or road reserve. The Minister has the final control over all roads as part of the Control of Roads Act, which defines the road as;

“all streets, roads, courts, alleys, thoroughfares and culs-de-sac which were, immediately before the date when this Act comes into operation, public

streets, roads, courts, alleys, thoroughfares, or culs-de-sac within the meaning of any law then in force in the Northern Territory;"

The control The Minister has over the roads is defined in section three (III) of the Act, General Powers of Minister;

"The Minister may form, pave, drain, level and repair roads and footpaths, alter the levels of roads and footpaths, erect or construct bridges, culverts, water-tables, kerbs, gutters, lamps, direction boards, kilometre posts, rails, posts, walls, chains and fences, erect or build, or cause to be erected or built, a house or other building, verandah, structure or road side facility on or at the side of a road and may drain water from roads into or through adjacent land."

This gives The Minister the final control over the design and construction of any road and associated infrastructure. They also have the power to open, alter, and temporarily and permanently close roads. So for Darwin City Council, the Council has the control of the roads but they must remain within the land allocated and not be permanently closed without Ministerial approval. Section 186 from Part 12.3 of the Local Government Act defines the control a Council has over roads; the following are a couple of points from it;

"(1) Subject to this section, all roads within an area are under the care, control and management of the council.

(2) After consulting with a council, the Minister may, by Gazette notice withdraw a road from the care, control and management of the council and place it under the care control and management of the Territory.

(5) While a road remains under the care, control and management of a council, the following belongs to the council:

(a) all vegetation growing on the road;

(b) anything erected on, or affixed to, the road except infrastructure or equipment belonging to the Commonwealth or the Territory or a statutory authority of the Commonwealth or the Territory."

Darwin City Council has a policy relating to the maintenance and management of road assets. It briefly states that Council will determine maintenance standards, the standards will be determined from Council's levels of service and that pavement and maintenance management systems will be developed to record data and plan maintenance. The policy was initially adopted in 1997 and then reviewed in 2007, the new Asset Management Plan covers everything within the policy with more detail.

2.2.5.2 Footpaths

A footpath is the part of the verge formalised for pedestrian use. At Darwin City Council footpaths are paved and generally constructed of asphalt or concrete and are nominally 1.2m wide. There are two Council policies that relate to footpaths at DCC. The first is the Footpaths Maintenance Policy that was adopted in 1997. The entire policy is;

“The future priority for footpath maintenance and reconstruction will be directed towards addressing hazardous footpaths or sections of footpaths in the areas of greatest pedestrian use.

Priorities will be assigned following the annual assessment of the footpath condition survey.”

This is a very basic overview of how Council deals with maintaining and reconstructing existing footpaths. The Footpath Construction and Reconstruction Policy is a much more informative policy introduced in 2000. Its purpose is to provide guidance to Government, developers and the residents to footpath requirements, standards and priorities for reconstruction. The following is outlined within the policy;

- An obsolete footpath is an existing footpath where it is no longer considered necessary as another footpath exists and is being maintained on the other side of the road. These footpaths are often left to deteriorate and are able to be removed by residents. However, when still in place they are maintained to a minimal level for safety reasons.
- New footpath construction is prioritised by road hierarchy, planning zones and special needs.
- Reconstruction prioritised by road hierarchy, planning zones, special needs and existing footpath condition.
- For all new and existing roads the footpath requirements are;
 - Local roads - footpath on one side of road
 - Collector roads and above – footpath both sides
 - In addition to the above, footpaths are also required on
 - Medium-high residential housing side of road
 - Commercial, special use, industrial and community use side of road
 - On the side of the road where a special need is identified
- Footpaths are to be designed to Austroads Guide to Traffic Engineering Practice, Part 13 and Council’s Standard Drawings, this ensures they meet all Australian Standards Requirements.

- The process of advising residents of the construction and reconstruction program (currently under review)

Several similar policies were found for other Councils, such as the City of Charles Sturt, City of Swan, Kwinana City Council and a draft policy from Brisbane City Council. Most policies are very similar to the Darwin one with what they are outlining, the main difference is the way the priorities are decided. The City of Charles Sturt and the City of Swan both prioritise roads by the number of vehicles per day/week that use the road. For the City of Swan they also have a range of recommended minimum widths that are dependent on the type of road and also location of the footpath within the verge, their widths are a minimum of 1.5m can be located on the property boundary, back of kerb or mid-verge. The draft Brisbane City Council policy also provides a table for the appropriate width of footpath relative to land use and road hierarchy, the figure below is an extract from the table in the Policy.

Road Hierarchy → ↓ Land Use					
	Local Access	Neighbourhood Access	District Access	Suburban Route	Arterial Route
Residential Areas					
Low Density, Low-Medium Density & Character	-	1.2 ³	1.2	1.5	1.8 ²
Medium Density & High Density	1.2	1.2	1.5	1.8 ²	1.8 ²
Centres					
Convenience	1.5 ²	1.8 ²	Full ¹	Full ¹	Full ¹
Suburban	1.8 ^{2,4}	1.8 ²	Full ¹	Full ¹	Full ¹
Major	1.8 ^{2,4}	1.8 ^{2,4}	Full ¹	Full ¹	Full ¹
City	Full	Full	Full	Full	Full
Industrial Areas	1.2	1.2	1.2	1.5	1.8

Figure 6 - Brisbane City Council - Guidelines for Footpath Width Selection

Darwin City Council's footpath construction and reconstruction policy outlines how and why footpaths are reconstructed and constructed. As all footpaths are constructed to the same width within the Darwin municipality, tables such as the Brisbane City

Council one for widths are not necessary. The criteria for prioritisation are very similar to other Councils' policies where road hierarchy is an important factor, along with special requirements for an area. Levels of service are not considered in either of the DCC's footpath policies, the footpath maintenance policy may need to be rewritten to included levels of service being a criterion for maintenance. The Council policies must be adhered to for all maintenance activities and future programming. The footpath construction and reconstruction policy will be used as the footpath program is developed.

2.2.5.3 Driveways

A driveway is a formalised access that connects a road to a property, in other municipalities it can also be referred to as a crossover.

The DCC driveway policy states that;

“Council will maintain a single driveway to each and every driveway within the Municipality.”

It then goes on to outline the minimum requirements for driveways such as residential properties zoned R1 and R2 will have a maintained 3m wide driveway. Properties zoned I1 and R3 are entitled to a 4.5m wide driveway and I2, I3 and R4 zoned properties have 6m wide driveways. The next part of the policy is in regards to repairs, where if a driveway is considered less than 50% serviceable then it is replaced, if it is greater than 50% serviceable then only minor repairs are undertaken. In the case of existing asphalt driveways, if it is greater than 50% serviceable the owner may request for it to be replaced with concrete and pay a percentage of the cost, equivalent to the percentage serviceability of the driveway. The policy also refers to the Council's standard drawings for driveways (DCC-103) and also states that the Director of Technical Services (now General Manager of Infrastructure) may approve non-conforming materials and widths at their discretion.

The Shire of Wyndam East Kimberley does not have a policy on driveways but does have fact sheets that outline the specifications required of driveways. They also indicate that in order to meet statutory requirements and in particular the Local Government (Uniform Local Provisions) Regulations 1996 (Western Australia), the council is obliged to pay 50% of the cost of the first crossover to a property, or a crossover that meets or is above the standard crossover requirements.

The City of Stirling in Western Australia has a crossovers policy that also outlines the standards of construction and also the regulation of contributing to 50% of the cost of the driveway as long as it is constructed to their standards and with the appropriate approvals.

From the research undertaken it was found that maintaining driveways to properties was a Northern Territory practice. Western Australia, under the Local Government (Uniform Local Provisions) Regulations 1996 contributes to the cost of a driveway, in Queensland no costs are covered and in both cases the driveways must be constructed to the relevant standards.

The Darwin City Council policy on Driveways clearly outlines how a driveway will be maintained and the technical drawings illustrate how a driveway will be constructed. Knowing this is essential in planning for replacement and maintenance activities. The DCC policy will be used in the driveway replacement program development.

2.2.5.4 Asset Management

Darwin City Council does not current have an Asset Management Policy. The shire or Townsville does, it records the Council's commitment to manage Council assets with best practice. The areas outlined are the responsibilities of sections, definitions and the Council's commitments. The specific assets are not discussed but it does ensure that Council adopts a 'bigger picture' approach to managing assets. Some of the commitments include (from the policy);

- To develop clearly defined Levels of Service after consultation with the Community;
- To maintaining a long term financial plane which demonstrates that the full costs of an asset are borne equitable by all users (including future users) of the asset;
- To adopt best practice asset management techniques.

The City of Charles Sturt has an Asset Management Policy that sets the 'broad framework for implementing consistent asset management processes throughout the City of Charles Sturt.' It indicates the aims of the policy, the responsibilities of offices and how the policy outcome should be achieved. The Asset Management Plan adopted by Darwin City Council does cover these issues, just not as specific and concise as an asset management policy, such as the ones researched.

As part of the Local Government Act, Part 3, requires Council's to have a regional management plan and a municipal or shire plan. For Darwin City Council this means they have a management plan as part of Region 1 which includes the surrounding areas such as the City of Palmerston and Litchfield Town Council. Section 23, Contents of municipal or shire plan, from Part 3.2 Municipal or Shire Plans from the Local Government Act (point (1) only);

“(1) A municipal or shire plan:

(a) must contain:

(i) a service delivery plan for the period to which the municipal or shire plan relates prepared in accordance with planning requirements specified in a relevant regional management plan; and

(ii) the council's budget; and

(b) must contain, or incorporate by reference:

(i) any long-term community or strategic plans adopted by the council or a local board and relevant to the period to which the municipal or shire plan relates; and

(ii) the council's long-term financial plan; and

(c) must contain, or incorporate by reference, the council's most recent assessment of:

(i) the adequacy of constitutional arrangements presently in force for the council under this Act and, in particular, whether they provide the most effective possible representation for the area; and

(ii) the opportunities and challenges for local government service delivery in the council's area; and

(iii) possible changes to the administrative and regulatory framework for delivering local government services in the council's area over the period to which the plan relates; and

(iv) whether possibilities exist for improving local government service delivery by cooperation with other councils, or with government agencies or other organisations; and

(d) must define indicators for judging the standard of its performance.”

This plan must be sent to the Agency (department responsible for administration of the act) annually, it must also be published in draft form for public comment. The 2009/10 City of Darwin Municipal Plan has the following programs that relate to asset management and infrastructure;

- Asset Management
- Operations
- Pathways
- Road Maintenance
- Infrastructure Projects

The program profiles summarise the responsible officer, resources associated with it, related strategic goals and outcomes, service levels and the budget allocated. This provides a good guideline of how each asset will be resourced and an overview of the service levels. It does not however, specify how the assets will be maintained.

Darwin City Council currently does not have an asset management policy but does have an asset management plan that details the methods of managing Council's assets. The 2009/10 City of Darwin Municipal Plan provides information on the budget allocations on the programs, as required by the Local Government Act.

2.3 Summary

The information gathered in the literature review is essential in being able to continue with the development of asset maintenance programs at Darwin City Council. By understanding what asset management and maintenance is and to what standards the assets must be kept at, the program can be developed to meet these requirements.

Using industry standards and guidelines means that the program will be relevant to today's standards. In particular the International Infrastructure Maintenance Manual (2006) guides how Councils develop asset management Programs. The recently developed Condition Assessment and Asset Performance Guidelines for Kerb & Gutter and Footpaths are particularly useful in performing condition surveys on the assets. They ensure that assessment is consistent across all Councils that utilise the guidelines for condition surveys and that the surveys are carried out in the most effective way.

Most Council's have developed asset management policies and procedures that provide an overview into the aims of asset management in their respective Council. Many of the larger Councils have also developed asset management plans that define

how their assets are to be maintained or how their maintenance programs are developed.

Through the use of this research the Darwin City Council maintenance programs can be developed in the most optimal way. This also relates to the survey practices at Darwin City Council as they will be improved to meet the industry standards and provide all of the information to create the most effective asset maintenance programs.

2.4 Outline

The methodology of the project is summarised in the list below and also on the brainstorming chart (Appendix 2). The project methodology is divided into four main sections; research, analysis, development and review.

- Research
 - Asset management requirements through industry guidelines and past research projects
 - Plans and programs developed by other Councils and organisations
- Analysis
 - Analyse current asset maintenance programs and surveys at DCC
 - Determine what aspects of the information gained from research can be used to improve DCC programs
- Development
 - Identify what aspects of programs and surveys are to be improved
 - Develop plan for future surveys and carry out any interim surveys required for program development
 - Develop maintenance program
- Review
 - Review programs developed and any provide recommendations further improvements for future program

These general tasks are used in the timeline section (3.3) as a guide to ensure the project is proceeding as planned. By using this methodology the project has specific targets to be aim for and be achieved. Much of the first section, the research section, has essentially been covered with the literature review.

2.5 Resources

The resources likely to be required for undertaking this project are

- various literature as available within DCC, libraries and on the internet
- time spent with DCC staff members discussing programs and the project
- general resources of technology from home and at work (DCC)

Most Council's throughout Australia have some form of asset management plan, either for specific assets such as roads, or for procedures on how assets are managed. These have, as recognised in the literature review and will, be accessed as required.

There are several main sources of literature and knowledge used in asset management in Australia. The Institute of Public Works Engineering Australia (IPWEA) and Austroads both produce publications on asset maintenance and management. There are also Australian Standards that relate to asset management in regards to valuations and condition of the specific assets and how they are to be constructed.

The actual maintenance of the assets is also a resource that needs to be considered. As this plan will only be implemented in the following financial year, the changes won't be as significant as to detrimentally impact on Council's resources, as identified in the consequences section (1.4.1). These resources are not required in the actual project but do need to be considered with the program being developed.

The resource requirements for this project are primarily in time and literature, both may be restrictive at times, but can be worked around and won't prevent the project from being completed.

3 ASSET OVERVIEW

3.1 Summary

This chapter is an overview of what the assets are, including the technical information and data already collected. The surveys and programs are covered in chapters 4 and 5 respectively.

There are over 420 kilometres of roads that Darwin City Council controls maintains. This represents 29 percent of the 2008 total asset replacement value, equivalent to over \$191 million (from Corporate Asset Management Plan, DCC, 2009, page 16). As roads are the second largest asset class in value, with stormwater being the largest, it is vital that the condition is monitored and maintained to a suitable level. As part of the DCC asset hierarchy the 'Roads' asset includes every asset within the road reserve, as shown in the figure below (from Project 2, Asset Management Improvement Program).

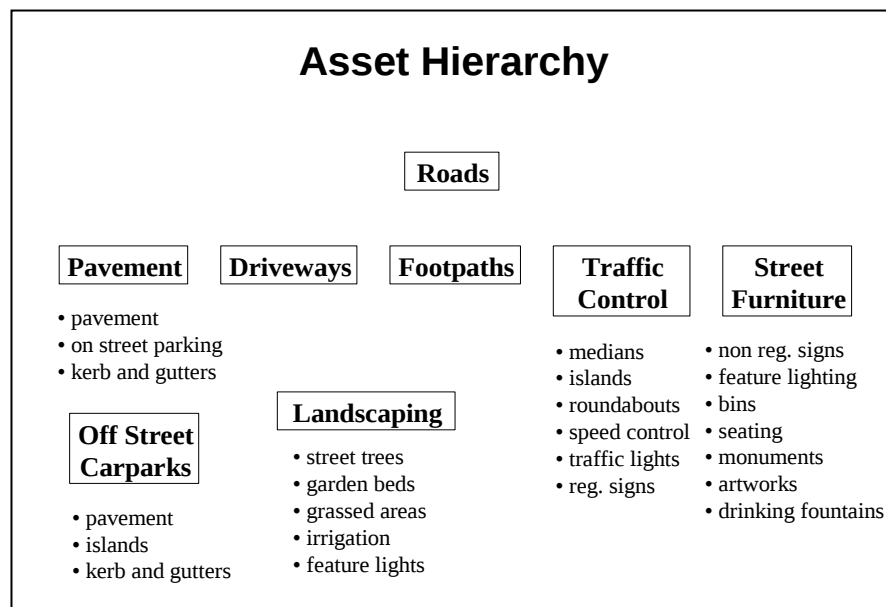


Figure 7 - Road Asset Hierarchy

For this project, roads will be considered to be from kerb to kerb, which includes the kerb (and gutter), road pavement and road surface. Each asset class is separated into segments, for roads this is measured along the centreline of the road between

intersections, with one intersection being designated the start, and the other the end. The other assets of driveways and footpaths are looked at in the following section of this project.

The cross section applies to all newly constructed roads and a large percentage of older roads. Older roads (constructed pre-2000) generally have the traditional kerb and gutter, with newer roads being constructed with layback kerbs. The length, condition and value of kerb and gutter is currently unknown, but there is assumed to be over 700 kilometres of kerb and gutter within the road network.

Unlike kerb and gutter the condition of the road network has been recorded in surveys conducted in the last 8-10 years. Some of the data obtained from previous surveys are not entirely consistent with the actual condition, mainly due to a camera survey being undertaken initially. The current data will be discussed further with each asset type.

Footpaths and driveways are considered to be part of the 'roads' asset in the hierarchy report mentioned in the previous section. This has been changed by the Asset team at Darwin City Council so they now come under the 'pathways' hierarchy with walkways and cycle paths. There are over 360 kilometres of footpath and 18,000 driveways maintained by Council, so by having an understanding of their current condition programs can be developed to ensure they meet the required levels of service.

Wherever a footpath is constructed on a local urban street they will intersect the driveways. Data is collected for these assets by segments, where each property boundary has a length of footpath and a driveway. The length of footpath within the driveway is considered to be the driveway asset and is excluded from the length of the footpath.

3.2 Technical Information

3.2.1 Road Surface

The illustration below indicates the general typical cross-section of a road within the Darwin municipality (from DCC-101 Standard Drawings, Road Reserve – Typical Cross Sections).

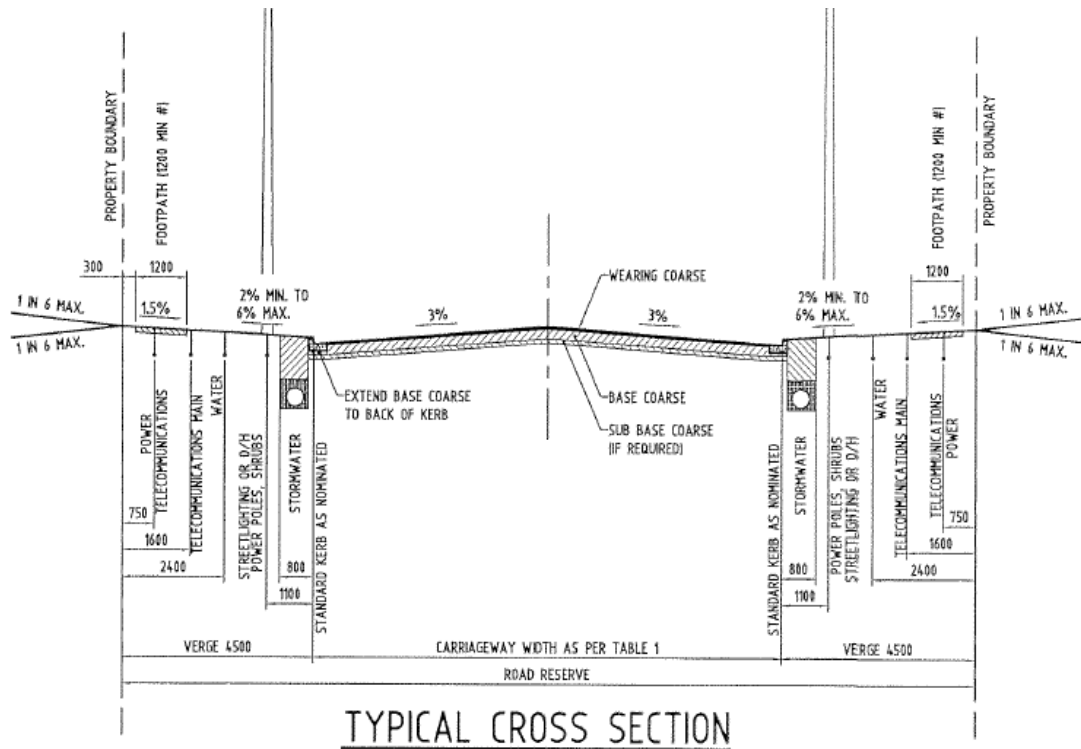


Figure 8 - DCC Typical Cross Section

For road surface it is just the wearing course that is of interest. The types of surfaces recorded in the Darwin City Council are chip seal, asphalt, concrete and brick pavers.

Asphalt is the wearing course for the all new pavements within the urban areas of the municipality, as per the DCC subdivisional guidelines. The guidelines (Part 3: Design Requirements) specify a minimum compacted thickness of asphalt of 25mm over a primer seal. The asphalt must also comply with the type 2 mix standard (from the Department of Infrastructure. Part 4 of the guidelines, Construction Requirements details what primer seal is to be used and the technical data for the asphalt. In some cases chip seal may be approved in which case the specifications are in the guidelines.

For maintenance most surfaces have a chip seal applied over the existing surface which will either be asphalt or a previous chip seal. In the CBD (central business district) the preferred treatment is asphalt overlay, or removal of the existing surface and replacing with new asphalt, this is for a variety of reasons such as ride quality, amenity and cleanliness of construction. The following table outlines what primer chip seal and asphalt surfaces are and the situations they are used in for maintenance activities. For both surfaces C170 bitumen is used as this is all that is readily available in the Northern Territory.

Table 10 - Chip Seal and Asphalt Descriptions

Treatment	Description	Uses
Chip Seal	- Hot bitumen binder sprayed thinly and evenly onto prepared surface then aggregate (7mm or 10mm usually) layered over and rolled into the bitumen until it cools and 'holds' aggregate in place. - Provides a waterproof seal over the previous surface which may be asphalt or existing chip seal. - A rubber additive is often used in the bitumen to improve the performance of the bitumen. 7mm aggregate used for most local roads 10mm aggregate used for higher-trafficked roads and industrial areas - Design life of 12-15 years - Approximately \$5/m²	- Surfacing new surfaces as a primer seal for asphalt - Resurfacing existing asphalt or chip seal surfaces. - Not suitable for surfaces where surface correction required - Not suitable for high turning movement areas, such as cul-de-sac bell-ends - Occasionally used over a geo-fabric layer to prevent reflective cracking
Asphalt	- Dense graded hot-mix asphalt with 10mm aggregate - Premixed bitumen and aggregate is heated and then placed onto a prepared surface at 25mm+ thickness where is rolled and compacted until it's cool and hardened. - Usually placement is by a paving machine that provides a level surface, for smaller areas hand-work is used to place the asphalt. - Design life of 25-30 years - Approximately \$30/m²	- Used for new surfaces or as a resurface - Where kerb height is a problem or existing surface has significant shape defects then existing surface is profiled out and then new asphalt placed - Used in cul-de-sac bell-ends - Used in CBD - Used for patching smaller areas as part of general maintenance - Occasionally used in thicker layers to replace deteriorated pavement

Depending on the size of the maintenance the works are carried out in-house using DCC crews for smaller jobs and contracted out for larger repairs and the resurfacing program. The programs chapter discusses this further.

3.2.2 Road Pavement

Road pavement is required to be built with a design life of 40 years (DCC Subdivisional Guidelines) and are considered to have a useful life of 70 years. Pavement within the general urban areas are constructed with basecourse over prepared sub-grade. A

sub-basecourse will be constructed where necessary, such as on high traffic volume roads, or where there are poor quality underlying materials. Most existing pavements have been constructed with 150mm each of prepared sub-grade and 150mm basecourse. Recently more pavements have been constructed with concrete or deep-lift asphalt.

The basecourse will generally be either fine-crushed rock (road base) or cement stabilised gravel with 2-3% cement. The gravel properties conform to mix type 2 as specified in the Department of Planning and Infrastructure's technical specifications. Recycling of pavements is also done where-ever possible, particularly using the existing pavement to improve the subgrade.

Repairs on sections of roadway are generally done with cement stabilised gravel or deep-lift asphalt. Larger areas, such as full-width pavement are contracted out and are constructed with either cement stabilised gravel or road base.

3.2.3 Kerb and Gutter

Below is a sample of some of the typical kerb and gutter types within the Darwin City Council road network, taken from DCC-102 Kerbing Details.

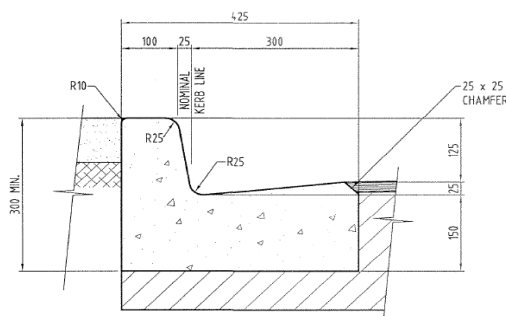


Figure 9 - Typical Kerb and Gutter Design

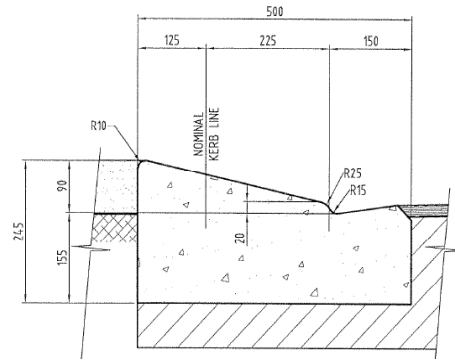


Figure 10 - Typical Layback Kerb Design

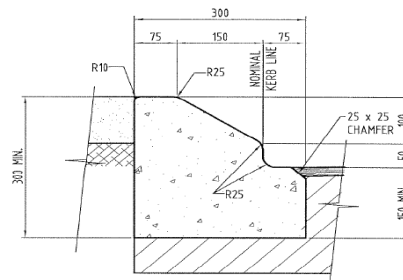


Figure 11 - Typical Semi-Mountable Kerb Only Design

3.2.4 Footpaths

A footpath is considered to be a pathway constructed of concrete or asphalt that is no greater than 2.5 metres wide (except in the CBD) and is situated adjacent to a road. The illustration below is from DCC's standard drawings (DCC-104 Footpath).

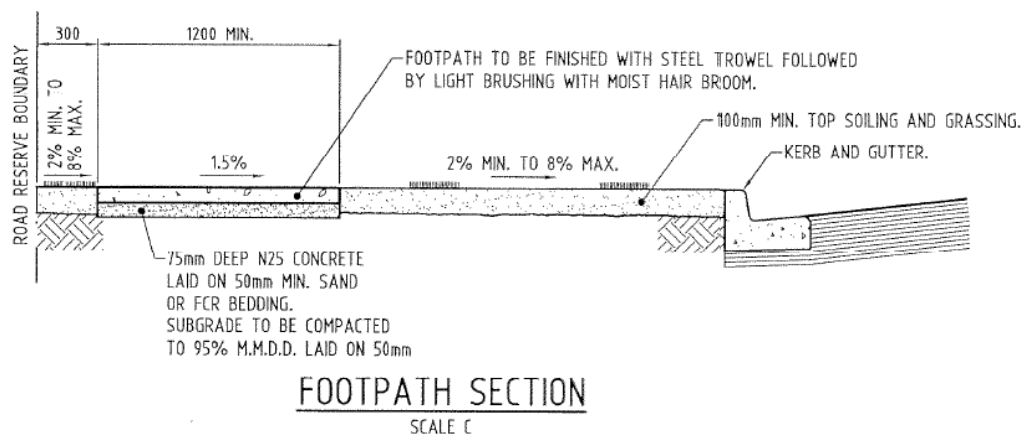


Figure 12 - Standard Footpath Cross Section

Concrete footpaths are constructed 75mm thick and 25MPa strength on a sand base and prepared subgrade. The finish for local streets is plain concrete with broom finish, in the CBD the standard is a specific exposed aggregate mix for the full width of the road reserve. Private contractors and builders may use stencilled concrete or exposed aggregate as approved and in accordance with Council's footpath policies.

Footpaths are designed to be constructed 300mm from the adjacent property boundary and have a crossfall of 1.5% ($\pm 0.5\%$) to meet disability access requirements. Where a property boundary is a solid wall or fence then the footpath is constructed to the boundary and hence becomes 1.5m wide. The remainder of the verge is then matched to the footpath levels. In situations where there is established vegetation on the verge the footpath can be re-aligned to a more suitable location in the verge, this may mean in some situations the footpath is constructed behind the kerb.

One area of difficulty is constructing new footpaths in already established streets where the driveways have not been constructed to contain a footpath. The driveway can fall to the road can be up to 6% (or more in some cases) which means if the entire driveway is this steep, retrofitting a footpath near the property boundary is a difficult task. In these situations the up to 2m of the driveway is removed to match the levels of the footpath with the existing driveway. Where the difference in levels are too great or the driveway is fairly damaged then the driveway will be reconstructed in conjunction with the footpath. Identifying driveways for reconstruction are a large part of the program development for footpaths.

3.2.5 Driveways

A driveway is a concrete or asphalt property access that is constructed from behind the kerb to the property boundary and has a width of 3 to 6 metres. The illustration below is from DCC's standard drawings (DCC-103 Driveway).

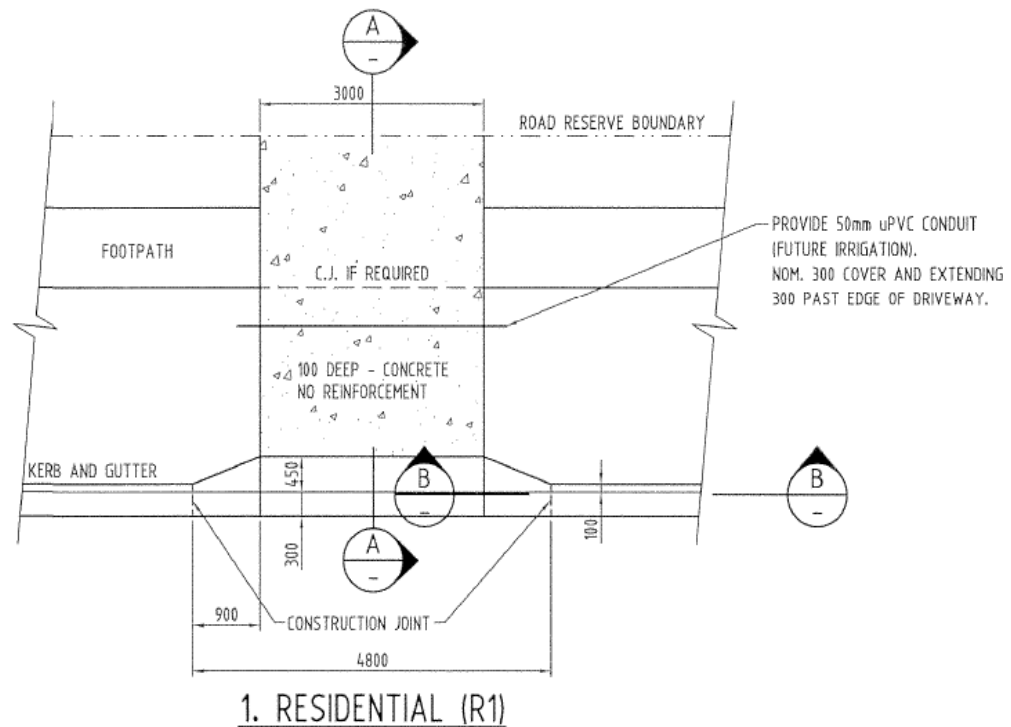


Figure 13 - Standard Residential Driveway Plan Design

New driveways in residential areas are required to be broom finish plain concrete with a minimum thickness of 100mm, for industrial areas the thickness increases to 150mm and steel reinforcing mesh is used. This is the standard Council constructs driveways to, where an owner/builder has obtained a permit to construct a driveway they can will often use reinforcing mesh and/or use different finishes (such as exposed aggregate). Prior to about 1980 driveways were generally constructed with 25mm thick asphalt, these driveways are now starting to reach the end of their useful life and take up a large part of the driveway replacement budget.

Driveway widths range from the minimum 3m that Council will maintain to a maximum of 6m for multiple dwelling driveways (such as apartments). If a property owner requests a driveway wider than the standard 3m the request is generally granted where possible with the owner paying for the cost of the additional width. How the asset is calculated for replacement is not clear as Council policy is only to provide a 3m access where the average driveway width is actually 3.9m.

The fall of the driveway is to be constructed as per the drawing specifications shown in the image below.

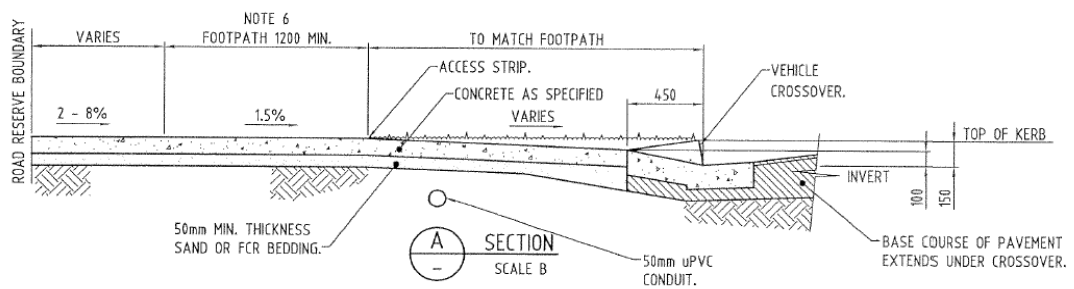


Figure 14 - Driveway Cross-Section Standard

As can be seen the driveway needs to match into the existing footpath. The typical road cross section details (figure above) show that the verge fall to the road should be between 2 and 6 percent. Although this is recommended, where a footpath goes through the verge the priority is to ensure the footpath is to standard (1.5%). This means that the remaining section of driveway between the footpath and road can be a lot steeper than the 6% fall but as long as access is still suitable then it is allowed.

Where a driveway is constructed where no footpath currently exists the footpath section is still constructed at 300mm from the property boundary, as per the footpath standards. If a footpath is later constructed on the street as part of the footpath construction and reconstruction program then it is tied into the existing driveways. As mentioned in the previous footpath section, identifying which driveways need replacing is an important part of the footpath program.

The general reconstruction of driveways is done on a reactive basis as per the Driveway Policy discussed in the literature review.

3.3 Existing Data

3.3.1 Road Surface

Road surface data has been collected from construction drawings and condition surveys. The initial information was provided by analysing construction drawings for surface types, widths and construction year. From here conditions surveys have been carried out to determine the condition of the road surface. The information is stored in MapInfo tables for graphical and database use. Data has also been analysed in the dTIMS software to determine the deterioration of each asset segment over time.

A summary of the data is provided in the table below.

Table 11 - Road Data Summary from 2006 Summary

Total Road Length	462 km
Average Age of Surface	1996
Average Width	8.3 m
Total Length Chip-Seal	310 km
Total Length Asphalt	99 km

The image below is a screenshot of MapInfo with the roadsurvey data table on, the different colour lines represent the different surfaces.

**Figure 15 - MapInfo Road Survey**

3.3.2 Road Pavement

Pavement data was retrieved from construction information along with the road surface information. Where possible the types of pavement and technical information have been recorded, but the data available is limited. The condition surveys also provide some data on pavement condition, but it is only very basic

information such as isolated defects. The information is stored with the surface data in MapInfo tables.

3.3.3 Kerb and Gutter

Currently there is no data on kerb and gutter, surveys underway for the 2010 condition survey are collecting the kerb and gutter information. The information recorded will be kerb type, height and condition.

3.3.4 Footpaths and Driveways

Footpath and driveway data has been collected from conditions surveys where the type, width and condition of the footpath have been recorded. Data is again stored in MapInfo tables for use as a database and visual analysis. The table below summarises some of the data collected.

Table 12 - Footpath and Driveway Data from 2006 Survey

Total Footpath Length	363 km
Total Asphalt Footpath Length	86 km
Total Concrete Footpath Length	272 km
Number of Driveways	18140
Average Driveway Width	3.9 m
Number Asphalt Driveways	3094
Number Concrete Driveways	13348

The image below represents the type of footpath for each asset segment, which is one lot frontage.

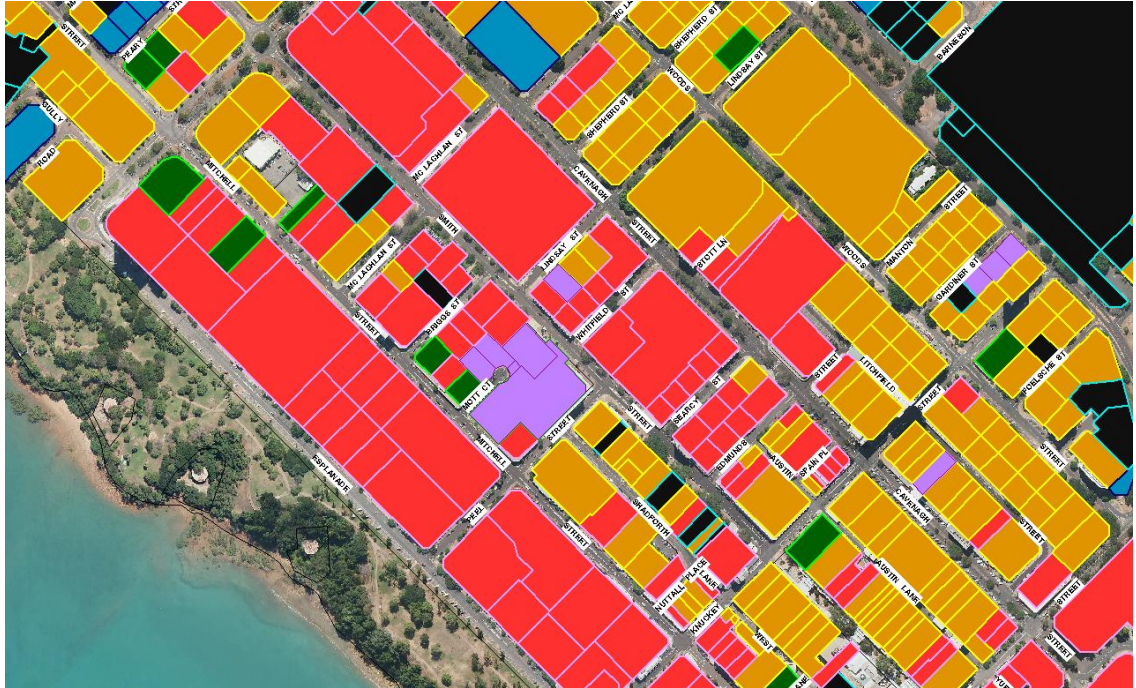


Figure 16 - MapInfo image Footpath Types

4 SURVEYS

4.1 Summary

Currently, all surveys carried out on roads, footpaths and driveways are done on a four-yearly cycle. A software package from GBM (Geobasemap) provides a range of programs to collect and analyse the data. GBM mobile is a program designed for handheld, pocket PC's (personal computer) and GBM portable is designed to be used on laptops or standard PCs. There is a 'manager' for each program that allows custom forms to be created for the data collection, such as drop down menus for lists of options etc. The original data is loaded from a MapInfo table into the GBM software where it can be visually analysed and then the forms work over top of the table to allow the data to be collected. The MapInfo tables can then be viewed, analysed and extracted for further interrogation.

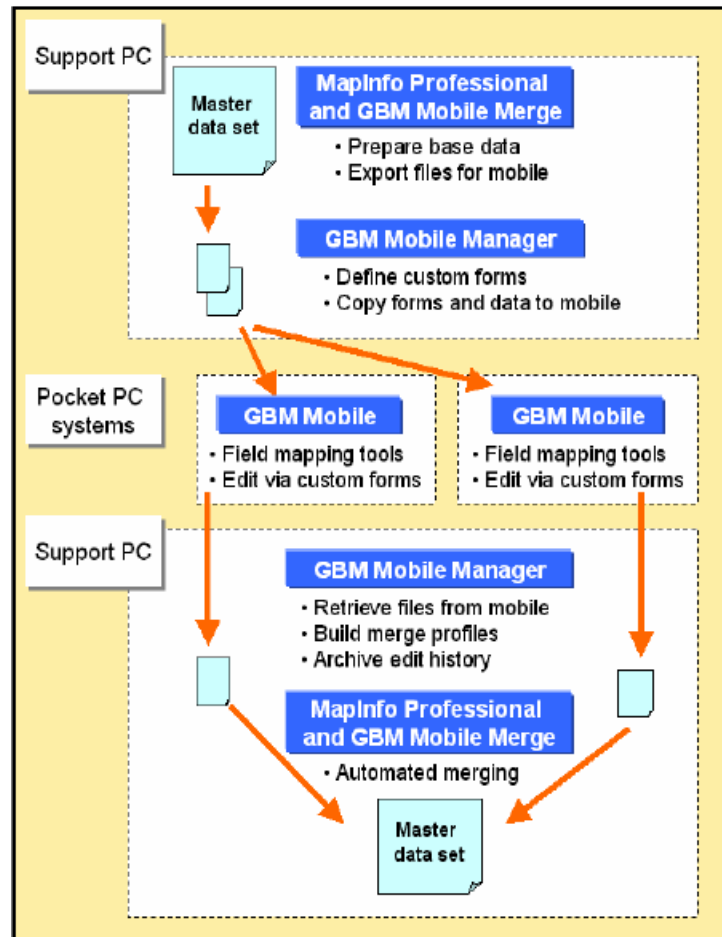


Figure 17 - GBM Mobile Process

All condition surveys are visual surveys where one or two people drive/walk along the asset and record the data with the software as they go. To record the condition of the asset, the segment or item is selected on the map window and then the custom form can be updated for the condition etc. The specific forms will be discussed in the following sections. Once the data is collected, it is extracted from the device and loaded onto the server for editing and analysis. The analysis is undertaken to determine the programs and will be discussed in the following chapter.

Updating the data between surveys is important as there would have been maintenance carried out from both the programs and on a reactive basis. By updating the data regularly the data that is used when the survey is conducted will be accurate and less time will be wasted chasing up previous records. The data will also be more accurate for programming as the asset may have had reactive works undertaken that change its priority. It also means that annual financial records are more accurate.

4.2 Roads and Kerb & Gutter

GMB portable software is used on a tablet notebook computer for road surveys. The custom form contains the following information with the options shown. As part of the program development, additional data was added, including the kerb and gutter information, the new fields are highlighted on the table in orange. All 'extent' options are considered by the percentage length of the road, with each lane having a length, i.e. a 50% of the inbound lane is actually 35% of the entire length of the road (for a two-lane road). The abbreviations for the treatment and kerb types are briefly described in the tables following. In regards to the actual defects, appendix I is an extract from the DCC Data Collection Manual that explains how the data should be collected. The figure below shows the interface of the software program when a road segment is selected.

Figure – GBM Portable Image for Road Survey

Table 13 - Road Condition Survey Form

Description	Field	Options									
Road Name	Street	Yes	No								
Surface Type	L_SurfType	Not editable									
Surface Year	L_SurfYear										
Road Start	LO_Start	Not editable									
Road End	LO_End	Not editable									
Cracks Present	CrackPresent	Yes	No								
Longitudinal Cracking	CrkLongExtent	0	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	CrkLongSev	< 3mm	> 3mm								
	CrkLongPump	Yes	No								
	CrkLongDense	Low	Med	High	Severe						
Transverse Cracking	CrkTransExtent	0	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	CrkTransSev	< 3mm	> 3mm								
	CrkTransPump	Yes	No								
	CrkTransDense	Low	Med	High	Severe						
Block Cracking	CrkBlkExtent	0	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	CrkBlkSev	< 3mm	> 3mm								
	CrkBlkPump	Yes	No								
	CrkBlkDense	Low	Med	High	Severe						
Crocodile Cracking	CrkCrocExtent	0	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	CrkCrocSev	< 3mm	> 3mm								
	CrkCrocPump	Yes	No								
Crack Patching	CrackPatch	Yes	No								
Patch	Patch	None	< 5%	6 - 10%	11 - 25%	26 - 50%	> 50%				
Pothole	Pothole	None	1	2 - 5	> 5						
Isolated Defect	Iso_Defect	Type	None	Shoving	Failure	Deform	Other				
	IsoDefectUrg	Urgency	Fix	Monitor	Ignore						
Ravelling	Ravelling	None	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	RavSeverity	Low	Med	High	Severe						
Stripping	Stripping	None	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	StripSeverity	Low	Med	High	Severe						
Flushing	Flushing	None	< 5%	5 - 10%	10 - 25%	25 - 50%	> 50%				
	FlushSeverity	Low	Med	High	Severe						
Proposed Treatment	PropYear	1	2	3-5	5	5+					
Proposed Treatment	PropTreatment	CS7	CS10	CO	AC	AR	PAVE				
Road	RoadComments										
Kerb Left	KerbLeftType	KG	KO	LB	SG	SO	FL				
	KerbLeftHeight	0 mm	<50mm	50-100mm	>100mm						
	KerbLeftCond	1	2	3	4	5					
Kerb Right	KerbRightType	KG	KO	LB	SG	SO	FL				
	KerbRightHeight	0 mm	<50mm	50-100mm	>100mm						
	KerbRightCond	1	2	3	4	5					
Kerb	KerbComments										

Table 14 - Road Treatments

Treatment	Description
CS7	7mm Chip Seal
CS10	10mm Chip Seal
CO	Crack Seal Only
AC	Asphalt Overlay
AR	Mill and Replace Asphalt
PAVE	Pavement reconstruction

Table 15 - Kerb Details

Treatment	Description
KG	Kerb and Gutter
KO	Kerb Only
LB	Layback Kerb
SG	Semi-Mountable Kerb and Gutter
SO	Semi-Mountable Kerb Only
SL	Special Layback
CO	Concrete Invert
FL	Flush Kerb
SS	Sealed Shoulder
US	Unsealed Shoulder

The survey for 2010 has commenced using these new data fields, as the survey progresses, improvement to the forms and data collected will be noted for the next survey. A few options already noted are;

- Patches – need to distinguish between a successful patch and an unsuccessful patch
- Patches – need to distinguish whether it is just a trench for a service crossing
- Potholes – need ability to record un-patched and patched pothole

The new fields were considered to be important data that could be used in assisting developing the programs and were also easily understood by the surveyors so additional training wasn't required. The proposed year and treatment were added to provide a subjective opinion based on the expertise of the surveyor, this data would not be used for the program specifically, but as a comparison to validate the program once it has been developed. The road start and end information was included to allow the user to determine the left and right sides of the road for the kerb data collection.

Continual improvement will allow the data to increasingly better reflect the true condition of the road. For example, saying the road has a 50% patch is considered a

defect, but if it is a successful patch then the affected area is likely to be in better condition than the surrounding pavement.

With the kerbs, the important records are the type of kerb and the condition. The kerb height was also recorded to get an idea for reseals and possible stormwater issues. The condition is based on the IPWEA Practice Notes with the options representing the 1-5 system suggested in the guidelines. The table below summarises what the values of 1-5 actually represent.

Table 16 - Kerb and Gutter Condition Rating

Rating	Description
1	As new - no defects
2	Good - minor cracking
3	Ok - some defects
4	Poor - significant defects
5	Replace

The kerb and gutter data will allow maintenance programs to be created, along with the ability to value the asset and determine a suitable budget to ensure the condition doesn't deteriorate.

Rutting and roughness data collection has been contracted to external agencies for automatic collection with a survey vehicle. When this data is recorded it will be added to the analysis for the program development.

Condition surveys on road surface and pavement and also kerb and gutter allows for maintenance and rehabilitation programming. The more data collected, the more refined the program, however this can also mean that surveys may be too time consuming or start collecting irrelevant information. By improving the surveys each time the programs that come from the data will also improve.

4.3 Footpaths and Driveways

Footpaths and driveways are surveyed together on a four-yearly cycle, as with the other condition surveys. GBM Mobile software is used on a portable, ruggedized PC (or PDA). By using the smaller device the footpaths and driveways can be surveyed by a single person on a scooter or on foot. By being on the asset all defects are easily

seen and hazards such as steplifts are noted for immediate rectification where necessary. The data recorded is summarised in the following table.

Table 17 - Footpath Condition Data

DATA	ID MODE
FULL STREET	Automatic
XST_NUM	Automatic
XSTREET	Automatic
SUBURB_LOC	Automatic
SIDE	Automatic
SURVEY DATE	Automatic
SURVEYOR	Automatic
COMMENTS	Visual
OLD ID	Automatic
S06_ID	Automatic
LANDSCAPING	Visual
FP TYPE	Visual
FP WIDTH M	Measuring Wheel
FP LENGTH M	Measuring Wheel
FP CROSSFALL %	Smart Level
FP CRACKING (M)	Measuring Wheel
FP DAMAGE (RATING)	Visual
FP STEPLIFT RATING	Visual
FP STEPLIFT (EXTENT)	Visual
FP EDGEDROP EXTENT (M)	Measuring Wheel
FP ROOT DAMAGE	Visual
FP URGENT WORKS	Visual
PRAM CROSSINGS (1)	Smart Level
PRAM CROSSINGS (2)	Smart Level
PIT PRESENT	Visual
PIT TYPE	Visual
PIT HAZARD	Visual
DW TYPE	Visual
DW WIDTH (M)	Measuring Wheel
DW LENGTH M	Measuring Wheel
DW XFALL %	Smart Level
DW CRACKING (M)	Measuring Wheel
DW DAMAGE %	Visual
DW STEPLIFT SEVERITY	Visual
DW STEPLIFT (EXTENT)	Visual
DW EDGE DROP (EXTENT)	Visual
DW2 PRESENT	Visual
DW2 TYPE	Visual
DW2 WIDTH M	Measuring Wheel
DW2 LENGTH M	Measuring Wheel
DW2 XFALL %	Smart Level
DW2 CRACKING EXTENT	Visual
DW2 DAMAGE %	Visual

DW2 STEPLIFT SEVERITY	Visual
DW2STEPLIFT EXTENT	Visual
DW2 EDGE DROP	Visual
DW3 PRESENT	Visual
DW3 TYPE	Visual
DW3 WIDTH M	Measuring Wheel
DW3 LENGTH M	Measuring Wheel
DW3 XFALL %	Smart Level
DW3 CRACKING EXTENT	Visual
DW3 DAMAGE %	Visual
DW3 STEPLIFT SEVERITY	Visual
DW3 STEPLIFT EXTENT	Visual
GBM EDIT T	Automatic
GBM EDIT F	Automatic

Once the data is collected it is exported to the main server for analysis. The footpath data is analysed in spreadsheet format with an overall rating being given to each asset segment, this is then used to create the construction and reconstruction program, as per the Footpath Construction and Reconstruction Policy. The driveway data is downloaded and is, at this stage, only used for reference information.

5 PROGRAM DEVELOPMENT

5.1 Summary

Program development begins once all the data has been collected and the desired condition has been determined. This includes understanding service levels and what the condition data represents. The desired outcome is to have integrated and optimised programs for all of the assets discussed. The following sections outline the current/previous programs, the most recent 2009/10 programs and also the desired outcome from future programs.

5.2 Service Levels

Levels of service are the primary reason for maintenance programs; they ensure that the assets meet all safety requirements, legislative requirements and also the needs of the community. The programs in the DCC Annual Municipal Plan refer to outputs and service levels; these will be the primary levels to be addressed. Following this the draft service levels will be used to ensure that all other areas are catered for wherever possible. As the levels of service are improved, the desired outcomes will be clearer and hence the programming of maintenance activities.

For roads maintenance the outputs and service levels were;

- Monitor roads for maintenance needs, including preventative maintenance
- Overlay, reseal and repair roads
- Monitor and replace signage along roadways – regulatory within 24 hours, other - within one month (not relevant to this project)
- Potholes – urgent within 24 hours, other – within one month
- Linemarking – refreshment intervals outlined from 2 years to 5 years dependant on hierarchy of road (not relevant to this project)

For pathways, which includes footpaths and driveways;

- Monitor the condition of footpaths, driveways, cyclepaths and walkways throughout the municipality

- Construct, reconstruct and maintain these pathways as required
- Cyclepath sweeping – fortnightly cycle walkway patrols 8-12 week cycle (not relevant to this project)
- High pressure cleaning of footpath to remove mould – on complaint basis(not relevant to this project)
- Reactive repairs to damage primarily caused by tree roots
- Reactive repairs to cyclepaths, driveways and walkways
- Response times – make safe – 24 hours (safety), make good – 1 week (urgent), make good – 1 month (non urgent)

The reactive works will not be considered directly in the program development, but when a survey is conducted the defects requiring urgent works would get recorded as a condition which would affect the priority when programming (unless it required addressing immediately)

The main area of concern that directly relates the condition to the program development is the physical condition. The draft service levels refer to the intervention level not being greater than 4. This applies to all the assets being considered, it will be assumed that the kerb and gutter will be considered as part of the road at this stage. This means that every asset given a rating of 5 must be addressed in the following program, with 4's given the next highest priority, then 3's etc. Once the rating is no longer the main factor in determining the program then the other service levels need to be considered.

The other areas the draft service levels cover are addressed in the table below. Although they don't relate to the program directly, they do have an impact. For example a significant number of customer complaints may increase the priority of an asset having maintenance works undertaken on it.

Table 18 - Pathways Service Levels for Programming

Key Performance Indicator	Program Influences	Specific Performance Measure	
		Roads	Pathways
Safety / Legislative Requirement	All assets must comply to relevant standards, this means new work must meet requirements and the existing assets need to be maintained to conform. The condition survey identifies where assets don't meet requirements and then these assets are either	<=5 complaints / asset / quarter	<=3 accidents in 3 years at the same location <=15 complaints / year / road

	treated immediately or added to the next program.		
Cost Effectiveness	Ensure the program does not unnecessarily treat assets that still have a useful life. The program will ensure the priorities are calculated on the correct criteria.	Maintenance cost per kilometre (when calculated) will provide a guide to the cost effectiveness and the programs adjusted to ensure the programs are consistent and effective.	
Customer Satisfaction	By following the council policies and the other service levels, complaints should be kept to a minimum. Another way satisfy customers, is to ensure that no area is seen to be getting more maintenance than others, so where like-for-like assets are being maintained tracking the locations is essential.	85% customer satisfaction	
Physical Condition	The physical condition of the road is rated through the condition surveys. An overall rating is given after the analysis is done, each asset is given a rating between 1 and 5. The score is average for the asset, however if any individual component has a score 4 this becomes the defaults score for the asset. This is the initial indicator for the prioritisation of the assets to be maintained.	Intervention level not to exceed 4.	Intervention level not to exceed 4. Other surface (eg manhole) to seal difference shall not exceed 20mm.
Response Time	This refers to reactive works, it provides a guide to how quickly defects should be repaired once reported.	Response 1 hour Make good - 1 day (safety) Make good - 1 week (urgent) Make good - 1 month (non urgent)	
Functional Suitability (Pathways Only)	To provide infrastructure that is constructed to suit the local environment including dimensions. This affects the program by the selection of types of footpath for construction and reconstruction. Generally all footpaths are constructed in concrete, as per the Footpath Construction and Reconstruction Policy. In some circumstances, such as obstructive trees, root barrier is used to prevent damage from the roots.	Footpaths are constructed from concrete. If trees are an obstruction then root barriers are utilised.	
Capacity / Demand (Rods Only)	To ensure road intersections provide for minimum traffic delays, this doesn't apply directly to the maintenance program as road geometry isn't modified. The program can assist by ensuring the correct treatment is chosen for the road.		<3 complaints / year

5.3 Roads and Kerb & Gutter

5.3.1 Current Programs

For all road works, reactive maintenance activities are carried out in-house where hot-mix asphalt is bought as required and then hand-worked for placement. This is generally only for potholes, small patches and smaller areas. A period contract is in place for larger maintenance activities and work is allocated on a reactive basis using works orders. The annual program for resurfacing includes all chip seal and asphalt works on the entire list of roads specified in the program, a contract is tendered for the entire program each year.

For the road surface program, once a condition survey is conducted the data is analysed and a draft program created from the computer analysis (using dTIMS). This provides the road surface program for the next ten years, with all relevant information such as cost, treatment and reason for selection. After the initial list is created a few roads are inspected to validate the results. As each year arrives, the entire proposed list is inspected to verify the locations and treatments. After any changes are made the list is used to generate the contract for works.

This process is quite straight forward for the road surface, particularly once the analysis is completed. The road pavement and kerb and gutter are not currently programmed in this manner which will be explored in the following section.

5.3.2 New Programs (2009/10)

The road surface program for 2009/10 has been completed, with the program for 2010/11 also considered complete dependant on the results of the recent road survey currently being undertaken. This program was developed using a combination of the previous process and also consideration of the new ideas from this project. Ideally the program would include, perhaps not for the same works contract, any associated kerb repairs and reconstruction works and also road pavement work.

The process used to develop the program was;

1. Look at 10 year resurfacing program to see what roads were scheduled in the next three years.
2. Conduct a field inspection of the 2009/10 to 2011/12 roads
3. From inspection prioritise the roads on a 1,2,3 scale, where 1 was definite do in the upcoming years' work, 2 was consider and 3 was not at all or postpone to a later year.
4. Proposed treatment was also checked and changed as required.

5. Kerb and gutter condition was also inspected and where required the location works required were noted.
6. Many roads were found to have been resurfaced in the last couple of years, highlighting the need for up-to-date data, all of these roads were removed from the program list.
7. The roads were mapped onto MapInfo with different colours for priority to visually see their location relative to one another.
8. Where roads had the same priority and could be done in the upcoming year or following year they were grouped to get roads in the same vicinity on the same program.
9. Once the proposed roads were decided the areas were verified on MapInfo (see image below)
10. The program was then finalised to fit within the budget available, which included allowing for asphalt in the bell-ends of cul-de-sacs.

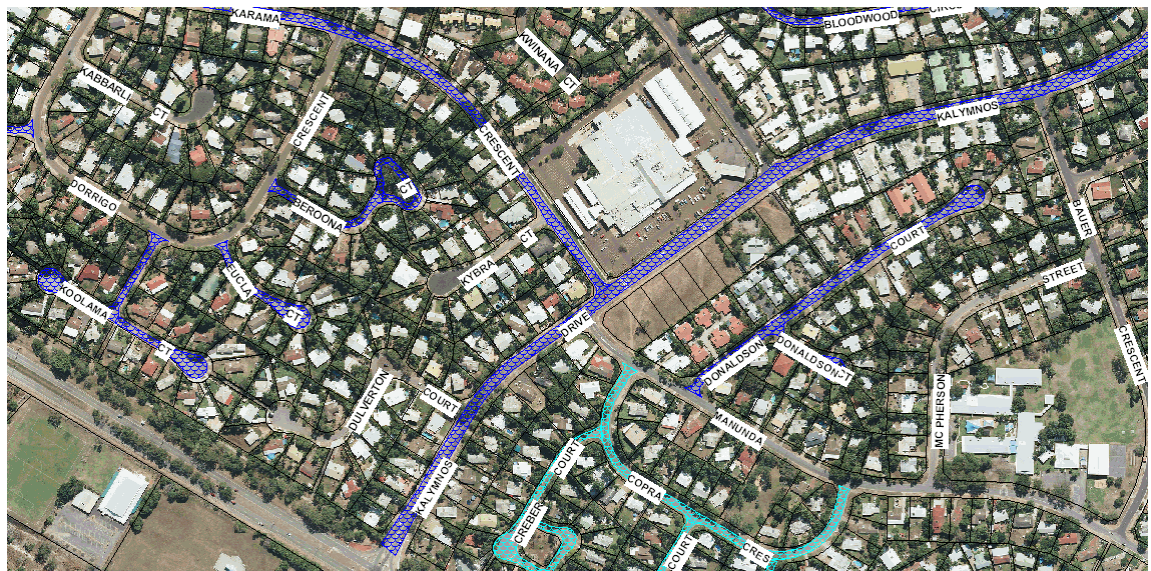


Figure 18 - Reseal Program Roads

The table below is an extract from the final program, which is included in appendix J.

Table 19 - 2009/10 Road Surfacing Program

Road	Suburb	Treatment	Area m2
WHEEL COURT	ANULA	SP7C	932
CLIFTON COURT	ANULA	SP7C	959
JADE COURT	ANULA	SP7C	639
MOO STREET	BERRIMAH	SP10	800
VIGILANT LANE	BERRIMAH	SP10	1710
HAZELL COURT	COCONUT GROVE	SP7C	2580
CRAIG CRESCENT	COCONUT GROVE	SP7	2519
MUSGRAVE CRESCENT	COCONUT GROVE	SP7	2408
OLD MCMILLANS ROAD	COCONUT GROVE	SP10	6385
PETERS STREET	COCONUT GROVE	SP7	646
RADFORD COURT	COCONUT GROVE	SP7C	1110
HERBERT STREET	DARWIN	AR	1360
SPAIN PLACE	DARWIN	AC	398
STOTT LANE	DARWIN	AC	950
YUEN PLACE	DARWIN	AC	340
ROSS SMITH AVENUE	FANNIE BAY	AC	1260
BRAZIL CRESCENT	KARAMA	SP7	880
BUD COURT	KARAMA	SP7C	351
EUCLA COURT	KARAMA	SP7C	830
KOOLAMA COURT	KARAMA	SP7C	700
PERON COURT	KARAMA	SP7C	691
SUNDEW COURT	KARAMA	SP7C	1090
WYLIE COURT	KARAMA	SP7C	490

The table below briefly describes the treatments in the previous table.

Table 20 - Road Surface Program Treatment

Treatment	Description
AC	Asphalt Overlay
AR	Mill and Resurface Asphalt
SP7	7mm Chip Seal (rubberised bitumen)
SP7C	7mm Chip Seal (rubberised bitumen) with Asphalt Cul-de-sac
SP10	10mm Chip Seal (rubberised bitumen)

As described in the steps the key improvement in this year's program was ensuring roads within the vicinity of one another received treatment in the same year wherever possible. This will provide the following benefits;

- Reduce time of program due to transportation and traffic control.

- Reduce disruption to residents, they will only get disrupted once rather than every year for the next few years.
- Possibly reduce costs as contractor may recognise the increase in efficiency from doing roads near one another.
- Keeps roads of a similar age and condition on the same maintenance regime

As no kerb and gutter data existed at the time of developing this program the kerbs were just noted as the roads where inspected. This led to the identification of one kerb requiring replacement when the adjacent road is resurfaced. By doing the kerb in conjunction with the road it increases the disruption to residents as they will consider it to be one project, and also allows the kerb to be constructed to match the new surface and vice-versa.

Pavement was not identified in this program and the roads assessed were not considered to require additional pavement works, for future programs any associated pavement works would be recognised at the time of inspection.

5.4 Footpaths and Driveways

5.4.1 Current Programs

The current programs for footpaths and driveways are completely independent of one another. Often driveways are repaired or replaced when a footpath is newly constructed or reconstructed but they are not considered prior to the works so the budget is not determined, and neither is the additional time or disruption to residents. Driveways are currently only treated on a reactive basis, their condition is recorded but the works are carried out after a complaint/request or a Council officer recognises the need for maintenance or replacement.

The footpath program is created from the forward works program developed from the previous condition survey. The forward works program is determined using the overall rating from the condition of existing footpaths and then considering the need for new footpaths. This is done in accordance with the Footpath Construction and Reconstruction Policy. Once the list is obtained the footpaths identified are inspected and verified. After the list is finalised it begins the process of public consultation which is quite extensive and is currently under review.

The works are completed either by the Darwin City Council field staff or it is given to the relevant period contractor. The quantity of works done in-house versus contractor depends on resources available from both the time and budget perspective. The same applies for the driveway maintenance and replacement. When asphalt driveways and footpaths are maintained it is in-house with the asphalt crew.

5.4.2 New Programs (2009/10)

The 2009/10 program was developed with some of the improvements considered. The process involved the following steps;

1. Obtain the list of intended footpaths for reconstruction or new construction.
2. Inspect the footpaths and rate from 1-5, with 1 being definitely do down to 5 for not required at this stage. The ratings of 3 and 4 could be postponed if required.
3. Develop draft program from priorities, including consideration for footpaths in close vicinity to one another and also other programmed works that may be in the area in the near future.
4. Check measurements of lengths and areas and determine approximate cost of works, considering in-house and contractor price differences.
5. Consult with DCC Concrete Service Team Leader to obtain which footpaths are able to be constructed in-house and which are required to be done by contractors.
6. Finalise program to fit within budget

The final proposed program is shown Appendix K. The driveways have not been considered for this program yet due to time constraints but it is intended that the driveways will be inspected prior to the works being carried out so some planning can be done prior to the works commencing.

5.5 Future Programs

Future programs are envisioned to be more integrated between the assets and optimised due to the surveys and service levels etc being further developed. The

optimal program will meet all of the service levels within the budget and without the asset classes deteriorating beyond a maintainable condition. The roads and kerb and gutter programs will be integrated, particularly for the development of the kerb and gutter and road pavement programs. This will allow for budget justification and also more accurate knowledge of the condition of the asset. The footpaths and driveways will also be integrated, and this will greatly benefit the driveway program for both time saving and budget reasons.

The intended program for the road surface, pavement and kerb and gutter program will include the following processes and ideas.

1. Obtain analysed data and extract the proposed roads and treatments.
2. Get kerb and gutter condition data and look at alongside roads proposed
3. Verify roads and treatments including kerb and gutter and pavement through field inspections
4. Do final prioritisation of roads from field survey
5. Confirm measurements and areas
6. Program works according to budget and resources, includes road surface program, road pavement program and kerb and gutter program
7. Once works are complete ensure information is updated in databases

The program for footpaths and driveways will include the following concepts and processes.

1. Obtain analysed data and extract the proposed footpaths for new construction and reconstruction
2. Get driveway condition data and look at alongside footpaths proposed
3. Verify footpath locations and driveways requiring maintenance or replacement
4. Do final prioritisation of footpaths from field survey
5. Confirm measurements and areas
6. Program works according to budget and resources, includes footpath program, and driveway program
7. Once works are complete ensure information is updated in databases

6 RECOMMENDATIONS

Below is a summary of recommendations to improve the program development for all assets. These recommendations can also be applied to other infrastructure assets such as stormwater infrastructure, cyclepaths, linemarking, signs, walkways and buildings.

1. Policies
 - a. Review existing policies relating to footpaths, roads and driveways to ensure they tie-in with the levels of service and the current maintenance practices
2. Levels of Service
 - a. Create levels of service for kerb and gutter, particularly for safety and physical condition
 - b. Ensure condition levels are directly related to the data collected and output of analysis
3. Condition Surveys
 - a. Continually improve data collection methods
 - b. Ensure condition data is relevant to program development and also reflects levels of service required
 - c. Ensure analysis of data is representative of the actual condition of the asset, particularly for road surface and the dTIMs modelling
4. Program Development
 - a. Further develop future programs using guidelines in section 5.5 with particular consideration of
 - i. Integrating assets as much as possible, both within and between asset classes
 - ii. Maintaining assets within the immediate area of one another

These recommendations can all be achieved through continual development of the three key areas of levels of service, surveys and program development. In order for programs to be optimised, the areas need to work alongside one another. If this is achieved the maintenance programs at Darwin City Council will be integrated, efficient and optimised for time and money.

7 CONCLUSION

This project had the aim of developing an Asset Maintenance Program for the Darwin City Council. One of the main objectives was to integrate the assets as much as possible to optimise the maintenance of the assets. Optimising the programs will allow for budgets to be monitored and work schedules created more effectively. The assets focussed on were road surface, road pavement, kerb & gutter, footpaths and driveways.

Darwin City Council currently has programs in place for maintaining most of the assets in line with its Asset Management Plan. This project has developed these programs to work alongside each other rather than independently. Reviewing the current survey practices and levels of service has also been done ensure all information coming in is relevant and able to be used to create the best maintenance plans.

The programs were not developed to the extent envisioned but have begun the process of being integrated and will continue to be optimised in future programs. The levels of service were recognised as requiring review and the surveys have been enhanced, particularly for the road survey where the kerb and gutter data was included.

Further work is required from this project to implement the recommendations. Most of the work required is determining what the levels of service represent and how they relate to condition surveys and the final maintenance programs. The work will continue for future programs using the information obtained from this project. Further work from this project could also include investigation into the cost side of asset maintenance, this project focussed on selection of assets within the budget already available. This is only a small part of asset management as the asset needs to be considered for its entire useful life, this would require analysis into the cost of maintenance compared replacement cost of the assets etc.

The main outcome of developing the asset maintenance programs at Darwin City Council has commenced. By continuing the program development, the maintenance programs will be more developed, efficient and cohesive programs for the assets considered in this project. The concepts used for these assets will also be able to be used to optimise the other infrastructure assets under the control of Darwin City Council.

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Appendix A – Project Specification

Appendix A

University of Southern Queensland

FACULTY OF ENGINEERING AND SURVEYING

ENG4111/4112 Research Project PROJECT SPECIFICATION

FOR: *Nadine Douglas*

TOPIC: Management of Physical Assets

SUPERVISOR: *Dr David Thorpe, USQ*

SPONSORSHIP: *TBA*

PROJECT AIM: Development of an Asset Maintenance Programme for the Darwin City Council.

PROGRAMME: (Issue A, 23/03/2009)

1. Undertake research into asset management in local government
2. Develop research methodology
3. Identify assets to program
4. Investigate asset management and maintenance requirements of the selected assets
5. Determine asset survey requirements and frequencies
6. Analyse information obtained in previous surveys
7. Determine suitable duration of programme (3 years, 4 years)
8. Provide recommendations on implementing options
9. Write and submit dissertation in format required by the University

If time permits

10. Prepare program of works with available budget and information
11. Implement program in 2009/2010 financial year
12. Report on options to optimise program development and implementation
13. Analyse implementation of program after first 2/3 months

AGREED _____ (student) _____ (supervisor)
Date: / / 2007 Date: / / 2007

Co-examiner: _____

Appendix B – 10 Year Works Plan

ROAD ANCILLARY ASSETS

Technical Services - Ten Year Works Program

2

PROJECT	Responsible Officer	2008/2009			2009/2010			
		Operating Expense	Capital Replacement/Reimbursement	New Capital Expense	Operating Income	Capital Income	Operating Income	Capital Income
Mosquito Control Program								
Drains Repairs/Maintenance	Dave Thiele	153,000		110,000	102,000	73,000	110,000	73,000
Construction of Erosion Control Structure:	Dave Thiele							
Cyclepaths								
CBQ Bicycle Infrastructure (eg Lockers)	Mark Spangler			30,000				
CBQ Cyclepaths	Mark Spangler			50,000				
Cyclepath Strategy	Mark Spangler			40,000				
Cyclepath Construction	Mark Spangler		80,000			80,000		
Flower Drive - Baped to Dick Ward Drive	Mark Spangler				10,000		200,000	
Outcomes of Cyclepath Strategy	Mark Spangler				12,500		250,000	
Rapid Creek Road Cyclepath	Mark Spangler							
Rocklands Drive Connector	Mark Spangler							
Walkway Resurfacing								
Walkway Resurfacing	Dave Thiele		80,000				80,000	
Roads								
Resealing & Rehabilitation Program	Dave Thiele		705,000			705,000		
Footpaths								
Bl Park Masterplan Works	Dave Thiele		30,000			30,000		
Footpath Reconstruction Program	Dave Thiele		800,000			800,000		
New Footpaths	Dave Thiele		40,000			40,000		
Stuckey Street Retaining Wall and Footpath	Mark Spangler		170,000					
Adjacent Elevation								
Disability Access								
Implementation of Rolling 5 Year Program	Dave Thiele		50,000			50,000		
Rapid Creek Bridge Fishing Platform	Dave Thiele		250,000					
Water Gardens Disabled Access	Dave Thiele							
Miscellaneous								
Lyons Maintenance (to be included in new financial year budget)								
Municipal Maintenance (to be included in new financial year budget)								
Initiatives in relevant year budget								

ROAD ANCILLARY ASSETS

Technical Services - Ten Year Works Program

PROJECT	Responsible Officer	2008/2009				2009/2010			
		Operating Expense	Capital Replacement	New Capital Expense	Operating Income	Capital Replacement	New Capital Expense	Operating Income	Capital Income
Mosquito Control Program Drains Repair/Maintenance	Dave Thiele	153,000		110,000	102,000				
	Dave Thiele								
Cyclepaths CBD Bicycle Infrastructure (eg Lockers) CBD Cyclepaths Cyclepath Strategy Cyclepaths Reconstruction Frizer Drive - Bagot to Dick Ward Drive Outcomes of Cyclepath Strategy Rapid Creek Road Cyclepath Rocklands Drive Connector	Mark Spangler			30,000					
	Mark Spangler			50,000					
	Mark Spangler			40,000					
	Dave Thiele		80,000						
	Mark Spangler								
	Mark Spangler						10,000		200,000
	Mark Spangler						12,500		250,000
	Mark Spangler								
Walkway Resurfacing Walkway Resurfacing									
	Dave Thiele		80,000					80,000	
Roads Resealing & Rehabilitation Program									
	Dave Thiele		705,000					705,000	
Footpaths Bl Park Masterplan Works Footpath Reconstruction Program New Footpaths Knuckey Street Retaining Wall and Footpath Adjacent Evolution									
	Dave Thiele		30,000					30,000	
	Dave Thiele		800,000					800,000	
	Dave Thiele		40,000					40,000	
	Mark Spangler		170,000						
Disability Access Implementation of Rolling 5 Year Program Rapid Creek Bridge Fishing Platform Water Gardens Disabled Access									
	Dave Thiele		50,000						
	Dave Thiele		250,000					50,000	
	Dave Thiele								
Miscellaneous Lyons Maintenance (to be included in new initiatives in relevant year budget) Muirhead Maintenance (to be included in new initiatives in relevant year budget)									
Total		153,000	1,895,000	740,000	102,000	73,000	175,500	1,895,000	73,000

Legend

Reserve Funding

Reserve & Loan Funding

Appendix C – DCC Budget Extract

Program Profile	ProjectType	ProjectName	Cost	Grant Funds	Reserve Funds	Revenue Funds
Building Maintenance	Capital Refurbishment	Asbestos Removal Program	20,000	-	-	20,000
		Gardens Golf Link Bridge Replacement	40,000	-	-	40,000
		Building Maintenance - Program Cyclical Works	248,000	-	34,000	214,000
		Air Conditioner Civic Centre (community services)	50,000	-	-	50,000
		Darwin Entertainment Centre Capital Refurb Works	500,000	-	-	500,000
		Nightcliff Hall Slab Replacement	100,000	-	30,000	70,000
		Replacement of Electronic Lighting & Power Systems - The Mall	30,000	-	-	30,000
		Smith Street Garden Beds	30,000	-	-	30,000
		Toilet Block Replacement / New Program	180,000	-	-	180,000
		Capital Refurbishment Total	1,198,000	-	64,000	1,134,000
Building Maintenance Total	Capital New	Disabled Access / Toilet Facilities at Child Care Centres	50,000	-	-	50,000
		Urban Enh - East Point Conservation Interpretive Signage	20,000	20,000	-	-
		Bishop Street Wash Down Bay	30,000	-	-	30,000
		Child Care Centres (7) Installation of Grease Arrestors	70,000	-	-	70,000
		Renewable (wind) Power Generation (Council Buildings)	50,000	-	-	50,000
		3 x Swimming Pool Defib Units	9,000	-	-	9,000
		Swimming Pool Vacuum - Stage 1 of 2	15,000	-	-	15,000
		Bishop Street Security Card Access (AdminOffice)	10,000	-	-	10,000
		Capital New Total	254,000	20,000	-	234,000
		Building Maintenance Total	1,452,000	20,000	64,000	1,368,000
Off Street Parking	Capital New	Carparking - Electronic Vacancy Boards	150,000	-	150,000	-
		Carparking - Parking Study - Industrial, residential, commercial carparking contribution plan update	50,000	-	50,000	-
		Capital New Total	200,000	-	200,000	-
	Capital Refurbishment	Irrigation Infrastructure - General (Refurbishment)	50,000	-	50,000	-
		Parks Infrastructure Refurbishments	120,000	-	-	120,000
		Parks - Darwin General Cemetery Pathways Landscaping	25,000	-	-	25,000
		Irrigation	-	-	-	-
		Parks - Tree Replacement	75,000	-	-	75,000
		Road Ancillary - Bi Park Master Plan Works	30,000	-	-	30,000
		Parks - Cullen Bay Landscaping Upgrade	200,000	100,000	-	100,000
		Parks - Mindil Beach Sand Dunes (markets area) Fencing	60,000	-	-	60,000
		Urban Enh - Parap Shopping Centre Landscape & Footpath Upgrade - Stage 2 of 5	100,000	-	-	100,000
		Capital Refurbishment Total	660,000	100,000	50,000	510,000
Parks & Reserves Total	Capital New	Parks - Foreshore Fencing	65,000	-	-	65,000
		Parks - Trower Rd Landscaping	100,000	-	-	100,000
		Parks - Water Bubbler Backflow Prevention	50,000	-	-	50,000
		Parks - Smith Street Mall Upgrade - shade, shelter and planting	150,000	-	-	150,000
		Capital New Total	365,000	-	-	365,000
		Parks & Reserves Total	1,025,000	100,000	50,000	875,000

Program Profile	ProjectType	ProjectName	Cost	Grant Funds	Reserve Funds	Revenue Funds
Community Development and Support	Capital New	Urban Enh - Public Art Strategy Register	15,000	-	-	15,000
		Charles Darwin Commemorative Artwork Construction	250,000	-	-	250,000
		Aquatic Facilities Casuarina - CDU Project	150,000	-	-	150,000
		Display Poles for Cultural Village	15,000	-	-	15,000
	Capital New Total		430,000	-	-	430,000
Community Development and Support Total						
Sport and Recreation	Capital New	Regional Playground Strategy - Stage 1 of 3	150,000	-	-	150,000
	Capital New Total		150,000	-	-	150,000
Port and Recreation Total	Capital New	Stormwater - Parap / Fannie Bay Drainage Study	100,000	-	-	100,000
	Capital New Total		100,000	-	-	100,000
Form Water Drainage Construction Total						
Urban Infrastructure	Capital New	Urban Enh - CBD Street Scape Implementation	200,000	-	-	200,000
	Capital New Total		200,000	-	-	200,000
Urban Infrastructure Total						
Road Construction and Traffic Management	Capital New	LATM - General Works as Approved	150,000	75,000	-	75,000
		Roads - Minor Capital Works	120,000	-	-	120,000
		Black Spot - Woolner Road and Bishop Street	725,000	670,000	-	55,000
	Capital New Total		995,000	745,000	-	250,000
Road Construction and Traffic Management Total						
Roadways	Capital Refurbishment	Footpath Reconstruction Program	800,000	-	-	800,000
		Walkway Resurfacing	80,000	-	-	80,000
		Cyclepath Reconstruction - Refurb	80,000	-	-	80,000
	Capital Refurbishment Total		960,000	-	-	960,000
	Capital New	Urban Enh - Walkway Upgrades	70,000	-	-	70,000
		Cyclepaths in CBD	50,000	-	-	50,000
		Cyclepath Strategy - New	40,000	-	-	40,000
	Capital New Total	Mangrove Boardwalk Extension - Footpath to reach	150,000	-	-	150,000
Roadways Total						
Roadways Maintenance	Capital Refurbishment	Driveway Replacement Program	200,000	-	-	200,000
		Kerb Replacements - various	30,000	-	-	30,000
		Traffic Signal Upgrades	55,000	-	-	55,000
		Roads Resealing and Rehab Program	850,000	-	-	850,000
		Reseal Carpark - Civic Centre	10,000	-	10,000	-
		Streetlighting Refurbishment - various locations subject to complaint and request	80,000	-	-	80,000
	Capital Refurbishment Total		1,225,000	-	10,000	1,215,000
	Capital New	Disability Access	50,000	-	-	50,000
		Shoal Bay Road Seal Shoulders	33,000	-	33,000	-
		Lighting - Park commencing Broilga St to Lee Pt Rd (Wulagi Greenbelt 550m & lights)	60,000	-	-	60,000
	Capital New Total		143,000	-	33,000	110,000
Roads Maintenance Total						
Street Cleaning	Capital Refurbishment	Litter Bin Replacement Program	50,000	15,000	-	35,000
	Capital Refurbishment Total		50,000	15,000	-	35,000
Street Cleaning Total						
			50,000	15,000	-	35,000

Program Profile	ProjectType	ProjectName	Cost	Grant Funds	Reserve Funds	Revenue Funds
Waste Management	Capital New	Env -Wheel Wash Shoal Bay	200,000	-	200,000	-
		Env -Weigh Bridge Duplication	250,000	-	250,000	-
Waste Management Total	Capital New Total		450,000	-	450,000	-
Environment General	Capital New	Env -EMP Program Works	20,000	-	20,000	-
		Env -EMP Land Protection Program	5,000	-	5,000	-
		Env- EMP Waterway Program	20,000	-	20,000	-
		Env -Coastal Foreshore Erosion Program	10,000	-	10,000	-
		Env -Climate Change Response Program	50,000	-	50,000	-
		Env -Water Conservation Program	25,000	-	25,000	-
Environment General Total	Capital New Total		130,000	-	130,000	-
Mosquito Control	Capital New	Mosquito Control -Construction of Erosion control structures	110,000	73,000	-	37,000
Mosquito Control Total	Capital New Total		110,000	73,000	-	37,000
Fleet Management	Capital Refurbishment	Plant Replacement Program	2,051,286	-	1,166,322	884,964
	Capital Refurbishment Total		2,051,286	-	1,166,322	884,964
	Capital New	Parks - Scarifier / Sweeper	40,000	-	-	40,000
Fleet Management Total	Capital New Total		40,000	-	-	40,000
Financial & Management Accounting Services	Capital New	Capital Works Project in Waters Ward - to be determined	2,091,286	-	1,166,322	924,964
			67,000	-	-	67,000
Financial & Management Accounting Services Total	Capital New Total		67,000	-	-	67,000
IT Management	Capital Refurbishment	IT Server Replacement Strategy	100,000	-	-	100,000
		IT Desktop PC and Laptop Replacement Strategy	187,000	-	-	187,000
	Capital Refurbishment Total		287,000	-	-	287,000
	Capital New	IT WEB 2-0 Technologies	15,000	-	-	15,000
IT Management Total	Capital New Total		15,000	-	-	15,000
Grand Total			10,390,286	953,000	2,103,322	7,333,964

Appendix D – Service Level Legislative Requirements

Northern Territory	
Legislation	Requirement / Asset Related Implications
Aboriginal Land Act	Outlines legislative issues local governments need to consider where its assets may be impacted by Aboriginal Land.
Architects Act	Provides for the registration of persons who are qualified to practise architecture and the regulation of the practise of architecture, and for related purposes – applicable to Council owned buildings and facilities
Associations Act	Applicable to Community groups that that may use Council controlled and owned facilities
Building Act & Regulations	Provide for the establishing of technical standards for buildings, the registration of building practitioners and certifiers, the regulation of building matters, the granting of building and occupancy permits and the establishing of a building appeal process, and for related purposes
Bushfires Act & Regulations	Applicable to local government parks and reserves where the prevention and suppression of bushfires may be pertinent
Business Tenancies (Fair Dealings) Act & Regulations	Outlines the rights and obligations of landlords and tenants of shops and premises. Applicable to local governments that lease or own assets that are tenanted for use as certain retail shops and other business premises.
Cemeteries Act & Regulations	Sets out the role, responsibilities and powers of a local government in relation to the care and control of cemeteries where they may be where they may be part of a Board of Trustees for a cemetery
Commercial Passenger (Road) Transport Act	Outlines legislative issues local governments need to consider in relation to the provision of facilities for taxis, buses and other commercial vehicles on Council controlled roads.
Construction Contracts (Security of Payments) Act	Outlines legislative issues local governments need to consider in relation to contractual arrangements it may enter into for the construction, operation and maintenance of new and existing assets
Construction Industry Long Service Leave and Benefits Act & Regulations	Outlines obligations local governments need to consider in relation to a long service levy they may have to pay for certain construction works.
Control of Roads Act	Sets out the role, responsibilities and powers of a local government in relation to the care and control of roads
Crown Lands Act & Regulations and Crown Lands Freehold (Conversion from Crown Leasehold) Act	Outlines legislative issues local governments need to consider in relation Crown Land that may exist within a municipality that the local government (or other parties) may have the use, care and control of. This may include but not be limited to recreation facilities, airstrips, waste disposal sites and roads.
Cullen Bay Marina Act &	Relates to the subdivision and management of certain land at Cullen Bay with

Northern Territory	
Legislation	Requirement / Asset Related Implications
Regulations	the Darwin Municipality and the obligations and liabilities of certain persons in relation to the development of that land, and for other purposes
Dangerous Goods Act and Regulations	Outlines legislative issues local governments need to consider in relation to the safe storage, handling and transport of certain dangerous goods that the local government may need to use for the maintenance and operation of some assets e.g. chlorine for swimming pools
Darwin Port Corporation Act	Identifies that the Darwin Port Corporation is exempt from local government rates, charges and taxes but recognises that their activities may impact on certain local government assets such as roads. The costs of these impacts need to be balanced against the benefits the port brings to the community of Darwin.
Darwin Rates Act & Regulations	Sets out the role, responsibilities and powers of a local government in relation to the raising of funds through the a rating system to assist in the funding of the construction maintenance and operation of assets that service the community.
Disasters Act	Outlines legislative issues local governments need to consider in relation to measures necessary for the protection of life and property from the effects of disasters and emergencies and for other purposes.
Environmental Assessment Act	Outlines legislative issues local governments need to consider in relation to the assessment of the environmental effects of development proposals and for the protection of the environment
Environmental Offences and Penalties Act 1996	Outlines offences local governments local governments (and other parties) may be liable for where their acts and omissions maybe detrimental to the protection of the environment.
Essential Goods and Services Act	Outlines legislative issues local governments need to consider in relation to the impacts that the management and control of shortages of prescribed goods or services may have on local government assets e.g. water shortages; delivery of goods and services over council controlled roads when trafficking is not appropriate due to saturation of pavements.
Fire and Emergency Act	Outlines legislative issues local governments need to consider in relation to the prevention of fires and other emergencies as an owner and occupier of land
Food Act	Outlines legislative issues local governments need to consider in relation to the use of premises or sites they may own or have the care and control over that are used for the sale of food for human consumption
Heritage Conservation Act & Regulations	Outlines legislative issues local governments need to consider in relation to the protection and conservation of places and objects of prehistoric, protohistoric, historic, social, aesthetic or scientific value, including geological structures, fossils, archaeological sites, ruins, buildings, gardens, landscapes, coastlines and plant and animal communities or ecosystems of the Territory that may occur in municipal areas.

Northern Territory	
Legislation	Requirement / Asset Related Implications
Land Development Corporation Act	Outlines legislative issues local governments need to consider in relation to the impacts that the Land Development Corporation activities could have on the various assets, such as roads, stormwater, buildings and land, that the local government has under its care and control.
Land Title Act & Regulations	Outlines legislative issues local governments need to consider in relation to land ownership, easements and other purposes that may impact on various assets, such as roads, stormwater and buildings that the local government has under its care and control.
Lands Acquisition Act & Regulations	Outlines legislative issues local governments need to consider in relation to land they own that could be compulsorily acquired by the Northern Territory for the purpose of the provision of essential services and facilities being power (including gas), water, sewerage, road or communication services or facilities to or across the prescribed land, or access to any of them.
Litter Act	Outlines legislative issues local governments need to consider in relation to managing litter in and around assets that they have the care and control of.
Local Government Act & Regulations	Sets out the role, purpose, responsibilities and powers of local governments in relation to assets that they may have ownership, care and control of
Local Government Grants Commission Act	Sets out the role, purpose, responsibilities and powers of a Local Government Grants Commission to make recommendations concerning the distribution of financial assistance to local government bodies and for related purposes
Major Cricket Events Act 2003	Outlines legislative issues local governments need to consider in relation to major cricket events being held on or adjacent to areas under the care and control of the local government.
Motor Vehicles Act	Outlines legislative issues local governments need to consider in relation to the use of plant and equipment for the delivery of services to the community.
National Environment Protection Council (Northern Territory) Act	Outlines legislative issues local governments need to consider in relation to the impacts that the National Environment Protection Council activities could have on the various assets, such as roads, stormwater, buildings and land, that the local government has under its care and control.
National Trust (Northern Territory) Act	Outlines legislative issues local governments need to consider in relation to the impacts that the National Trust (Northern Territory) activities could have on the various assets, such as roads, stormwater, buildings and land, that the local government has under its care and control.
Northern Territory Aboriginal Sacred Sites Act	Outlines legislative issues local governments need to consider in relation to the impacts that the Aboriginal Sacred Sites could have on the various assets, such as roads, stormwater, buildings and land, that the local government has under its care and control.
Ozone Protection Act &	Outlines legislative issues local governments need to consider in relation to the

Northern Territory	
Legislation	Requirement / Asset Related Implications
Regulations	impacts that various assets under its care and control could have on the ozone layer.
Place Names Act	Outlines legislative issues local governments need to consider in relation to the naming of various assets such as roads, buildings, parks and reserves, that the local government has under its care and control
Places of Public Entertainment Act	Outlines legislative issues local governments need to consider in relation to the use of various assets for public entertainment purposes, such as buildings, parks and reserves and entertainment centres, that the local government has under its care and control
Planning Act & Regulations	Outlines legislative issues local governments need to consider in relation to providing for appropriate and orderly planning and control of the use and development of land within the municipality
Plumbers and Drainers Licensing Act & Regulations	Outlines legislative issues local governments need to consider to ensure the health and welfare of the community when using plumbers and drainers to carry out works on council assets.
Power and Water Corporation Act	Outlines legislative issues local governments need to consider in relation to Power and Water Corporation whose power, water and sewerage infrastructure may impact on the local governments assets such as the road network, parks and reserves and other land.
Soil Conservation And Land Utilization Act	Outlines legislative issues local governments need to consider in relation to soil conservation and land under its care and control.
Special Purposes Leases Act	Outlines legislative issues local governments need to consider in relation to the impact of special purpose leases of Crown Land held by either the local government or parties on their assets. This could include roads. Park and reserves and some building on these assets.
Terrorism (Emergency Powers) Act	Outlines legislative issues local governments need to consider in relation to the risks and impacts a possible or actual terrorism act may have on the local governments assets and the service the assets provide.
Traffic Act	Sets out the role, responsibilities and powers of a local government in relation to the regulation of traffic on council controlled roads
Validation (Native Title) Act	Outlines legislative issues local governments need to consider in relation to possible Native Title over land under its care and control
Waste Management and Pollution Control Act & Regulations	Outlines legislative issues local governments need to consider in relation to management of waste disposal sites and controlling of pollution emanating from assets under the care and control of the local government e.g. the road and stormwater network.
Water Act & Regulations	Outlines legislative issues local governments need to consider in relation to the

Northern Territory	
Legislation	Requirement / Asset Related Implications
	use of water for its assets e.g. parks, gardens, buildings and other public facilities.
Water Supply and Sewerage Services Act	Legislative issues that need to be considered in relation to the impacts water and sewerage infrastructure may have on the local governments assets such as the road network, parks and reserves and other land.
Weeds Management Act & Regulations	Outlines legislative issues local governments need to consider in relation to the management of weeds on local governments assets such as the road network, parks and reserves and other land.
Work Health Act	Legislative issues need to consider in relation to work place health and safety issues in relation to persons that work at or on or use local government assets

Commonwealth of Australia	
Legislation	Requirement / Asset Related Implications
Airports Act	Outlines legislative issues local governments need to consider in relation to the impacts airports may have on the local governments assets and the services these assets provide.
Disability Discrimination Act	Outlines legislative issues local governments need to consider in relation to the ensuring that persons with disabilities are not discriminated against when wishing to use Council owned assets
Environment Protection and Biodiversity Conservation Act	Outlines legislative issues local governments need to consider where its assets may impact on the protection of the environment and the conservation of biodiversity,
Infrastructure Australia Act 2008	An Act to establish Infrastructure Australia and the Infrastructure Coordinator, Infrastructure Australia has the primary function of providing advice to the Minister, Commonwealth, State, Territory and local governments, investors in infrastructure and owners of infrastructure on matters relating to infrastructure.
National Environment Protection Measures (Implementation) Act	Outlines legislative issues local governments need to consider where its assets may impact on the quality of the environment.
Native Title Act & Amendments	Outlines legislative issues local governments need to consider where its assets may be impacted by Native Title.
Ozone Protection and Synthetic Greenhouse Gas Management Act	Outlines legislative issues local governments need to consider where its assets may contain ozone depleting substances

Commonwealth of Australia	
Legislation	Requirement / Asset Related Implications
Renewable Energy (Electricity) Act	Outlines legislative issues local governments need to consider where its assets may be capable of delivering or using renewable energy e.g. gases generated in waste disposal sites
Road Transport Reform (Vehicles and Traffic) Act	Sets out the role, responsibilities and powers of a local government in relation to the regulation of traffic on council controlled roads
Roads to Recovery Act	Provides for access to Commonwealth funding for roads expenditure by local governments
Telecommunications Act	Outlines legislative issues local governments need to consider where its assets may be impacted by telecommunications services.

Appendix E – Driveways Policy



Title: Driveways
 Policy No: 133
 Responsibility: Director Technical Services

Version	Decision Number	Decision Date	History
1	17\1228	25/02/97	Adopted
2	19\4604	12/06/07	Reviewed
3			
4			

- Council will maintain a single driveway to each and every property within the Municipality.
- Council will maintain a three (3) metre wide driveway to each residential allotment, zoning R1 and R2.
- Council will maintain a 4.5 metre wide driveway to each allotment, zoned R3 and I1.
- Council will maintain a 6m driveway to each allotment, zoned R4, I2 and I3.
- Where a driveway is less than 50% serviceable a concrete driveway is provided. If the driveway is more than 50% serviceable, the driveway is repaired.
- Home owners may have an existing bitumen driveway replaced in concrete by contributing towards the cost on a pro rate basis eg 60% serviceable - 60% contribution, Council will provide balance of cost.
- Under Council's By-Laws, Council has the authority to insist that an unused driveway or a driveway in use but which has not been constructed according to standard, be reinstated or repaired as necessary and recover costs from the property owner.
- All driveways constructed within the Municipality will conform with Council's Standards, Drawing No. 5041/2.
- Driveways not conforming with Council's Standards (materials or width) may be approved at the Director Technical Service's discretion.

Appendix F – Road Standards Policy



Title: Road Standards
 Policy No: 277
 Responsibility: Director Technical Services

Version	Decision Number	Decision Date	History
1	17\1228	25/02/97	Adopted
2	19\4604	12/06/07	Reviewed
3			
4			

Council will determine road maintenance standards.

Road maintenance standards will be determined from Council's levels of service and measured using performance indicators.

A Pavement Management System will be developed for specific road maintenance to determine the most effective treatments.

A Maintenance Management System will be developed for routine maintenance activities to insure the most efficient maintenance practice.

Council will develop or access a corporate database to house inventory and condition data.

Appendix G – Footpath Construction and Reconstruction Policy



Title: Footpath Construction and Reconstruction
 Policy No: 154
 Responsibility: Director Technical Services

Version	Decision Number	Decision Date	History
1	18\755	31/10/00	Adopted
2	19\1960	30/08/05	Amended
3	19\4604	12/06/07	Reviewed – Version 3
4	19\4787	31/07/07	Amended

Purpose

The purpose of this policy is to provide guidance to Government, developers and residents on where Council requires footpaths to be provided throughout the municipality, the standards for design and construction and the priorities that Council applies to reconstruction programs.

Definitions

"Footpath" – paved area within the verge in the road reserve constructed predominantly for pedestrian travel. Unpaved areas are considered to be verge.

"Construction" – construction of a new footpath where one previously did not exist.

"Reconstruction" – replacement of an existing footpath with a new footpath.

"Obsolete Footpath" – on local roads where only one footpath is to be provided on one side of the street, an existing footpath on the opposite non preferred side will be classified as an obsolete footpath.

Exclusions

This policy does not cover the following:

- paths through parks and other public land that are not road reserve.
- walkways or laneways (refer to "Walkway Policy")
- footpaths used for alfresco dining and other commercial activities (refer to the "Alfresco Dining Policy", the "Policy for Footpath Dining Permits" or the "Mitchell Street Precinct Development Policy").
- footpath maintenance.
- pedestrian requirements along verges (refer to "Nature Strip Policy").
- cyclepaths and combined pedestrian/cyclepaths.



General Principles

Council will construct and maintain a footpath network throughout the municipality to provide appropriate pedestrian linkages to properties and public and private facilities in accordance with the following principles:

Council will aim to provide equal access opportunity to all and will not discriminate against people with a disability.

New footpath construction will be determined according to the road hierarchy, town planning zones and special needs.

Reconstruction will be prioritised within budgetary constraints and according to the road hierarchy, town planning zones, special needs and existing footpath condition.

Along a verge where a footpath is not being provided, a pedestrian corridor must be provided and maintained in accordance with Council's "Nature Strip Policy".

Footpath Construction for New Developments and Subdivisions

In new developments and subdivisions a footpath will be provided on:

- (i) one side of the road for local roads
- (ii) both sides of the road for collector roads and above on the road hierarchy
- (iii) the side of the road containing medium to high density residential housing (Zones R2 and above)
- (iv) the side of the road containing commercial, special use, industrial and community purpose zonings
- (v) a side of the road to meet a special need.

On the side of a local road where a footpath is not provided, access to all properties must be provided via the driveway in accordance with AS1428 Part 1.

Footpath Construction and Reconstruction for Existing Roads

Within financial constraints and priorities based on condition and need, Council will provide a footpath on:

- (i) one side of the road for local roads
- (ii) both sides of the road for collector roads and above on the road hierarchy.
- (iii) the side of the road containing medium to high density residential housing (Zones R2 and above).
- (iv) the side of the road containing commercial, special use, industrial and community purpose zonings.
- (v) a side of the road to meet a special need.

Where a footpath is not provided, access to all properties must be provided via the driveway in accordance with AS1428 Part 1, subject to physical constraints.

Footpath Standards

Footpaths shall be designed and constructed in accordance with Austroads Guide to Traffic Engineering Practice, Part 13 and Council's Standard Drawings and Specifications. Council's Standard Drawings and Specifications will take precedence over the Austroads Guide where they differ. Generally the footpath in a residential or industrial area will be constructed from concrete, be 1.2m wide and offset 300mm from the property boundary with a 1.5% cross-fall, however, the footpath may be located anywhere within the verge width to meet specific local requirements. In a commercial area the footpath will generally be full verge width, except in new developments or redevelopments where substantial softening of those areas with appropriate landscaping is required. Ramps and crossings will generally exceed the minimum requirements of AS1428 Part 1.

Polished and smooth, sealed surfaces, eg. ceramic tiles will not be approved.

Root barriers will be installed on both sides and along the full length of all new footpaths in new subdivisions and developments. In established road reserves root barriers shall be installed where required during new constructions and reconstructions.

Visual Aids

Council is still considering the appropriate use of tactile tiles and other forms of grade definition to assist pedestrians with a visual impairment. Developers should approach Council staff to determine requirements on a case by case basis until a position is finalised.

Lighting

Generally footpaths will be lit from the street lighting system in accordance with AS/NZS 1158.3.1. Where there is no street lighting the footpaths will not be separately lit.



Removal of Obsolete Footpaths

On local roads where a serviceable footpath has been provided on one side of the road and an existing footpath on the opposite side of the road has deteriorated to such an extent that it is no longer practical to maintain (the obsolete footpath), Council may remove the obsolete footpath and replace it with either gravel or soil and seed depending on the circumstances within that street. If soil and seed is provided, Council will rely on the resident to propagate and maintain the verge. Council may leave an obsolete footpath in place if it does not pose any significant safety concern to the public. Council will provide only minimum maintenance to obsolete footpaths.

If an owner or resident wishes to upgrade their verge, they may remove the obsolete footpath at their expense and upgrade the verge in accordance with Council's "Nature Strip Policy".

Reconstruction Priorities on Existing Roads

Council's priority is to provide at least one fully compliant footpath in good condition generally throughout the whole of the municipality before commencing reconstruction of footpaths on the opposite side of the road. Exceptions to this will be based on need and merit, eg. special mobility needs.

Issues to be considered when determining which roads and which sides of the road have highest priority may include but are not limited to the following:

- concentrations of pedestrian and vehicular traffic and potential for conflict,
- access to community, public and commercial facilities,
- preferred pedestrian paths ie. shortest distance walked,
- linkages to other paths,
- verge vegetation,
- location of services,
- special needs,
- pedestrian links identified in Council strategies,
- other site specific issues.

Footpaths will generally not be constructed adjacent vacant or undeveloped lots due to potential damage caused during subsequent development. If however the footpath is a high usage linkage, or there is a special need mobility issue or there are considerable delays expected in the development of the land, a suitable standard footpath may be provided.

Construction and reconstruction of new footpaths will generally be considered a higher priority than removal of obsolete footpaths unless safety is an issue.

Access to Commercial Properties

Commercial property owners are required to provide equal access to their building within their property boundaries. Generally ramps will not be approved in the public space, however where only minor changes of grade are required and there is no adverse impact within the road reserve, minor adjustments may be approved at the owners expense.

Process Advising Residents

- I) Council will send out a standard letter to the owner/resident at the beginning of the financial year advising of Council's intention to construct/reconstruct a footpath on the odd/even numbered side of the road and requesting that any objection to the proposal be lodged within 30 days (Attachment E to Report Number 07TS0185).
- II) Approximately 2 weeks prior to construction/reconstruction of the footpath, staff will letterbox residents notifying them of the intended commencement of construction/reconstruction (Attachment F to Report Number 07TS0185).
- III) If significant tree/root pruning is required, staff will letterbox drop residents approximately 3 working days in advance advising of impending works (Attachment B to Report Number 07TS0185).
- IV) If a driveway is more than 50% damaged and is to be reconstructed as part of the footpath reconstruction program, the affected residents are letterboxed 3 days in advance to ensure that appropriate property access is arranged (Attachment D to Report Number 07TS0185).

Returned results of the first letter will be compiled and any objections will be responded to by staff to try to satisfy the residents concerns. If a street has an overwhelming "no" response i.e. more than 50% of residents oppose the construction / reconstruction it generally will not proceed until such time as there is a change in support from the local residents, unless a special need exists. If there is a strong but not overwhelming objection (20-50% of residents/owners) staff will put a report to Council with a recommendation whether to proceed or not. Residents/owners will be advised of the outcome. If there is weak objection (<20% of residents/owners) staff will advise the residents/owners of our intention to proceed.

During Step 2, staff will try and visit or contact each resident/owner who objects to the construction and try to satisfy their concerns. If the staff member is unable to satisfy their concerns, the objector will be advised to write in formally to Council. The Operations Manager normally responds to these objections with copies going to Ward Aldermen and normally advises that the works would proceed. If a petition is received prior to commencement of construction, or if a direction comes from the Director of Technical Services or Chief Executive Officer the works are postponed and a report is put to Council. If the works have already begun, a decision may be made to halt the works or proceed depending on the circumstances.

Appendix H – Footpath Maintenance Policy



Title: Footpaths Maintenance
 Policy No: 157
 Responsibility: Director Technical Services

Version	Decision Number	Decision Date	History
1	17\1228	25/02/97	Adopted
2	19\4604	12/06/07	Reviewed
3			
4			

The future priority for footpath maintenance and reconstruction will be directed towards addressing hazardous footpaths or sections of footpaths in the areas of greatest pedestrian use.

Priorities will be assigned following the annual assessment of the footpath condition survey.

Appendix I – DCC Data Collection Manual

DARWIN CITY COUNCIL DATA COLLECTION MANUAL

4. Pavement Condition Rating

4.1 Background

The current data collection manual provides a simple, practical and low cost methodology to collect reliable data on pavement condition. Though more sophisticated, complex or automated methods are available, for all practical purposes this method provides data with sufficient accuracy and reliability for managing pavement maintenance.

The aim of this section is to assist in the rating of pavement conditions in a uniform and consistent manner. This will ensure the consistency of data for the planning of pavement maintenance and rehabilitation work programs in the future.

The methodology for collecting and rating of condition data is based on a simple systematic visual assessment. Individual short sections – data blocks – are to be inspected by the rater in a continuous manner. Inventory and condition data is to be recorded on the "Field Data" sheets or directly in a small computer carrying the electronic equivalent of the field data sheet.

The underlying principles of this data collection methodology are

1. The rater collects information, making as few judgements on the road as possible
2. The information is recorded for short, uniform sections, usually 20 – 50 m long.
3. The recorded information will be aggregated for the segments by the location-referenced system (dTMS).
4. The recorded information fall into the following categories, i.e.
 - a. Surface defects
 - b. Pavement defects
 - c. Riding quality
 - d. Inventory and condition

Another grouping of the data types is:

- Structural integrity (Deflections, Pavement defects)
- Safety (Surface defects, texture, shoulders)
- Durability (Surface defects, age)
- Functionality (roughness, width)
- Inventory (line marking, roadside furniture, traffic facilities)

Some of the collected data may fall into more than one of the above categories. Collecting (or omitting) data in the above categories determines outcomes and depth of the analysis.

 DARWIN CITY COUNCIL DATA COLLECTION MANUAL

5. The locations of the data blocks is defined by their sequence in the database and their length.

6. The aggregated information is always linked to a location.

The measured defects such as Cracking, Rutting, Local pavement defects and Flushing is recorded in details. This usually involves counting the number of occurrence, or measuring length of the distressed pavement. In order to make the data collection more efficient, only the per cent length or area will be recorded.

For Darwin City Council it is proposed to collect some of the data as the per cent length. To take into account multiple lanes, the percent length of each lane is to be assessed, added up and divided by the number of lanes. E.g. the two lane street has one direction cracked 30% and the other direction is cracked 90% of its length. The cracked length to be recorded will be $(90+30) / 2 = 60\%$.

The rated distresses such as Ride Quality and Kerb are rated typically on a scale of 1 – 5 ("1" being excellent and "5" for worst) based on a set of predefined condition scores.

The above methodology was developed to address a few major concerns related to visual condition surveys, such as:

1. Reliability of data is linked to two questions, namely (a) does the rater assess the data correctly and (b) is the assessment representative for the rated section. The correctness of the assessment can be addressed by training and experience. The second issue usually demands a certain "mental averaging" by the rater. By using short data blocks the need for any judgement by the rater is removed, as the short data blocks are easier to assess and are more likely to be uniform. The automated data aggregation creates a more reliable data set. It is also easier to go back and check the results.
2. Rating is a subjective decision, where the rater has to decide the score based his understanding of the condition. The current methodology removes the need to make decisions and replace it with recording the facts wherever possible. For the sake of simplicity, the proposed methodology does not require any measurements in its current format. Instead of making measurements, the rater estimates length or area. Based on past experience, the error in estimating say cracked length within a 20 m long section is within 10% (or 2 m). The least possible error in a rating system (ranging from 1 to 5) is one unit, i.e. 20%. Even when estimates are used, the potential error is smaller than with a rating system
3. Deterioration is not measurable when using a rating system. The condition of a pavement is clearly understood when say the cracking extent increases from 10 to 15%. However the meaning of the condition deteriorating from score of 2 to 3 is less clear.
4. Deterioration is gradual when using physical dimensions, such as length or area as opposed to using a scoring system where condition is represented with whole (integer) numbers

 DARWIN CITY COUNCIL DATA COLLECTION MANUAL

4.2 Data Blocks

Data blocks are created to make data collection easier, more flexible and at the same time the rater more accountable. The length of the data block is left entirely for the rater to decide. It can be any length as long as the length is recorded.

This allows to rate homogeneous sections in one go by creating one long data block and to break up a section into several homogeneous blocks.

The suggested data block length is between 20 – 100 m. Any block length longer than 100 m will diminish the reliability of the data and will need to be checked

The database offers facilities to create and record data blocks.

4.3 Pavement Defects

A detailed methodology for collecting or rating the primary distress is to obtain quantitative data for use in the planning of maintenance work program.

Defects that affect the pavement structure at some depth are usually termed as "pavement defects".

The observed distresses are:

- Cracking
- Rutting
- Potholes and localised failures
- Repaired potholes and patching
- Deformation

4.3.1 Cracking

Cracking is the indicator of fatigue due to age or structural weakness of the pavement. It is related to the general health of the surface and structural integrity of the pavement.

Pavement cracking in the data block is measured according to: -

- The predominant type of cracking

<i>L (Longitudinal)</i>	Cracking running lengthwise along the pavement (Figure 3)
<i>T (Transverse)</i> (Figure 4)	Cracking running across the pavement
<i>B (Block) or crocodile</i>	Interconnected or interlaced cracks forming a series of small polygons (Figure 1 and Figure 2)
- The severity of cracking

Severity of cracking is usually defined in terms of crack width. This is rarely consistent within even one crack, let alone over a number of cracks. The severity of cracking – or crack width – is not recorded according to this manual.
- The extent of cracking

Extent of cracking is measured according to the per cent of the length affected by the cracking.

DARWIN CITY COUNCIL DATA COLLECTION MANUAL

The affected area of cracking at a location will be calculated automatically, i.e. it is not recorded by the rater.

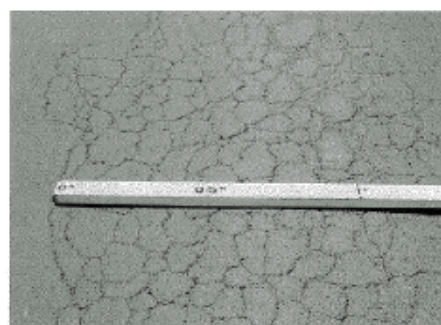
Note: transverse cracking is defined as cracks which are not closer than 2 m; if this is not the case, the cracking is to be considered "block" or crocodile. Transverse cracks are not quantified, only their existence is noted by writing "yes" into the relevant field.

As cracking can be different on the different lanes or side of the road, 100% of the data block length is interpreted as the total lane length. Consequently if one lane is cracked in full length, it should be recorded as 50% cracked. If both lanes are cracked about 50%, the total cracked length is 50%. The cracked area will be calculated by using the number of lanes. An other example: a two lane street has one direction cracked 30% and the other direction is cracked 90% of its length. The cracked length to be recorded will be $(90+30) / 2 = 60\%$.

Table 1 Example for cracking

Chainage	Percent length of block length		
	Block length	Longitudinal	Transverse
0	25	10%	Yes
25	25	30%	no
50	25	0	no

Figure 1 Crocodile / Block Cracking (1)



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Figure 2 Crocodile or Block cracking (2)

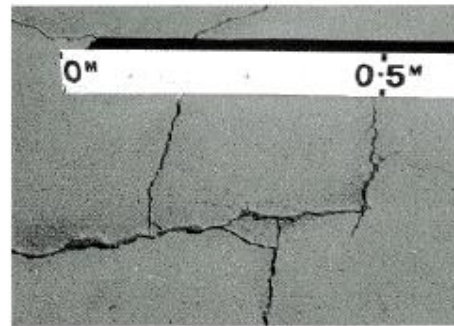
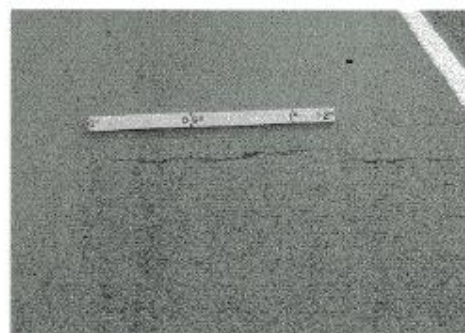


Figure 3 Longitudinal Cracking



Figure 4 Transverse Cracking



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4.3.2 Rutting

Rutting is defined as the continuous longitudinal depression that forms in the wheel paths of a road under traffic loading. It is one of the principal ways in which a road may fail. A rutted road will usually require major treatment making its identification at an early stage an important factor in maintenance forecasting.

Rut depth is defined as the maximum surface level variation measured from an imaginary straight line between two points on the pavement surface (usually measured under a 1.2m straight edge). (Figure 5)

For practical purposes no physical measurements are to be taken, but the rater assesses the typical rut depth over the block length (20-50 m) and records the per cent length of the block for the relevant rut depth category.

The typical rutting in one of the following five major groups is to be recorded for every block.

The percent length refers to the total lane length if there is more than one trafficked lane. E.g. if the half block length is rutted in one lane and there are two lanes, 25 percent length is recorded.

The total of the five rutting columns should be 100 per cent.

Table 2 Example for rutting

Chainage	Block length	Rutting category				
		0 - 5 mm	5-10 mm	10 - 15 mm	15 - 20 mm	>20 mm
0	25	100%			0	
25	25	30%		70%	0	
50	25	0	100	0	0	

Rutting may differ in the two wheel paths. The worst of the two wheel paths should be observed and the other is to be ignored.

Care should be taken for not recording very short "rutting" as these should be recorded as depressions.

Figure 5 Rutting



4.3.3 Deformations

Deformations appear as localised depressions on the surface. Deformations usually indicate structural deficiency, i.e. a break down

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of the structural integrity of the pavement. Shoving is a typical deformation.

The rater records the total per cent length of the data block that shows deformations

Figure 6 Shoving



Figure 7 Pothole



4.3.4 Pothole

A pothole is an area where the pavement surface has deteriorated, resulting in the cracking and eventual breaking up of the surface to form a cavity.

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The rater records only the presence of potholes, without quantifying it. (It is anticipated that potholes will be treated within a short time)

4.3.5 Repaired Pothole

Repaired pothole appears as a small patch. The rater records only the presence of repaired potholes within a data block.

Figure 8 Patches



A *Patch* is defined as a successfully executed permanent repair. It provides a surface condition equivalent to the surrounding pavement surface and provides a waterproof seal over its surface and around its perimeter. Any rehabilitation or major treatment larger than 100m in length and at least one full lane wide is not considered a patch. Edge patching extending less than 300mm into the Trafficable Width is to be ignored as it does not indicate the structural or surface condition of the pavement.

The rater records the per cent length of the block where patches are present

4.4 Surface Defects

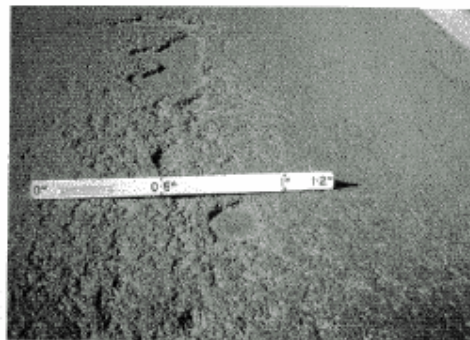
Surface defects are the deterioration of the surfacing that contribute to the breakdown of the surface condition. The number of surface defects also indicates the maintenance effort required for maintaining the integrity of the surface.

Surface defects include temporary or unsuccessful patches, shoving, ravelling, flushing and stripping.

The rater records the per cent length of the data block affected by each of the surface defects.

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Figure 9 Ravelling



4.4.1 Flushing

Flushing is the occurrence of excessive bitumen at the surface of either a spray bituminous chip seal (CS), Asphalt Concrete/Slurry Seal (AC), resulting in a smooth bitumen rich surface.

Flushing is an assessment of future serviceability of the surface. It generally leads to surface deterioration and unsafe travelling. A flushed surface may pick up leading to potholing.

Flushing typically occurs where traffic runs, i.e. wheel paths. It is therefore the per cent length of wheel paths is to be recorded where the pavement surface has flushed.

Figure 10 Flushing

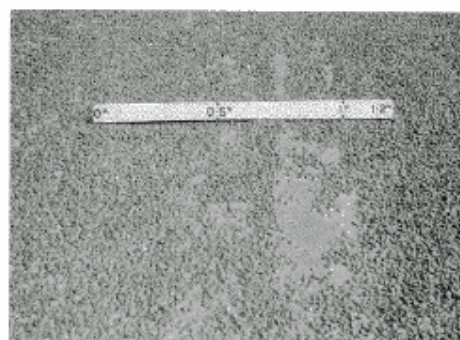


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4.4.2 Stripping

Stripping is the loss of aggregate from the surface of a spray bituminous chip seal surface. It is an indicator of serious wearing surface failure in pavements. If left in this condition, the base course layer becomes exposed to adverse weather and traffic conditions thus accelerating deterioration of road pavement. The per cent length of stripping is to be recorded.

Figure 11 Stripping

**4.5 Ride Quality / Surface Evenness Rating**

Ride Quality or surface evenness is identified as the general profile of the pavement in the longitudinal direction with the condition score based on the amount of horizontal deviation in the pavement surface. In lieu of an objective measure, this is a subjective indicator of driver's comfort. When more objective and cost effective roughness measurement becomes available, that should be used instead of the current visual (subjective) method.

The condition score is the number against the condition description which best describes the typical condition of ride quality within the block. It is recognised, that the same comfort level may be rated differently on different roads, as some conditions may be acceptable on certain roads whilst would be unacceptable on others.

- Condition 1 = Excellent smooth surface. No treatment is required.
- Condition 2 = Good smooth surface with some depressions. The riding quality is generally good.
- Condition 3 = Fair riding comfort with some rough sections. Condition is acceptable. Treatment is required in the future (more than 5 years)
- Condition 4 = Poor and rough surface requiring attention in the near future. Ride is not comfortable. Treatment is required in the near future
- Condition 5 = Very rough surface, without any ride comfort. Immediate rehabilitation is required.

The lesser reliability of this data is taken into account in the evaluation and analysis.

Appendix J – Road Resurfacing Program 2009/10

NOTES						
All areas where the mapinfo area was more than 10% greater than the spreadsheet area, the areas were changed to reflect the more accurate area.						
Cul-de-sacs have been given an allowance of an extra 300 sq m, as quite often the MapInfo areas were over 30% the original area.						
Priorities - as determined from site inspection of all roads with 2008, 2009 and 2010 proposed treatment years						
Treatments						
AC - Asphalt Overlay						
AR - Asphalt Resurface (mill existing asphalt)						
SP7 - Spray Seal with 7mm Aggregate						
SP7C - Same as SP7 with cul-de-sac end being asphalt						
2009/10 Program by Suburb						
Road	Suburb	Treatment	Area m2	Priority	Year	Comments
WHEEL COURT	ANULA	SP7C	932	1	2009	
CLIFTON COURT	ANULA	SP7C	959	1	2009	
JADE COURT	ANULA	SP7C	639	1	2009	
MOO STREET	BERRIMAH	SP10	800	1	2009	No cul-de-sac
VIGILANT LANE	BERRIMAH	SP10	1710	1	2009	No cul-de-sac
HAZELL COURT	COCONUT GROVE	SP7C	2580	1	2009	
CRAIG CRESCENT	COCONUT GROVE	SP7	2519	1	2009	
MUSGRAVE CRESCENT	COCONUT GROVE	SP7	2408	1	2009	
OLD MCMILLANS ROAD	COCONUT GROVE	SP10	6385	1	2009	To Trower Road only (Coconut Grove)
PETERS STREET	COCONUT GROVE	SP7	646	1	2009	
RADFORD COURT	COCONUT GROVE	SP7C	1110	1	2009	
HERBERT STREET	DARWIN	AR	1360	1	2009	Postponed from 2008
SPAIN PLACE	DARWIN	AC	398	1	2009	
STOTT LANE	DARWIN	AC	950	1	2009	Includes carpark
YUEN PLACE	DARWIN	AC	340	1	2009	
ROSS SMITH AVENUE	FANNIE BAY	AC	1260	1	2009	Postponed from 2008
BRAZIL CRESCENT	KARAMA	SP7	880	1	2009	
BUD COURT	KARAMA	SP7C	351	1	2009	
EUCLA COURT	KARAMA	SP7C	830	1	2009	
KOOLAMA COURT	KARAMA	SP7C	700	1	2009	
PERON COURT	KARAMA	SP7C	691	1	2009	
SUNDEW COURT	KARAMA	SP7C	1090	1	2009	
WYLIE COURT	KARAMA	SP7C	490	1	2009	
BAUDIN COURT	KARAMA	SP7C	918	1	2009	
KOOLAMA COURT	KARAMA	SP7C	1170	1	2009	
LEOBEN COURT	KARAMA	SP7C	1150	1	2009	
NONDA COURT	KARAMA	SP7C	880	1	2009	
SPATHE COURT	KARAMA	SP7C	1000	1	2009	
BERNIER COURT	KARAMA	SP7C	1810	1	2009	2 Dead ends
BLOODWOOD CIRCUIT	KARAMA	SP7	2104	1	2009	
BRAZIL CRESCENT	KARAMA	SP7	2509	1	2009	
FOURCROY STREET	KARAMA	SP7	2316	1	2009	
FREYINET STREET	KARAMA	SP7	2723	1	2009	
KARAMA CRESCENT	KARAMA	SP7	4484	1	2009	
BEROONA COURT	KARAMA	SP7	1580	1	2009	No cul-de-sac
KALYMNOS DRIVE	KARAMA	SP7	6071	1	2009	
KALYMNOS DRIVE	KARAMA	SP7	6496	1	2009	
KOOJARRA COURT	KARAMA	SP7C	1730	1	2009	
DOTTEREL COURT	LEANYER	SP7C	798	1	2009	Postponed from 2008 for subsoil drainage
TIMOR COURT	LEANYER	SP7C	703	1	2009	
DANIELS STREET	LUDMILLA	SP7	2307	1	2009	No cul-de-sac
EMMIT STREET	MALAK	SP7	296	1	2009	
ROSS STREET	MALAK	SP7	249	1	2009	
SUNNINGDALE COURT	MARRARA	SP7C	684	1	2009	
TEE COURT	MARRARA	SP7	320	1	2009	No cul-de-sac
TROON PLACE	MARRARA	SP7C	519	1	2009	
WENTWORTH COURT	MARRARA	SP7C	561	1	2009	
CARNOUSTIE CIRCUIT	MARRARA	SP7	4968	1	2009	
CARNOUSTIE CIRCUIT	MARRARA	SP7	5472	1	2009	
COOLIBAH STREET	NIGHTCLIFF	SP7	1693	1	2009	
DRYSDALE STREET	PARAP	AC	1944	1	2009	Needs new K&G on even side
PARAP PLACE	PARAP	AC	3960	1	2009	Include small section of Virmy Lane
JOHNSTON PLACE	RAPID CREEK	SP7C	826	1	2009	
JORDAN PLACE	RAPID CREEK	SP7C	673	1	2009	
FOX CRESCENT	RAPID CREEK	SP7	1768	1	2009	
RAMIREZ STREET	STUART PARK					Postponed from 2008
MARIA STREET	WAGAMAN	SP7	628	1	2009	
COUSIN STREET	WINNELLIE	SP10	3146	1	2009	

2010/11 Program (by priority)						
Priority 1 - Roads given priority 2 for 2009						
Priority 2 - Roads given priority 1 for 2010						
Priority 3 - Roads given priority 2 for 2010 - Will need to be confirmed						
Road	Suburb	Treatment	Area	Priority	Year	Comments
KOHINOOR STREET	ANULA	SP7	2931	2	2009	Taken off 2009 list
MAUDE STREET	ANULA	SP7	2088	2	2009	Taken off 2009 list
STRATH ROAD	BERRIMAH	SP10	5490	2	2009	Taken off 2009 list
BRIGGS STREET	DARWIN	AC	1000	2	2009	
EDMUNDS STREET	DARWIN	AC	1833	2	2009	
WEST LANE	DARWIN	AC	1980	2	2009	
FIG COURT	KARAMA	SP7C	780	2	2009	Removed from 2009 Program
MORETON PLACE	KARAMA	SP7C	1350	2	2009	Removed from 2009 Program
PELHAM COURT	KARAMA	SP7C	1140	2	2009	Taken off 2009 list
COPRA CRESCENT	KARAMA	SP7	3025	2	2009	Removed from 2009 Program
CREBER COURT	KARAMA	SP7	2250	2	2009	Removed from 2009 Program
CASHEW COURT	KARAMA	SP7C	980	2	2009	Removed from 2009 Program
BATHURST STREET	LEANYER	SP7	2470	2	2009	
DUNDAS STREET	LEANYER	SP7	780	2	2009	
FIELD COURT	LEANYER	SP7C	398	2	2009	
ORD PLACE	LEANYER	SP7C	297	2	2009	No Geofab
BONAPARTE STREET	LEANYER	SP7	2757	2	2009	
EXMOUTH COURT	LEANYER	SP7C	1240	2	2009	
COBURG DRIVE	LEANYER	SP7	4649	2	2009	
HANDS COURT	MALAK	SP7C	820	2	2009	
MACHELL COURT	MALAK	SP7C	312	2	2009	Taken off 2009 list
HARCUS COURT	MALAK	SP7C	1233	2	2009	Taken off 2009 list
TODD CRESCENT	MALAK	SP7	2714	2	2009	No Geofab
HARCUS COURT	MALAK	SP7C	342	2	2009	Taken off 2009 list
MILLNER STREET	MILLNER	SP7	2441	2	2009	No Geofab
ROBERTS PLACE	MILLNER	SP7C	306	2	2009	
SPRIGG STREET	MILLNER	SP7	1924	2	2009	No Geofab
BOYLE STREET	MOIL	SP7	840	2	2009	No Geofab
OMEQ STREET	BRINKIN	SP7	3255	1	2010	
DONALDSON COURT	KARAMA	SP7C	615	1	2010	
DONALDSON COURT	KARAMA	SP7C	2630	1	2010	
MILKWOOD CIRCUIT	KARAMA	SP7	4480	1	2010	
GLYDE COURT	LEANYER	SP7C	1238	1	2010	
SHOAL COURT	LEANYER	SP7C	368	1	2010	
CULLEN STREET	LEANYER	SP7	3534	1	2010	
SANFORD STREET	LEANYER	SP7C	4250	1	2010	
CADELL STREET	LEANYER	SP7	3822	1	2010	
BEE COURT	MALAK	SP7C	360	1	2010	
MARSHALL COURT	MALAK	SP7C	403	1	2010	
PAQUALIN ROAD	MALAK	SP7	3444	1	2010	
SQUIER COURT	MALAK	SP7C	722	1	2010	
HAZARD COURT	THE NARROWS	SP7C	364	1	2010	Do with Fleming St - no cul-de-sac
FLEMING STREET	THE NARROWS	SP7	2815	1	2010	
ROCKLANDS DRIVE	TIWI	SP7	5100	1	2010	Needs to go further
BOWEN STREET	WINNELLIE	SP10	3350	1	2010	
ELLISON COURT	ANULA	SP7C	823	2	2010	No Geofab
EMPIRE COURT	ANULA	SP7C	1028	2	2010	
HOWLEY CRESCENT	ANULA	SP7	3631	2	2010	No Geofab
EVELEEN COURT	ANULA	SP7C	835	2	2010	
MIRAMBEENA STREET	DARWIN	SP7C	2130	2	2010	
MCARTHUR COURT	LEANYER	SP7C	998	2	2010	
KAPOL CRESCENT	MALAK	SP7	2880	2	2010	
LAKES CRESCENT	MARRARA	SP7C	5080	2	2010	
LINKS ROAD	MARRARA	SP7	4990	2	2010	
FITZGERALD STREET	MILLNER	SP7	1550	2	2010	No cul-de-sac, no geofab
ROWLING STREET	NAKARA	SP7	3425	2	2010	Wrong seal year
CHARLTON COURT	STUART PARK	SP10C	2680	2	2010	Look at
LEE POINT ROAD	WANGURI	SP7	3720	2	2010	Look at
LEE STREET	WINNELLIE	SP10	1970	2	2010	

Appendix K – Footpath Program 2009/10

Priority		From	To	Suburb	Side	Constr. Type	Length	Area
3	Alawa Crescent	Trower Rd	Gsell St	Alawa	E	R	1300	1560
3	Scriven Street	Alawa Cres	Dripstone Rd	Alawa	O	C	240	288
2	Clifton Court	#12	Springhill St	Anula	E	R	140	168
3	Leviathan Court	#1	#17	Anula	O	R	210	252
2	Lucy Street	Trower Rd Gsell St	Shackle St	Anula	O	R	60	72
2	Matthews Road	Mc Millans Rd	Patterson St	Anula / Wanguri	O	R	1420	1704
3	Angelo Street	Trower Rd	Gsell St	Casuarina	E	R	200	240
1	Mitchell Street - outback jacks	#28	#26	CBD	E	C	50	200
1	Mitchell Street - ducks nuts	#76	#72	CBD	E	C	90	360
4	Harry Chan Avenue	Smith St	Cavenagh St	Darwin City	O	R	400	1600
1	Keith Lane	Hinkler Cres	Ross Smith Ave	Fannie Bay	O	R	160	480
4	Newell Crescent	Kilian Cresc	Kilian Cresc	Jingili	E	R	310	372
3	Smith Street	Packard Pl	Lambell Tce	Larrakeyah	O	R	540	648
1	Leanyer Drive	Parkside Cresc	Vanderlin Dv	Leanyer	O	R	410	492
3	Fitzmaurice Drive	Lee Point Rd	Cadell St	Leanyer	O	C	680	816
2	Harcus Court	#1	#7	Malak	O	R	180	216
2	Jarvis Street	Dalwood Cres	Vanderlin Dv	Malak	E	R	180	216
2	Lowrie Court	#1	#6	Malak	E	R	180	216
2	Maddock Court	#1	#9	Malak	O	R	220	264
2	Radge Court	#12	Darwent St	Malak	O	R	190	228
3	Ringwood Street	Matthews Rd	Darwent St	Malak	O	R	160	192
2	Stapleton Court	#1	#7	Malak	O	R	170	204
3	Westralia Street	Margaret St	Mary St	Stuart Park	E	R	320	384
3	Erlunda Street	Trower Rd	Calvert St	Twini	O	R	150	180
3	Wanguri Terrace	Lee point Rd	Tambling Tce	Wanguri	O	R	1360	1632
4	Albatross Street			Winnellie		R	840	1008