

Document Verification

Project title	Chirnside Park Melbourne Water Works	ACN 080 852 231 ABN 73 080 852 231
Document title	Maintenance Manual for Green Spine WSUD	Project number 981
Description	Summarises Management and Maintenance Requirements for WSUD components of the Green Spine	
Client Contact	Gary Bateman	

	Name	Signature	Issue:	Date
Prepared by	Jamie Tainton / Rod Wiese		C	3/12/10
Checked by	Jamie Tainton / Rod Wiese			
Issued by	Rod Wiese			
Filename	Green Spine WSUD Maintenance Manual V1.doc			

Document History

Issue to:	Issue A		Issue B		Issue C	
	Date	No. Copies	Date	No. Copies	Date	No. Copies
Council	30/06/10	pdf	5/11/10	pdf	3/12/10	pdf
Melbourne Water			5/11/10	pdf	3/12/10	pdf

Commercial in Confidence

All intellectual property rights, including copyright, in designs developed and documents created by STORM CONSULTING Pty Ltd remain the property of that company. Any use made of any such design or document without the prior written approval of STORM CONSULTING Pty Ltd will constitute an infringement of the rights of that company which reserves all legal rights and remedies in respect of any such infringement.

The information, including the intellectual property, contained in this document is confidential and proprietary to STORM CONSULTING Pty Ltd. It may only be used by the person to whom it is provided for the stated purpose for which it is provided, and must not be imparted to any third person without the prior written approval of STORM CONSULTING Pty Ltd. STORM CONSULTING Pty Ltd reserves all legal rights and remedies in relation to any infringement of its rights in respect of its confidential information.

© 2010 STORM CONSULTING Pty Ltd

Disclaimer

This report is prepared by STORM CONSULTING Pty Ltd for its clients' purposes only. The contents of this report are provided expressly for the named client for its own use. No responsibility is accepted for the use of or reliance upon this report in whole or in part by any third party.

This report is prepared with information supplied by the client and possibly other stakeholders. While care is taken to ensure the veracity of information sources, no responsibility is accepted for information that is withheld, incorrect or that is inaccurate. This report has been compiled at the level of detail specified in the report and no responsibility is accepted for interpretations made at more detailed levels than so indicated.

TABLE OF CONTENTS

1.0	DESCRIPTION OF THE MANUAL	1
1.1.	Overview.....	1
1.2.	Structure of the Manual	1
2.0	INTRODUCTION	2
2.1.	Background	2
2.2.	Design Objectives.....	2
2.3.	System Components	3
3.0	MANAGEMENT.....	4
3.1.	Management Issues	4
3.2.	Roles	6
4.0	INSPECTION/MONITORING	8
5.0	MAINTENANCE WORK.....	10
6.0	INCIDENT MANAGEMENT.....	12
7.0	SPECIFICATIONS.....	13
7.1.	Hard Engineering Structures	13
7.2.	Catch Drains.....	14
7.3.	Footpath	15
7.4.	Batters and Backfilled Areas	16
7.5.	Sediment Pit with Rock Surround.....	17
7.6.	Rock Chutes	18
7.7.	Infiltration Zones.....	19
7.8.	Bioretention	20
7.9.	Plantings.....	22
8.0	CONTACT LIST	24

APPENDICES:

APPENDIX A - Detailed Design Plans for WSUD components of the Green Spine

APPENDIX B - Inspection Checkmaps

APPENDIX C - Inspection Calendar

APPENDIX D - Maintenance Calendar

Glossary of terms

- Bioretention – a WSUD element comprising specified media that filters stormwater to improve the water quality
- Catch Drains – a small channel designed to intercept overland flows and direct them to a specified point
- Checkmap – the document that records inspection information
- Catchment – an area of land bounded by its highest land areas, that drains all runoff to a particular low point in the landscape. Also known as a Watershed.
- Debris – litter and organic material that may be transported by stormwater flows
- Downstream – area where the point of interest would drain stormwater to
- Drainage layer – a layer of gravel at the base of a bioretention system (raingarden) with a perforated pipe sitting within it to collect excess water in the raingarden.
- Filter media – specified materials that are used in bio-retention or raingardens for stormwater quality improvement
- Hydrocarbons – oils and greases
- Infiltration – the movement of water through a filter media or into the soil
- Inundation – covered by water (submerged) normally as a result of flooding or intentional capture for stormwater treatment (as in the case of a raingarden)
- Littoral vegetation – species that grow in damp environs but do not remain inundated
- Raingarden – A rain garden is a depressed area of the ground planted with vegetation. It is a landscape feature that is designed to collect and filter all (or as much as possible) stormwater runoff from impervious urban areas (such as roofs, driveways, car parks, paths and compacted lawn areas). This runoff has the opportunity to infiltrate into the groundwater supply or be returned to the atmosphere through evaporation and evapo-transpiration. Also known as a bio-retention system.
- Runoff – Runoff is a term used to describe excess water from rainfall, or irrigation practices when soils are saturated, that flows over the land surface and is not absorbed into the ground, instead flowing into streams or other surface waters or land depressions.
- Scour - erosion
- Sedimentation – the process of depositing sediment that has been transported from the upstream catchment to its point of 'rest'.
- Sub-soil drainage – a pipe normally in a gravel media to drain any excess water in the soil/media profile
- Transition layer – specified media placed above the drainage layer within a raingarden or bio-retention system
- Upstream – area in the catchment above that drains to the point of interest
- WSUD – water sensitive urban design. Drainage design elements that aim to capture, cleanse and convey stormwater in an improved state of quality.

1.0 DESCRIPTION OF THE MANUAL

1.1. Overview

This Maintenance Manual represents a framework for the management of the Water Sensitive Urban Design (WSUD) components within the “Green Spine”, Maroondah Highway.

It provides information to enable managerial and maintenance staff from Yarra Ranges Shire Council (Council) to manage the WSUD features in a flexible manner that can be refined in the light of accumulated experience.

Routine checks and maintenance are required to ensure the system functions as designed and is vital to the longevity of the project and its performance.

1.2. Structure of the Manual

The manual is organised into the following sections.

Introduction - This section provides a brief background and description of the Green Spine Project. It also describes the management issues and highlights why ongoing maintenance is essential to the success of the project.

Management - This section explains the format for the maintenance of the Green Spine as well as describing the reporting structure and proposed relationship between the relevant parties.

Inspection and Monitoring - This section provides clear instructions for the inspection frequency of the Green Spine, relevant check maps and communication procedure to the maintenance party.

Maintenance Work - This section provides clear procedure following reports from the monitoring and inspections party and specifications for the personnel on-site undertaking maintenance of the Green Spine.

Incident Management - This section describes the actions to be taken in the event an unusual event in Green Spine (oil spill, pest outbreak, etc).

Specifications – This section provides the necessary actions to identify and rectify issues within the Green Spine.

Contact List – This section provides a list of personnel involved with the management and ongoing upkeep of the Green Spine.

2.0 INTRODUCTION

2.1. Background

As part of the Chirnside Park Urban Design Master Plan, the “Green Spine” extends along the Maroondah Highway from Manchester Road to Brushy Creek (approximately 25 kilometres East of Melbourne).

The Green Spine Project includes walkways, landscaping and public art to be accessed by the local community and travellers through the area.

Storm Consulting (STORM) completed the detailed design of the WSUD components of the Green Spine Project for Council through the lead consultant, ASPECT Studios. STORM's scope has since extended to produce this Maintenance Manual.

This area is to be maintained by Council from back of kerb to the property boundary. VicRoads will continue to maintain the pavement assets.

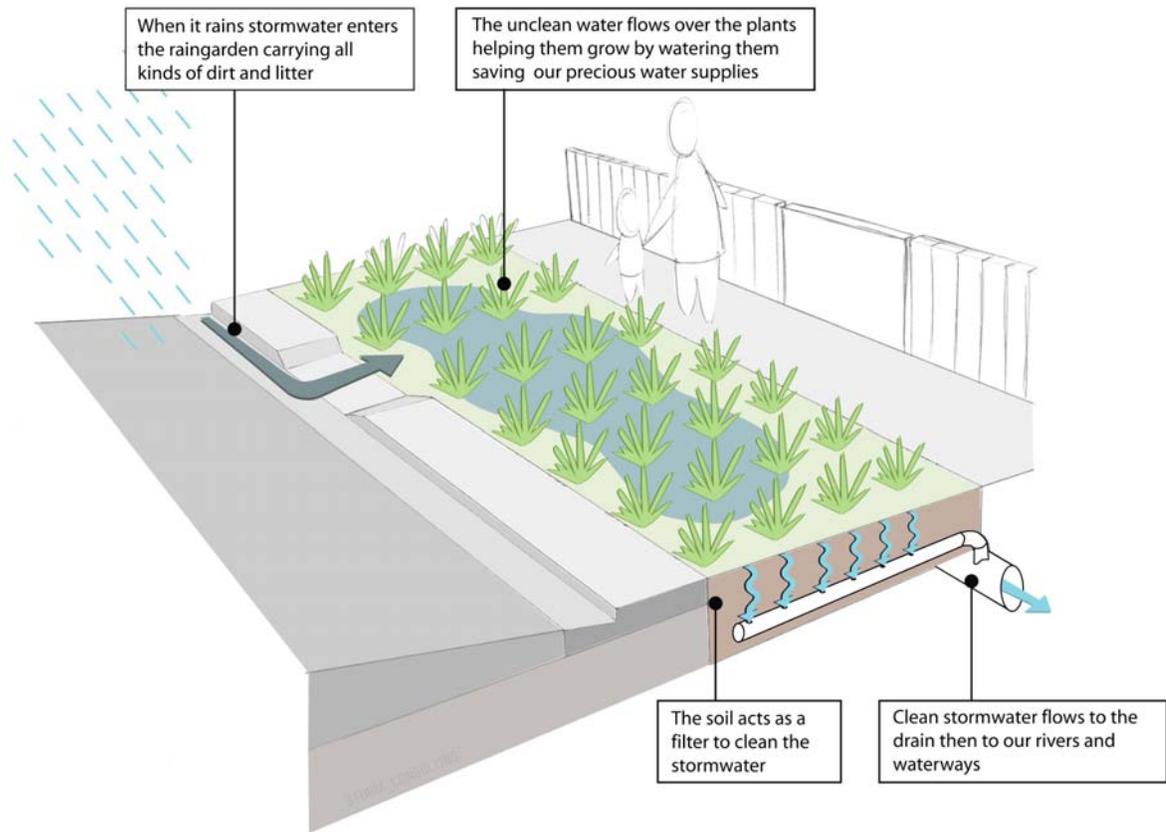
2.2. Design Objectives

Council has a vision that includes maintaining and reinforcing environmental quality and sustainability in all its senses. Council aims to produce environmentally and socially sensitive solutions to urban design issues.

Impervious surfaces typically generate pollutant loads that are washed into the drainage system by stormwater runoff. WSUD components intercept these pollutants and remove much of them allowing cleaner stormwater to enter the drainage system before reaching urban waterways.

The specific design objectives of the overall Green Spine Project are:

- To provide an easily identifiable green lung;
- To provide a gateway experience and central orienting space;
- To provide a sustainable brand for the shire – a gateway element;
- To provide a location for a shared pathway with links into the Brushy Creek and Lilydale; and
- To provide a location for ephemeral wetlands and swales for the improvement of stormwater quality.
- To provide safe and accessible connections, contributing to the improved liveability of the Chirnside Park area.



2.3. System Components

The components of the project include:

- new pits and pipes;
- interception of road runoff;
- infiltration areas;
- catch drains;
- scour protection;
- native plantings;
- swale and graded batters;
- integration with new retaining wall and footpath.

Refer Appendix A for Detailed Design Plans for Green Spine Project

3.0 MANAGEMENT

3.1. Management Issues

The following is a listing and definition of the main management issues facing the Green Spine Project.

The essential information to assist the inspectors and maintenance staff is detailed in the Monitoring and Maintenance sections in this Manual.

3.1.1. Vegetation

Specific plants have been specified as part of the project, designed by ASPECT.

They can be divided into several groupings including; groundcovers (littoral and terrestrial), shrubs and trees. Plants have been nominated based on their value, function and ability to thrive in the designed environment.

Maintenance of the Green Spine should aim to sustain the nominated densities of desirable vegetation. Inspection and maintenance personnel should expect gradual changes in vegetation, as a result of aggressive species out-competing more passive species, death of plantings and impacts from animals eating or destroying plants.

Various species such as birds and insects may be an issue particularly when plants are establishing. If fauna does become an issue then specific management plans must be devised with input from qualified persons. An example solution would be to construct nets over the new plantings to prevent bird access during plant establishment.

Additional plant species may be introduced from the surrounding catchment through various means. These could be natives or exotics and may require suitable management to ensure the nominated vegetation dominates the Green Spine's environment.

3.1.2. Sedimentation & erosion

Erosion around the Green Spine may be caused by high-energy water flows as well as people and animal movements. Sediment results from erosion, but is also derived from catchment surfaces such as roads, pathways, unvegetated areas and upstream construction activities.

Erosion and sedimentation can have a particularly damaging affect on designated infiltration areas by smothering plants and blocking filter media.

Regular inspections, particularly after storm events, will ensure that sediment deposition and erosion areas are monitored and rectified if deemed necessary. Inspection and enforcement of sediment and erosion controls on upstream construction sites would limit the potential for sediment accumulation in the WSUD components.

3.1.3. Swale and embankments

Maintenance effort will be required for maintaining the designated flowpaths including swales and embankments. The ideal scenario for the embankments are grassy vegetated batters with minimal erosion. However in reality, weeds are likely to colonise the batters and this needs to be managed to ensure maintenance access is not reduced and that shading of other vegetation does not occur.

3.1.4. Site runoff/run on

Management of site water is divided into two systems; road runoff and stormwater from local pits and pipes. The Green Spine is designed to accommodate a portion of flow from the highway and convey existing pipe flows. In large events the capacity of the system may be exceeded and damage may result. Inspections should be carried out after significant periods of rain and/or intense rainfall events.

3.1.5. Flood inundation

Generally plants and landforms have been designed and/or designated to tolerate flood waters, however some damage may occur due to intense storms, erosion, sedimentation and debris accumulation and other natural disasters. After such incidents the Green Spine should be inspected and relevant check map(s) completed.

3.1.6. Engineering structures and components

Pits and pipes are amongst the concrete structures used to manage stormwater and capture sediment. These components must be maintained regularly to ensure sediment is removed and there are no blockages.

Flushpoints within the raingardens need to be annually flushed to remove any sediment build up to ensure raingardens are drained effectively.

3.1.7. Theft / Vandalism

Some of the components of the Green Spine are susceptible to theft and/or vandalism, particularly the retaining wall and board walk. Damage to plants and infiltration areas through vandalism is possible.

Regular inspection of the area will ensure that theft or vandalism does not significantly affect the performance of the system.

Theft or vandalism will not greatly impact on the immediate function of the system, though repair and/or replacement will be necessary to ensure the system maintains an aesthetic appeal.

3.1.8. Chemical Spills

Spills in the catchment could have an impact on plants and infiltration components.

If spills or contamination of runoff occurs within the catchment the Green Spine should be inspected immediately and relevant check map(s) completed.

3.1.9. Hydrocarbons (Fuels, Oils, etc.)

Normally occur in small but constant loads from general vehicle movements and degradation of the asphalt. The loads may be exacerbated by older ill-maintained vehicles or even a vehicular accident.

Typical quantities should not affect the health of the vegetated areas and infiltration zones as they tend to become trapped on the surface where they decompose relatively quickly in the presence of soil microbes and water.

3.1.10. Rogue Vehicle Movements

Physical damage from vehicles has the potential to affect all hard and soft engineering components of the Green Spine depending on the extent of damage. Evidence of this should be obvious and reported accordingly.

3.2. Roles

The following provides a brief description of the roles and responsibilities for managerial and maintenance staff in relation to the Green Spine stormwater management assets.

Executive Officer (Site Manager):

- Provide overall guidance on the management of the Green Spine;
- Review and collate reports from Inspection Officer.

Environment Officer (Inspection Officer):

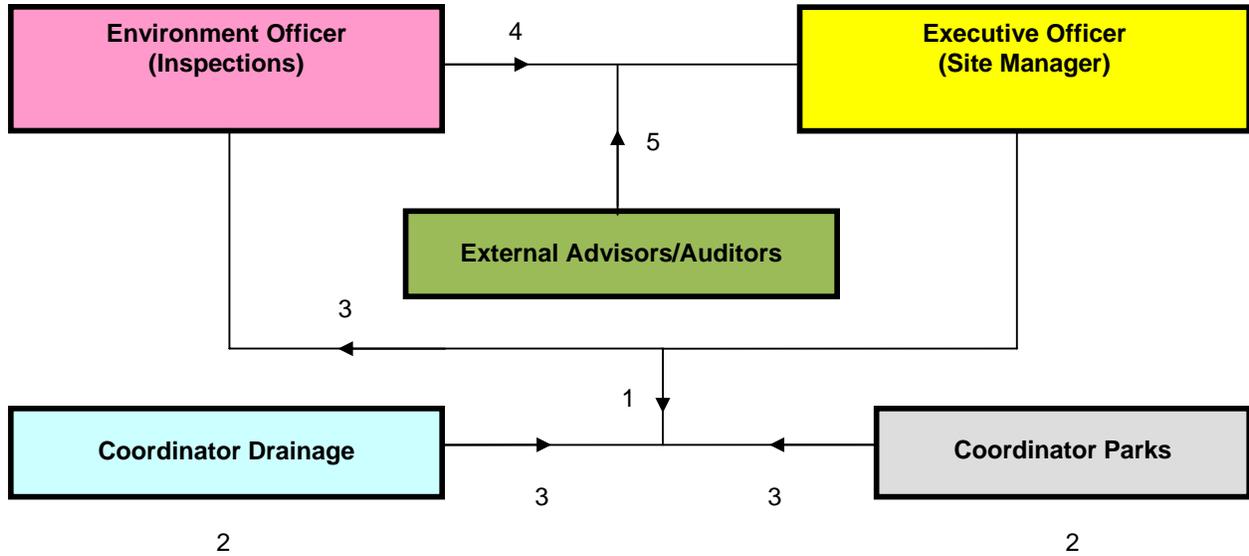
- Monitor the Green Spine in accordance with the inspection calendar;
- Complete checkmaps and initiate works order if maintenance is required;
- Brief the Maintenance Supervisor if maintenance is required (supply works order and checkmap);
- File correspondence to and from Maintenance Supervisor;
- Submit inspection reports to the Site Manager.

Coordinators (Drainage and Parks):

- Undertake maintenance activities as per the marked up checkmaps from the Inspection Officer;
- Sign off checkmaps following completion of works and return to the Inspection Officer;
- Undertake programmed maintenance of the Green Spine as per the maintenance calendar with the use of checkmaps to record any works completed;
- Supply the Inspection Officer with all checkmaps completed during programmed maintenance;
- Undertake works in accordance with specifications.

External Advisers/Auditors:

- Provide technical advice to Council's Site Manager and Environment Officer as required.



- 1 Routine inspection (inspection calendar, checkmaps) & request for maintenance works
- 2 Programmed maintenance (maintenance calendar, checkmaps) & maintenance identified through routine inspections. Works to be undertaken using specifications
- 3 Informing Environment Officer of works completed
- 4 Formal reporting to Executive Office (Site Manager)
- 5 External & internal technical advisors & auditors will visit site to inspect and check design performance from time to time.

Figure 1 - Green Spine Management and Maintenance Reporting Structure

4.0 INSPECTION/MONITORING

Inspection and monitoring is the responsibility of both the Environment Officer and the Coordinators (Parks and Drainage). This process is to be undertaken using Checkmaps to ensure consistency. Refer **Appendix C**.

Using Checkmaps is a simple way to identify whether maintenance is required, ensure that the main components of the Green Spine are examined for different issues and provide a means of recording when maintenance needs to be or has been completed.

The maps should be used for both routine inspections, programmed maintenance checks and one-off inspections (e.g. following a storm event).

The Environment Officer or Coordinators (Parks and Drainage) should make copies of the relevant checkmaps and complete them during inspections. Copies of the completed inspection Checkmap should then be filed for future reference.

The Environment Officer will be responsible for identifying maintenance works on the checkmaps and issuing this map with a works order to the Coordinators (Parks and Drainage).

The Coordinators (Parks and Drainage) will be responsible for signing off on the copy received from the Environment Officer after maintenance has been completed.

The Coordinators (Parks and Drainage) will also supply a copy of checkmaps used when undertaking programmed maintenance highlighting the maintenance works undertaken.

The Inspection and Maintenance Calendars form part of the recommended maintenance program and will help determine which management function to undertake at a given time. Refer **Appendix C** and **Appendix D**.

The Calendars detail a suggested timing for activities in a 1 year period though some activities extend beyond this time frame and are noted as such.

Note the Inspection Calendar includes periodic monitoring of the Green Spine whilst the Maintenance Calendar is separate and designates programmed maintenance work that is to be undertaken on a regular basis.

The suggested timings can be reviewed and refined (frequency decreased or increased) in the light of accumulated experience.

Figure 2 describes the sequence of tasks for inspections and monitoring.

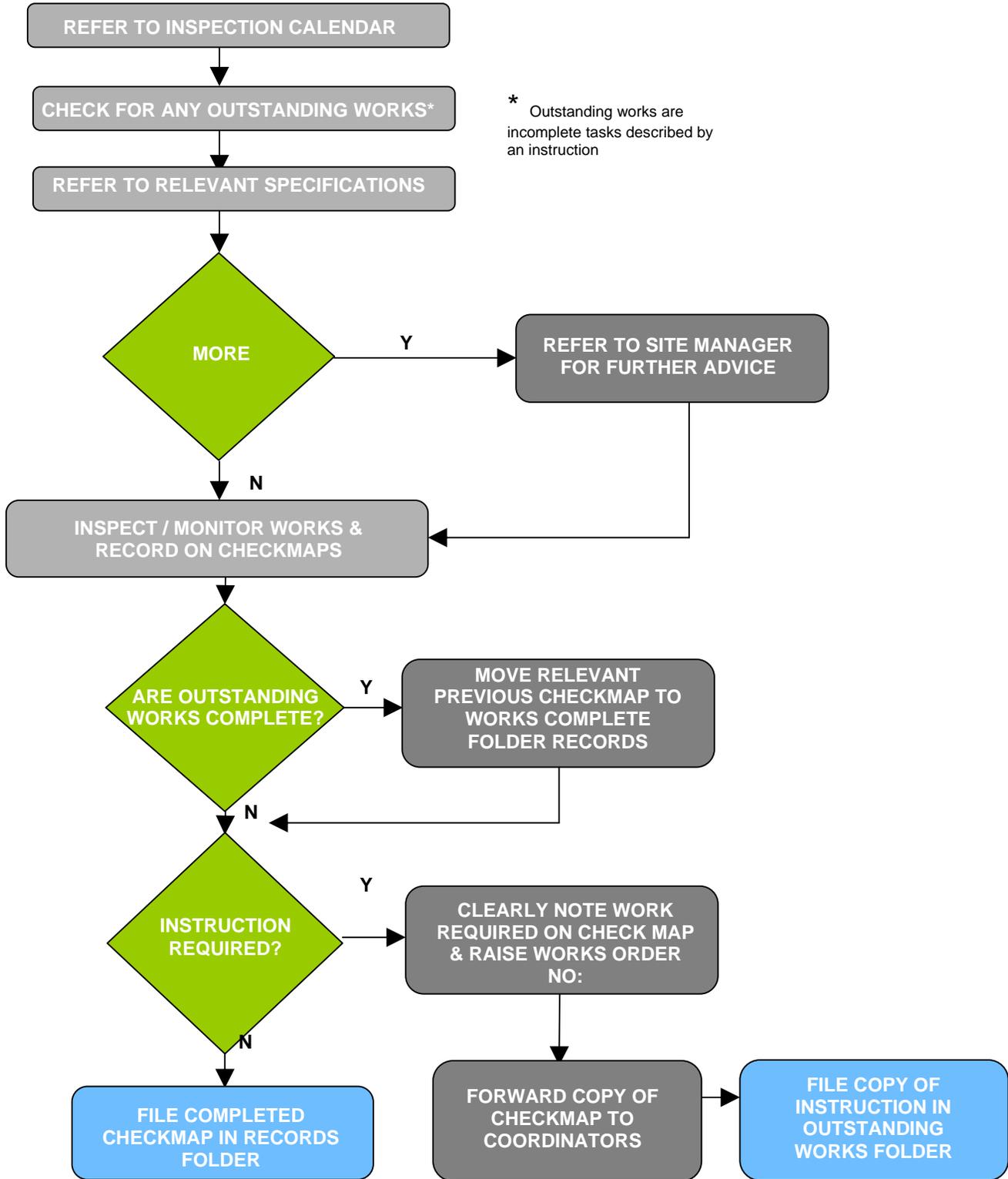


Figure 2: Inspection / Monitoring Flow Chart

5.0 MAINTENANCE WORK

Maintenance works will be initiated either through:

1. Periodic routine or post storm event inspections (by the Environment Officer) that identify the need for maintenance work; or
2. Programmed maintenance which refers to those activities that are scheduled on the Maintenance Calendar.

The Environment (Inspection) Officer that undertakes routine inspections will be responsible for highlighting necessary non-programmed/non-scheduled maintenance works, details of which shall be noted on the relevant inspection checkmaps.

Once maintenance work is identified the Environment (Inspection) Officer will ensure a unique works order number is raised and this together with the Checkmap will then be forwarded to Coordinators (Parks and Drainage) for action.

Maintenance works are to be undertaken in accordance with the Specifications - refer **Section 7.0**.

Once the maintenance works have been successfully undertaken the issued checkmap is to be signed and filed in a works complete register. A copy is to be forwarded to the Environment Officer for their records.

The flow chart in Figure 3 describes the sequence of tasks for maintenance work.

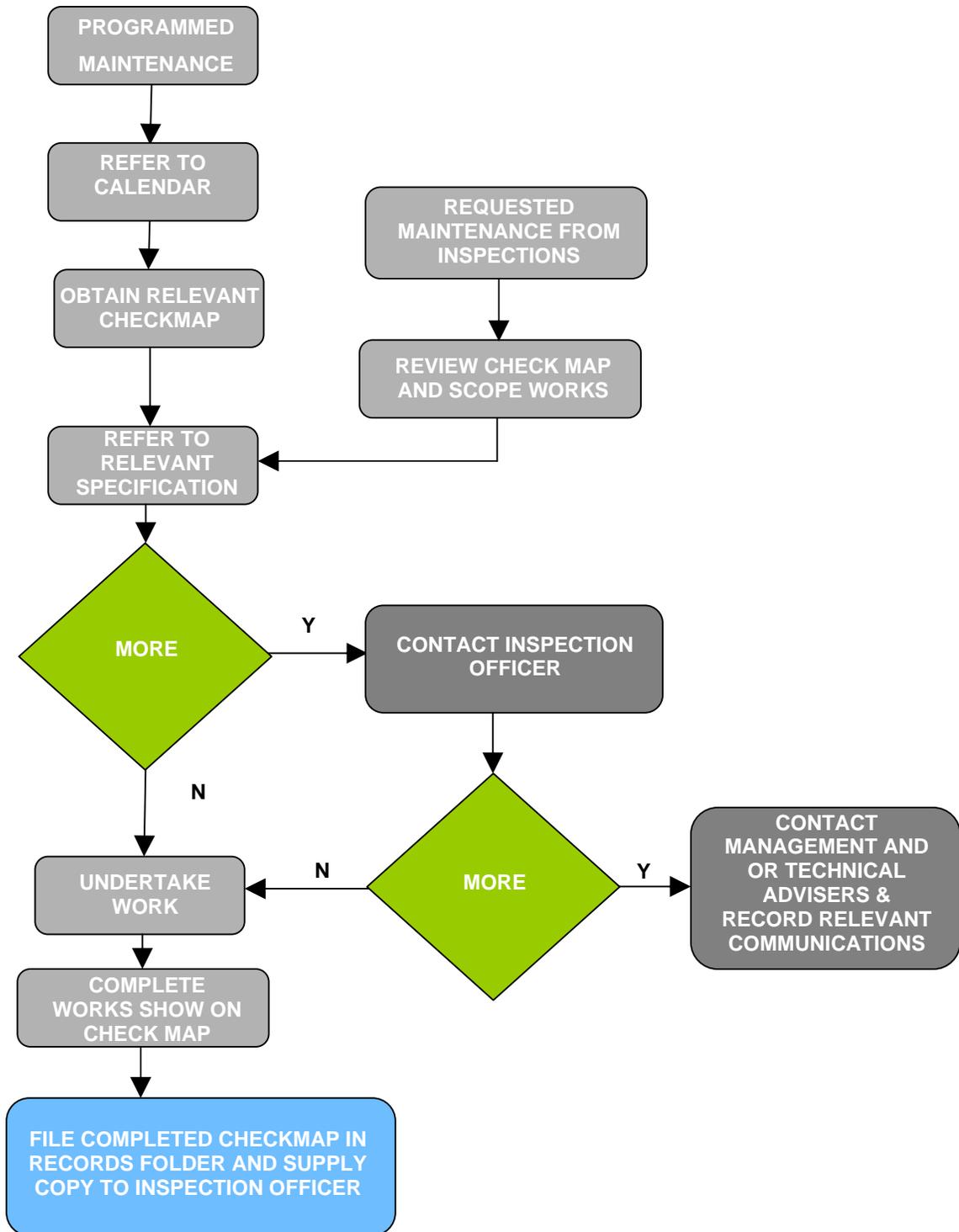


Figure 3: Maintenance Management

6.0 INCIDENT MANAGEMENT

Some incidents in the Green Spine are expected that require a management response. If an incident such as a major storm and flood or pest occurs an incident inspection Checkmap should be used to identify any maintenance requirements for the Green Spine and to issue any maintenance instructions.

The response is described in the form of a flow chart in Figure 4 below.

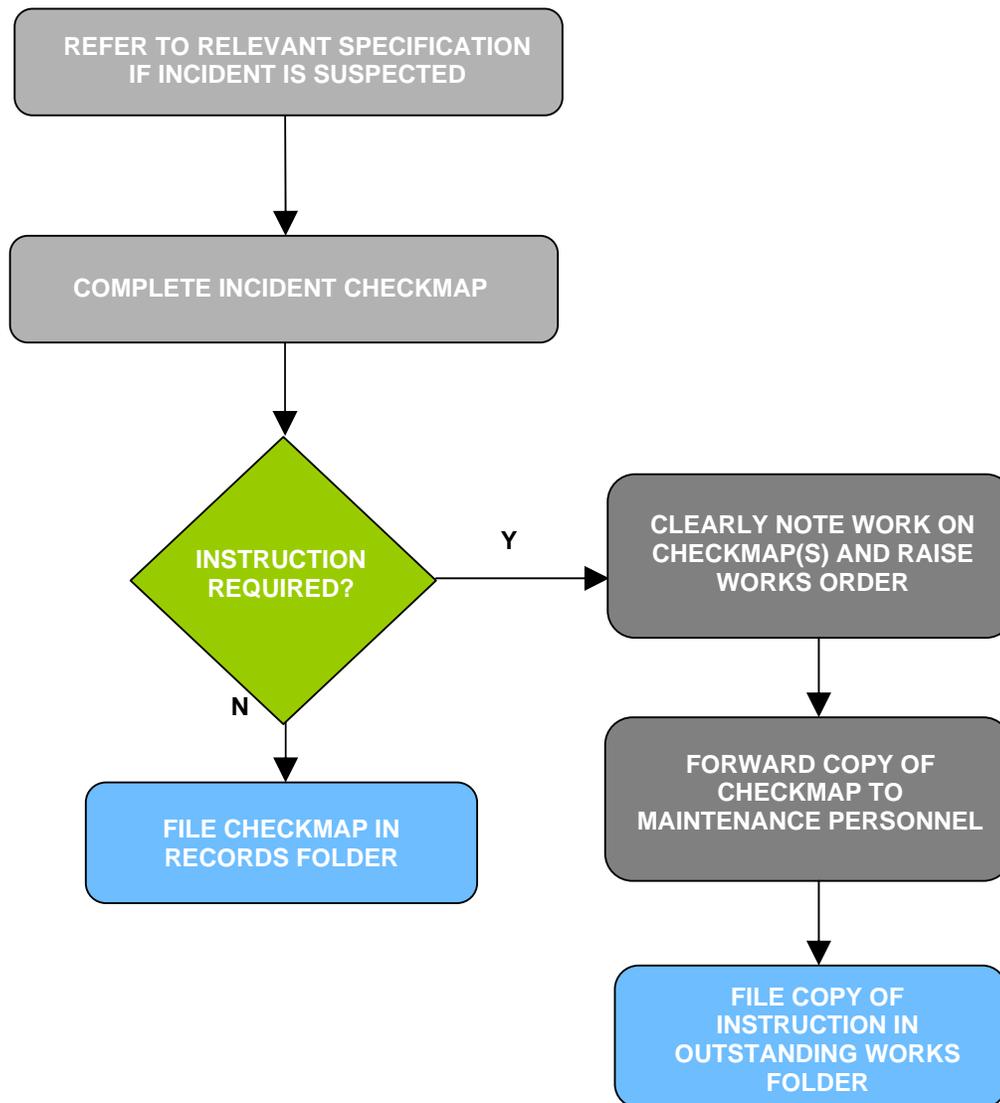


Figure 4: Incident Management

7.0 SPECIFICATIONS

7.1. Hard Engineering Structures

Issue:	To ensure hard engineering components are in good condition, functioning hydraulically and are free of obstruction
Definition:	All pits, pipes, headwalls, concrete drains, side entry pits (SEP's) and grates
Detail:	Refer to drawings
Purpose of monitoring:	Failure of any of the items defined above can impact on the hydraulic function of the Green Spine increasing the likelihood of flooding.
Tasks:	<p>Inspect condition of all hard engineering structures and report any damage, signs of failure and/or blockages</p> <p>Remove any debris, gross pollutants and accumulated sediment caught in these structures</p> <p>Identify source of litter (organic and rubbish) - e.g. from catchment (commercial precinct); overflow of rubbish bins; local landscaping maintenance etc. Where required address source of litter (organic and rubbish) – increase frequency of rubbish collection; improve landscape maintenance practices, community education and/or compliance action.</p> <p>RISKS: Maintenance workers should be aware of traffic and risks associated with sharp objects when removing litter and wear/use appropriate personal protection equipment</p>
Objectives:	Clean, structurally sound stormwater drainage system
Checkmap reference:	Check Map 1
Inspection Officer	Coordinator - Drainage

DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

7.2. Catch Drains

Issue:	To ensure catch drains are functioning as intended and adequately intercepting and conveying overland flows to intended source
Definition:	The 1 metre wide depression along the site boundary intended to direct overland flows to local pits
Details:	<i>Insert section</i>
Purpose of monitoring	To prevent site runoff migrating to adjacent property
Tasks:	<p>Inspect condition of catch drain to ensure adequate intercepting and conveyance capacity.</p> <p>Remove any gross pollutants and accumulated sediment in the bottom of drain</p> <p>Repair any erosion</p> <p>Ensure grass and vegetation within drain is of appropriate height to allow water to be carried to intended pit/s (allowing minimum 200mm depth in drain)</p> <p>Identify source of litter (organic and rubbish) - e.g. from catchment (commercial precinct); overflow of rubbish bins; local landscaping maintenance etc</p> <p>Where required address source of litter (organic and rubbish) – increase frequency of rubbish collection; improve landscape maintenance practices, community education and/or compliance action.</p> <p>RISKS: Maintenance workers should be aware of risks associated with sharp objects when removing litter and wear/use appropriate personal protective equipment (PPE)</p>
Objectives:	Adequately graded (approximately 1:60) clean catch drain, minimum 200mm deep
Checkmap reference	Check Map 1
Inspection officer	Coordinator - Drainage

DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

7.3. Footpath

Issue:	Safe pedestrian access
Definition:	The designated concrete walkway running through the site
Detail:	Refer to drawings
Purpose of monitoring:	To ensure footpath condition is safe for pedestrians and cyclists.
Tasks:	<p>Inspect condition of footpath and identify any cracks, depressions, trip hazards or any other evidence of structural failure. Report any of these signs and arrange to have them remediated.</p> <p>Identify any graffiti and remove</p> <p>RISKS: Maintenance workers should be aware of cyclists and dogs</p>
Objectives	To maintain a clean, safe walk/cycle way
Checkmap reference	Check Map 1
Inspection officer	Coordinator - Parks

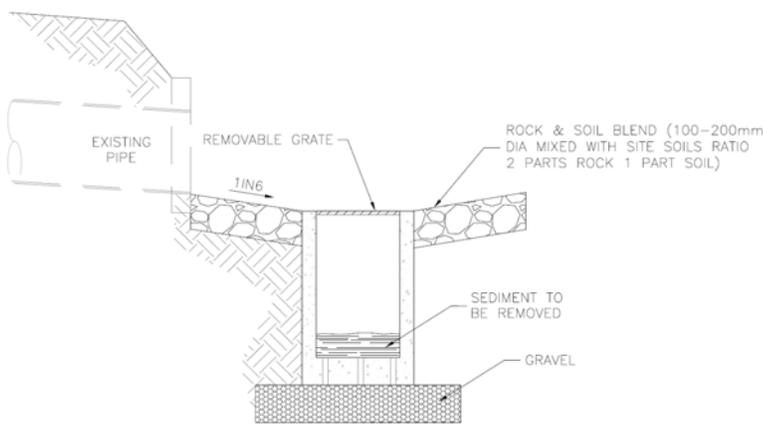
DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

7.4. Batters and Backfilled Areas

Issue:	Slumping and sinking of these areas that may impact on surrounding infrastructure
Definition:	The base and sides of the Green Spine, generally earth base, grassed and vegetated
Purpose of monitoring	If batters and backfill areas slump or become unstable, there is potential for scour and/or sediment transport to surrounding area impacting infiltration zones and reducing flow capacity. There is also the risk that hard engineering structures such as pits, pipes and footpaths can move if the ground supporting these structures shifts.
Tasks:	<p>Check for evidence of slumping and identify areas of scour and erosion. Repair by backfilling and or revegetating as required to achieve design profiles.</p> <p>Ensure plantings on batters are healthy as these help to maintain stability.</p> <p>Remove weeds by the most appropriate method</p>
Objectives:	Backfilled areas and batters are as per design profiles free of scour.
Checkmap reference	Check Map 1
Inspection officer	Environment Officer

DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

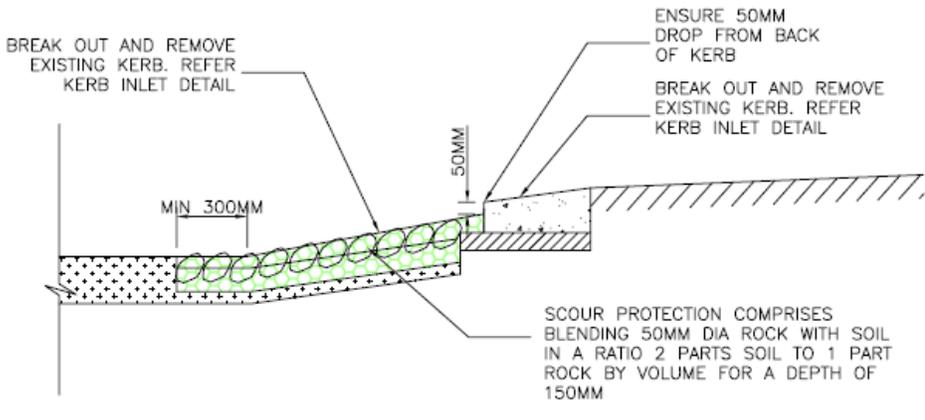
7.5. Sediment Pit with Rock Surround

Issue:	Litter and sediment accumulation
Definition:	The litter/sediment collection pit or inlet to a particular section of the Green Spine
Detail:	
Purpose of monitoring	<p>Sediment has the potential to limit flow capacity, promote weed growth and limit infiltration through specified medias.</p> <p>The sediment pits are designed to intercept and capture litter/ sediment contained in local runoff before it enters various sections of the Green Spine.</p> <p>Sediment pits have a rock surround to prevent scour and disperse flows at the outlet of the respective pipes.</p>
Tasks:	<p>Remove any gross pollutants and accumulated sediment in the bottom of the pit</p> <p>Identify source of litter (organic and rubbish) - e.g. from catchment (commercial precinct); overflow of rubbish bins; local landscaping maintenance etc</p> <p>Where required address source of litter (organic and rubbish) – increase frequency of rubbish collection; improve landscape maintenance practices, community education</p> <p>RISKS: Maintenance workers should be aware of risks associated with sharp objects when removing litter and wear/use appropriate personal protection equipment</p>
Objectives:	Litter and sediment absent, rock surround stable and preventing scour
Checkmap reference	Check Map 1
Inspection officer	Coordinator - Drainage

DESIRABLE
Insert pics

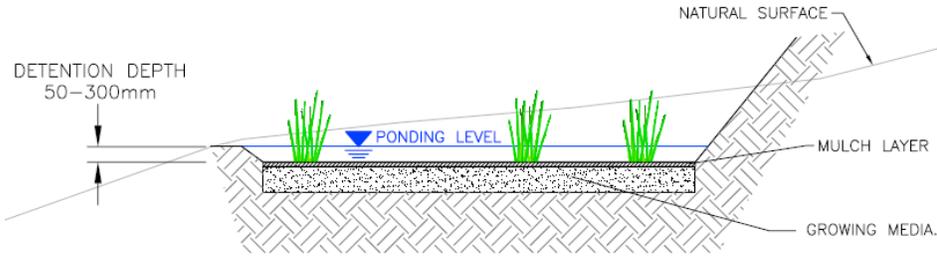
REQUIRES MAINTENANCE/REPAIR

7.6. Rock Chutes

Issue:	Stability of rock chute
Definition:	The designated breakout points in kerb to allow road runoff to enter Green Spine. The rockwork located immediately down side of the breakout extend to toe of bank (defined as the “rock chute”) is designed to prevent scour by physically protecting the erodible surface of the banks and dissipating runoff energy as it enters the system
Detail:	
Purpose of monitoring	<p>To ensure that rock chute is stable and preventing scour noting that high flows can also cause scour where rockwork is not sufficiently sized or extended</p> <p>Ensure clean, open flow path for stormwater entering the system, i.e. no weeds, gross pollutants blocking flowpath</p>
Tasks:	<p>Ensure rock armoring is sufficient in extent and placement</p> <p>Repair erosion areas by either modifying rock, replacing rock or adding additional rock as required</p> <p>Remove and dispose of weeds/ gross pollutants within rock chute</p>
Objectives:	Ensure no erosion present at kerb inlets and weeds/gross pollutants absent
Checkmap reference	Check Map 1
Inspection officer	Environment Officer

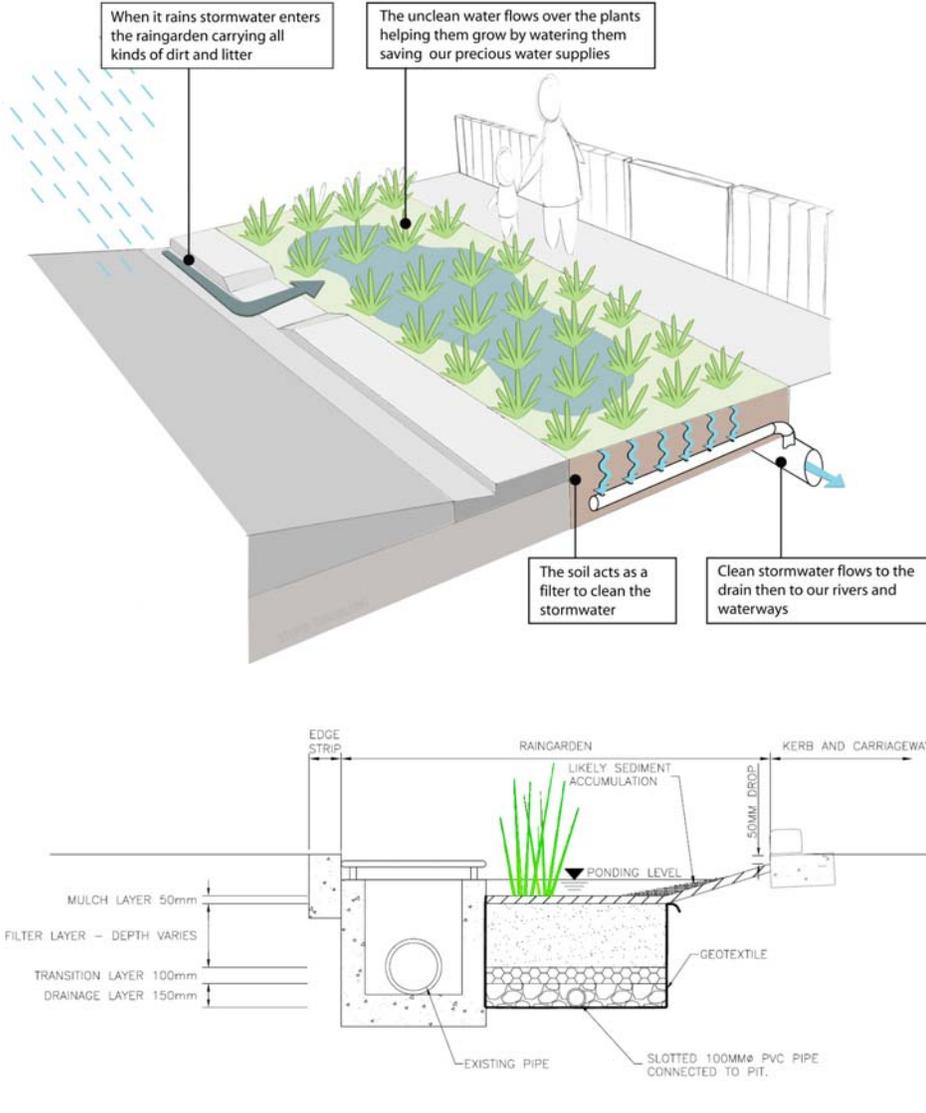
DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

7.7. Infiltration Zones

Issues:	Infiltration zone levels
Definition:	There are several designated infiltration zones within the Green Spine. These areas are depressed relative to the surrounding ground levels, therefore causing ponding and allowing infiltration. These zones are designed to treat small frequent rainfall events and can have a significant impact on improving water quality
Detail:	
Purpose of monitoring	If these infiltration zones lose ponding capacity less water is allowed to infiltrate and therefore water quality improvement potential is lost.
Tasks:	<p>Ensure the base of the infiltration zone is below the surrounding ground levels in accordance with the design plans.</p> <p>Check that infiltration zone base area is relatively level to promote even distribution of runoff over the surface</p> <p>Remove deposited sediment</p>
Objectives:	Infiltration zone is depressed, clean and level.
Checkmap reference	Check Map 1
Inspection officer	Environment Officer

DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

7.8. Bioretention

Issues:	Even distribution of ponding stormwater over the surface area, sufficient infiltration capacity, flush points, presence of scour and weeds
Definition:	<p>The bioretention zone is an area designed to filtrate and treat stormwater and allow this water to be returned to the adjacent pit and pipe stormwater system.</p> <p>The flush points within the bioretention zone are capped vertical pipes above the finished surface level that connect to and allow flushing of the subsurface collection pipework</p>
Detail:	 <p>The diagram illustrates the bioretention process. Rainwater enters the raingarden, carrying dirt and litter. The water flows over plants, which help filter the water. The soil acts as a filter to clean the stormwater. Clean stormwater flows to the drain, then to rivers and waterways.</p> <p>The cross-section shows the following layers and components:</p> <ul style="list-style-type: none"> MULCH LAYER 50mm FILTER LAYER - DEPTH VARIES TRANSITION LAYER 100mm DRAINAGE LAYER 150mm EDGE STRIP RAINGARDEN LIKELY SEDIMENT ACCUMULATION PONDING LEVEL GEOTEXTILE EXISTING PIPE SLOTTED 100MMϕ PVC PIPE CONNECTED TO PIT. KERB AND CARRIAGEWAY 50MM DROP
Purpose of monitoring	<p>To ensure even ponding of stormwater over bioretention zone to allow maximum filtration potential</p> <p>To ensure infiltration capacity of the bioretention zone is as per the design intent. Note percolation into the underlying media may be reduced if the surface has been compacted or sediment has accumulated on the surface</p>

	<p>Ensure profile of the bioretention is as per the design i.e. no slumping of surrounding banks/batters and no scouring as these all have the potential to carry sediment to the filter media</p> <p>Flush points allow material captured in subsurface collection pipes to be removed by flushing with high pressure water jets</p> <p>Ensure plantings are as per the design as the specified species promote infiltration and nutrient uptake.</p>
<p>Tasks:</p>	<p>Ensure the base of the raingarden is relatively level to promote even distribution of runoff over the base surface</p> <p>Sediment generally accumulates at the inlet. Remove accumulated sediment down to top of mulch layer (suggested to use a square mouth shovel or spade) with care not to disturb the vegetation. If weeds begin to proliferate in the sediment accumulation area then remove this sediment and the mulch. The mulch will require replacement in this case. Replace vegetation as required.</p> <p>At some point the raingarden may be entirely covered by sediment and weed control becomes difficult. It is recommended to remove all the sediment and mulch. Replace the mulch. It is preferred to undertake this by hand to protect the existing vegetation. Any destroyed vegetation will require replacement. If mulch is to be replaced, ensure it is replaced to match the detail above and that the finished surface is still below the surrounding land area to allow water flows to enter and be contained to allow for subsequent filtration.</p> <p>Examine during a storm event and monitor ponding times and look for flows emanating from the sub-surface drain. If flows in the sub-surface drain are observed then it is likely to be functioning properly. However if there are no flow observed and ponding continues for more than 3 hrs after inflows have ceased then there is likely a blockage. Examine the surface for presence of a relatively impermeable layer and remove as necessary. If the blockage appears to be deeper in the profile then resetting of filter media and possibly other sub-surface layers may be required. It is recommended to seek professional advice if this is suspected.</p> <p>Alternatively when not exposed to a storm event, use a section of pipe to test infiltration by firmly placing the inverted pipe on the base of the raingarden and filling with water. Measure draw down and compare to the infiltration rates specified for the filter media (typically 150mm/hr).</p> <p>Inspect flush points (ensure these are located or notify maintenance authority if they cannot be found) and flush at least once annually.</p> <p>Ensure flushing events are recorded and pits are inspected to determine the amount of sediment flushed through.</p> <p>Ensure nominated plant species are present and healthy and weeds are removed.</p>
<p>Objectives:</p>	<p>Sufficient infiltration capacity, sediment absent, no compaction evident, no weeds present, healthy vegetation cover, erosion absent, flush points are easy to locate and are flushed at least once per year.</p>
<p>Checkmap reference</p>	<p>Check Map 1</p>
<p>Inspection officer</p>	<p>Environment Officer</p>

DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

Plantings

Issues:	Health of vegetation, weeds, pests
Definition:	<p>Desired vegetation – as specified in design</p> <p>Weeds should be considered to be “plants out of place”</p> <p>Pests – flora or fauna that have potential to threaten desired vegetation</p>
Purpose of monitoring	<p>Plants are crucial to the performance and aesthetics of the Green Spine</p> <p>During dry periods: Plants help maintain the structure and porosity of the batters and filter areas</p> <p>During rainfall events: Vegetation aboveground acts to dissipate flows and provides scour protection. Below ground the roots provide an important media for trapping and absorbing pollutants as they percolate through the media profile</p> <p>Pest and insect species may cause significant damage to vegetation</p>
Tasks:	<p>Regular watering/irrigation of desired vegetation until plants are established and actively growing</p> <p>Pruning of vegetation (if required) to preserve the optimal height and encourage lateral growth</p> <p>Vegetation pest monitoring and control as required (eg spraying or netting)</p> <p>Remove weeds by the most appropriate method</p> <p>Check the health of vegetation and if die back or dead plants are obvious schedule an investigation into the cause. Once the problem is rectified infill planting may be required</p>
Objectives:	Designated species (and densities) are present and healthy, weeds and pests absent
Checkmap reference	Check Map 1
Desirable species	Refer Appendix E for Green Spine Planting Schedules
Undesirable Species	Weeds should be considered to be “plants out of place”.
Inspection officer	Environment Officer

DESIRABLE
Insert pics
REQUIRES MAINTENANCE/REPAIR

8.0 CONTACT LIST

Role	Company	Name	Contact
Executive Officer (Site Manager)	Yarra Ranges Shire Council		Ph Mob Email
Environment Officer	Yarra Ranges Shire Council		Ph Mob Email
Coordinator Drainage	Yarra Ranges Shire Council		Ph Mob Email
Coordinator Parks	Yarra Ranges Shire Council		Ph Mob Email
External Advisers / Auditors	Storm Consulting Pty Ltd Suite 7, 84 Church Street Richmond VIC 3121	Rod Wiese Jamie Tainton	Ph +61 3 9208 0111 Fax +61 3 9208 0199 info@stormconsulting. com.au

APPENDIX A

Detailed Design Plans for WSUD components of the Green Spine

APPENDIX B

Inspection Checkmaps

APPENDIX C

Inspection Calendar

INSPECTION CALENDAR

Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kerb Inlets/Rock Chutes – Environment Officer												
Erosion	✓			✓			✓			✓		
Weeds	✓			✓			✓			✓		
Sediment Pits – Coordinator Drainage												
Check for sediment accumulation	✓			✓			✓			✓		
Check for general damage	✓			✓			✓			✓		
Raingardens – Environment Officer												
Check for scour, blockages or damage	✓			✓			✓			✓		
Deaths and general health of vegetation	✓			✓			✓			✓		
Weeds	✓			✓			✓			✓		
Flush subsoil drain	✓						✓					
Infiltration Zones/Landscaped depressions – Environment Officer												
Scour, erosion, settlement	✓			✓			✓			✓		
Deaths and general health of vegetation	✓			✓			✓			✓		
Weeds and Pests	✓			✓			✓			✓		
Swale – Environment Officer												
Evidence of erosion & scour	✓			✓			✓			✓		
Evidence of sedimentation	✓			✓			✓			✓		
Inlets and outlets – Coordinator Drainage												
Check all pits and pipes are free from obstruction	✓			✓			✓			✓		
Check structural integrity	✓			✓			✓			✓		
Retaining wall – Coordinator Parks												
Check for cracking, subsidence, damage	✓			✓			✓			✓		
Boardwalk – Coordinator Parks												
Check for cracking, subsidence, damage	✓			✓			✓			✓		
Check railing and ensure secure	✓			✓			✓			✓		
Check for trip hazards	✓			✓			✓			✓		

APPENDIX D

Maintenance Calendar

MAINTENANCE CALENDAR

Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kerb Inlets/Rock Chutes												
Erosion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weeds	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sediment Pits												
Remove accumulated sediment	✓ Within 1 week of all significant storm events											
Check for general damage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Raingardens												
Check for scour, blockages or damage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Deaths and general health of vegetation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weeds	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Flush subsoil drain	✓						✓					
Infiltration Zones/Landscaped depressions												
Scour, erosion, settlement	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Deaths and general health of vegetation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weeds and Pests	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Swale												
Evidence of erosion & scour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Evidence of sedimentation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Inlets and outlets												
Check all pits and pipes are free from obstruction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Check structural integrity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Retaining wall												
Check for cracking, subsidence, damage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Boardwalk												
Check for cracking, subsidence, damage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Check railing and ensure secure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Check for trip hazards	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

APPENDIX E

Planting Schedules