



Auckland Stormwater NDC Application

Appendix F:

Stormwater Management Plan Template

March 2017

Healthy Waters

Infrastructure and Environmental Services

Auckland Council



Stormwater Management Plan

Template

March 2017

Healthy Waters

Infrastructure and Environmental Services

Auckland Council

Stormwater Management Plan Template

The purpose of this template is to guide a common approach to developing a Stormwater Management Plan (SMP) for Special Housing Area (SHA) developments and to indicate the expected content and level of detail that is required to inform the following processes:

1. structure planning and private plan changes including precinct plan provisions;
2. discharge consents;
3. compliance with the Auckland Council Code of Practice for Land Development and Subdivision: Chapter 4 Stormwater (SWCOP); and
4. infrastructure funding and vesting.

The SMP documents integrated land use and stormwater management planning and design processes for SHA projects. The intent of the design process is to enable development and growth to meet demand and the stormwater management approach directed by the Proposed Auckland Unitary Plan (PAUP) for new developments.

Refer to the *Special Housing Area – Stormwater Advice Note* for further guidance.

Timing

Stormwater management planning and recording starts at the beginning of land use and development planning process. A formal version of the SMP should be lodged for approval by the SWU prior to lodging plan change and consent applications. Additional updated versions may be needed as development advances from conceptual through to more detailed design, recognising that the design will evolve as the development process progresses. Information requirements may also vary through this process.

Role of a SMP

- Details proposed stormwater management for a development and how it integrates with catchment stormwater management;
- Demonstrates how stormwater management related expectations under PAUP Appendix 1.1 Structure Planning have been met;
- Informs authorisation under an existing Network Discharge Consent (NDC) or any necessary applications for a variation or new NDC / Discharge Consent application including consideration of possible options and selection of the preferred option as the BPO;
- Informs Infrastructure Funding Agreements with the SWU and determination of targeted development contributions;
- Demonstrates design principles and consistency with the SWCOP for initial approval of concept for stormwater assets to be vested to Council;
- Informs plan change applications as far as they relate to stormwater management.

How to use this document

Use of the template is voluntary, but strongly encouraged to assist the HPO to complete assessments in a timely manner. Follow and complete the template, making amendments if required to adequately describe and document the proposal. Simplify or expand the structure to reflect the scale of the development as required.

Black text reflects the basic document structure. Retain this unless it clearly doesn't fit the development. Red text identifies expected content of each section. Delete it from completed SMPs. It includes an indication of the level of detail that is anticipated and potential reference material.

How to Source Information from SWU

Much of the information required to support the SMP will be provided by the developer or will be publically available on the Auckland Council website. In some instances additional information may be held by the Auckland Council Stormwater Unit (SWU). Enquiries for additional information should be directed to stormwaterdevelopment@aucklandcouncil.govt.nz. Include "SHA development – [location]" in the email subject.

Table of Contents

1.	Stormwater Concept Plan	3
1.1	Concept plan	3
1.2	Additional plans	3
1.3	Staging, Timing, Responsibility and Funding	3
1.3.1	Timing.....	3
1.3.2	Schedule of costs and proposed funding of them.....	5
1.3.3	Specifications of assets where vesting or Council funding is sought.....	5
1.3.4	Mechanisms to ensure delivery of the stormwater plan.....	5
1.3.5	Dependencies/contingencies.....	6
1.3.6	Departures.....	6
1.3.7	Operations, maintenance and monitoring requirements.....	6
2.	Catchment Description and Context	7
2.1	Nature of the Catchment	7
2.1.1	Catchment description.....	7
2.1.2	Natural features.....	7
2.1.3	Existing hydrology/stormwater network	7
2.2	Receiving Environment	8
2.2.1	Freshwater environment.....	8
2.2.2	Coastal environment.....	8
2.2.3	Groundwater.....	8
2.3	Existing Catchment and Development Plans	9
2.3.1	Auckland Plan.....	9
2.3.2	Proposed Auckland Unitary Plan.....	9
2.3.3	Area Plan/Master Plan/Structure Plan/Framework Plan/Plan Changes.....	9
2.3.4	Catchment Plan/Network Discharge Consents.....	9
2.4	Gaps.....	9
3.	Site Description.....	10
3.1	Natural and Physical Characteristics.....	10
3.1.1	Topography and sub-catchment boundaries	10
3.1.2	Floodplains and overland flow paths	10
3.1.3	Soils, geotechnical and contaminated land.....	10
3.1.4	Significant ecological and heritage features	11
3.2	Receiving Environments.....	11
3.2.1	Streams, lakes and wetlands.....	11
3.2.2	Coastal environment.....	11
3.2.3	Aquifers and soakage.....	12
3.3	Current Land Use and Infrastructure	12
3.3.1	Current land use	12
3.3.2	Existing stormwater network.....	12
4.	Development Concept.....	13
4.1	Overview of Proposed Development.....	13
4.2	Requirements and Constraints.....	13
4.2.1	Development requirements and constraints	13
4.2.2	Other infrastructure requirements and constraints.....	13

5.	Stormwater Management Issues, Opportunities and Constraints	14
5.1	Key Stormwater Management Issues/Opportunities	14
5.1.1	Flooding and overland flow paths	14
5.1.2	Stormwater quality	14
5.1.3	Stormwater flow effects	14
5.1.4	Streams, lakes and wetlands	14
5.1.5	Infrastructure	14
5.1.6	Opportunities	15
5.2	Stormwater Sub-catchments	15
6.	Assessment of Options	16
6.1	Option 1 (preferred).....	16
6.2	Option 2.....	16
6.3	Option 3.....	16
6.4	Assessment of options	16
6.5	Reasons for the Preferred Option.....	17

Figures

[Add figure captions to all maps]

Tables

Table 6-1: Assessment of Options – Option 1	16
Table 6-2: Assessment of Options – Option 2	17
Table 6-3: Assessment of Options – Option 3	17

Appendices

Appendix 1: Water Sensitive Design Considerations for Development.....	17
--	----

1. Stormwater Concept Plan

Purpose

- To map and describe a stormwater concept plan to form a part of the precinct plan.

Level of Detail

THIS SECTION IS PREPARED LAST, but included in the document first for easy reference.

Describe the preferred stormwater management option and expected outcomes in sufficient detail to understand what is proposed using detailed maps and other information.

1.1 Concept plan

Include:

- Stormwater sub-catchments with a key identifying the management approach.
- The communal stormwater assets proposed (both public and private) including green infrastructure.
- Road hierarchy with a key identifying the management approach (where applicable).
- Natural hydrological features (lakes, streams and wetlands).
- Appropriate zoning (e.g. Green Infrastructure Corridor Zone (GIC) for land to be used exclusively for stormwater management purposes e.g. a detention basin).
- Sub-catchment boundaries.

1.2 Additional plans

Show other major stormwater design elements, including maps that show the following:

- Post development landform and imperviousness.
- Indicative post development 1% AEP flood plain, OLFPs and indication of flood prone areas (if known), including significant changes to those up or downstream of the site.
- Main trunk stormwater / primary pipe network including green infrastructure elements.
- Discharge points – streams, coast, infiltration/soakage.
- Clearly identify assets to be vested and components servicing a wider catchment.

1.3 Staging, Timing, Responsibility and Funding

1.3.1 METHOD Stormwater Infrastructure Costing for Plan Changes

A. General Principles

- a) The landowners and developers of the growth area meet the full costs of the stormwater infrastructure to enable the growth in their area.
- b) Allocating stormwater infrastructure costs between land owners should be done based on the proportion of new maximum imperviousness surface area that each developer can create under the zoning rules.
- c) There is no commitment to fund stormwater infrastructure in any development unless there is a formal contract in place (such as a developer agreement or infrastructure funding agreement) signed by Council Officers with appropriate delegations. **Note that a condition in a Resource Consent to vest a stormwater**

asset to Council is not an obligation for Council to fund that asset. Any negotiations, discussions or correspondence with developers for funding from Council are done on an “without prejudice” basis.

1.3.2 Methodologies to Allocate Costs between land owners and developers

- a) Landowners and developers that are developing an entire sub catchment with a coastal discharge or stream discharge are required to construct all stormwater infrastructure to mitigate their effects in accordance with an approved Stormwater Management Plan; the Auckland Council Code of Practice for Land Development and Subdivision (CoP) and any relevant conditions of Network Discharge Consents.
- b) The landowner or developer will fund all of the costs of the stormwater infrastructure. Stormwater assets that are to be publically maintained (e.g. in the roads and public parks) and associated land should be vested to Council at no cost. Green infrastructure corridors (i.e. streams and associated flood plains) are required to be vested at no cost to council
- c) In cases where there are more than one landowner or developers in a sub catchment and shared stormwater infrastructure is necessary to service them all:
 - i. The first to develop must design and construct public stormwater infrastructure to cater for Maximum Probable Development (MPD) (refer to the CoP).
 - ii. Contribution to the costs of the shared infrastructure between landowners and developers should be based on the proportion of the maximum allowable impervious surface area (permitted in the zone or proposed zone) each developer is able to create.
 - iii. The first developer/investor can recover payment from the other landowners and developers that will utilise the assets by the following means.
 - A private agreement could be negotiated between interested parties prior to constructing the infrastructure. The agreement should that define the costs and relative contributions.
 - Build the assets within their own land, maintain them as private assets and recover costs when adjoining landowner seeks access to their land for connection.
 - Request the creation of a specific funding area where the Council collects subcatchment specific developer contributions as properties develop and refunds the first investor as future developments are approved: Note this would require new systems, processes and policy from various council departments (in particular Finance). This is the least preferred funding arrangement. Council reserves the right not to create a specific funding area
 - An Infrastructure Funding Agreement (IFA) can be applied for to seek Council funding for infrastructure that serves sites beyond the developer’s site. This could include compulsory land acquisition, although compulsory acquisition is not preferred as it is a long and complicated process with high cost implications for the developer and council. Funding is subject to Council approval processes and available budgets.

1.3.3 Costing Process

Stormwater infrastructure is very site specific. The following process will provide a guide as to what is required in the infrastructure costing report.

Mapping

- a) Stormwater Growth Area (SGA) landuse identified by HPO or strategic planners and mapped on a plan
- b) Draw natural hydraulic subcatchments on the same map based on latest LIDAR (GIS) contours
- c) Draw property boundaries on. Include existing and proposed roads. (Nb. Steps 7 to 8 can easily be done on GIS)

Analysis

- a) Consider whether the SGA extends beyond the ownership or control of one owner/developer. If it covers multiple properties, mark out properties which do not have clear access to a stream or the marine receiving environment.

- b) Consider whether stormwater infrastructure is required to serve upstream (non SGA) areas and/or whether downstream infrastructure is required. Assume MPD in the upstream and downstream catchments. Ensure stream corridors and Overland Flow Paths (OLFPs) are of sufficient width to convey the 1:100 year ARI (1% AEP) in the MPD scenario. Where the upstream and/or downstream area is zoned Future Urban please consult with the Stormwater Unit as to an appropriate assume imperviousness.
- c) With Water Sensitive Design principles at the forefront:
 - i. Consider alignment of proposed roads
 - ii. Consider any likely building platform and/or balance cut and fill requirements.
 - iii. Consider the likely development practice of earthworking to meet road levels.
 - iv. Consider any other known constraints and opportunities
 - v. Assume retention of permanent and intermittent watercourses to convey stormwater and flood flows

Design

- a) Amend slightly the natural subcatchments, taking into consideration steps 8 to 10.
- b) Work out the imperviousness in each sub-catchment based on zoning (GIS exercise)
- c) Determine all shared stormwater infrastructure required based on the tweaked subcatchments, and any other upstream/downstream requirements. This will likely be an iterative analysis and design process

Costing

- a) Label the subcatchments in a sequential order. Cost the **shared** infrastructure in each subcatchment, detailing pipe sizes and lengths, number of manholes and catchpits, treatment devices and rates used per subcatchment. Assumptions will be likely but must be stated.
- b) Work out the imperviousness per property (GIS exercise) based on land-use (zoning) MPD as a basis for cost apportioning of shared infrastructure if required. An exception will be when Council purchases capacity to accommodate existing development; this will likely be based on the increase in capacity and not as an impervious percentage ratio.

1.3.4 Timing

- Outline expected timing and staging of the development and stormwater management solutions.

1.3.5 Schedule of costs and proposed funding of them

Provide detailed cost estimates, accounting for both capital cost and operational costs for all stormwater infrastructure, and land to be purchased, specifying:

- which (if any) of these contribute to wider catchment benefit beyond the development area.
- proposed funder (e.g., the developer, Council or other).

This information will be used to calculate targeted Development Contributions and for other Council budgeting and asset management planning purposes.

1.3.6 Specifications of assets where vesting or Council funding is sought

- Location, purpose, performance specifications, and sizing of trunk network, devices, green infrastructure which the developer seeks to vest to Council or for which an IFA will be sought with Council.

1.3.7 Mechanisms to ensure delivery of the stormwater plan

- Land title restrictions - proposed easements, covenants, or consent notices that will be placed on title/s to require or protect stormwater management assets/solutions.
- Proposed plan change provisions for stormwater management – cross reference plan change documentation (cite version).
- Any designations required.

- How zonings will be applied especially for green infrastructure to be vested to Council (e.g., the GIC) - cross reference plan change documentation (cite version).

1.3.8 Dependencies/contingencies

- Council works needed prior to development (staging/timing).
- Note any necessary political/Parks/SWU approval.
- Whether an NDC application or variation will be required.
- Devices on land not under developer control and mechanisms required.

1.3.9 Departures

Code of Practice

- Record of departures from the SWCOP that are known at this stage.

Network Discharge Consent and Catchment Management Plan

- Identify proposed discharge consenting pathway (i.e., authorisation under NDC or private discharge consent) and reasons.
- Provide a short compliance assessment, outlining compliance and departures from any NDC conditions and catchment management plan objectives and recommendations. Where there are departures, the developer will need to follow Stormwater Unit processes and deliver information as required in order for the Stormwater Unit to approve the proposal for vesting, and in some cases, to progress additional manager's approval or NDC variation with Council's Resource Consents Department.

Proposed Auckland Unitary Plan

- Note any major departure from PAUP policy direction and reasons. Do not include a full planning assessment.

Reference material

- Special Housing Area – Stormwater Advice Note. Section 3 and Appendix 2 in particular.

1.3.10 Operations, maintenance and monitoring requirements

- Note which assets an Operations and Maintenance plan will be provided for, including communal devices to remain in private ownership.

2. Catchment Description and Context

Purpose of this section

To briefly outline the catchment, land use and receiving environment characteristics relevant to stormwater management (including state, trends and current stressors).

Level of Detail

Overview section – more specific site based information provided later. This assessment should have been completed before development and stormwater management solution design.

Where the development site covers the majority of a catchment, sections 2 and 3 may be combined in to one section to reduce duplication.

Reference material

- Potential information sources are provided below.

2.1 Nature of the Catchment

Purpose

To briefly outline catchment characteristics relevant to stormwater management and the context of the site.

2.1.1 Catchment description

- Brief description of catchment size, soil type/geology, topography and land uses in catchment.
- Map of the catchment, showing catchment/s boundary, existing land uses and development site location.

2.1.2 Natural features

- Identification and brief comment on relevant natural resources: soil type, streams (state, length of permanent and intermittent), terrestrial sites of significance.
- Any relevant PAUP overlay information (see below).

2.1.3 Existing hydrology/stormwater network

- Current hydrological information e.g. flood plains, flood hazards, overland flow, zone of tidal influence, and coastal inundation.
- Current imperviousness (by sub-catchment).
- Identify existing stormwater network and management devices (flow mitigation, flood detention and contaminant management).
- Significant contaminant sources (where known) – existing High Contaminant Generating Activities (as defined in the PAUP) and other contaminant sources (landfills etc).
- To the extent that these factors affect or are affected by the development, provide a brief description of existing network and performance/capacity issues (mapped if possible), including ground soakage where applicable.

Reference material

Any current catchment management plans and analyses held by Auckland Council's Stormwater Unit. SWU can advise on this. Information may also include:

- Flood plain and OLFP maps in Auckland Council's GIS viewer. SWU may have available more detailed modelling of pre-development/developed floodplains and hydrological features of the drainage catchment or site.
- Proposed Auckland Unitary Plan Overlays: Stormwater Management Area – Flow overlay and supporting technical report TR035, Aquifer, High Use Stream Management Area, Natural Stream Management Area, Lake Management Area, Natural Hazard – Coastal Inundation, Flood Plain, Flood Prone Area, Flood Sensitive Area.
- Any available inventory and map of historic flood damage sites, and an estimation / account of the frequency and severity of the flood damage. Areas where flooding has historically occurred downstream of stormwater discharge points should also be identified.
- Any available inventory and map of erosion and sedimentation sites within the catchment and receiving environment.
- S Map, Landcare Research online database.

2.2 Receiving Environment

Purpose of this section

To briefly outline receiving environment characteristics, current state and existing stressors to provide a context for stormwater management requirements.

Generally, provide more detailed information on receiving environments where the development departs significantly from NDC conditions, catchment management plans, SWCOP and PAUP policy direction and less where there is little departure.

2.2.1 Freshwater environment

- Describe the nature of lakes, streams and wetlands, including degree of modification, land use effects on flows and contaminants, and if available, state and trends.
- Brief comment on enhancement and restoration efforts/potential.
- Summarise any assessment of existing (natural or modified) base-flow fluctuations in receiving waters and their effects on stream health and downstream water abstraction uses.

2.2.2 Coastal environment

- Description of nature of coastal environment (high/low energy), degree of modification, sensitivity to contaminants and any obvious erosion potential, state and trends.

2.2.3 Groundwater

- Description of groundwater aquifers, recharge and breakout areas if known.

Available Reference Material

- Any current catchment management plans, watercourse management plans, stream assessments and analyses held by Auckland Council's Stormwater Unit.
- Auckland Council's State of the Environment reports and Technical Publications (monitoring reports).
- PAUP degraded marine areas map.
- PAUP high use and quality sensitive aquifers.
- Other reports as available.

2.3 Existing Catchment and Development Plans

Purpose

To summarise any known direction and plans for growth in the catchment including expected type and location of growth, key direction guiding growth (issues, values, priorities, outcomes sought) and any new growth already in planning or delivery phase.

Where this summary is already provided in structure plan reports for the proposed development, cross reference to avoid repetition.

Add or remove subsections as relevant - all sources should be assessed for relevance.

2.3.1 Auckland Plan

- Check the development strategy in particular.

2.3.2 Proposed Auckland Unitary Plan

- Zoning, precincts.

2.3.3 Area Plan/Master Plan/Structure Plan/Framework Plan/Plan Changes

- New subsection for each (if any).

2.3.4 Catchment Plan/Network Discharge Consents

- Identify any existing catchment management plan and/or Network Discharge Consent and outline whether they explicitly anticipate and/or provide for the proposed growth. If not, a variation or new Network Discharge Consent may be required.
- Summarise relevant requirements/considerations, infrastructure constraints etc.
- Summarise conditions pertinent to the proposal.

Reference Material

- Relevant Plans as per headings above.
- Catchment Plan and NDC where available.

2.4 Gaps

Identify any significant gaps in catchment information (if any). These should be discussed with the SWU.

3. Site Description

Purpose

To describe the characteristics of the site and identify issues and constraints that should be considered in designing the development and stormwater management solution, and potential effects of stormwater runoff from the development.

Level of detail

High level of detail, specific to the proposed development site. This section does not include analysis of any change as a result of the proposed development. This assessment of the site should have been completed before development and stormwater management solution design.

Cross reference to section 2 as appropriate/necessary to reduce duplication and describe the site within the context of the catchment.

3.1 Natural and Physical Characteristics

3.1.1 Topography and sub-catchment boundaries

- Map of topography and sub-catchment boundaries within the development site.

Reference material

- Site survey if available. Note that it is likely that some site survey will only be required for modelling purposes if the development recontouring will potentially significantly affect stream flows and/or habitable floor flooding e.g. stream cross-sections.
- Alternatively topography from Council GIS or other sources.

3.1.2 Floodplains and overland flow paths

- Map of existing 1% AEP floodplains and OLFPs, showing extent.

Reference material

- Auckland Council's GIS Viewer – 1 % AEP flood plain, OLFP, Flood Prone Areas.
- Site assessment/modelling may be needed to deliver more accurate floodplain and OLFP extents, particularly where Council's modelling is coarse (e.g., 10m Rapid Flood Hazard Model).

3.1.3 Soils, geotechnical and contaminated land

- Map(s) of soils, unstable land/ geotechnical constraints, ground soakage capacity if applicable (e.g., if ground soakage for stormwater disposal is to be used in addition to the 10mm retention requirement).
- Identify any known contaminated land, landfills, HAIL sites. Cross reference to any contaminated land reports.

Reference material

- S Map, Landcare Research online database.
- Council's databases of contaminated land/ tagged sites (site enquiry required).
- Historical aerial photos.

3.1.4 Significant ecological and heritage features

- Map showing significant ecological, cultural and heritage features that may form a constraint for stormwater management solutions, from available information. Cross reference to the structure plan report or ecological reports as appropriate.

Reference material

- Available reports and site specific surveys.
- PAUP overlays – Significant Ecological Areas, Sites and Places of Significance/Value to Mana Whenua, Stormwater Management Area – Flow 1 and 2, Coastal Natural Character Areas, Outstanding Natural Features, Outstanding Natural Landscapes, Historic Heritage Places.
- Any bush areas subject to covenants (e.g., QEII).

3.2 Receiving Environments

3.2.1 Streams, lakes and wetlands

- Map permanent and intermittent streams, wetlands and lakes, showing any piped/modified sections, dams, and any areas of riparian vegetation.
- Cross reference to any ecology report associated with the site and development. For example, a description of the state, any existing ecological valuation (fish and macro-invertebrate abundance and diversity), erosion, modification, piped sections, existing network/discharges, stream morphology (channel shape, meander etc), low flow regime of water bodies.
- Note that an SEV or other ecological assessment may be required if permanent or intermittent streams are to be modified or piped/infilled.

Reference material

- Auckland Council (2014). Guidance for Classifying Drainage Systems. Auckland Council Technical Report and Fieldsheets. DRAFT, yet to be released.
- Council's GIS layer for OLFPs can indicate intermittent stream location until a site assessment is completed – refer to the guidance note above.
- Existing stream ecology/water quality assessment reports (SWU may have available information).
- Auckland Council Technical Reports and State of the Environment Monitoring.
- Notes from site inspections.
- Stream surveys (as required).

3.2.2 Coastal environment

Include:

- Marine sediment contaminant levels and any ecosystem assessments (if available).
- Any significant natural areas, including landscape values.
- Existing coastal erosion.

Where it is likely that a discharge may be direct to a coastal environment, provide a more detailed assessment of the immediate coastal environment

Reference material

- PAUP coastal sections.
- Existing ecology assessment reports.
- Auckland Council Technical Reports.
- State of the Environment Monitoring.
- Notes from site inspections.

3.2.3 Aquifers and soakage

If there are no underlying aquifers, soakage or peat soils, state this under this heading.

This section is particularly necessary if development is likely to rely on soakage and/or there will be substantial recontouring.

- Map aquifer recharge/soakage areas and peat areas that may require soakage to retain moisture levels.

Reference material

- Auckland Council Technical Reports and State of the Environment Monitoring.
- AC GIS system.
- Site surveys and other reports.

3.3 Current Land Use and Infrastructure

Some of this subsection may not be necessary for greenfields sites where there is little or no existing infrastructure/urban development. Consideration should be given to upstream developed areas if stormwater from these areas is to be directed to/through the development area. Consider where there is any other existing drainage infrastructure (for example farm drains) that may be used or affect the stormwater design.

3.3.1 Current land use

- Map and description of current zoning, land uses and imperviousness.
- Aerial/satellite photo where available.

Reference material

- PAUP zoning map.
- Auckland Council GIS aerial photos, Google Earth.

3.3.2 Existing stormwater network

- Map of existing network.
- Describe state, capacity (e.g. network modelling analysis/data) and purpose.
- Discuss any known issues with current network.
- Identify any new network or infrastructure planned by the SWU or planned and approved by other developers.
- This section should not include infrastructure proposed as part of development of this site.

Reference material

- Auckland Council Stormwater Unit's portfolio database of planned works to support growth, address flooding, and/or enhance waterways.
- Other development plans/approvals.

4. Development Concept

Purpose

To recognise the broad range of matters in addition to stormwater (e.g., housing yield and type, roading networks, urban design etc) that are under consideration in the design of the development, and identify key outcomes and constraints that may affect the stormwater management approach.

Level of Detail

Brief outline and summary.

4.1 Overview of Proposed Development

Provide or cross reference to a brief outline of the development proposal including:

- Approximate number of lots, land use zonings, type of development.
- Development outcomes sought.
- Precinct Plan/subdivision layout.

4.2 Requirements and Constraints

4.2.1 Development requirements and constraints

- Map and briefly describe significant requirements / constraints on development. For example, include development viability (e.g., minimum lots/houses) and key urban design requirements/outcomes that might affect stormwater solutions.

4.2.2 Other infrastructure requirements and constraints

- Map and briefly describe transport, wastewater, parks or other infrastructure requirements or constraints that may affect development design and stormwater solutions. Cross reference structure plan reports or infrastructure assessments where appropriate.
- Note any obvious opportunities to enhance existing environments.

5. Stormwater Management Issues, Opportunities and Constraints

Purpose

To outline the key stormwater management issues opportunities and constraints sought, specific to the site, in the context of the wider catchment and receiving environment.

Level of Detail

Level of detail commensurate with the expected scale of issues. This assessment should have been completed before development and stormwater management planning.

5.1 Key Stormwater Management Issues/Opportunities

- Based on the information in sections 2 and 3 briefly summarise and map constraints and opportunities associated with the site which should be considered or provided for in the design of the development and stormwater management solutions.
- Identify potential effects on receiving environments that need to be considered when designing the development and stormwater management solutions.

5.1.1 Flooding and overland flow paths

- Stormwater runoff calculations/modelling for the catchment under likely future development conditions (including maximum probable development).
- Potential increase in flows/flood risk downstream (and upstream where relevant).
- Key risk areas - identification of flooding which poses key threats to people, property or receiving environmental values.
- Overland flow paths which need to be provided for in the design.

5.1.2 Stormwater quality

- Key sources and loads of stormwater contaminants from the development, including those from High Contaminant Generating Activities, other roads, and other sources.
- Potential effects on streams/coastal/groundwater if not mitigated.

5.1.3 Stormwater flow effects

- Likely effects of concentration of flows and discharges, and change in volumes and peak.
- Likely extent of impervious area and where maximum impervious area for zones is likely to be exceeded. Sensitivity and values (social, cultural, ecological, economic) of receiving environments, potential risk to the receiving environment values from changes in flow including base flow fluctuations (low rainfall events (100%, 50% and 20% AEP) – channel erosion, stream health.
- Identification of high risk areas for erosion and sedimentation (terrestrial, stream channel and coastal).
- Soakage/recharge requirements.

5.1.4 Streams, lakes and wetlands

- Identify areas where retaining, piping, infilling or otherwise altering lakes, rivers, streams and wetlands may be a significant issue/constraint for development.

5.1.5 Infrastructure

- Site features which preferably should not be disturbed with infrastructure, or which infrastructure could either adversely affect (heritage sites etc) or be constrained by (e.g., unstable land).

- Site characteristics which will create an engineering or other constraint for infrastructure.

5.1.6 Opportunities

- Identify any opportunities to reduce existing adverse effects and restore/enhance receiving environments.
- Opportunities to use natural assets or green infrastructure in preference to construction of other built assets.

5.2 Stormwater Sub-catchments

On the basis of the development concept and the site considerations (Section 3), identify any logical division of the development area into sub-catchments which require a different stormwater management approach (if appropriate). For example, stormwater management outcomes and options may differ for areas discharging to different receiving environments (such as streams, the coast, or ground soakage), or for areas with distinctly different land use zoning. It is expected that these will be refined as the design progresses.

- Map, list and describe the management areas (if any).
- Describe their specific management requirements/issues.

6. Assessment of Options

Purpose

To identify credible options for stormwater management and water sensitive design associated with development scenarios and to assess them in terms of how well they address stormwater management issues and constraints, while meeting wider objectives and requirements for the development.

Level of detail

Liaise closely with the HPO and SWU as these options are developed and the preferred option is selected.

Where the stormwater management approach (to flooding, contaminants, flows, WSD, retention of streams/natural features etc) aligns with the direction of the PAUP, a brief summary is sufficient to show alternatives have been given due consideration. However, if the proposed option differs markedly from PAUP policy direction, then a more detailed assessment is required. Where the development will potentially affect downstream habitable floor flooding a discussion of modelling outcomes will be required.

Only credible and reasonable alternatives should be considered. Non-realistic options should not be included simply to provide alternative options.

6.1 Option 1 (preferred)

Describe and summarise each option in sufficient detail to understand what the option entails and what it will achieve in respect of the identified objectives. Include:

- Brief summary of stormwater management approach by stormwater sub-catchment (table of options for each sub-catchment/sw management zone) (calculations etc do not need to be included).
- Consideration of Water Sensitive Design as a core development approach, at source, and other management of flow, quality and discharges.

6.2 Option 2

As above – brief summary of option.

6.3 Option 3

As above – brief summary of option.

6.4 Assessment of options

The purpose of this assessment is to compare options to identify the preferred option. Provide a brief summary in Table 6.1 and any further explanatory notes required.

Table 6-1: Assessment of Options – Option 1

Option 1 (preferred)	Sub-catchment 1	Sub-catchment 2	Sub-catchment 3
Water Sensitive Design			
Retention			
Detention			
Quality management			

Flood management			
Other			

Table 6-2: Assessment of Options – Option 2

Option 2	Sub-catchment 1	Sub-catchment 2	Sub-catchment 3
Water Sensitive Design			
Retention			
Detention			
Quality management			
Flood management			
Other			

Table 6-3: Assessment of Options – Option 3

Option 3	Sub-catchment 1	Sub-catchment 2	Sub-catchment 3
Water Sensitive Design			
Retention			
Detention			
Quality management			
Flood management			
Other			

6.5 Reasons for the Preferred Option

Summarise reasons for the preferred option(s) based on the assessment above. Further detail on the preferred option is detailed in Section 1: Stormwater Concept Plan.

APPENDIX 1: WATER SENSITIVE DESIGN CONSIDERATIONS FOR DEVELOPMENT

WSD Element	Structure/Framework Plan		Small multi-unit/site development/single site
	Greenfield land	Existing Urban	
Avoid developing in sensitive areas			
Identify natural features including natural drainage patterns, overland flow, intermittent and permanent streams and vegetation	✓	✓	✓
Identify wider environment values, features and considerations	✓		
Identify stormwater management areas to be set aside from development (e.g., by applying the Green Infrastructure Zones)	✓	✓	
Protect existing vegetation and streams (including margins) during development	✓	✓	✓
Avoid generation of adverse effects			
Minimise the use of heavy machinery in riparian corridors and other natural / open space areas	✓		
Minimise the extent of earthworks and change in contours , soil compaction, topsoil removal and modification of natural drainage patterns	✓		
Retain, re-establish and/or enhance streams, vegetation and riparian margins including connectivity	✓	✓	✓
Use vegetation and natural features in management/reduction of runoff	✓	✓	✓
Rehabilitate soil infiltration properties following completion of earthworks	✓	✓	✓
Reconcile site layout with natural drainage patterns and site features	✓		
Protect flood plains and overland flow paths from development	✓	✓	✓
Minimise impervious area footprints, including roads and maximise infiltration	✓	✓	✓
Intensify developed areas in preference to new areas where possible	✓	✓	
Cluster development and impervious areas and creation of coherent open space/vegetated areas	✓	✓	✓ (multi unit)
Minimise aggregation and concentration of stormwater flows	✓	✓	
Use open space/grass areas for temporary stormwater detention and/or stormwater treatment	✓	✓	
Avoid the use of high contaminant generating building materials	✓	✓	✓
Meet stormwater runoff equivalent to pre-development conditions	✓		
Design road layouts to provide for efficient traffic movement and multiple values including amenity and stormwater management - use of trees and other green infrastructure	✓	✓	
Minimise stream crossings and structures within streams.	✓	✓	
Use stormwater for non-potable use, including passive irrigation of landscaped areas and vegetation, car washing, toilet flushing	✓	✓	✓
Use vegetation for shading to reduce thermal impact	✓	✓	
Provide public access to natural features and watercourses	✓	✓	
Design and manage areas that may be prone to litter generation (public congregation and other activities) to minimise litter discharge	✓	✓	
Use multiple mitigation elements when discharging into sensitive receiving environments	✓	✓	
Mitigate adverse effects			
Apply at source / on – site flow and quality stormwater management, and targeted communal management where appropriate	✓	✓	✓
Use green infrastructure for stormwater management including bio-retention devices and similar for stormwater treatment	✓	✓	✓
Provide for lifelong ownership and cost effective maintenance and operation of communal devices	✓	✓	