Discharge Points

Generally, all rear of allotment (roofwater) drainage reticulation systems of this nature must discharge into the back of a suitably located stormwater gully or manhole in the street. Where the private roofwater reticulation system outlet is so isolated from a stormwater gully or manhole that connection is not reasonable, discharge may be allowed into the kerb and channel from an inspection manhole or inspection opening located 0.6 m maximum inside the property.

The maximum permissible discharge to the kerb and channel must be limited to 30 L/s (ie maximum 3 single house lots), and twin 100 mm diameter pipes (equivalent 150 mm diameter) with approved kerb adaptors must be used. Unless approved otherwise by the Engineering Officer Development & Regulatory Services, discharge into the high side kerb of a one-way crossfall street is generally not permitted. Consideration will only apply to single house roofwater drains.

Kerb Adaptors

Only approved full height kerb adaptors are permitted within Brisbane City. The kerb adaptors must be placed in a location where service pits on the footpath will not conflict with the future pipe location.

Where hot dipped galvanised RHS is used as an alternative to prefabricated kerb adaptors, the ends of the section protruding through the kerb must be cut flush with the face of the kerb and treated with an appropriate corrosion treatment. This configuration is compulsory for industrial and commercial developments.

The opening in the kerb must be sawcut and kerb adaptors must be installed flush with the top of the kerb. Kerb adaptors must be fixed in accordance with the manufacturer's specification and all gaps must be filled with approved materials.

6.7.3 Roof and Surface Water (Industrial/Commercial Subdivisions)

A drainage system must be designed to collect roofwater and runoff from paved areas within an allotment. Treatment of collected water prior to discharge to the street or drainage system will need to be incorporated. This drainline is a private system and is not maintained by Council. At least one suitably sized connection must be provided to each allotment within the subdivision. Refer Sections 6.3.2 and 6.3.3.

6.8 DESIGNED OPEN CHANNELS

6.8.1 General

Designed open channels must not only satisfy hydraulic requirements, but also to enhance the environmental and amenity aspects of the area. In addition to the design requirements set out in Section 8.06 of *QUDM*, the following requirements of Sections 6.8.2, 6.8.3 and 6.8.4 will also apply.

6.8.2 Types of Designed Open Channels

The Stormwater Management Code of the *Brisbane City Plan* promotes the use of natural channel design and water sensitive urban design principles. Alternative treatments of channels should be considered and discussed with the Engineering Officer Development & Regulatory Services prior to commencement of design. Consultants are required to use the publication *Natural Channel Design Guidelines* (Brisbane City Council, 2000) as a guide for open channel designs (also refer Section 6.2.1).

Where grass lined channels are proposed the aesthetic value of these channels should be enhanced by the liberal inclusion of native canopy trees. The tree species and planting density must be selected to enable:

- Easy maintenance (mowing).
- Sufficient light penetration to not only sustain the grass cover but also minimises weed growth.

The hydraulic conveyance of a drain under major flows must be designed to include the impacts of long term vegetal growth. The possible effects of scouring at the grass/concrete interface as indicated in *QUDM* must be assessed and works to overcome any problems must be incorporated in the proposal. The use of linear wetlands and off-line wetlands whilst encouraged, needs to be agreed to by the Engineering Officer or Ecologist, Development & Regulatory Services. Care must be taken to ensure that the wetlands do not continually run dry.

6.8.3 Manning's Roughness Coefficients

Manning's 'n' for a grassed open channel is determined by a number of factors including vegetal retardance and hydraulic radius. The table and charts set out in Council's supplement to *QUDM* (Appendix A) provide sufficient correlation to determine Manning's n for most developments.

Council's minimum landscaping requirements for open channels dictates a minimum Manning's 'n' of 0.08 although greater values may be directed by Council where deemed appropriate. A sensitivity analysis should always be undertaken for a Manning's 'n' of 0.15 to ensure the freeboard is not exceeded in a design.

Table B6.8.3.1 provides a semi-quantitative approach towards the evaluation of various Manning's roughness coefficients. Source reference: *Natural Channel Design Guidelines* (Brisbane City Council, 2000).

TABLE B6.8.3.1 FLOODPLAIN REVEGETATION DENSITY GUIDELINES FOR VARIOUS MANNING'S ROUGHNESS VALUES

Manning's 'n'	Description
0.03	Short grass with the water depth >> grass height.
0.04	Short grass with the water depth >> grass height on a slightly irregular earth surface. Trees at 10 m spacing and areas are easy to mow.
0.05	Long grass on an irregular (bumpy) surface with few trees and irregular ground could make grass cutting difficult. Alternatively, trees at 8m spacing on an even, well grassed surface, no shrubs, no low branches.
0.06	Long grass, trees at 6 m spacing, few shrubs. Easy to walk through vegetation. Area not mowed, but regular maintenance is required to remove weeds and debris.
0.07	Trees at 5 m spacing, no low branches, few shrubs, walking may be difficult in some areas.
0.08	Trees at 4 m spacing, some low branches, few shrubs, few restrictions to walking.
0.09	Trees at 3 m spacing, weeds and long grasses may exist in some locations. Walking becomes difficult due to fallen branches and woody debris.
0.10	Trees at 2 m spacing, low branches, regular shrubs, no vines. Canopy cover possibly shades weeds and it is difficult to walk through.
0.12	Trees at 1.5 m spacing with some low branches, a few shrubs. Slow to walk through.
0.15	Trees and shrubs at 1 m spacing, some vines, low branches, fallen trees, difficult and slow to walk through. Alternatively, a continuos coverage of woody weeds with sparse leaves and no vines.
0.20	Trees and shrubs at 1 m spacing plus thick vine cover at flood level and fallen trees, very difficult to walk through. Alternatively, a continuous coverage of healthy shrubs and woody weeds from ground level to above flood level.

6.8.4 Hydraulic Considerations

All hydrologic and hydraulic calculations for major watercourses or creeks for the purpose of determining ultimate flood levels and development fill and flood levels are based on:

- Q_{100} flows for a fully developed catchment. The effects of lesser flows must also be investigated.
- A fully vegetated waterway corridor using a Manning's n of 0.15, unless the scope of full revegetation is not possible due to an unacceptable increase in flood levels. The restricted revegetation areas within the Flood Regulation Lines (or the inundation extent where applicable) are usually identified in available Council studies such as the Stormwater Management Plans, Waterway Management Plans, and Flood Studies. In general, the planting of trees and shrubs impedes the passage of flow, thereby leading to increased flood levels. The high vegetal roughness coefficient allows for generally unrestricted planting of vegetation.

The proposed development must not cause any adverse flooding, nor make matters worse with respect to flooding of developed or developable areas, erosion potential, or the general amenity of the area. The Developer must not assume that the downstream drainage will be upgraded at a future date thereby allowing its proposal to be of a lower standard. Developers cannot rely on future maintenance by Council to support a proposal.

6.8.5 Velocity

An open channel with critical or supercritical conditions is not acceptable. The velocity must be limited to less than 90% critical velocity in the major storm event.

The maximum velocity allowed in an unlined channel is set out in Table 8.03 of *QUDM* for earth and vegetated channels and must not exceed 2 m/s unless approved by the Engineering Officer Development & Regulatory Services.

The velocity used to determine the time of concentration for the designed channel must not be less than the velocity in the design channel or alternatively, an average value of 2 m/s is adopted. Unless the actual velocity in drainage system upstream is determined, the adopted pipe velocity must not be less than 3 m/s.

Channel velocity checks must assume that a downstream undersized culvert will be upgraded to current design standards at some time in the future. The afflux caused by any roadway crossing over a watercourse must not affect the adjoining properties.

6.8.6 Freeboard

Refer flood immunity levels specified in Section 2.2 of Part B of this document.

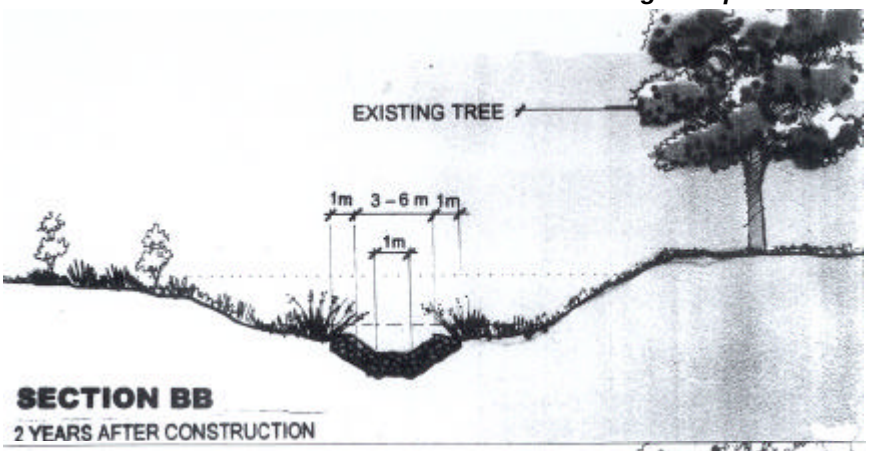
6.8.7 Batters, Landscaping and Maintenance Access

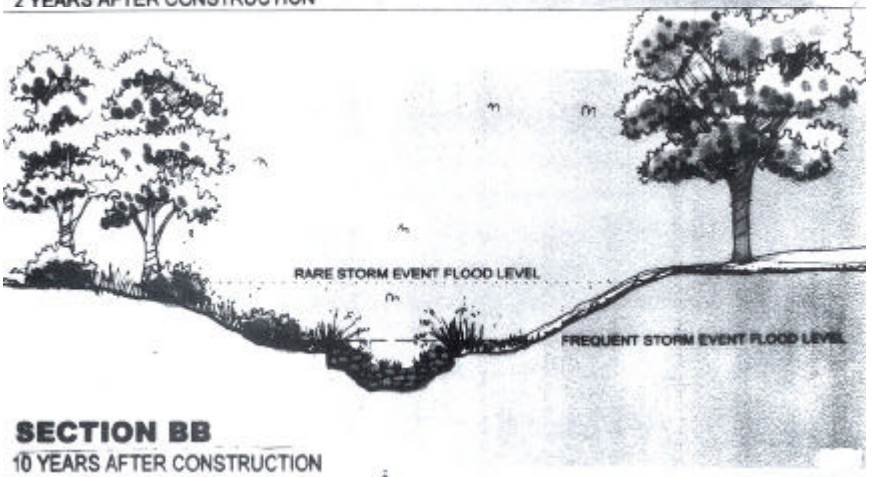
The side slope of the channel banks must not be steeper than 1V:4H (vegetated) and the preferred side slope is 1V:6H (grassed or vegetated). Boulders can be provided intermittently in localised areas to improve the aesthetic appearance of the channel.

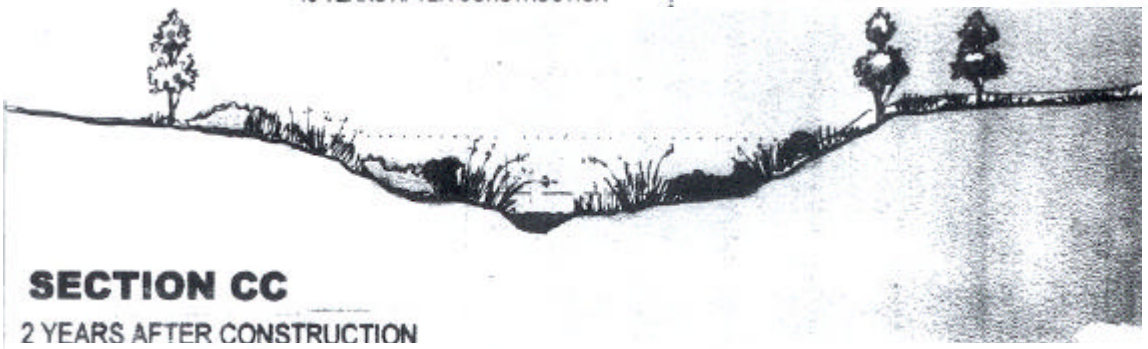
Landscaping of the open channel is very important from a visual amenity perspective and future maintenance. The Developer must submit landscape plans to the Landscape Architect Development & Regulatory Services prior to hydraulic calculations commencing so that Council is satisfied that the channel will be a feature and not merely ‘a drain’.

The preferred treatment for designed open channels must be in accordance with the publication *Natural Channel Design Guidelines* (Brisbane City Council, 2000). Typical design examples are shown on Figure B6.8.7.1.

Berms of 6.0 m (minimum) must be provided along each side of the open channel for maintenance, environmental and recreational purposes. Access locations to potential trouble spots within the channel must also be provided.







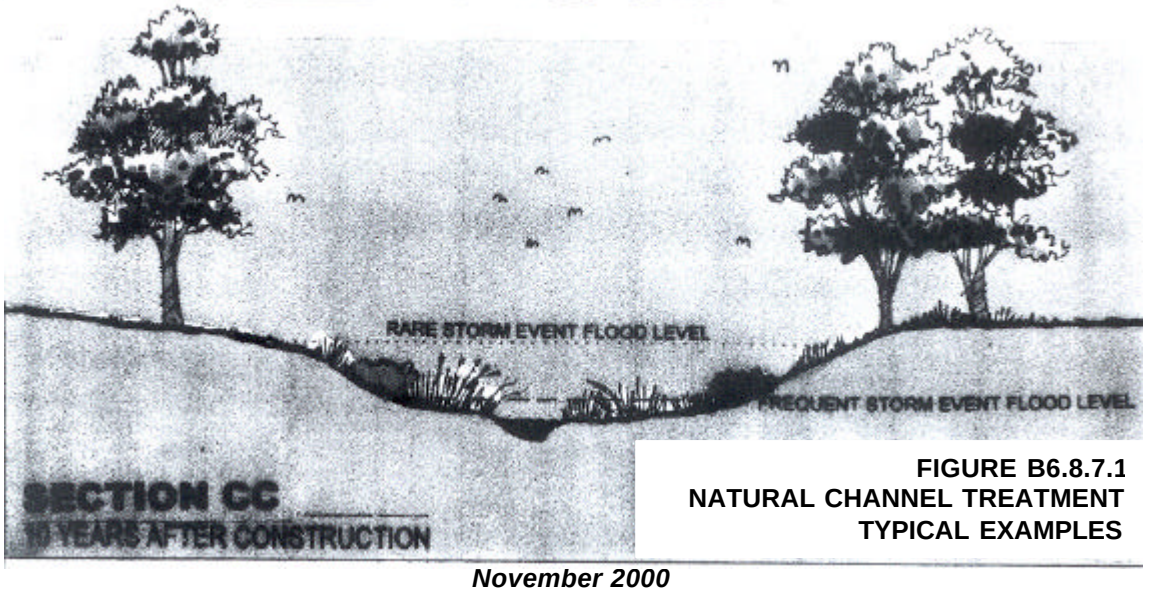


FIGURE B6.8.7.1
NATURAL CHANNEL TREATMENT
TYPICAL EXAMPLES

6.8.8 Minimum Longitudinal Grades

If a channel is proposed in a low lying drainage problem area where grades are relatively flat (minimum velocity 0.6 m/s), the submission must consider the sensitivity of the proposed waterway/channel to siltation which may cause eventual flooding of surrounding land. The analysis provided by the Consultant must include the effects of siltation in the order of 150 mm having been deposited. The provision of a concrete invert and access to facilitate the removal of sediment should be considered. A further consideration is the provision of silt traps at the head of the drain to minimise the environmental effect of silt removal along the full drain lengths.

6.8.9 Outfalls and Outlets

Pipe drainage outfalls to open channels and natural creeks must be designed to control the discharge velocity to spread the concentrated discharge to avoid erosion to the bed and banks and to enhance the water quality by stripping contaminants. Plunge pools are more desirable at outlets on environmental and aesthetic grounds. Outlet diffusers should be set back into the creek bank to allow for future migration or erosion of the creek. Similarly manholes should not be located on the assumption that the creek morphology is stable. Reference should also be made to the publication *Guidelines - Stormwater Outlets in Parks and Waterways* (Brisbane City Council, 2000).

6.8.10 Energy Dissipators

Energy dissipators to control the outlet velocity should be designed using a recognised design practice and supported with calculations and references to the chosen design method. Generally plunge pools with rock bottoms are preferred over baffle blocks, as the latter may pose a safety hazard if any children are trapped in the stormwater drain during a storm.

Energy dissipators should be free draining. Designs based upon downstream ponding are not generally recommended; however, such design will be considered if health and maintenance aspects have been adequately addressed. Debris collection around baffle blocks should be a design consideration. It should be noted that wide baffle blocks would trap less debris than narrow blocks.

The spacing between blocks transverse to the flow must be designed to suit individual site conditions. Spacing between transverse blocks would normally be at least 1.5 times the block width, the spacing between consecutive baffle blocks parallel to the direction of flow being at least 4 times the block height if fully drowned conditions are assumed to occur around the blocks.

Energy dissipators, outlets and drop structures etc, when located in parkland, must address aesthetics, maintenance and safety issues. Refer the publication *Guidelines - Stormwater Outlets in Parks and Waterways* (Brisbane City Council, 2000) for further details.

6.8.11 Drop Structures

Drop structures may be divided into two categories (ie high drop when the depth of flow < drop height or low drop when the depth of flow > drop height). Generally drop structures should be avoided where environmental concerns are an issue eg aquatic life is to be maintained within a creek, migratory routes, faunal corridors. Drop structures should also be avoided wherever possible for safety reasons.

There is only a limited amount of literature available for the design of drop structures and generally this literature is restricted to the design of drops in rectangular channels. The use of trapezoidal or irregular shaped channels can introduce a three-dimensional flow pattern if the approach flow is allowed to accelerate toward the drop. Experience has shown that this flow pattern can significantly reduce the efficiency of the downstream hydraulic jump, resulting in a submerged jet that is unable to be modelled by simple hydraulic calculations.

It should therefore not be assumed that a hydraulic jump would occur downstream of a non-rectangular drop structure. Similarly it should not be assumed that uniform flow conditions exist near any drop structure. Fully drowned drop structures can be analysed by a simple backwater analysis using appropriate expansion/contraction loss coefficients and representative cross sections.

Guidelines (if applicable).for the design of drop structures can be obtained from the following references:

- *Urban Storm Drainage - Criteria Manual Vol. 2*. Denver Regional Council of Governments Ed. Wright - McLaughlin Engineers, March 1969.
- *Training Workshop on Integrated Urban Stormwater Management Vol 3,* AWWA Canberra Branch and Hydrological Society, Canberra Ed. Brett C. Phillips.
- Peterka, A.J. 1984, *Hydraulic Design of Stilling Basins and Energy Dissipaters*, U.S. Department of the Interior Bureau of Reclamation Engineering Nomograph No. 25, Washington, U.S.A.
- *Water Under the Bridge - Aspects of Culvert Design - Part 1*. G.M. Witheridge, R. Tomlinson.
- *Drop Structure Design Problems*. G.M. Witheridge.

Where several drop structures are required to descend a steep grade reference should be made to the design of stepped spillways. A suitable reference being:

- *Hydraulic Design of Stepped Spillways*. CIRIA Report 33 I.T.S. Essery and M.W. Horner

Council preference is that drop structures be cast in situ reinforced concrete or natural rocks. Rock filled mattress type protective works has created maintenance problems in the past and are only to be considered under special circumstances.

6.8.12 Service Crossings above Channel Bed

Isolated service pipe crossings located above the bed are not allowed where such a structure will affect visual amenity. If Council is satisfied that visual amenity is not compromised, afflux from the structure is to be no more than 150 mm and is to be contained within the site area. It is preferable that the level of the crossing be as low as possible or above the flood level. The crossing must be designed to avoid debris collection and to take account of scour at the bank entry or in the bed below the pipe.

6.8.13 Service Crossings below Channel Bed

Pipe crossings which are located below the bed of an unlined channel must have at least one metre clear cover or additional scour protection may need to be provided along the open channel in the vicinity of a pipe crossing. If mitigation works have already been undertaken on the watercourse or if the channel is in a stable condition, this requirement may be relaxed at the discretion of the Engineering Officer Development & Regulatory Services, provided appropriate protection works are undertaken. The Consultant's submission must include a plan and cross section of the proposed works and a longitudinal section of the bed.

6.8.14 Erosion Control

The possible effects of scouring at the interface of lined and unlined sections must also be incorporated to the proposal. For more information about erosion and sediment control in general, refer to Part C – Water Quality Management Guidelines, of this document.

6.9 RETENTION AND DETENTION BASINS

6.9.1 General

When a development is likely to increase runoff to such an extent that the downstream drainage cannot cater for the additional capacity or adverse impacts are created, it may become necessary to incorporate a detention basin. These basins can be either dry (detention basin) or wet (retention basin). Off-line basins can lessen the risk of a sequential over-topping. Both types may have multiple uses eg pollution control, environmental wetland, recreational, as well as hydraulic functions. Also refer Part C - Water Quality Management Guidelines, of this document.

6.9.2 Ownership

Council will not accept retention/detention basins in Council owned land other than parkland. The basin can be retained in private land provided that an easement is granted over the basin. Any Developer wishing to locate a basin within parkland must consult the Open Space Planner Development & Regulatory Services at the conceptual design stage to obtain approval for such a use.

6.9.3 Hydraulic Design

Refer to *QUDM* Section 6 and Council's supplement to *QUDM*.

6.9.4 Visual Aesthetics

Once authorised to have a basin in parkland an important design criterion is that the basin does not look like a hydraulic structure but rather has special character. This will involve the use of variable slopes, the retention of upstream gullies, the camouflage of inlets and outlet structures and the like. A rectangular or geometrically shaped basin is undesirable. Landscape drawings must be lodged for approval by the Landscape Architect Development & Regulatory Services.

6.9.5 Embankments

The maximum batter for grassed embankments is 1V:6H. Landscaped embankments must not be steeper than 1V:4H. The selected use of boulder retaining walls is encouraged to provide variety. In some instances (eg occurrence of rapid drawdown), geotechnical investigations/designs may be required to assess the embankment stability.

6.9.6 Floor Treatment

All basins must have a minimum 600 mm diameter low flow pipe unless the design dictates that a smaller outlet pipe is required. Subsoil drainage is required and the floor is to have a minimum of 150 mm topsoil prior to grassing. The minimum grade across the floor of the basin is to be 1V:150H.

6.9.7 Inlets and Outlets

Inlet and outlet grates must be hot dipped galvanised and set inconspicuously into the embankments of the basin. Vegetated screenings must be provided. However these must not affect the hydraulic performance of the inlet and outlet. Refer *QUDM* Sections 6.03.3, 6.07.1 and 6.07.2.

6.9.8 Safety

The danger to children moving in and out of the basin during times of inundation must be carefully considered. The outlet/inlet grates must be designed such that any child will be able to crawl away from the grate under all operating conditions. Dense landscaping can be used to deter access.

The maximum depth of water in the basin must be limited to 1.2 metres at Q_{20} flows. Sensitive signing must be erected at strategic locations alerting people to the possible hazards of the detention basins. Where detention basins are located directly upstream of a dedicated roadway or residential property, safety and damage consequences as a result of basin collapse or overtopping to the road users/residents must be carefully evaluated.

6.10 LAKES, PONDS AND WETLANDS

6.10.1 General

A feasibility study must be undertaken to ensure that the water body is sustainable, particularly if the facility is off-stream. Account must be taken of the prevailing winds and the length of any fetch created. Safety of residents, particularly children, must be considered in the design of any lake/pond/wetland. Gentle side slopes are preferable. Key design criteria are outlined in Part C – Water Quality Management Guidelines, of this document.

6.10.2 Statutory Requirements

Refer Chapter 6.0, Part C - Water Quality Management Guidelines, of this document.

6.10.3 Water Quality Control

Refer Chapter 6.0, Part C - Water Quality Management Guidelines, of this document.

6.10.4 Sedimentation

All lakes/ponds/wetlands will require ongoing maintenance. Therefore, it is important to ensure that satisfactory access for maintenance purposes is provided. Where lakes/ponds/wetlands are proposed to improve the quality of stormwater, the residents in the immediate neighbourhood must be forewarned of the need for periodic desilting and other forms of maintenance. Council will not always accept control of the resulting water bodies. Where Council does not accept control there may be a security deposit required by Council as a bond on maintenance.

6.10.5 Geotechnical

Geotechnical investigations/designs are required for existing or proposed water retaining structures such as detention basins to confirm stability and erosion potential. On completion, certification by a qualified Geotechnical Consultant (with RPEQ registration) must be submitted prior to On Maintenance acceptance.

6.10.6 Storage Size

Overall hydraulic design of the lake/pond must be carried out generally in accordance with Section 6.0 of *the Queensland Urban Drainage Manual* and Council's supplement to *QUDM*.

6.10.7 Outlet Structures

In addition to the requirements for the design of the Outlet Structures detailed in *QUDM*, the Consultant must consider the following:

1. Compatibility of the proposal with the use of the surrounding land and amenity of the area.
2. Sensitivity of the proposal with respect to the environment.

6.10.8 Maintenance Requirements

Also refer Chapter 15.0, Part C - Water Quality Management Guidelines, of this document. A detailed management plan, including costs, for the future maintenance of any lake/pond/wetland that is proposed to be handed over to Council, must form part of any submission and should include the following:

1. Contingencies for responding to pollution events.
2. Arrangements for any dredging of the lake which may become necessary.
3. Means of maintaining the water level.
4. Means of emptying the lake or pond (eg valve control at the outlet pipe).

6.11 EASEMENTS

6.11.1 When are Easements Required

Drainage easements are corridors registered on a certificate of title for the purpose of underground drainage pipes and/or overland flow paths. Any construction within the drainage easement and/or near/over stormwater infrastructure must be avoided whenever possible. This approval process is outlined in Section 6.14. Pipe drainage easements are required over any pipe 225 mm diameter or larger.

6.11.2 Types of Easements

Roofwater Reticulation

Roofwater drainage reticulation pipes of 225 mm and 300 mm diameter must be provided with an easement 1.5 metres wide in favour of Council. Roofwater reticulation drainage of 150 mm diameter (ie servicing up to 3 single house lots of nominal 180 m^2 roof area each) does not require an easement.

Underground Pipe Drainage

This easement allows for the construction and/or maintenance of underground drainage. Approval to build over an easement must be in writing and does not alter the terms of the easement agreement.

The minimum easement widths required for underground pipe drainage other than roofwater lines must be the greater of 3.0 m or the outside pipe diameter/culvert box width plus 1.0 m clearance distance from edge of pipe/culvert. For example, 3 m easement widths apply to single pipes 300 mm to 1050 mm diameter.

Open Cut Drainage

This type of easement allows for the construction and maintenance of an open drain or channel within the easement. The easements should be wide enough to incorporate any berms along the top of open channel. See Section 6.8.7 for berm requirements.

Overland Flow

This provides for passage of stormwater along the easement and prohibits the erection of structures, the alteration of surface levels, and any activity within the easement which may obstruct the flow of storm runoff, eg debris retentive fences, landscaping, walls, filling. The easement must be the full design flow width. A minimum height clearance of 2.0 m is required between the invert of the flow path (to be protected from potential scouring) and the underside of any overhanging structure for maintenance purposes.

Access

Access easements permit Council to have access from a surveyed road to an easement to facilitate construction and/or maintenance of the drainage facility. (Unless agreed otherwise by the property owner, the access is usually the most direct route through the property.) This will normally form part of all underground open cut and overland flow easements.

Combined Underground/Aboveground Drainage

Combinations of the above easement types will often be required eg underground and overland flow where there is an overland flow associated with a piped drainage.

Portion of Land within the Flood Regulation Lines

Flood Regulation Lines (FRL) are lines used by Council to indicate floodplain areas reserved for floodwater storage and flow, and where development may be restricted. Flood Regulation Lines (FRL) have been in use by Council since the mid 1960s, although much of the FRL network was not formalised until the early 1980s with the majority of these lines being interim in nature. The interim FRL is generally based on historical flood level information and the available ground level data at the time of its creation. The modelled FRL has been set based on the detailed hydraulic modelling results of the watercourse, and modelled FRL can sometimes differ substantially from the interim FRL. The positions of the existing interim FRL are progressively refined and modified by Council, once more study results become available.

For any assessable development (eg material change of use, reconfiguration of lots, operational works, etc), Council will require as a minimum, a drainage easement (access or open cut or overland flow) for the portion of land within the Flood Regulation Lines, as a condition of approval. The preferred option, especially on major watercourses, is that the land be transferred as open space, drainage reserve or park and placed under Council's control.

When public access is likely to occur over easements, whether restricted or unrestricted, such land may in some circumstances be best transferred as open space and placed under Council's control, although it may not form part of the parkland contribution.

6.11.3 Survey Information

When submitting a RP survey plan of an overland flow path easement to Council for approval and prior to the registration of the survey plan with the Titles Office, the finished surface levels of the area under easement must be shown on the RP Plan. Titles Office has advised that they will accept survey levels on RP Survey Plans.

Where early signing and sealing occurs as a result of performance bonding, a plan of the finished surface levels must be submitted prior to the works going On Maintenance.

Where the overland flow easement is over an area inside the Flood Regulation Line, the design surface levels where works are constructed and/or existing surface levels where no works have been undertaken, must be shown on the real property survey plan. Prior to the works being accepted On Maintenance, As Constructed levels must be submitted to demonstrate the finished levels are within the accepted construction tolerances.

6.11.4 Variation to Easement Terms

There is no statutory procedure for the variation of a registered easement except by decision of Council. A variation or modification of the terms of the easement agreement can be achieved by surrendering the existing easement and by the granting of a new easement. All costs are the responsibility of the applicant.

6.11.5 Extinguishment of Easements

To have an easement extinguished, the owner of the property has to obtain the agreement of the grantee (ie the Council) to execute a surrender of the easement and have that surrender document registered by the Registrar of Titles. Council may also wish to recover previously paid compensation monies at the present market value. All costs are the responsibility of the applicant.

6.12 PUMPS AND STORAGE

6.12.1 Pumped Stormwater Drainage

A pumped drainage system will not be permitted on conventional title subdivisions. Council will only consider a pumped stormwater drainage system if:

1. Council is satisfied all other avenues have been exhausted.
2. Letters of refusal are received from all property owners through which the roofwater line could be taken by gravity to the street, including acknowledgement that significant overland flow will occur at times of power or mechanical failure.
3. It is part of a comprehensive stormwater recycling system.

Further, the applicant must satisfactorily address all the following requirements.

1. A suitably experienced Registered Professional Engineer in Queensland (RPEQ) must be engaged to prepare and certify the design. Further the RPEQ must inspect the works during construction to ensure that the design intent is achieved and certify same. Refer Section 6.1.
2. Demonstrate that the overspill can take the form of sheet flow to reflect pre-development conditions when the pump capacity is exceeded.
3. Demonstrate that in the event of malfunction, the consequences are not catastrophic. For example overflows should leave the site in a safe manner and not inundate habitable or non-habitable areas.
4. The pump well storage and pump capacities must be designed for the minimum 10 year ARI critical storm burst. The critical storm burst is the storm duration that dictates the maximum active storage size, and this storm duration is usually independent of the sub-catchment time of concentration. Typically pumping and storage characteristics during smaller storm events (eg 2, 5 and 10 year ARI) for a

range of duration (say up to 2 hours) would need to be investigated, to ensure that the pump operates within the manufacturer's recommendations.

5. In some instances the 10 year ARI design event maybe inadequate. For example, pumps may need to be sized for more extreme storm events when dewatering basement carparks or where overland sheet flows cannot be achieved.

6. Council prefers that the pumped systems be discharged directly to a gully, a manhole or a drainage line. Direct discharge to a kerb and channel is not permitted. Where the kerb and channel is the only lawful point of discharge, the outlet from the pump must feed to a storage manhole which then drains by gravity to the kerb and channel. Regardless of these disposal methods, a check of road capacity and existing drainage system is required to demonstrate that there are no adverse impacts.

7. Storage areas can be a combination of underground and aboveground areas, for example, shaped car park or landscaped area to hold water till pumping system restarts. However care needs to be exercised with aboveground storage area that public safety or amenity is not compromised.

8. The pump well design must consider the following factors.
   - Minimise deposition of solids.
   - Excessive foaming and air entrainment (usually caused by stormwater dropping from a high level inlet pipe) in the wet well to be avoided.
   - Structural design to resist uplift, soil and water pressures.
   - Suitable openings to enable pump removal, and for electrical and pipework access.
   - Sufficient space to be provided around the chamber for maintenance access and sufficient headroom for lifting tackle to be erected so as to raise the pumps if necessary.

9. The pump design must consider the following factors.
   - In addition to the operating duty pump, an equivalent standby pump (ie of equal size to duty pump) must be installed to safeguard against mechanical failure.
   - In order to assure reliability of the standby pump, the pumping system must be set up by automatic rotation to ensure that the hours run by both the duty and standby pumps are approximately similar.
   - The most likely stormwater pump station configuration is usually the submersible wet well centrifugal type pumps normally employed in the wastewater industry. These pumps are available off the shelf and come in an extensive range of sizes and configurations. They are also not self priming ie they require a positive head at their inlet in order to commence pumping without initial priming (removal of air from the pump casing).
   - Pump sizing calculations must incorporate the system resistance, pump duty point, frequency of pump motor starts, etc.

10. The property owner is responsible for all costs associated with installation, operation and maintenance; and is liable for damages as a result of system malfunction.

6.13 SEDIMENTATION BASINS AND GROSS POLLUTANT TRAPS

Refer Chapter 5, Part C - Water Quality Management Guidelines, of this document and the publication *Sediment Basin Design, Construction and Maintenance Guidelines* (Brisbane City Council, 2000).

6.14 BUILDING OVER/NEAR STORMWATER FACILITIES (BONSW)

This section outlines Brisbane City Council's assessment and approval requirements for **any building work over or near** underground and/or aboveground stormwater (BONSW) facilities. **BONSW approval must be obtained prior to the issuance of any building approval**. In the context of this document stormwater facilities are defined as any component, whether by way of natural topography (eg gully or depression forming the overland flow path) or constructed infrastructure (eg open cut channel, pipe, conduit, manhole), that forms part of a stormwater drainage system. The relevant application form is available from Development & Regulatory Services Customer Service & Regional Business Centres. **Note: Building work proposed over or near stormwater facilities is generally not permitted unless Council is satisfied other alternatives are not available**.

Approval of building applications without consideration of the likely adverse impacts on stormwater facilities and the City's residential properties can often lead to undesirable outcomes including:

- Nuisance flooding. This can occur when a slab on ground house is built in or across the overland flow path thereby blocking flows and leading to flow diversion to neighbouring properties or when the habitable floor level is set below an acceptable inundation level from adjacent overland flow paths.
- Degradation or damage to the stormwater infrastructure. This can occur when the stormwater infrastructure (eg pipe, manhole, pipe trench) are disturbed during construction, or when additional loads are transferred to the pipe system eg through inappropriate foundation design, or accidental damages incurred due to lack of knowledge of the presence of any underground infrastructure.
- Unexpected costs and time delays. This can occur when stormwater infrastructure is discovered during advanced excavation thus requiring redesign of foundation, or repair costs to damages sustained during construction.
- Development of properties in overland flow paths where insufficient flood free land is available for a building pad.
- Development of properties in high flood hazard areas ie velocity depth product >0.6 m^2/s and/or flow velocity >2 m/s and/or flow depth >0.5 m (0.3 m depth applies to vehicular access/accommodation areas).

WHEN IS AN APPLICATION NECESSARY

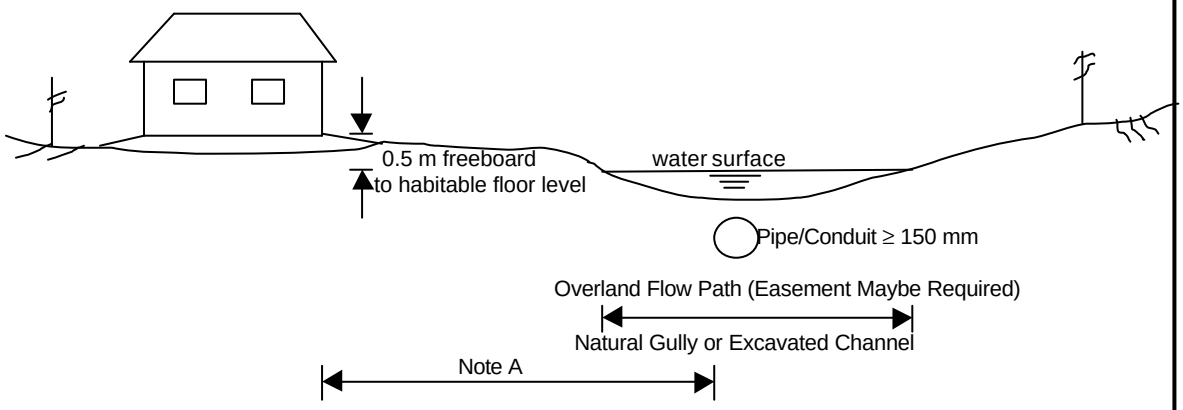
For **aboveground stormwater facilities** with or without drainage easements, a Building Over/Near Stormwater (BONSW) application will be required if the site is subject to any one or more of the following conditions.

- ☐ Any proposed works contravening the drainage easement terms. The easement conditions usually prohibit any part of the building extending over the drainage easement.
- ☐ Open cut channel for the passage or conveyance of stormwater traversing the site.
- ☐ Overland flow path traversing the site, whether natural or excavated/engineered grassed or landscaped swales.
- ☐ Overland flow path over underground drainage system on site, as commonly encountered in city streets and developments such as carparks, estates and shopping centres.
- ☐ Combined underground drainage and overland flow on site. This is the most common basis for conveyance of stormwater in new estates whereby minor flows are piped and excess flow is channelled via an engineered or landscaped topography.
- ☐ Stormwater pipes strapped to the underside of building basements or aboveground pipes fixed to roof and wall. Aboveground pipes can occur on rare occasions where it is not possible to relocate the pipe clear of the structure, generally because the building is constructed right to the side boundaries. The risks of consequential pipe failure must be assessed. (Note: In a few areas of Brisbane, stormwater drains are visible and in some cases partially above surface levels).

For **underground stormwater facilities** with or without drainage easements and where pipes or conduits are greater than or equal to 150 mm in diameter or width, a Building Over/Near Stormwater (BONSW) application will be required if the site is subject to any one or more of the following conditions.

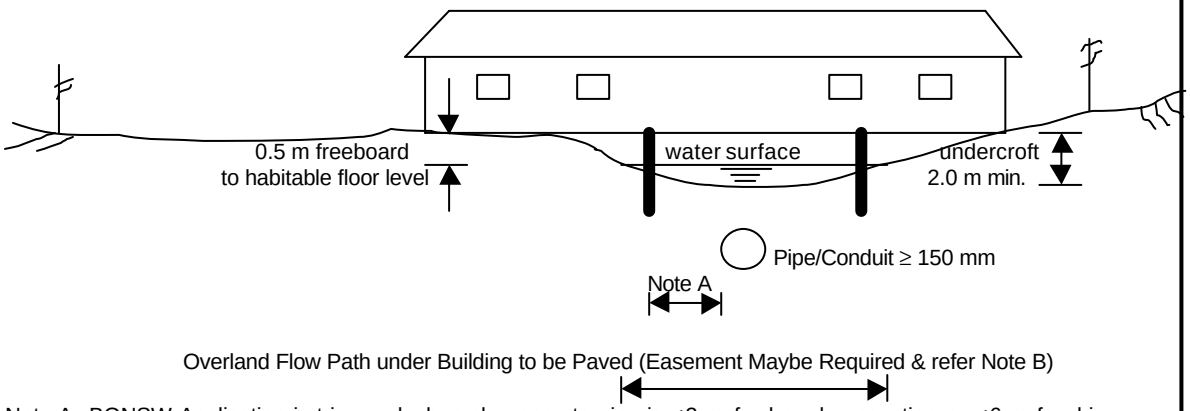
- ☐ Any proposed works contravening the drainage easement terms.
- ☐ Any earthworks proposed directly over the stormwater drainline or manholes that will result in changes to surface levels over these stormwater facilities.
- ☐ Any building work proposed over the stormwater drainline or manholes. This is generally not permitted unless Council is satisfied other alternatives are not available.
- ☐ Bored excavations for piers or footings proposed within 2 metres (edge to edge distance) of the stormwater drainline or manhole.
- ☐ Driven piles or piers proposed within 6 metres (edge to edge distance) of the stormwater drainline.
- ☐ Any proposed works that will affect the structural integrity of the drainline or its trench.
- ☐ Proposed changes to the loading conditions on an existing manhole cover, for example, changing the use of a non-vehicular trafficable area to a vehicular trafficable area.
- ☐ Proposed use of rock bolts or anchors on site.
- ☐ Proposed property access width of less than 2 metres from the front entrance or access road to any manhole or property connections located on site.
- ☐ Proposed driveways or concrete pavements over manholes or property connections.
- ☐ Clashing of services or utilities (other than sewers) with the stormwater drainline that may affect the structural integrity of the stormwater drainline or its trench, or sewers larger than 150 mm diameter crossing any stormwater drainline.

The different components of typical stormwater facilities within private properties are depicted below, accompanied by the relevant BONSW triggers for assessment.



Note A: BONSW Application is triggered when clearance to pipe is <2 m for bored excavation or <6 m for driven piles.

EXAMPLES OF BONSW ASSESSMENT TRIGGERS
BUILDING ADJACENT TO OVERLAND FLOW PATH AND STORMWATER PIPE



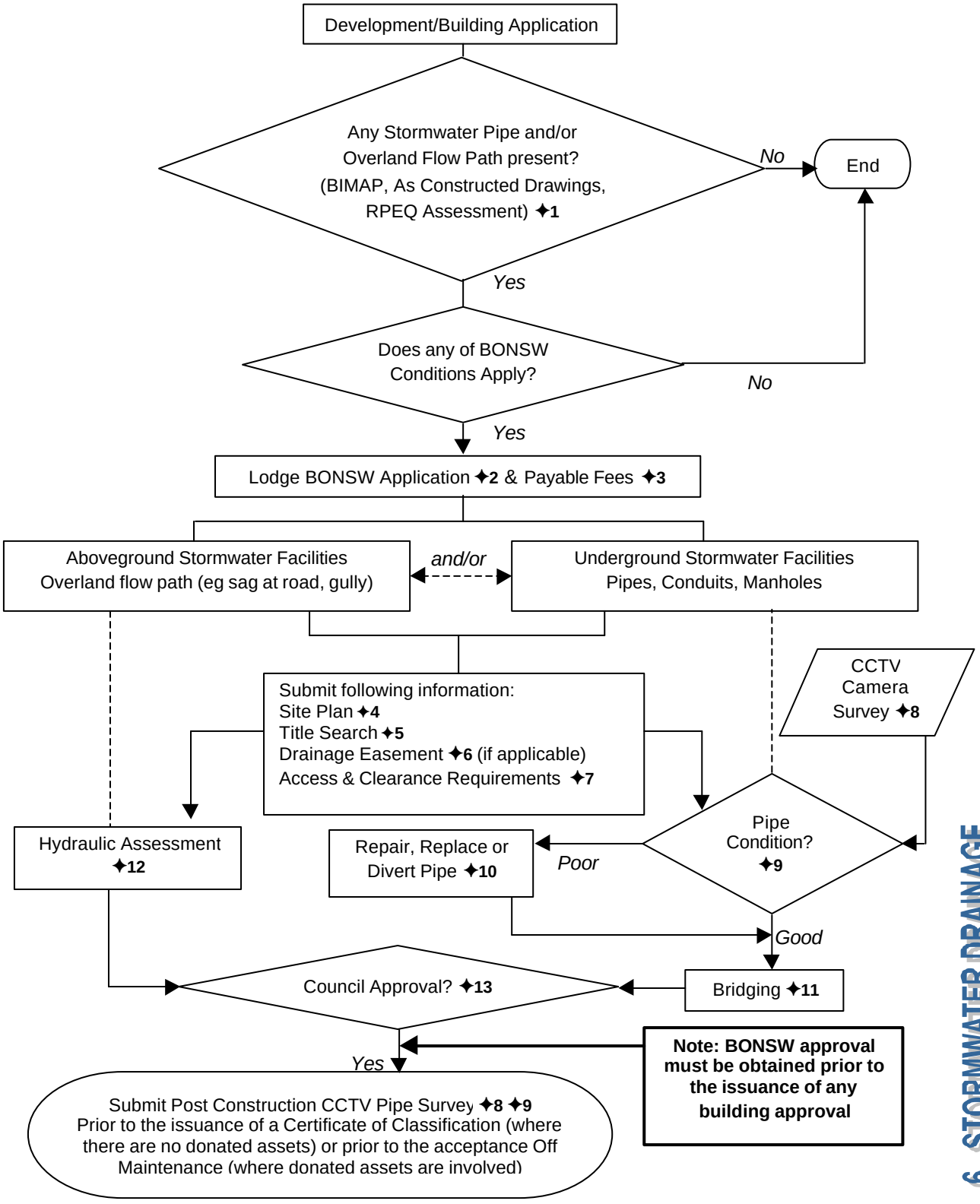
Note A: BONSW Application is triggered when clearance to pipe is <2 m for bored excavation or <6 m for driven piles.

Note B: Flow Velocity ≤ 2 m/s; Depth x Velocity ≤ 0.6 m^2/s, Flow Depth ≤ 0.5 m (0.3 m at vehicular accommodation/access areas). No utility areas permitted in overland flow path. No enclosure is permitted under house. Piers to be designed for water and impact debris loadings.

EXAMPLES OF BONSW ASSESSMENT TRIGGERS
BUILDING OVER THE OVERLAND FLOW PATH AND STORMWATER PIPE

ASSESSMENT PROCESS

The flow chart below documents the assessment process of any building applications affected by aboveground and/or underground stormwater facilities.



✦1 Presence of any stormwater pipe and/or overland flow path can be identified initially from the BIMAP themes (eg 1 m contour, stormwater, flood search flag) at the Customer Service & Regional Business Centres. **Currently Council's BIMAP does not extend to the delineation of overland flow paths, therefore the applicant must engage a suitably qualified RPEQ to undertake this assessment**. Major overland flow paths are usually identified in available Council studies such as the Stormwater Management Plans, Local Stormwater Management Plans or Waterway Management Plans. (Note: Not all pipes are mapped on BIMAP). It is recommended that all BIMAP information be verified from site inspection. There is also lead time involved in transferring 'As Constructed' information to the BIMAP database for new subdivisions. In this instance, infrastructure facilities should be sourced from 'As Constructed' plans which may be available from the developers.

✦2 Lodge application and accompanying documents in any DRS Customer Service & Regional Business Centres.

✦3 All costs associated with the application must be borne by the applicant. The applicant is responsible for all payable fees, lodging all the necessary documentation, damages sustained during construction, and any works required by Council to obtain the necessary approval.

✦4 Site plan (layout and elevation) showing the relevant elements such as location, size, and depth of pipe and manholes; structure clearances; and overland flow path.

✦5 Supply title search details to confirm the presence or absence of any drainage easement. This information can be purchased from any of Council Customer Service & Regional Business Centres or Queensland Department of Natural Resources.

✦6 If a drainage easement is present, the applicant must supply a copy of title deed detailing the extent and terms of the easement. The applicant can obtain these details from the Land Interests and Titling Office, Queensland Department of Natural Resources.

✦7 ✣ Manholes must remain accessible when dwelling is completed ie a minimum 2 metre radius from centre of cover must be maintained. Suitable and permanent access must be provided from the front boundary or access road to all manholes without having to pass through buildings. The access must have a minimum width of 2 metres and a minimum head height of 2 metres.

✣ The minimum clearances between the edge of either stumps or spread footings to the edge of the conduit must be 0.3 m for concrete pipes <900 mm diameter; 0.5 m for concrete pipes ≥ 900 mm diameter; 1.0 m for any brick conduits. The minimum clearance for a bored pier is 1 metre. The minimum clearance may be increased if it is anticipated bedding will be affected.

✣ A minimum height clearance of 2 metres is required between the invert of the flow path and the underside of the structure for maintenance purposes. Applicant must ensure that adequate scour protection is provided.

✦8 ✣ Closed circuit television camera (CCTV) inspections of the pipe can be arranged through Local Asset Services, Brisbane City Council (Contact: Local Coordinator Asset survey, officer code LCAS, telephone 3403 8888). Any person entering Council's stormwater drains must fulfil the requirements of the Workplace Health and Safety Act 1995 (eg confined space training). The CCTV pipe survey must conform to Council's standard inspection and reporting protocols.

✣ If longitudinal crack is observed at the obvert of the pipe, particular attention should be paid to the invert and the 3 o'clock and 9 o'clock positions for evidence of crushing. All cracks must be closely monitored whilst the camera is in motion. All joints must be fully scanned (over 360°) whilst the camera is stationary. Particular attention should be paid to possible infiltration at joints and connections. All connections must be closely inspected; their diameter, type and position being recorded.

✣ The video display and hardcopy report must show all the faults, features and connections in the line. The typical example given below illustrates the reporting format to Council's standard procedures and fault codes.

Manhole 133 → Manhole 132 (upstream), Line 125, 900 mm cast-in-situ concrete.
Distance:

1.6 m	-	start survey
29.0 m	-	spalling, position 9 o'clock, width 50 mm, length 100 mm, depth 40 mm
49.3 m	-	minor faulty 100 mm connection, position 1 o'clock
53.7 m	-	protruding 150 mm connection, position 12 o'clock, depth 400 mm
70.8 m	-	change in pipe material, length 1500 mm
70.8 m	-	minor longitudinal crack, position 12 o'clock, depth 1000 mm
73.2 m	-	minor tree roots up to 25%, position 3 o'clock, length 3000 mm
80.4 m	-	up to 25% debris, width 200 mm, length 1500 mm, depth 20 mm
85.0 m	-	major eroded invert, length 13500 mm, width 700 mm, depth 100 mm
105.0 m	-	survey completed

✦9 Pre and post construction pipe surveys are required to determine the pipe condition where the pipe diameter is equal or greater than 150 mm. (Note: In older areas of Brisbane, some 150 mm and 225 mm dia pipes discharge from street gullies, traversing private properties). The applicant must submit both the hardcopy report and a video display of the CCTV inspection. To achieve a high level of consistency, it is recommended that the same contractor be engaged to undertake both the pre and post construction surveys. All payable fees must be borne by the applicant. The post construction surveys must be submitted prior to the issuance of a Certificate of Classification (where there are no donated assets) or prior to the acceptance Off Maintenance (where donated assets are involved).

✦10 Council will advise the applicant if there are any repairs or future works required prior to construction within the site. However as part of the approval conditions, Council may require that degraded pipe be repaired, replaced or diverted. Council may seek cost contribution from the applicant.

✦11 Footing details indicating where bridging is to occur (no loading is to be transferred onto the pipe). Bridging detail must be certified/designed by a suitably qualified Registered Professional Engineer in Queensland (RPEQ).

✦12 The applicant must engage a suitably qualified Registered Professional Engineer in Queensland (RPEQ) to undertake the appropriate hydrologic and hydraulic assessments. The applicant may wish to engage City Design Water & Environment, City Business, Brisbane City Council (Contact: Principal Engineer Drainage Design, officer code SELDP, telephone 3403 8888) for this service. For localised overland flow path, habitable floor must be at least 0.5 m above the flood level for the 50 year ARI event. For river/creek flooding, habitable floor must be at least 0.5 m above the flood level for the 100 year ARI event.

✦13 The applicant must satisfy all Council requirements and conditions before BONSW approval is issued. BONSW approval must be obtained prior to the issuance of any building approval.

BONSW CHECKLIST

The checklist below summarises key Council requirements in the assessment of any building work over or near underground and/or aboveground stormwater facilities.

	Key Step (in chronological order)	Applicable? Yes/No	Addressed? ✓ / ✗	Reference
1	Are there any Stormwater Facilities?			
	BIMAP Themes			
	▪ 1 m Contour	☐	☐	✦1
	▪ Stormwater	☐	☐	
	▪ Flood Search Flag	☐	☐	
	▪ Overland Flow Path (this is currently unavailable)	☐	☐	
	Available Council Studies	☐	☐	
	As Constructed Plans	☐	☐	
	RPEQ Assessment	☐	☐	
2	Does any of BONSW Conditions Apply? Refer Section – When is an Application Necessary. If No, end of process. If Yes, lodge application and payable fees.	☐	☐	✦2 ✦3
3	Submit following information:			
	Site Plan (Layout & Elevation)	☐	☐	✦4
	Title Search	☐	☐	✦5
	Drainage Easement (if applicable)	☐	☐	✦6
	Access & Clearance Requirements			
	▪ 2 m radius from manhole cover?	☐	☐	✦7
	▪ Suitable permanent access?	☐	☐	
	▪ Adequate clearance to edge of pipe?	☐	☐	
	▪ Minimum 2 m undercroft height clearance?	☐	☐	
4	Underground Stormwater Facilities			
	▪ Pre-construction Pipe Survey	☐	☐	✦8 ✦9
	▪ Replace or Divert Pipe (if applicable)	☐	☐	✦10
	▪ Bridging Details	☐	☐	✦11
	▪ Post-construction Pipe Survey (must be submitted prior to the issuance of a Certificate of Classification or prior to the acceptance Off Maintenance for donated assets)	☐	☐	✦8 ✦9
5	Aboveground Stormwater Facilities Appropriate hydrologic and hydraulic assessments must be undertaken by a suitably qualified Registered Professional Engineer in Queensland (RPEQ). For localised overland flow path, the habitable floor must be at least 0.5 m above the flood level for the 50 year ARI event. For river/creek flooding, the habitable floor must be at least 0.5 m above the flood level for the 100 year ARI event.	☐	☐	✦12
6	BONSW Approval granted by Council? If Yes, end of application. If No, repeat steps 3-5. (Note: BONSW approval must be obtained prior to the issuance of any building approval).	☐	☐	✦13