

Shire of Mundaring



**Environmental Guidelines for the
Construction of Dams**

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**Prepared by the EMRC Environmental Services
in association with the Shire of Mundaring**

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1. PURPOSE

The purpose of these guidelines is to put in place dam assessment procedures aimed at minimising the impacts of the dams on watercourses and the broader environment. These guidelines have been developed in consultation with EMRC Environmental Services, Shire staff and the Water and Rivers Commission.

2. BACKGROUND

The Shire of Mundaring is one of the largest and most diverse municipalities in the Perth Metropolitan Region with significant forest areas designated for conservation, water catchment and recreational uses. One of the key features of the Shire is the extensive network of waterways, creeklines and seasonal upland wetlands.

Council receives numerous requests and development applications for the construction and/or excavation of water supply dams. Concern regarding environmental, hydrological and landscape impacts associated with dams, particularly those within defined creeklines, identified a need for guidelines to properly assess the significance of potential impacts.

Broad criteria to assess dam proposals available from the Water and Rivers Commission was utilised in the past, however more specific guiding principles with respect to the environmental structural and hydrological aspects associated with dams was considered necessary.

Under the *Rights in Water and Irrigation Act 1914*, which is administered by the Water and Rivers Commission, landowners may take water from the watercourse free of charge for the purposes of domestic use, stock watering and garden irrigation for areas up to two hectares. This usage is known as “riparian rights” and requires landowners to use the water in a manner that:

- must not affect the use enjoyed by others downstream;
- ensures water is shared in an equitable way; and
- does not add any polluting material to the stream.

The Water and Rivers Commission recognises that licensing as a management tool may have benefits, however, the licensing process can be very resource intensive. The Water and Rivers Commission are seeking to establish other mechanisms for managing water diversions in a manner that:

- minimises the impact on the waterway system;
- supports the values of the Local Government; and
- provides landowners with a self-supply water resource.

At the Federal and State Government level, the Council of Australian Governments (COAG) has agreed to commit the nation to water reform to address a range of issues associated with sustainable water resource use and allocation. The Western Australian Government, through the Water and Rivers Commission, is proposing to amend the *Rights in Water and Irrigation Act 1914* to accommodate the changes needed to conform to COAG water resource objectives. A series of water resource proposals were prepared by the Water and Rivers Commission and subjected to public consultation during 1997 and 1998.

Of relevance to these guidelines are proposals related to off-stream farm dams and dams on watercourses. Although there are minimal proposed changes to the management of off-stream farm dams, the water reform proposals may require the formulation of local water rules to manage the configuration and operation of dams on watercourses in a manner that protects other people and the environment. In areas of intensive water use, licensing of dams may be required. The outcomes of the water reform proposals relevant to dams will need to be incorporated into these guidelines as information becomes available.

According to the Water and Rivers Commission, the construction of a dam should require the preparation of a development application as this provides the opportunity for the Commission and the Local Government to work together to ensure dams are constructed and used in a sustainable manner.

This approach is consistent with provisions of TPS3, which require all dam construction or dam remediation proposals within the Shire of Mundaring to be accompanied by a development application. In most cases, dam applications are referred to Council for approval.

The Shire of Mundaring Town Planning Scheme No. 3, under section 4.17 (11) General Development Provisions (for Rural Landscape Living, Residential and General Rural Zones) contains provisions regarding the development of land along river valleys, creeks and watercourses which are summarised below:

- a) Stream flow shall be maintained to ensure the protection of the biota and the aesthetic quality of the stream system;
- b) All existing vegetation along water courses shall be retained;
- c) Sensitive development practices shall be employed to minimise run-off and erosion;
- d) No buildings or earthworks shall be permitted within 100 metres from the bank of any river, creek or watercourse and no landfill shall be undertaken within such area or its associated flood plain area;
- e) No dam shall be constructed or the flow of water artificially retarded without the approval of the Water and Rivers Commission and
- f) If in the opinion of Council, land within 100 metres of the watercourse is denuded of vegetation and contains disturbed surfaces, Council may require the landowner to undertake revegetation.

Provisions (d) and (e) relate directly to dam construction. In relation to (e), the Water and Rivers Commission have recently advised that they are only interested in large scale dam referrals and/or those within proclaimed public water supply catchments. Most of the Shire of Mundaring is within existing Helena River public water supply catchments or the proposed Jane Brook public water supply catchment.

This arrangement requires considerable time and resource demands from both officer and Councilor perspectives. One of the main objectives of these guidelines is to assess and resolve most development applications of dams at the officer level with only large dams or dams on watercourse requiring Council approval. Dam proposals along watercourses are generally considered inappropriate, given the existing provisions in TPS 3 and the recognised importance of retaining the natural features associated with watercourses.

However, proposals for dams to be constructed within or adjacent to a watercourse are the most common dam applications referred to the Shire, which highlights the need for careful dam planning, assessment and management. Clearly, there is a need to balance the benefit gained by an individual having a dam with the preservation of a naturally occurring watercourse feature. Issues including the intended use of the dam, justification for its location and size, zoning requirements and the need to refer the proposal to surrounding landowners require consideration.

This report addresses five key areas requiring consideration in the assessment of dam construction proposals within the Shire of Mundaring, namely;

- dam location,
- dam size and stability,
- maintenance of natural water flow,
- the cumulative impacts associated with a series of dams along a watercourse, and
- vegetation clearing.

Each of these areas are briefly addressed below. Table 1 provides for a simple method of assessing each dam proposal by summarising the dam characteristics and their potential impacts.

Each impact is weighted allowing for the summation of a score. The total score allocated against each dam proposal will assist in ascertaining the level of assessment for each proposal.

3. KEY AREAS

3.1. Dam Location

The location of the dam is one of the most important considerations. Dams built within a watercourse can impede the natural flow of water, cause disturbance to fringing vegetation and fauna habitat and potentially deprive downstream users of water. These dams may also collectively impede natural base flows and capture unseasonal rain events due to increased storage within the watercourse. These types of dams also have a tendency to collect sediments as they effectively block the transportation of silt downstream. Dams located within a watercourse contravene TSP3 provisions and are likely to have a potentially high impact, given the combined effect on the environment and on downstream users.

Dams built adjacent to the watercourse, but outside to the natural flow path, may not impede the natural water flow and are designed to take water from the watercourse during peak flows. Dams adjacent to watercourses do not generally collect sediments from the watercourse or impede the transportation of silt downstream. In addition, they are also unlikely to interrupt the flow of the stream during summer rain events and therefore are likely to have a moderate impact on the environment and downstream users. Construction of dams within 100 metres of a watercourse is also contrary to TSP3 provisions and therefore will require Council approval. From an environmental perspective, these dams may be acceptable, providing they are structurally sound and address issues such as vegetation protection, erosion controls, maintenance of local hydrology and revegetation requirements.

Dams located higher in the landscape, and well outside a defined watercourse (i.e. 100 metres or greater), obtain water mainly from the surface catchment and are therefore unlikely to impact on local hydrology. This is the preferred location for water supply dams, but may only be suitable for rural farm dams on larger properties.

3.2. Dam Size and Stability

The structural safety and water holding capacity are very important considerations to be taken into account before beginning earthworks.

There is limited information regarding acceptable standards for “sizing” dams based on proposed use or land area. As a guide, the Water and Rivers Commission suggest that water requirements for a 2 - 4 hectare property based on riparian rights may be achieved with storage capacities in the order of 2,000 - 2,500 kilolitres. This assumes that:

- the water would be used for domestic use, irrigation and stock; and
- the landowner has a 92,000 litre rainwater tank.

The foundations for the dam must be structurally sound, built on clay and not be situated on gravel, sand or on seepage areas. Clay content, water holding capacity, wall design and spillway design are also important factors requiring consideration as part of dam construction proposals. In most cases, it is recommended that expert advice from a structural engineer and/or hydrogeologist addressing these issues is obtained and forwarded to the Shire for assessment prior to the construction of a dam.

3.3. Maintenance of Natural Water Flow

The maintenance of a natural streamflow, particularly under base flow conditions, has implications for downstream users and the environment.

A watercourse dam without a dedicated provision to maintain natural water flow has the potential to adversely impact on the downstream uses and the environment. All watercourse dams must demonstrate that natural base flows are maintained within the watercourse. In essence, during base flow conditions (i.e. non-rain periods) the amount of water flowing onto each property should be equal to the flows leaving the property. During rain periods when flows are greater than base flows, it is generally acceptable to harvest excess water whilst maintaining stream flows. These measures protect the rights of downstream users, protect water quality and minimise impacts on downstream ecosystems.

Water supply principles being advocated by the Water and Rivers Commission include:

- (i) Dams constructed off-stream are preferred;
- (ii) Storage capacities (2,000 - 2,500 kilolitres) may require surface runoff and the diversion of water from the watercourse;
- (iii) Except under high flows conditions, landowners would only be permitted to pump or divert water from the stream to dam storage for about 2 hours per day;
- (iv) No water is to be diverted from the watercourse between November and April;
- (v) If on-stream dam is the only option, the maximum storage capacity is 500 kilolitres with a bypass channel to divert all streamflow occurring between November and April to the watercourse.

Preferred dams are offset dams (dams adjacent to watercourses), which only receive stream flow during a storm event (i.e. high flow conditions), and catchment dams which do not receive any water from a watercourse.

These guidelines advocate the construction of dams off-set from the watercourse which capture increased flow during rainfall events and maintain natural base flows. This approach also minimises the potential for the silting up of dams which is a common problem with dams built on watercourses.

3.4. The Cumulative Impacts Associated With a Series of Dams Along a Watercourse

Careful consideration should be taken into account regarding the cumulative impacts of dams along a watercourse. A series of dams can seriously limit the amount of water flow available for downstream users, particularly natural base flows and early winter flows. In these cases, the increased storage volumes in dams along the watercourse favor upstream users with downstream users subject to restricted flows and possibly increased sedimentation of dams due to disturbance and subsequent erosion.

The cumulative impacts of dams therefore requires investigation during the assessment of dam proposals. It is likely that dam construction proposals along sections of a watercourse with numerous dams already located downstream and upstream will need to consider cumulative impacts. The proponents may be required to demonstrate in more detail how the base flows will be maintained and erosion minimised during dam construction.

3.5. Vegetation Clearing

Riparian vegetation plays an important role in water quality and special care needs to be taken to protect remnants and enhance degraded vegetation. The clearing of remnant trees, shrubs and sedges for dam construction contravenes the Shires Town Planning Scheme, is likely to have high local impacts on the environment and also has the potential to cause water quality problems downstream (nutrient export, siltation, increased salinity, erosion).

Vegetation retention and minimising the downstream impacts on water quality are important aspects related to dam construction.

The Shire's Watercourse Protection Code provides further information on vegetation protection and permissible vegetation removal alongside creeklines.

4. DAM ASSESSMENT

Table 1 below integrates the key areas of concern in relation to dams and provides a scoring method to assist in determining the significance of impacts associated with individual dam construction proposals. The methodology should only be used as a guide and will need to be supported with site specific information.

Table 1: Dam Construction Proposal Assessment Methodology Based on Potential Impact Significance

DAM CHARACTERISTICS	IMPACTS			
	HIGH (3 points each)	MODERATE (2 points each)	LOW (1point each)	NEGLIGIBLE (0 points)
Dam Location	Across a watercourse or within a public water supply catchment.	Adjacent to watercourse, but outside of the seasonal flow path.	Greater than 50 metres distance from natural flow of watercourse.	Greater than 100 metres from the watercourse.
Dam Size	Storage capacity exceeding 500 kilolitres (within watercourse) 2,500 kilolitres (outside watercourse) or 5,000 kilolitres (greater than 100 metres from watercourse).	Dam storage capacity no greater than 500 kilolitres (within watercourse) 2,500 kilolitres (outside watercourse) or 5,000 kilolitres (greater than 100 metres from watercourse).	Dams with storage capacity well below those previously stated.	Not applicable.
Maintenance of Natural Water Flow	Watercourse dam with limited structures to maintain natural flow.	Watercourse dam with comprehensive measures to maintain natural flows.	Offset dam that only receives flow during a storm event.	Catchment dam which does not receive any water from watercourse.
Cumulative Impact (500 metres upstream and downstream)	Greater than 4 dams within a one kilometre stretch.	2 - 4 dams within a one kilometre stretch.	1 dam within a one kilometre stretch.	No dams within a one kilometre stretch.
Vegetation Clearing	Requires extensive clearing of remnant trees, shrubs and sedges to construct dam.	Requires some clearing of remnant vegetation.	Requires minimal vegetation clearing.	Does not require any vegetation clearing.

In order to incorporate the dam construction assessment methodology into decision making, a level of assessment and referral procedure has been developed which corresponds to the potential impact significance of the proposal (see Table 2).

Table 2: Referral and Approval Procedure

Score Using Methodology	Impact Significance	Referral and Approval Procedure
greater than 10 points	High	Refer to Water and Rivers Commission and Council for assessment.
5 -10 points	Moderate	Assess proposal under Delegated Authority.
less than 5 points	Low	Dam proposal dealt with at Officer level.

Dam construction proposals with a potentially high impact significance (> 10 points), or within a gazetted public water supply catchment, will require referral to the Council and the Waters and Rivers Commission for approval. Proposals with a moderate impact significance (5-10 points) can be dealt with under delegated authority from Council and low impact significance proposals (<5 points) can be adequately dealt with at the Officer level. Note, that this scoring methodology only provides guidance on the potential impact of dams and each proposal will require assessment, particularly when the score is on the boundary of impact categories.

All new dam construction proposals and proposals to excavate existing dams will require the proponent to lodge a development application. The level of information required to support the application will be based on its potential impact significance as outlined in Table 3.

Table 3: Level of Supporting Information to Accompany Development Application for Dam Construction and Excavation Proposals

Impact Significance	Level of Supporting Information
High	<ul style="list-style-type: none"> • Comprehensive Hydrogeological and/or Geotechnical Report (including impact assessment and management provisions). • Report Certified by Professional Engineer. • Revegetation/Landscape Plan. • Location Plan. • Site Plan (include dam cross-sections).
Moderate	<ul style="list-style-type: none"> • Brief Report of Hydrogeological and/or Geotechnical Aspects. • Certification from a Professional Engineer on Dam Stability. • Combined Location and Site Plan.
Low	<ul style="list-style-type: none"> • Combined Location and Site Plan supported by available or site specific land capability information.

The level of supporting information provided in Table 3 is a guide and will need to be considered against the dam characteristics primarily responsible for the impact

significance score. There is also a checklist provided in Appendix 1, which identifies a range of issues requiring consideration when proposing the construction or excavation of a dam.

5. CONCLUSION

These environmental guidelines have highlighted the five key areas requiring consideration and an assessment methodology of dam construction proposals within the Shire of Mundaring. The use of the assessment method (Table 1), in conjunction with the referral and approval procedures (Table 2), provide direction on the assessment process for dam construction proposals based on their impact significance. Guidance is also provided on the level of supporting information required to accompany a development application for dam construction or excavation (Table 3).

The combinations of these measures aim to provide an adequate level of environmental protection with respect to dam construction proposals. In the future, it is considered appropriate for detailed guidelines to be developed, as further information becomes available from the water reform process being undertaken by the Water and Rivers Commission.

6. REFERENCES

Agriculture Western Australia, the Water and Rivers Commission, Engineering Company's and dam contractors will all have useful information and guidelines available for the construction of a dam.

Agriculture Western Australia has a range of useful information in the form of publications and Farmnotes, which describe in detail a range of topics including;

- Farmnote 41/86 Dimensions and volumes of farm dams.
- Farmnote 12/81 Irrigation dams.
- Bulletin 3825 Farm dams in high rainfall areas.
- Farmnote 76/81 Planning for farm water conservation.
- Farmnote 44/90 Land clearing regulations.
- Farmnote 15/91 Notification of draining or pumping saline land.
- Farmnote 51/76 Roaded catchments. Design and specifications.
- Farmnote 44/76 Roaded catchments and dam size.
- Farmnote 52/76 Roaded catchments. Construction
- Nelson K.D. Design and construction of small earth dams.

These reference documents have been attached in Appendix 2.

APPENDIX 1

Checklist for Planning a Dam

When planning to construct a dam care should be taken to ensure that all of the following issues are assessed:

- Examine alternative methods in which water demand could be met taking into consideration:
 - reliability;
 - cost; and
 - maintenance.
- Assess the size of the dam and the demand for water.
- Assess the soil types surrounding the dam site to ensure stability (engineering integrity).
- Determine the level of creek flow and assess whether your dam may alter creek flow
- What is the current water quality of the watercourse?
- Will your dam affect water quality or will your dam impact on the creek system by:
 - altering the local ecosystem; and
 - impacting on local vegetation.
- Will your dam effect other users of the watercourse through:
 - alteration of flow;
 - alteration of supply; and
 - possible effects due to dam burst.
- What is the size of the catchment and is your dam suitable for the amount of water generated.
- Have you planned for storm events?
- What measures do you propose to minimise sedimentation?
- What measure do you propose to control mosquitoes?
- Will your dam construction affect salinity levels?
- What are the safety issues involved in constructing and maintaining a dam?
- What are the local government requirements for building a dam in your area?
- Is there a local catchment group in the area?
- Is there a management plan covering the watercourse or catchment in your area.

Appendix 2