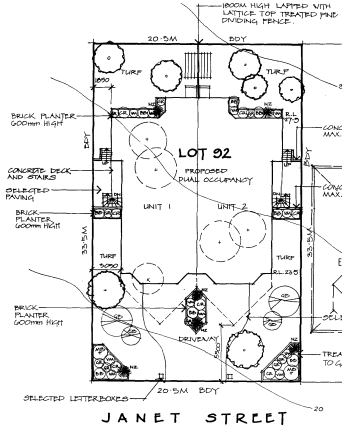


# Site discharge indicator



Water Smart development involves simple design and management practices that take advantage of natural site features and minimise impacts on the water cycle. It is part of the contemporary trend towards more 'sustainable' solutions that protect the environment and cost less.

This **Water Smart Practice Note** explains the concept of 'site discharge indicator'. This is a simple numerical indicator that determines how much area within a site needs to be managed by stormwater source controls. The Practice Note also explains how to calculate required storage volumes, and provides worked examples.

- **What is site discharge indicator?**
- **How is it calculated?**
- **Calculating storage volumes**

# Site discharge indicator

## What is site discharge indicator?

Site discharge indicator is a numerical value that provides an indication of the extent to which runoff from impermeable surfaces on a development site is managed by stormwater source controls such as water tanks and retention devices. The indicator is used in local planning controls as an overall performance criteria for assessing development proposals. In order to satisfy the criteria, designers need to incorporate measures to manage stormwater runoff from impermeable surfaces.

## Why are impermeable surfaces important?

Impermeable surfaces are hard surfaces through which rainwater cannot infiltrate to the underlying soil. Examples of impermeable surfaces include roofs, driveways and paving. All rainwater falling on these surfaces produces runoff.

Impermeable surfaces reduce the quantity of rainwater that infiltrates to the soil, increase the concentration runoff, displace trees and vegetation and increase the potential for pollutants to be transported to streams and waterways. The result is increased urban flooding, reduced base flow in streams and poor water quality.

In conventional stormwater systems, runoff from impermeable surfaces is collected by simple drains and conveyed directly to the street drainage system. In contrast, a 'water sensitive' approach seeks to reduce the direct flow of runoff from impermeable surfaces to the street drainage system. This can be achieved by applying various stormwater source controls. These measures help to reduce the quantity of runoff, delay the release of runoff, improve the quality of runoff, or achieve a combination of these effects. Examples of stormwater source controls include rainwater tanks, retention devices, porous paving, artificial wetlands and landscape measures.

## What does site discharge indicator measure?

Site discharge indicator is equal to the 'managed impermeable site area' expressed as a proportion of the total area of impermeable surfaces within the development site. Managed impermeable site area is the total area of impermeable surface within a development site that drains to one or more stormwater source controls. These controls must meet minimum capacity requirements that vary according to soil and rainfall conditions present at the site (see below under '**Calculating storage requirements**').

If all impermeable surfaces on a site drain directly to the piped street drainage system (that is, there are no stormwater source controls), the site discharge indicator will be zero. The greater the area of impermeable surfaces within a site that is managed by stormwater source controls (having the required storage capacity), the higher the site discharge index will be, up to a maximum of 1.0 where all impermeable surfaces are managed.

Using conventional drainage design, typical low and medium density residential development will score a very low site discharge indicator. However, by incorporating a number of simple measures, a site discharge indicator of 0.9-1.0 can be readily achieved. This is illustrated in Figures 1 and 2.

Development proposals need to achieve a site discharge indicator of at least 0.9. That is, 90% of all impermeable surfaces within the development site should drain to a suitable stormwater source control. This standard has been chosen to allow some leeway on sites where it may not be practicable to manage runoff from all paved areas.

Site discharge indicator is not a volumetric value, and does not measure the quantity of water leaving a development site, or the volume of stormwater that needs to be stored on the site. Instead, it relates to the area within the site that is managed by stormwater source controls.

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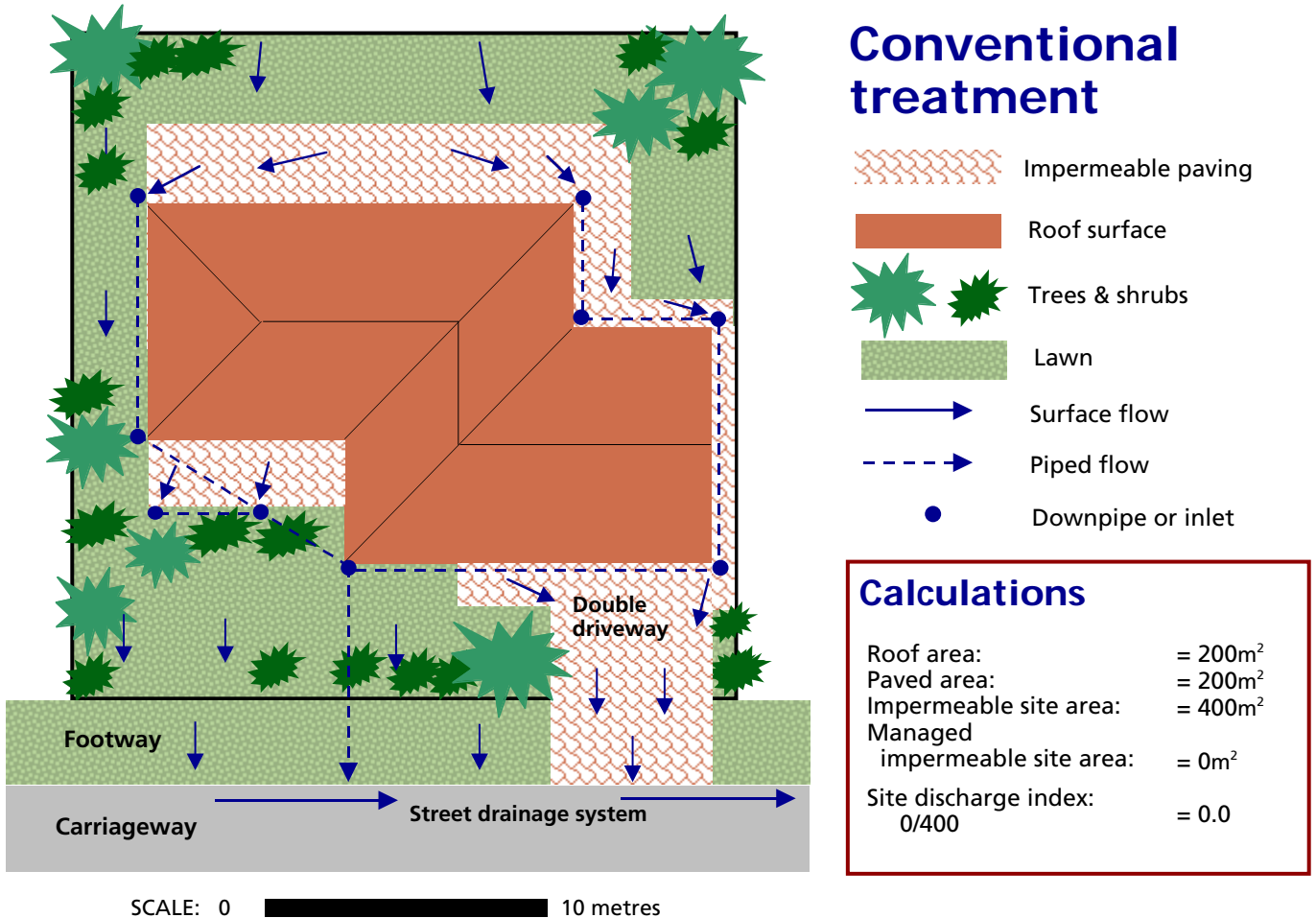


Fig 1: Typical detached dwelling with no stormwater source controls.

## Calculating site discharge indicator

The site discharge indicator for a development proposal can be calculated using the information contained in ordinary building and site plans.

### Step 1: Roof area

Calculate the total roof area (R).

### Step 2: Paved area

Calculate the total paved area (P).

### Step 3: Impermeable site area

Calculate the impermeable site area (I).

$$I = R + P$$

### Step 4: Managed impermeable area

Identify runoff paths for all impermeable surfaces. Then identify each component of impermeable surface that will drain to a stormwater source control. Only stormwater source controls that satisfy specified storage capacity requirements can be included (see below under '**Calculating storage requirements**').

Calculate the total area of impermeable surface that is managed by such stormwater source controls (M).

### Step 5: Site discharge indicator

Divide the managed impermeable site area by the impermeable site area.

$$SDI = M / I$$

# Site discharge indicator

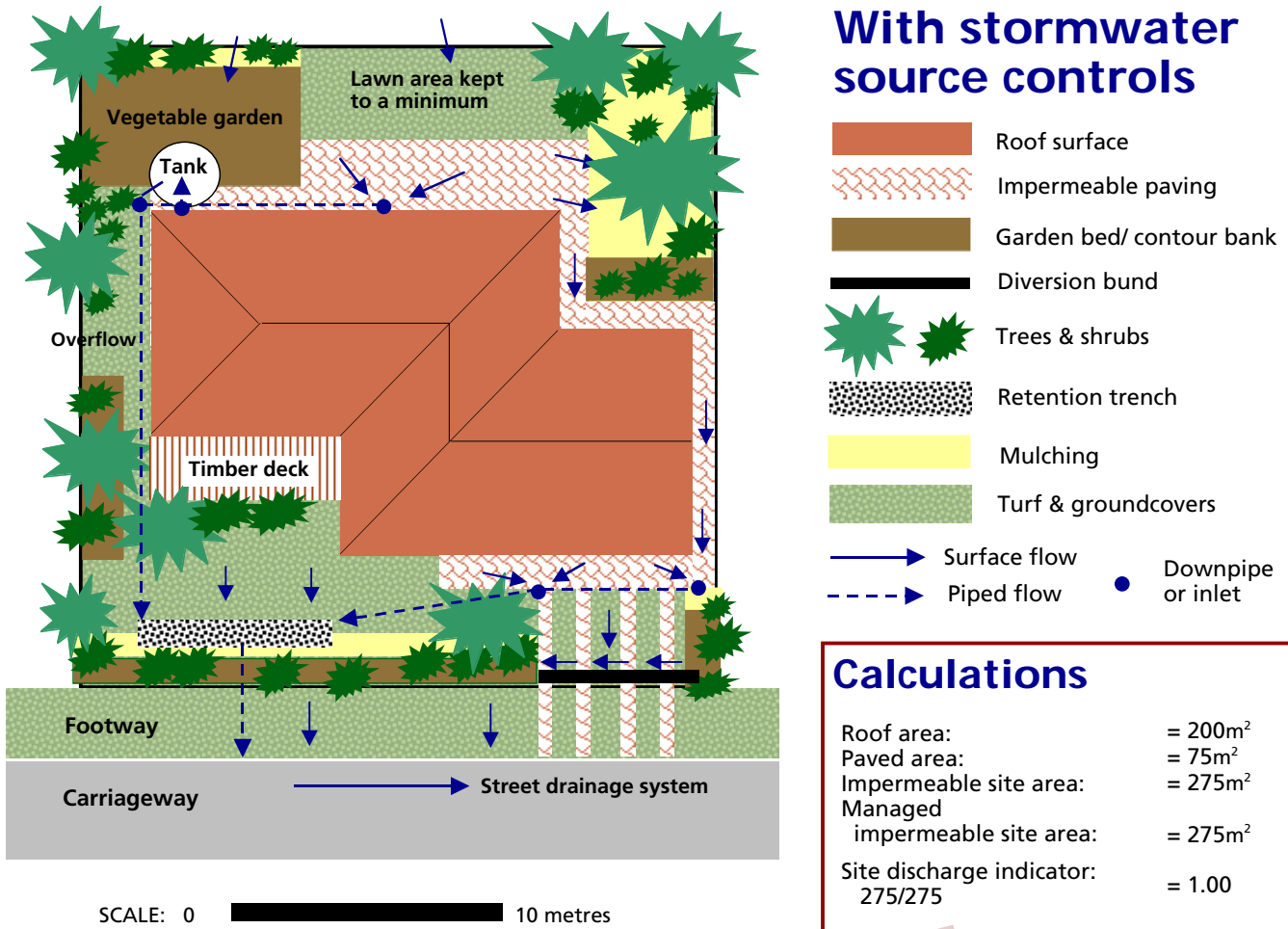


Fig 2: Stormwater source controls applied to the same site (as shown in Fig 1)

## Which measures can be used to increase SDI?

The site discharge indicator for a development site can be increased by incorporating any of the following stormwater source controls in the design:

- roof water tanks connected to toilets, laundry and hot water systems (see *Practice Note 4*)
- infiltration and retention devices (see *Practice Note 5*)
- permeable paving (see *Practice Note 6*)
- swales & other landscape measures (see *Practice Note 7*)
- sand/gravel filters for runoff from car parks and

driveways

- diverting runoff from driveways onto garden beds before leaving the property.

Figure 1 shows a typical dwelling in which all impermeable surfaces drain directly to the street drainage system. The site discharge indicator is zero. Figure 2 shows how simple stormwater source controls could be applied to the same site, increasing the site discharge indicator to 1.0.

In Figure 2, roofwater drains to a rainwater tank that supplies water for toilet flushing, laundry, hot water, and for outdoor use. The rainwater tank overflows to a retention trench. Most runoff from paths and driveways is directed to a retention trench, with some runoff draining to garden and mulched areas. Paved areas have been reduced from

# Site discharge indicator

200m<sup>2</sup> to 75m<sup>2</sup>. A diversion bund has been placed across the driveway to prevent contaminated runoff draining directly into the street gutter.

The example shown in Figure 2 is an example only. Actual site conditions will dictate which type of stormwater source controls are best suited to a particular site, and how they should be configured. For example, infiltration and retention devices can be readily utilised on sandy soils, but may be unsuitable on heavy clay soils unless carefully designed. Space requirements are another consideration. A further consideration is whether the site is within a salinity hazard area, as some stormwater source controls require special design in such areas.

The need for stormwater source controls can also be reduced by eliminating unnecessary impermeable paving. Some options include:

- using crushed gravel, raised timber decking or other treatments instead of paving
- constructing driveways in the form of narrow strips rather than full-width paving
- using porous paving (commercially available as a number of proprietary products).

## Capacity of stormwater source controls

Whilst the site discharge indicator can be used to determine the total area of impermeable surfaces that must be managed by stormwater source controls on a site (the 'managed impermeable area'), it cannot determine how much capacity those controls should have. This requires consideration of the site's rainfall and soil conditions.

Stormwater source controls need to contain runoff from impervious surfaces during frequent, low-magnitude rainfall events (those which occur on average at least once every 3 months). Such rainfall events are responsible for the bulk of stormwater quality problems.

By providing temporary storage of runoff from impermeable surfaces, stormwater source controls can be used to mimic the natural (pre-development) balance between runoff and infiltration. Storage capacity needs to be sufficient to completely mitigate increased runoff from impermeable surfaces. That is, the level of runoff from a given area of impermeable surface must not exceed the runoff that would be expected from an equivalent area of permeable (natural) surface during a rainfall event with an average recurrence interval (ARI) of 3 months or less.

The amount of storage required to mimic natural conditions varies with soil type. More storage is required on sandy soils (where a high proportion of rainfall naturally infiltrates to the soil), whereas less storage is required on heavy clay soils (where rainfall largely runs off to nearby streams).

The depth of stormwater runoff that must be captured to mimic the natural water balance during a 3 month ARI rainfall event is termed the *mitigation depth* (MD). It is expressed in millimetres. The mitigation depth is equivalent to the number of litres of storage capacity that must be provided for each square metre of impermeable surface that drains to a particular stormwater source control.

Mitigation depth varies from site to site according to rainfall characteristics and soil texture, as shown in Table 1.

Table 1: Mitigation depth (mm) for various locations & soil textures, Lower Hunter & Central Coast Region

Rainfall station	Soil texture			
	Sand	Sandy loam	Clay loam	Clay
Maryville (Newcastle)	14.0 mm	14.0 mm	10.0mm	7.0 mm
Williamstown				
Belmont				
Maitland				
Kurri Kurri				
Wyong				
Gosford				

Source: Coombes (2003)

**Not yet available**

# Site discharge indicator

## Calculating storage requirements

Storage requirements must be calculated individually for each proposed stormwater source control. This will ensure that all impermeable surfaces on the site are adequately managed.

The calculation method can be broken down into the following steps.

### Step 1: Rainfall station

Determine which of the rainfall stations listed in Table 1 is closest to the site.

### Step 2: Soil texture

Determine the relevant soil texture class for the site (sand, sandy loam, clay loam or clay). This can be determined by a simple soil test.

### Step 3: Mitigation depth

Using the information from Steps 1 and 2, read off the required mitigation depth (MD) for the site from Table 1.

### Step 4: Managed impermeable catchment

Determine the total area of impermeable surfaces (within the site) that drains to the proposed stormwater source control. This is termed the 'managed impermeable catchment' (MIC) for that stormwater source control. It must be measured in square metres.

### Step 5: Mitigation storage

Using the information from Steps 3 and 4, calculate the mitigation storage for the stormwater source control using the following formula:

$$MS = \frac{MIC \times MD}{1000}$$

Where:

- MS = mitigation storage (kilolitres)
- MIC = managed impermeable catchment (m<sup>2</sup>)
- MD = mitigation depth (mm)

## Worked examples

The process for calculating storage requirements can be demonstrated using the example shown in Figure 2 as a worked example. To illustrate the effect of different rainfall and soil conditions, it will be assumed that identical developments will be built on two hypothetical sites at distant parts of the region.

- *Site 1* is located at Rutherford. The nearest rainfall station is Maitland. The soil texture class is 'Clay'. From Table 1, the mitigation depth is [not yet available].
- *Site 2* is located at Hamilton. The nearest rainfall station is Maryville (Newcastle). The soil texture class is 'Sand'. From Table 1, the mitigation depth is 14.0mm.

The example in Figure 2 makes use of two principal stormwater source controls: a rainwater tank and a retention trench. The storage requirement for each device must be calculated separately, based on the actual area of impermeable surfaces that drains to each device.

### Rainwater tank

The rainwater tank captures runoff from the entire roof area, which has an area of 200m<sup>2</sup>. The managed impermeable catchment for the rainwater tank is thus 200m<sup>2</sup>. The required mitigation storage is calculated as follows.

*Site 1:*

$$\begin{aligned} SR &= \frac{200 \times \dots}{1000} \\ &= \dots \text{ kilolitres} \end{aligned}$$

*Site 2:*

$$\begin{aligned} SR &= \frac{200 \times 14.0}{1000} \\ &= 2.8 \text{ kilolitres} \end{aligned}$$

From the above, it can be seen that Site 2 requires ..... as much mitigation storage as that required at Site 1. As the two developments are identical, this is purely a product of the different

rainfall and soil conditions present at each site.

It is important to appreciate that mitigation storage (as calculated above) is not the same as total rainwater tank capacity. At any given time, much of the rainwater tank's capacity will be taken up by stored water. This is essential to ensure supply security during dry periods. Total tank capacity therefore needs to be sufficient to ensure that available capacity prior to storms exceeds the required mitigation storage.

Available capacity will vary according to a number of factors, including rainfall characteristics, roof area, number of occupants, and type of fixtures connected to the tank. For details on calculating rainwater tank sizes, refer to *Practice Note 4*.

## Retention trench

The retention trench captures runoff from 90% of the total paved area, which has an area of 75m<sup>2</sup>. The managed impermeable catchment for the retention trench is thus 67.5m<sup>2</sup>. The required mitigation storage is calculated as follows.

Site 1:

$$\begin{aligned} \text{SR} &= \frac{67.5 \times \dots}{1000} \\ &= \dots \text{ kilolitres} \end{aligned}$$

Site 2:

$$\begin{aligned} \text{SR} &= \frac{67.5 \times 14.0}{1000} \\ &= 0.95 \text{ kilolitres} \end{aligned}$$

Whilst less storage is required at Site 1, soil constraints associated with the site's heavy clay soils might limit the use of a retention trench or require special design measures. For example, extra separation distance will be required from buildings (including neighbours) in order to avoid foundation movement due to reactive ('shrink-swell') clays (see *Practice Note 5*). It will also be necessary to determine whether the site is within a salinity hazard area, in which case the trench will require an impermeable lining or other special design treatments.

The actual cubic volume of the trench (width x depth x length) will vary according to the type of material placed in the trench and its particle size range. For details on calculating dimensions of retention devices, refer to *Practice Note 5*.

## Using storage calculations to assist design decisions

Calculations for the quantity of required mitigation storage can be used to assist decisions about which type stormwater source controls should be used on a particular site, and where they may need to be located within the site.

For example, if it is proposed to construct a dwelling at Site 1 with a notional roof area of 200m<sup>2</sup>, it can be easily calculated before commencing the architectural design that it is necessary to provide ..... kilolitres of mitigation storage. In addition, ... litres of mitigation storage will be required for each square metre of paving. If the site area is small, there may be little space to accommodate a retention device. Consequently, a decision could be made at an early stage that the design should incorporate a rainwater tank to manage roofwater, and that paved areas should be kept to the absolute minimum (less than 10% of the impermeable site area).

The architectural design can proceed in the knowledge that a rainwater tank is required. Building layout and tank location can then be optimised so as to maximise gravitation from the tank, and avoid conflict between pumps and noise-sensitive rooms such as bedrooms (including neighbours).

In the case of a sandy site such as Site 2, it might be decided early in the design process that greater reliance will be placed on infiltration. A suitable location for an infiltration device (that satisfies required separation distances from surrounding buildings) will need to be determined, thereby defining the available 'building envelope'.

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## Other practice notes

Other WaterSmart Practice Notes are available in this series:

- No. 1 The WaterSmart Home
- No. 2 Site Planning
- No. 3 Drainage Design
- No. 4 Rainwater Tanks
- No. 5 Infiltration Devices
- No. 6 Paving
- No. 7 Landscape Measures
- No. 8 Landscape Practices
- No. 9 Wastewater Reuse
- No.10 Groundwater
- No.11 Site discharge indicator

To obtain copies, please telephone 02 4962 0918.

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