

Chapter 11. Interception





11. Interception

This Chapter discusses the interception activities that may pose a risk to Basin water resources as identified by the Basin Plan. No interception activities were identified as posing a significant risk to the water resources in Victoria's North and Murray water resource plan area. This Chapter meets the requirements of Part 5 of Chapter 10 of the Basin Plan.

11.1 Basin Plan requirements

The Basin Plan requires that:

A water resource plan must, having regard to the risk identification and assessment conducted for section 10.41 of the Basin Plan, specify whether any types of interception activity in the water resource plan area have the potential to significantly affect:

- a. the water resources of the water resource plan area; or
- b. water resources which are hydrologically connected to the water resources of the water resource plan area;

whether on an activity-by-activity basis, or cumulatively.

A water resource plan is required to:

- list interception activities that are identified as having the potential to have a significant impact on the water resources of the water resource plan area
- monitor the impact of these significant interception activities
- identify actions that will be taken in the event that monitoring indicates that the listed activities compromise environmental watering requirements or there is an increase in the quantity of water being intercepted

Actions are not required if increases in the quantity of water intercepted are included in the method used for determining the maximum quantity of water the water resource plan permits to be taken each year (see section 10.10(1) of the Basin Plan). Where volumes intercepted do increase above the SDL, action must be taken in accordance with section 10.13 of the Basin Plan, explained in [Section 9.4](#).

The Basin Plan (section 10.23) identifies the following interception activities that may have a significant impact on water resources in a water resource plan area:

- interception by runoff dams
- interception by commercial plantations
- interception by mining activities, including coal seam gas mining
- interception by floodplain harvesting

The Basin Plan defines a runoff dam as a dam that collects surface water flowing over land.

11.2 Interception in the risk assessment

The interception activities listed in the Basin Plan (section 10.23) were included in the risk assessment ([Appendix B](#)) conducted as part of the development of Victoria's North and Murray Water Resource Plan.

Table 11-1: Types of interception in the Basin Plan and their related cause in the risk assessment

Types of interception in the Basin Plan	Related cause and scenario in Victorian risk assessment
a) runoff dams	Farm dams
b) commercial plantations	Land use change (affecting availability)
c) interception by mining activities, including coal seam gas mining	Earth resource development
d) interception by floodplain harvesting	N/A (does not occur in Victoria)

The risk assessment found that the interception activities listed below, in [Table 11-2](#), [Table 11-3](#), and [Table 11-4](#), pose a medium or higher risk to water availability and/or condition to environment, consumptive, social and Aboriginal/Indigenous uses.

Table 11-2: Identified medium or higher risks to the availability and condition of surface water from interception of surface water in the Northern Victoria water resource plan area

Cause	Availability				Priority environmental assets		Condition			
	Environment	Consumptive	Social	Aboriginal/ Indigenous	Environment	Aboriginal/ Indigenous	Environment	Consumptive	Social	Aboriginal/ Indigenous
Increase in farm dams	3	3		4			3	3		4
Land use changes which affect availability	3	3		4						
Earth resources development⁵					5	5	5	5	5	5

Legend	5	4	3
		Very high risk	High risk

5. Earth resource development was found to be a cause of risk in the Northern Victoria water resource plan area for surface water. This risk was associated with sand and gravel extractions from the floodplain of the mid-Goulburn River.

Table 11-3: Identified medium or higher risks to the availability and condition of surface water from interception of surface water in the Victorian Murray water resource plan area

Cause	Availability				Priority environmental assets		Condition			
	Environment	Consumptive	Social	Aboriginal	Environment	Aboriginal/Indigenous	Environment	Consumptive	Social	Aboriginal
Increase in farm dams	3	3		4			3	3		4
Land use changes which affect availability	3	3		4						
Earth resources development							3	3	3	4

Legend	5	4	3
		Very high risk	High risk

Table 11-4: Identified medium or higher risks to the availability and condition of surface water from groundwater interception in the Goulburn-Murray water resource plan area

Cause	Availability				Priority environmental assets		Condition	
	Environment	Consumptive	Social	Aboriginal	Environment	Aboriginal/Indigenous	Consumptive	Aboriginal
Increase in farm dams				3				3
Land use changes which affect availability				3				3
Earth resources development⁶				4			3	4

Legend	5	4	3
		Very high risk	High risk

6. The risk assessment for the cessation of mining and associated groundwater pumping (e.g. in the Bendigo area) was found to be a localised risk in the Goulburn-Murray Groundwater water resource plan area.

11.3 Addressing risks to water resources from interception

The Basin Plan requires states to identify strategies to address medium, high and very high risks. These are described in detail in Victoria's North and Murray Water Resource Plan Risk Assessment (see [Appendix B](#)). These strategies and their application are described in [Chapter 5](#).

The Victorian Water Act prohibits the take and use of water for mining and by floodplain harvesting without a water entitlement. The take and use of water for these activities is accounted for in sustainable diversion limits as a formal entitlement, not an interception activity, and is not considered further here.

Water for Victoria (DELWP, 2016) recognised that there may be a number of water uses that are not accurately accounted for, monitored and reported and these may affect efficient water allocation as water becomes more scarce.

Two areas identified in the risk assessment that require closer monitoring are:

- the future increase in the use of rights under Section 8 of the Victorian Water Act to take water for domestic and stock use without a licence
- large scale changes to land use that affect catchment water balance

Both these risks were identified in the *Northern Region Sustainable Water Strategy* (DSE, 2009). The growth in farm dams and domestic and stock groundwater bores and the potential future conversion of pasture land to commercial wood plantations were identified as having potential to affect runoff and groundwater recharge.

More specifically, risks to Aboriginal values and uses of water from interception were identified as high risk and discussed in [Chapter 8](#). Victoria's Aboriginal water policy provides a framework for water planners and managers to better understand, recognise, incorporate and manage for Aboriginal values.

Risks to recreational/social values and uses of water from interception were also identified. They will be addressed through a strategy that aims to better understand, recognise, incorporate and manage for recreational values and which is discussed in detail in [Chapter 13](#).

11.3.1 Runoff dams

The Victorian Water Act permits landholders to build runoff dams without a licence if the dam is not located on a waterway and the water is not used for irrigation or commercial purposes. These two conditions significantly restrict the amount of water that can be taken by these runoff dams.

The first condition prohibiting the construction of runoff dams on waterways, including floodplains, limits the size of the local catchment above the dam site and consequently the runoff available to be captured. Dam sites with potential to reliably harvest significant volumes of runoff will be on waterways and will always require a licence.

The second condition that requires a licence for dams supplying irrigation and commercial uses removes the financial incentive to make runoff dams bigger than what is required for domestic and stock use.

11.3.2 Land use changes

Land use changes happen constantly and can include changes between:

- annual and perennial pastures
- grazing and cropping
- till cropping and no-till cropping
- pasture and plantations
- rural and urban land use

Runoff and groundwater recharge can increase or decrease, depending on the direction of the change in land use.

Statutory land use planning powers reside in the *Planning and Environment Act 1987* rather than the Victorian Water Act. Planning provisions are usually general in nature and not typically used to regulate land use activities on farms on how those activities might affect the catchment's water balance.

11.3.3 Earth resources development

Medium or higher risks were identified in the Northern Victoria Water Resource Plan Area due to sand and gravel extractions from the floodplain of the mid-Goulburn River and in the Goulburn-Murray Water Resource Plan Area from the cessation of mining and associated groundwater pumping around Bendigo.

As these risks are localised, they are not considered to present a significant risk to water resources in Victoria's North and Murray water resource plan area or connected water resource plan areas.

11.3.4 Monitoring potential interception activities

Victoria has established two processes to periodically assess the risks of interception activities on water resources in Victoria's North and Murray water resource plan area, and across the state more generally. These include actions that can be initiated once the Minister determines it is necessary to address those issues.

- Division 1B of Part 3 of the Victorian Water Act sets out the process for the Minister to prepare sustainable water strategies for regions of the State. Sustainable water strategies are used to identify risks to water resources and the actions intended to mitigate those risks. The Act requires the Minister to review sustainable water strategies every 10 years
- Division 1C of Part 3 of the Victorian Water Act requires the Minister to carry out long-term water resource assessments to identify if there has been:
 - any decline in the long-term availability of surface water or groundwater and whether the decline has fallen disproportionately on the environmental water reserve or on the allocation of water for consumptive purposes, and
 - any deterioration in waterway health for reasons related to flow

The Minister must determine what actions need to be taken if the assessment finds there has been a decline in the availability of surface water or groundwater that has disproportionately affected water for the environment or for consumptive use.

Action 8.4 of *Water for Victoria* (DELWP, 2016) commits to better monitoring and reporting on the effects of emerging water uses on other uses in the Victorian Water Accounts and to periodically review these emerging uses in sustainable water strategies and long-term water resource assessments.

11.4 Potential interception in Victoria's North and Murray water resource plan area

The catchment water balance of Victoria's North and Murray water resource plan area is monitored in sufficient detail to determine the impacts of licenced and regulated users on environmental watering requirements.

However, interception activities usually involve a range of natural landscape processes that are not well understood and difficult to monitor. As a result, there is not enough detail on the catchment water balance of Victoria's North and Murray water resource plan area to determine whether interception activities have a perceptible/substantial effect that would compromise environmental watering requirements. Data to empirically monitor the effects of interception activities is not available.

Types of potential interception activities in Victoria's North and Murray water resource plan area are summarised in [Table 11-5](#) and discussed in later sections.

Table 11-5: Catchment activities that may increase or decrease the quantity of water being intercepted

Activity	Comments
Activities that increase runoff or recharge (decrease interception)	
Urbanisation increases impermeable areas and increases runoff	1 ha of impermeable area in an area with 500 mm of rainfall per year will produce 5 ML of runoff per year.
Decommissioning farm dams in areas supplied by new piped supply systems, including the: <ul style="list-style-type: none"> West Loddon system (proposed) Mitiamo system (proposed) 	<p>Will reduce the amount of water captured by farm dams.</p> <p>Some dams in areas now served by piped systems have not been decommissioned, but these will deteriorate over time unless maintained.</p> <p>Decommissioning of farm dams in new piped supply areas is not always feasible without clear incentives.</p>
Shift from grazing enterprises to cropping enterprises	<p>Will reduce consumption of water from stock dams by an unknown amount, but likely to be significant volume. No data available.</p> <p>Conversion from deep-rooted native perennial pasture to shallow-rooted annual crops is likely to increase recharge and runoff. Over time, many farmers have adapted cropping practices to retain more soil moisture.</p> <p>Effect in aggregate could be significant because of large areas involved, but no estimates are available.</p>

Activity	Comments
Reduction in area of plantations	<p>It is estimated that the area of plantations in Victoria's North and Murray water resource plan area have remained stable. The estimated total area was 671 km² in 2009 and 668 km² in 2015 (a reduction of 3 km²).</p> <p>This small reduction is not detectable at a regional scale. At small local scales, increases in runoff and recharge, and therefore reduced interception, might be detectable where plantations have been removed, depending on what replaces the plantation.</p>
Reduction in use from runoff dams	<p>In a drying climate, water use from farm dams is likely to decrease where the yield and reliability of supply from dams fall and self-supply irrigation activities are less feasible. However, the overall impact on interception volumes may be marginal because evaporation from existing dams is expected to be higher in a drying climate.</p>
Activities that decrease runoff or recharge (increase interception)	
<p>Revegetation projects for waterway protection, dryland salinity control and biodiversity</p> <p>No estimate is available of the area revegetated, likely to be quite small in Victoria's North and Murray water resource plan area</p>	<p>Planted for environmental benefits and should be excluded from calculation of interception.</p> <p>In part replacing remnant vegetation that is deteriorating.</p>
Establishment of new commercial plantations	<p>Current trend is for the area of plantations to remain stable.</p> <p>Future changes in State and Commonwealth policy and legislation about carbon sequestration may see an increase in plantation area. No trend has been observed between 2009 and 2016.</p>



Activity	Comments
<p>Growth in number of runoff dams. The runoff dams are the primary source of domestic and stock water in the unregulated parts of Victoria's North and Murray water resource plan area</p>	<p>Growth in number of runoff dams is expected in all parts of Victoria's North and Murray water resource plan area, except for irrigation districts and forested areas.</p> <p>Many of these dams are upstream of the regulated parts of the water resource plan area. Any increase in interception will reduce water availability, directly affecting above cap water and the volume available for consumptive allocation.</p> <p>In a drying climate at first the net take by runoff dams will remain similar. Higher evaporation will tend to increase take, but this is likely to be balanced by a reduction in the availability of local catchment inflows. But as the climate dries more, long-term average dam inflows will be significantly reduced with dams staying dry for long periods. Take from runoff dams will be significantly reduced on average if there are no inflows to intercept. This reduction is expected to be very pronounced in the western parts of the WRP region.</p> <p>A similar effect happens in individual drought years with less water available to intercept if dam inflows are very low.</p> <p>There is an extra impact in a drying climate where partly empty dams will intercept small rainfall/flow events. This has potential to significantly affect downstream ecology.</p> <p>Net growth in the number and volume of runoff dams in Victoria's North and Murray water resource plan area is expected to continue at a low rate.</p>
<p>Interception by mining activities, including coal seam gas mining</p>	<p>There is a range of mining activities in Victoria's Northern and Murray water resource plan area. The risk assessment done for the water resource plan indicates that some of these activities have a significant risk of affecting <i>water quality</i> but none has a major risk of affecting <i>water quantity</i>.</p> <p>There is no coal seam gas mining in Victoria's North and Murray water resource plan area.</p>
<p>Floodplain harvesting</p>	<p>No floodplain harvesting is permitted in Victoria's North and Murray water resource plan area.</p>

In summary none of the four specific types of interception noted under the Basin Plan (section 10.23) is expected to have a significant impact on the water resources of Victoria's North and Murray water resource plan area.

- Interception by runoff dams: modest growth is expected over the period of the water resource plan, but any additional take as a result of growth is expected to be small and is unlikely to have a significant impact on water resources.
 - Take by runoff dams, excluding take under basic rights = 84 GL
 - Take by runoff dams under basic rights = 85 GL
- Interception by commercial plantations: no growth is expected over the period of the water resource plan, indicating that there will be no extra impact on water resources.
 - Take by plantations = 108 GL
- Interception by mining activities, including coal seam gas mining: there are currently no mining activities in the water resource plan area that intercept significant volumes of water
- Interception by floodplain harvesting: no floodplain harvesting is permitted in the water resource plan area

11.4.1 Farm dams in Victoria's North and Murray water resource plan area

11.4.1.1 Number and capacity of runoff dams

For the purposes of interception requirements under Chapter 10, Part 5 of the Basin Plan, runoff dams in Victoria's North and Murray water resource plan area are farm dams that:

- intercept catchment runoff, or overland flow
- are not filled using a water entitlement from another water source

Dams of this type are found throughout Victoria's North and Murray water resource plan area, but there are relatively few in the upland forested catchments and in the irrigation districts, as shown in [Figure 11-1](#).

For the purposes of Victoria's North and Murray Water Resource Plan, it will be assumed that no runoff dams occur in these areas. The total capacity of runoff dams in Victoria's North and Murray water resource plan area is estimated to be 261,000 ML (for more information see [Appendix C](#)). Note that the estimated capacity of the dam is not the same as the volume of take.

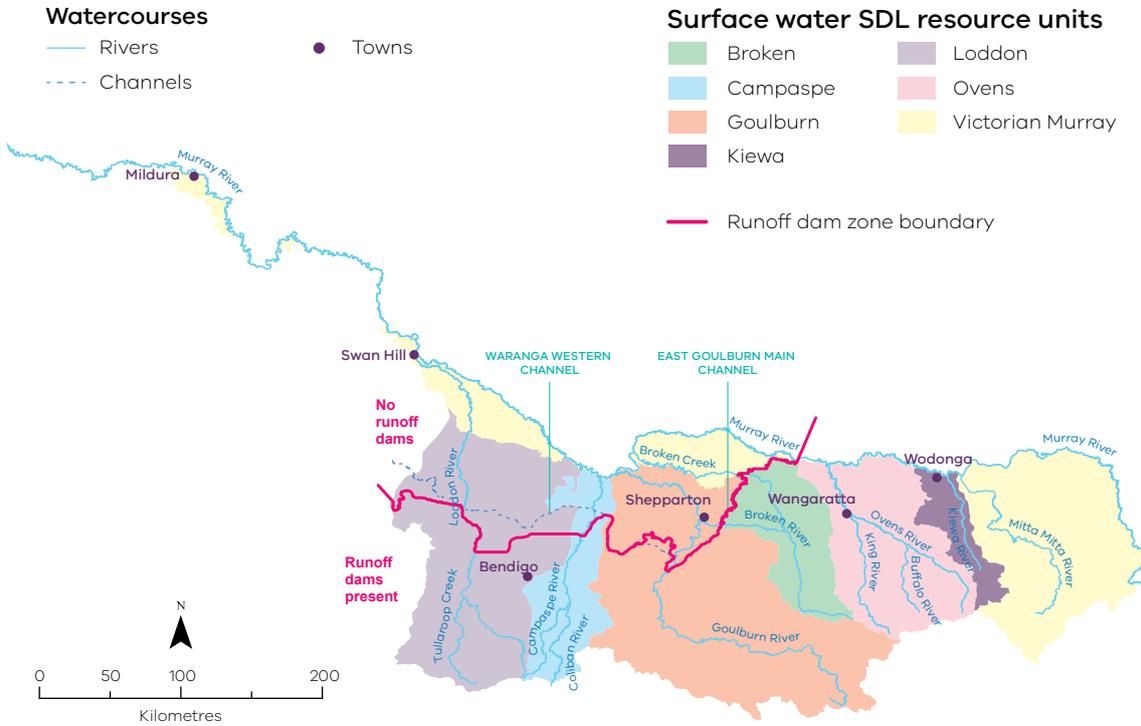


Figure 11-1: Locations of runoff dams across Victoria’s North and Murray water resource plan area

Note: The Victorian Murray and Kiewa SDL resource units are located within the Victorian Murray water resource plan area and the Goulburn, Broken, Campaspe, Loddon and Ovens SDL resource units are located in the Northern Victoria water resource plan area.

The estimated capacity of dams in each valley is shown in [Table 11-6](#). This information has been compiled from the Victorian farm dams spatial layer. This layer was originally compiled based on Geoscience Australia waterbodies data using aerial imagery from 2005, with some updates in the Campaspe and Goulburn basins using imagery from 2010. For the purposes of Victoria’s North and the Murray Water Resource Plan, this data is assumed to represent levels of development in 2009.

Table 11-6: Volumes of types of dams (ML) across each zone in Victoria's North and Murray water resource plan area

Valley	Dams in irrigation areas (ML) ^a	Other dams (ML) ^b	Total runoff dams (ML)
Victorian Murray (upstream of Hume Weir)	-	16,341	16,341
Kiewa	-	10,559	10,559
Ovens	-	38,196	38,196
Broken	-	25,125	25,125
Goulburn	34,145	73,677	73,677
Campaspe	7,711	36,231	36,231
Loddon	17,707	61,006	61,006
Victorian Murray (downstream of Hume Weir) ^c	22,482	-	-
Total	82,045	261,135	261,135

a. in the irrigation districts, all dams are assumed to have been constructed to be supplied from an external source and do not intercept surface runoff. This means that there are no runoff dams

b. outside of irrigation districts, all dams are assumed to be runoff dams

c. in the Victorian Murray SDL resource unit, downstream of Hume Weir, it is assumed that there are no runoff dams

Many of the dams in this table have an associated licence. The total volume of all licensed and registered runoff dams in Victoria's North and Murray water resource plan area is 83,500 ML, leaving 177,500 ML of unlicensed runoff dams used for domestic and stock purposes.

11.4.1.2 Take by runoff dams

It is relatively straightforward to estimate the capacity of runoff dams using available data. However, it is complex to estimate the take by runoff dams as it involves a high degree of uncertainty. The reasons for this are:

- estimates of on-farm demands: average volumes of water extracted from domestic and stock dams cannot be accurately estimated because very few of these dams are metered. Current estimates of annual extraction from domestic and stock dams are uncertain and range up to ± 50 percent. This directly translates to a degree of uncertainty in overall take
- estimates of inflows to dams: the volume of inflows to each dam has a major impact on take, but observed data at this scale is not available and estimates of inflows at a local scale are uncertain. Data products estimating local surface runoff across Australia have been developed recently by various research institutions but are still in their infancy and cannot provide locally accurate data
- changes in on-farm demands over time: in the future it is possible that on-farm demands may change based on climate or agricultural economic drivers. In a drying climate landholders may attempt to increase their reliability of supply by increasing the capacity of their dams. If on-farm demands remain the same, this may or may not increase the long-term take
- losses and level of hydrologic connection: seepage rates from dams and each dam's location in the landscape are major elements in understanding take by runoff dams. It is difficult to generalise dam characteristics across a region and some levels of hydrologic connection to downstream waterways are low.



This means that take by runoff dams estimated at each dam site may be very different to the take by the same dams estimated at a major downstream waterway

- Interaction with other users: increased take by runoff dams in future is likely to reduce system inflows and cause lower allocations in the regulated system. This will reduce the take in the regulated system, making the net effect on take across the whole system uncertain. The likely magnitude of this effect is not clear

Victoria recently developed a new method for estimating annual take by runoff dams (Morden, 2017). It relies on hydrologic modelling of each individual dam in an area, taking into account rainfall, evaporation, dam inflows and on-farm demands. This modelling indicates that the long-term average annual take by runoff dams in Victoria's North and Murray water resource plan area can be estimated with an uncertainty range of about ± 50 percent to ± 100 percent.

11.4.1.3 Future growth in runoff dams

DELWP estimates that the number of unlicensed farm dams across Victoria grew by 0.25 percent to 0.55 percent a year between 2010 and 2015, with each new dam having a capacity of about 1.7 ML on average. This is the best available information on which to estimate growth into the near future.

Assuming a conservatively high growth rate of 0.55 percent a year, the capacity of runoff dams across Victoria's North and Murray water resource plan area is estimated to increase by 11.3 GL over 10 years. However, the inherent uncertainty in estimating take could mean that current long-term average take from existing runoff dams can be estimated only to within ± 60 GL to 120 GL.

Also, any estimates of take may alter if patterns of on-farm demands change because of climate or agricultural economic drivers. More runoff dams could lead to increased take, but a drying climate and changing patterns of on-farm demand could reduce take.

Given the high uncertainty associated with estimating take from runoff dams, it is not clear whether increased numbers and capacity of runoff dams will necessarily lead to increased take. Estimating take as a result of future growth is not practical because the uncertainty in estimated take is significantly greater than forecast growth.

This reasoning leads to two important assumptions which have been adopted for reporting take from runoff dams:

- estimating take as a result of future growth is not practical and so Victoria will assume no growth in runoff dams unless spatial data is updated to allow that growth to be measured directly
- if growth is not to be considered, then the best available information on which to base estimates of take is the spatial data from around 2005. This data could be adjusted to represent growth up to 2009, but this is not suitable as it would introduce more uncertainty, with little practical benefit

11.4.1.4 Future monitoring

The Water Resource Plan Risk Assessment (see [Appendix B](#)) indicates that runoff dams are not considered a significant risk for Victoria's North and Murray water resource plan area. It recognises that future growth may elevate this risk, which cannot currently be quantified. On this basis, Victoria proposes to focus effort on improving hydrological understanding of runoff dams.

Collection of data on numbers and volumes of dams will remain a lower priority until hydrological uncertainties are reduced.

Victoria will review the impacts of runoff dams and the risks they pose to water resources as part of:

- the *Northern Region Sustainable Water Strategy* (DSE, 2009) outlined in the Victorian Water Act
- the Long-Term Water Resource Assessment outlined in the Victorian Water Act
- action 8.4 of *Water for Victoria* (DELWP, 2016) which commits to better monitoring and reporting on the effects of emerging water uses on other uses in the Victorian Water Accounts

These processes will provide opportunities to review and improve hydrological understanding of runoff dams in Victoria's North and Murray water resource plan area, and to consult stakeholders and communities about risks posed by runoff dams and possible mitigation measures.

11.4.1.5 Comparison with risk assessment

The Water Resource Plan Risk Assessment (see [Appendix B](#)) concluded that the risk associated with growth in runoff dams during the water resource plan period to 2029 was rated medium to very low, depending on the specific end-use of the water. Closer examination of the results indicated that runoff dams were a low to very low risk in almost all cases.

The risk to low-reliability consumptive water shares was slightly elevated, but still only rated as a medium risk. However, this risk rating was based on:

- a scenario of an additional 26.5 GL of domestic and stock dams in the water resource plan area within 10 years. This was largely based on farm dam growth assessments undertaken by the MDBA in 2008
- an assumption that the 26.5 GL of extra dams will have a total additional take of 26.5 GL/yr - that is, long-term average annual take = 100 percent of dam capacity. This "rule-of-thumb" was known to be a conservatively high assumption and was adopted in the absence of any comprehensive modelling to confirm the true figure

While these assumptions were based on the best information available at the time, more recent studies have shown that both assumptions are conservatively high. More appropriate assumptions would be:

- a scenario of an additional 0.55 percent of domestic and stock dams per year (by number) in the water resource plan area giving a total of approximately 11 GL of dams over 10 years. This is based on detailed assessment of growth in farm dams over selected areas in Victoria between 2000 and 2016, and more accurate assessment of dam numbers and volumes to each WRP region
- long-term average annual take from runoff dams in Victoria's North and Murray water resource plan area could vary from less than 20 percent of dam capacity to more than 60 percent, based on recent modelling developed by DELWP (Morden, 2017). This modelling produced estimates of take which were lower than expected, primarily due to smaller than expected catchment areas upstream of each dam

On this basis, the additional take from 11 GL of extra runoff dams could be 2.2 GL/yr or less, or 6.6 GL/yr or more. It is clear that the additional take due to growth in runoff dams appears to be a small fraction of that suggested in the risk assessment. The risk assessment used concepts of impact magnitude, duration, and extent to determine how a threat such as growth of farm dams might affect the availability or quality of water. One of the key factors leading to the "medium" risk rating in some cases was the potential magnitude of impact. Given that this magnitude has now been revised down, the "medium" risk rating is no longer appropriate for any risks relating to farm dams. In effect, this means that farm dams do not present a significant risk to water resources. All the numbers described above are provided in [Table 11-7](#) and [Table 11-8](#) for clarity.

Table 11-7: Victorian Murray water resource plan area

	Risk assessment figures	Revised WRP figures
Current number of dams (number)	10,000	14,259
Current capacity of dams (ML)	-	26,900
Future growth rate (% per year)	1%	0.55%
Future growth over 10 years (number)	1,000	804
Future growth over 10 years (GL)	1.5	1.4
Future additional take over 10 years (GL/yr)	1.5	0.3 to 0.8

Table 11-8: Northern Victorian water resource plan area

	Risk assessment figures	Revised WRP figures
Current number of dams (number)	166,660	103,895
Current capacity of dams (ML)	-	234,235
Future growth rate (% per year)	1%	0.55%
Future growth over 10 years (number)	16,666	5,858
Future growth over 10 years (GL)	25	10
Future additional take over 10 years (GL/yr)	25	2 to 6

Strategy number 1 (see [Table 4.2.1](#) in [Appendix B](#)) for addressing risk involves better recording, monitoring and accounting for significant uses of water and will ensure Victoria's understanding and management of interception continues to improve.

Victoria will update the risk assessment for farm dams when the uncertainty associated with estimates of take can be reduced.

11.4.1.6 Methods for estimating take

The long-term average annual take is the net change in streamflow caused by each dam. It includes the combined effect of storage, on-farm demands and rainfall and evaporation from the dam surface.

Victoria has developed a new method for estimating annual take by farm dams based on the best available data (Morden, 2017). The method itself is defensible but as many of the inputs are uncertain, it is not possible to estimate long-term average annual take by runoff dams with a reasonable degree of confidence.

Overall, the capacity of all runoff dams in Victoria's North and Murray water resource plan area is about 261 GL based on aerial imagery from 2005. This includes dams for irrigation as well as those for domestic and stock use. As a result of uncertainty in modelling inputs, long-term average annual take could vary between 55 GL or less, and 155 GL or more, with a 'best estimate' of approximately 126 GL.

Note that this figure of 126 GL includes take by all dams including irrigation, commercial or basic rights. The method for calculating take for different types of dams is defined below.

11.4.1.7 Take by runoff dams excluding basic rights

The Basin Plan Schedule 3 item 17(d), 18(d), 19(d), 20(d), 21(d), 22(d) and 23(d) requires that the sustainable diversion limit (SDL) includes the ‘long-term annual average limit on the quantity of water that can be taken by runoff dams (excluding take under basic rights) calculated on the basis of the quantity of water that could be taken under state water management law as at 30 June 2009’.

On this basis, the long-term annual average take by runoff dams excluding basic rights is estimated as 83.5 GL, which is the total volume of entitlements recorded in the Victorian Water Register associated with runoff dams as at July 2016. This volume of entitlements is equal to the maximum quantity of water which licensees could extract each year.

Data from the Victorian Water Register has been extracted as of July 2016. Due to ongoing improvements and data management within the Water Register, obtaining historical data from 2009 is currently not practical. However, Victoria’s adherence to the Murray-Darling Basin Cap means that the total entitlements volume in 2016 has remained unchanged since before 2009. As a result, licence information from July 2016 is considered a suitable source of information for this situation.

Permitted and actual take will be calculated using the same method as the SDL (see [Table 6](#) in [Appendix C](#))

11.4.2 Take by runoff dams under basic rights

The Basin Plan Schedule 3 item 17(f), 18(f), 19(f), 20(f), 21(f), 22(f) and 23(f) requires that the SDL includes the ‘long-term annual average take of water by runoff dams under basic rights calculated on the basis of the take under the level of development that existed on 30 June 2009’.

Using hydrologic modelling as described in (Morden, 2017), the long-term average annual take by all runoff dams is 126 GL, based on aerial imagery in 2005. This will be adjusted proportionally based on dam volumes to represent only take by runoff dams under basic rights, excluding take by runoff dams which are licensed under section 51 of the Water Act. This adjusted figure for take is 85 GL, as described in [Table 11-9](#).

Permitted and actual take will be calculated using the same method as the SDL (see [Table 6](#) in [Appendix C](#))

Table 11-9: Calculating take from runoff dams in Victoria’s North and Murray water resource plan area

Component	Volume	Method
Capacity of runoff dams	261 GL (A)	Source: <i>spatial data</i>
Total long-term average annual take	126 GL (B)	Source: <i>hydrological modelling</i>
Volume of section 51 licences associated with runoff dams	84 GL (C)	Source: <i>Victorian Water Register</i>
Capacity of runoff dams under basic rights	178 GL (D = A - C)	Calculation



Component	Volume	Method
Take by runoff dams (excluding take under basic rights)	84 GL (= C)	Calculation
Take by runoff dams under basic rights	85 GL (= B / A x D)	Calculation

11.4.3 Land use change

Net changes in interception associated with land use changes, excluding commercial plantations, are not expected to have a significant effect on the water resources of Victoria's North and Murray water resource plan area.

In recent decades, Victorian land use mapping indicates that there has been a shift from grazing activities on perennial and annual pasture to cropping activities in the Loddon and Avoca basins. In other areas, land uses have remained largely unchanged, despite some key difference in methods of attributing land use types in the available spatial data. The net effect of these changes on the catchment water balance is negligible.

Continuing higher density urbanisation around regional centres such as Bendigo and Shepparton will increase runoff and decrease groundwater recharge, although the impact is unlikely to be significant because the areas involved are expected to be relatively small. Lower density urbanisation will tend to increase numbers of runoff dams for domestic and stock purposes, which tends to decrease surface water runoff.

11.4.3.1 Commercial plantations

Commercial plantations are a significant industry in the Upper Murray, Kiewa and Ovens catchments, but less so in other catchments in Victoria's North and Murray water resource plan area. Plantations depend on rainfall and typically occur in regions with more than 600–800 mm of annual rainfall. Sufficient rainfall for commercial timber plantations occurs only in the eastern parts of the water resource plan area.

Based on spatial data from 2009 and 2016 sourced from plantation owners, and interpretation of aerial imagery from those periods, commercial plantations cover an area of 667 km² of Victoria's North and Murray water resource plan area (see [Table 11-10](#)). The area of plantations has remained stable since 2009, decreasing by only 0.4 percent and only in the Goulburn catchment. There are no indications within the plantation industry that the current stable trend will change in the near future. On this basis, little or no growth is expected to occur over the next decade, so interception by commercial plantations is expected to remain equal to 2009 levels.

Assessment of trends in plantation growth for years between 2009 and 2016 has not been undertaken. However, it is noted that all 2016 plantation areas were also present in 2009. This indicates that no new areas were planted in this period, suggesting that the years between 2009 and 2016 are unlikely to have shown any alternative trends.

The risk assessment considered a scenario of 5 percent increase in plantation area during the life of the Water Resource Plan. In general, this scenario was found to represent a low risk. The only exception was some low reliability water entitlements, where the risk was found to be moderate. As discussed above, more recent evidence suggests that there has been no growth in plantation areas and that this trend is expected to continue. On this basis, growth in plantations is expected to represent zero risk for the foreseeable future.

Table 11-10: Area of commercial plantations in Victoria’s North and Murray water resource plan area

Plantation type	2009	2015
Softwood plantations (km²)	595	592
Hardwood plantations (km²)	75	75
Total (km²)	670	667

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No interception activity has been identified to have a significant impact, nor to have the potential to have a significant impact, on water resources that are in or are hydrologically connected to the Victoria’s North and Murray water resource plan area.

<<end of accredited text for s10.23(1) of the Basin Plan>>

