



## 4 CATCHMENT CONDITION

### 4.1 Overview

This section details the physical condition, existing vegetation characteristics, trajectory and management implications of each of the key waterways within the project area. The catchment condition draws on observations from recent site inspections, discussions with land managers and review of aerial imagery and background information.

For the purpose of this Waterway Action Plan, the waterways have been split into reaches based upon the waterway's geomorphic characteristics, behaviour and catchment land use.

In addition to providing in the condition of each of the waterways included in this report, a summary of key processes has been provided.

**Notably, the project scope has not included a detailed site assessment of all the waterways contained within the project area.** The determination of field assessment locations was informed through:

- Input from both the Project Control Group and Project Reference Group.
- Consultation with the broader community through the Wodonga Urban Landcare Network.

Through this process, a list of sites was prioritised for site assessment. These sites, shown in Figure 4-1 were concentrated in the urban section of the project area. Additional localities were inspected across the project area to gain a broad understanding of the waterway/catchment condition. However, it should be noted that the site assessment process was biased towards the urban portion of the project area primarily due to the accessibility and visibility of the waterway network within these areas and response from the community.

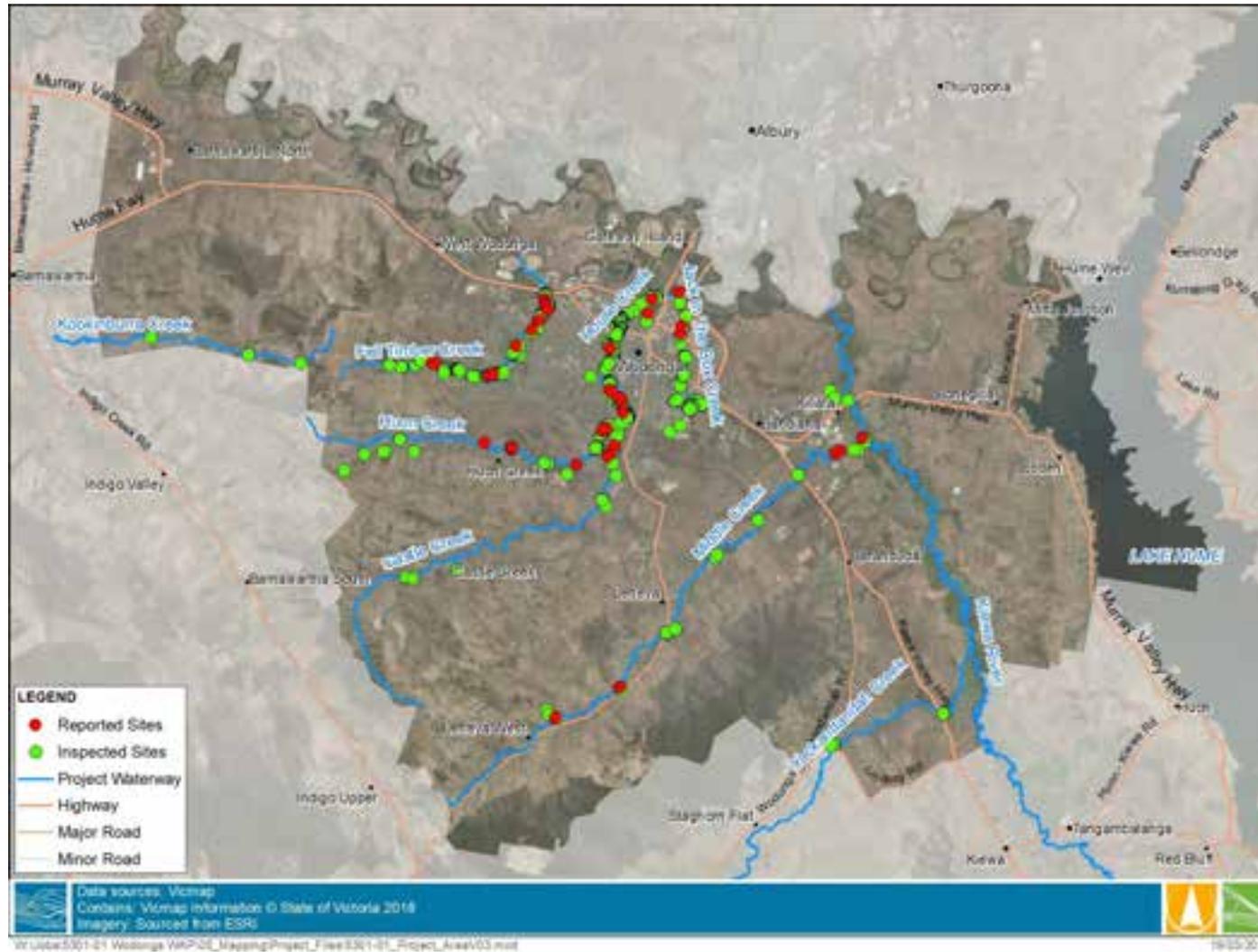


Figure 4-1 Site assessment locations. Reported sites are represented by the red dots, visited sites are represented by the green dots.



## 4.2 Kookinburra Creek

Kookinburra Creek (sometimes referred to as Cookinburra Creek or Kookaburra Creek) is a small ephemeral watercourse located to west of Wodonga (Figure 4-1). The upper catchment of Kookinburra Creek consists of steep hill slopes, raising to an altitude of approximately 500m. The hills have been largely cleared and are used for agriculture, primarily grazing. Kookinburra Creek flows west along Kookinburra Road to Indigo Creek (away from Wodonga City). Kookinburra Creek flows beyond the Council (and therefore project) boundary at Oates Gap Road, Barnawartha North.

For the purposes of this description, Kookinburra Creek has been divided into two reaches, namely Upper Reach and Mid Reach (Figure 4-2). The assessment of this reach was restricted to a roadside observation and aerial photography interpretation.

A condition summary map is provided in Appendix A.

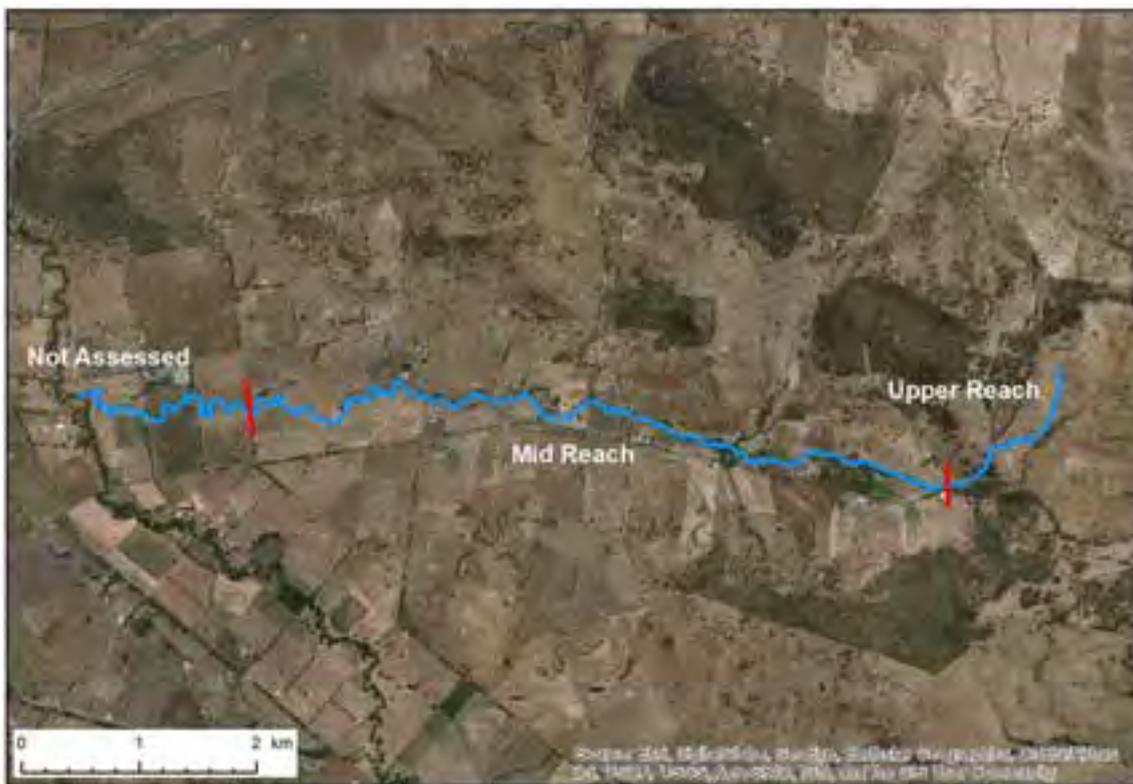


Figure 4-2 Kookinburra Creek reaches.

### 4.2.1 Upper Reach

#### 4.2.1.1 Physical Form

The Upper Reach of Kookinburra Creek is an ephemeral creek system located in the headwaters of the Kookinburra Creek catchment. The reach is characteristically defined as comprising a narrow and longitudinally steep valley floor that comprised bedrock steps and plunge pools. Bedrock is also evident in the surrounding hill slopes. This reach will be generally resistant to erosion.



#### 4.2.1.2 Vegetation Assessment

Due to the steep and relatively rocky nature of this reach, many remnant native trees and shrubs remain within the riparian zone (Figure 4-3). The land use in and around the riparian zone is predominantly grazing. The original Ecological Vegetation Class (EVC) is mapped as EVC175 Grassy Woodland (DELWP 2018a) and is described in its EVC benchmark as; “A variable open eucalypt woodland to 15 m tall or occasionally Sheoak woodland to 10 m tall on more skeletal soils. Understorey includes a diverse ground layer of grasses and herbs. The shrub component is usually sparse. It occurs on sites with moderate fertility on gentle slopes or undulating hills on a range of geologies” (DELWP 2018b). The native species observed in this sub-reach are characteristic of this EVC.



Figure 4-3 Vegetation along the upper Kookinburra Creek.

There is evidence of natural recruitment occurring in some areas and a mixed age of trees. This suggests that grazing pressures are not continuously high and natural recruitment is occurring along the creek in much of this reach.

This reach is relatively free from woody and herbaceous weeds with the exception of the area adjacent to the house on the northern side of the creek. A range of garden escapes surround the watercourse including Blue Periwinkle (*Vinca major*) and a variety of palms.

The riparian vegetation is mostly continuous until the most upper section of the creek where there is a complete absence of woody vegetation.

#### 4.2.1.3 Trajectory and Management Implications

- **The site assessment of this reach was restricted to a roadside observation and aerial photography interpretation due to access constraints.**
- **The vegetation within this reach has a relatively stable trajectory, with recruitment evident where woody vegetation is present.**



- **Whilst stock access to the creek is evident, the impacts are limited, likely due to the steep hill slopes surrounding the creek.**
- **The Blue Periwinkle has the potential to become invasive into the future. Eradication of this weed is recommended.**
- **Regular impingements against the valley margin in addition to bedrock outcropping in the bed through this reach of Kookinburra Creek suggest that the creek will be relatively resistant to erosion.**

## 4.2.2 Mid Reach

The upstream boundary of the Lower Reach of Kookinburra Creek is defined by where the valley widens, and the longitudinal valley gradient reduces. The Lower Reach extends downstream to the project boundary at Oates Gap Road.

### 4.2.2.1 Physical Form

The Mid Reach of Kookinburra Creek transitions from the confined setting of the Upper Reach into a wider, less confined valley setting. The longitudinal gradient significantly reduces compared to the Upper Reach and the channel sinuosity increases in a downstream direction.

Upstream of the Barnawartha South Bushland Reserve the channel is entrenched, which is likely associated with past bed deepening processes (Figure 4-4). The entrenched section has been fenced and revegetated. Due to access constraints it is not known if the entrenched channel is still subject to active bed deepening or associated bank erosion processes.

Bank instabilities appear to be more prevalent towards the downstream section of this reach (approximately within two kilometres upstream of Oates Gap Road (Figure 4-5)). The bank erosion appears to be most obvious on outside bends. The erosion is likely exacerbated by an absence of riparian vegetation and unrestricted stock access.



Figure 4-4 Entrenched section of Kookinburra Creek which has been fenced and revegetated.

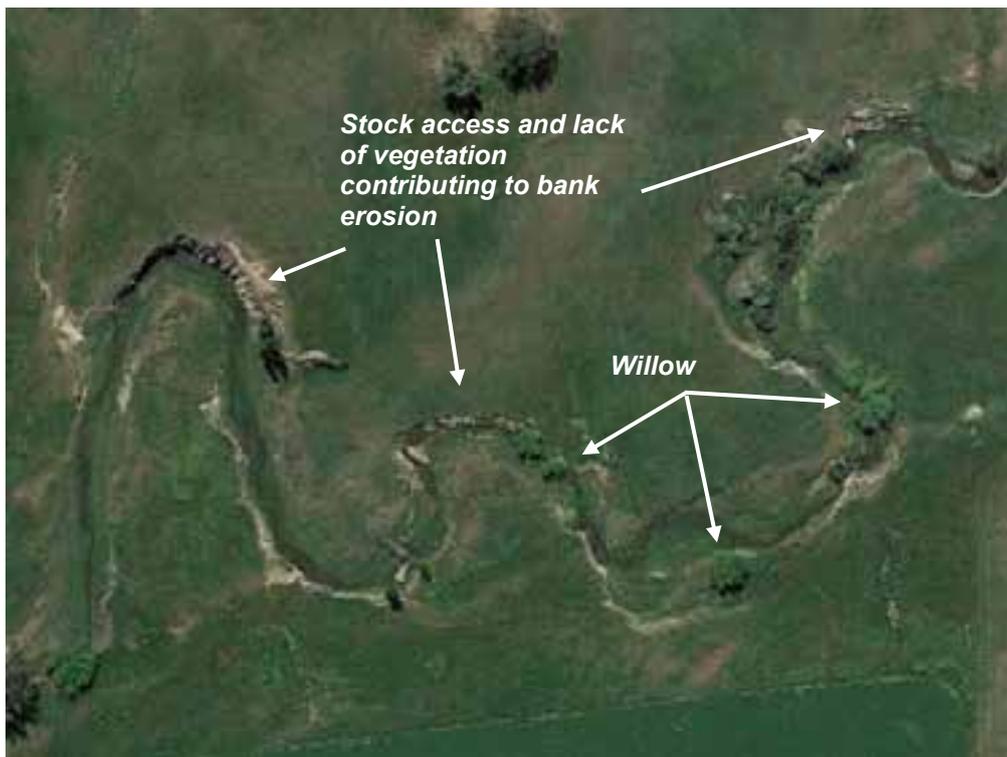


Figure 4-5 Bank instabilities on Kookinburra Creek.



#### 4.2.2.2 Vegetation Assessment

The land use within and surrounding the riparian zone within this reach is dominated by unrestricted grazing. The original Ecological Vegetation Class (EVC) is mapped as EVC68 Creepline Grassy Woodland (DELWP 2018a) and is described in its EVC benchmark as; “Eucalypt-dominated woodland to 15 m tall with occasional scattered shrub layer over a mostly grassy/sedgy to herbaceous ground-layer. This EVC commonly occurs on low-gradient ephemeral to intermittent drainage lines, typically on fertile colluvial/alluvial soils, on a wide range of suitably fertile geological substrates. These minor drainage lines can include a range of graminoid and herbaceous species tolerant of waterlogged soils and are presumed to have sometimes resembled a linear wetland or system of interconnected small ponds” (DELWP 2018b). In general terms, the upstream half of this reach comprises discontinuous woody vegetation (both remnant and revegetation, while the downstream half has sparse to patchy woody cover comprised of both native and exotic trees, principally Crack Willow in combination with isolated Black Willow.

#### 4.2.2.3 Trajectory and Management Implications

- **Due to access constraints it is not known if the entrenched section of channel is still subject to active bed deepening or associated bank erosion processes. Similarly, the extent and nature of bank erosion towards the downstream end of the reach requires further investigation.**
- **Due to the expanded valley floor (floodplain width) and absence of bedrock controls within this reach, the channel will typically have more capacity to erode compared to the upper reach.**
- **Unrestricted grazing and a lack of riparian vegetation are likely increasing erosion rates within this reach.**
- **Without grazing pressure control, this reach is likely to be subject to incremental loss of native vegetation, and the more tenacious exotic species (e.g. Crack and Black Willow) are likely to expand in their distribution.**
- **In the areas where the creek is fenced off, the condition trajectory is stable to improving.**
- **The downstream half of the reach currently has a declining vegetation trajectory. Most of this reach is subjected to uncontrolled grazing pressures and native vegetation recruitment is scarce.**

### 4.3 Felltimber Creek

Felltimber Creek commences within a steep, confined and largely cleared rural catchment, rising to an elevation of approximately 400m to the west of Wodonga (Figure 4-1). As the valley opens, the rural agricultural catchment is replaced by an urbanised catchment near the corner of McGaffins Road and Felltimber Creek Road. The creek subsequently flows through the Wodonga Golf Course and surrounding development. From here the creek continues north through public open spaces and Wodonga TAFE, before passing under the Hume Freeway. Downstream of the Hume Freeway, Felltimber Creek enters the Murray River floodplain. The creek has been diverted from its natural channel course around a floodplain quarry before discharging into a flood channel of the Murray River.

For the purposes of the following discussion, Felltimber Creek has been separated into four reaches (Figure 4-6) with the downstream limit being at the Hume Freeway. The four reaches are:

- The Upper Reach.
- The Mid Reach.
- The Golf Course Reach.
- The Lower Reach.



A condition summary map is provided in Appendix A.

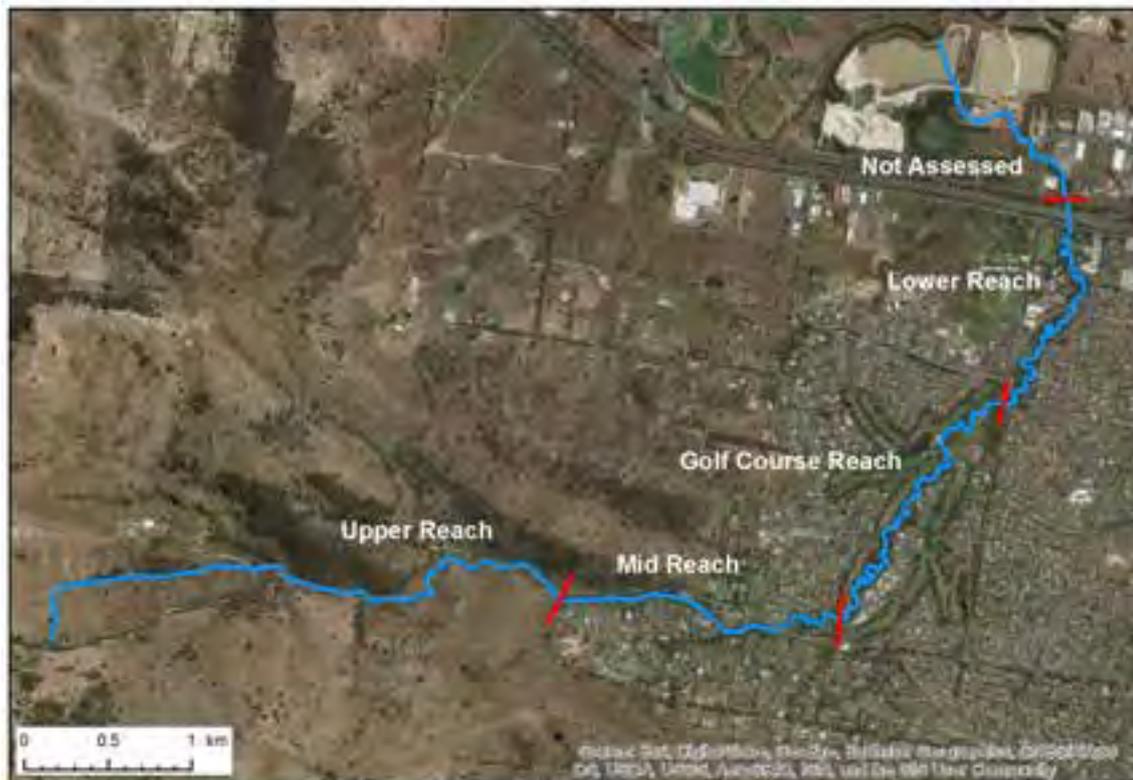


Figure 4-6 Felltimber Creek reaches.

### 4.3.1 Upper Reach

The Upper Reach of Felltimber Creek extends from the top of the catchment to near the corner of McGaffins Road and Felltimber Creek Road (Figure 4-6).

#### 4.3.1.1 Physical Condition

The Upper Reach of Felltimber Creek is characteristically a steep headwater system that is laterally confined by the surrounding cleared hill slopes (Figure 4-7). The creek bed generally consists of bedrock or floating rock which provides channel stability (Figure 4-8). Evidence of discontinuous gully erosion is present in some headwater tributaries; however, this is limited in extent.



**Figure 4-7** Looking down the Felltimber Creek valley. Note the largely cleared catchment, with the exception of the Swainsona Reserve.



**Figure 4-8** Looking upstream at Upper Reach of Felltimber Creek. The bedrock and floating rock make the reach highly stable.



#### 4.3.1.2 Vegetation Condition

The land use in and around the riparian zone is predominantly grazing, with the exception of Swainsona Reserve which is a conservation zone. The EVC mapping defines this entire reach and surrounds as an EVC22 Dry Forest, however the creek line and riparian zone is more representative of EVC68 Creepline Grassy Woodland. Although the upper sections of this reach have very sparse native woody vegetation cover, the Felltimber Creek Reserve and much of the areas downstream have mostly continuous, although narrow, woody vegetation cover including canopy trees and shrubs (Figure 4-8).

#### 4.3.1.3 Trajectory and Management Implications

- **Regular impingements against the valley margin in addition to bedrock outcropping in the bed through this reach of Felltimber Creek suggest that the creek will be relatively resistant to erosion.**
- **Discontinuous gully erosion in headwater tributaries has limited potential to worsen due to it being positioned at the top of the catchment.**
- **The headwater sections of the reach are in poor ecological condition, mostly devoid of native woody species and have a declining trajectory as woody recruitment is thought to be scarce due to uncontrolled grazing and a lack of parent material.**
- **The middle and lower sections of this reach have a relatively stable trajectory despite the grazing since pressures are not high and recruitment is evident.**

#### 4.3.2 Mid Reach

The Mid Reach of Felltimber Creek extends from near the corner of Felltimber Creek Road and McGaffins Road downstream to the Wodonga Golf Course boundary (Figure 4-6).

##### 4.3.2.1 Physical Condition

The Mid Reach of Felltimber Creek is characterised by a land use transformation from agricultural to urban. The channel is entrenched, and inset floodplain pockets have formed within in the upper section of the reach (Figure 4-9). Discontinuous bank erosion is also present within this section. The base of the concrete culvert on McGaffins Road has started to become undermined (Figure 4-10). Rock and concrete have been placed in the bed of the creek immediately downstream of the culvert in an attempt to prevent the undermining developing further.

Downstream of Felltimber Creek Road, changes in bed grade are evident within the channel. These changes in bed grade are currently being stabilised by willow roots. In-stream willows are also contributing to the bedform within this reach, through the deposition of sand.



**Figure 4-9** Downstream view of the entrenched section of Felltimber Creek. Inset floodplain pockets have formed in this section and discontinuous bank erosion is evident.



**Figure 4-10** Downstream view of the culvert crossing beneath McGaffins Road. The base of the structure is being to undermine.



Figure 4-11 Upstream view of a change in bed grade within Felltimber Creek downstream of Felltimber Creek Road, currently held by willow roots.

#### 4.3.2.2 Vegetation Assessment

Urban encroachment is evident throughout much of this reach with garden plantings and fencing located within close proximity to the channel in several locations (Figure 4-12). The vegetation within this reach is likely to have been most typical of EVC 68 Creekline Grassy Woodland. The reach still contains remnant native canopy trees and shrubs and revegetation works have been undertaken upstream of Felltimber Creek Road. However, the riparian zone is largely dominated by weed species that increase in abundance and diversity in a downstream direction (Figure 4-13). Weed species of most concern within this reach are those that reproduce readily and outcompete native plants. Key weed species of concern in this reach include:

- Tree weeds - Willow (Weeping, Crack, Black, Pussy and Twisted), Box Elder, Poplar, Robinia.
- Shrub – Blackberry, Privet.
- Ground – Ivy, Agapanthus.



**Figure 4-12** Downstream view of Felltimber Creek downstream of Felltimber Creek Road showing the urban encroachment and garden plantings.



**Figure 4-13** Felltimber Creek Mid Reach weeds become more abundant and diverse in a downstream direction.



#### 4.3.2.3 Trajectory and Management Implications

- **Upstream of Felltimber Creek Road, the creek is in the process of reattaining bed and bank stability. As such, widespread hard engineering works aimed at managing bank erosion are generally not required.**
- **Bed deepening processes are still evident within the section of Felltimber Creek downstream of Felltimber Creek Road. Any structural works undertaken within this reach should aim to manage this process.**
- **The existing willows are contributing to the bed form and channel stability within this reach. Any willow management works undertaken within this reach will need to consider the role the willows provide in relation to channel stability. Conversely, as the willows age, they will have an increasing tendency to collapse into the channel, potentially contributing to bank instabilities.**
- **The structural integrity of culvert crossing over McGaffins Road may be threatened by further scouring at the outlet.**
- **The exotic vegetation progressively increases in a downstream direction within this reach. The woody weeds in combination with English Ivy threaten to outcompete and smother even the larger native woody species.**

#### 4.3.3 Golf Course Reach

The Golf Course Reach flows through the Wodonga Country Club Golf Course. The upstream boundary of the Golf Course Reach is approximately 400m downstream of Felltimber Road and the downstream boundary is defined at Parkers Road (Figure 4-6).

##### 4.3.3.1 Physical Condition

Felltimber Creek is partly confined within this reach, with the dominant portion of the floodplain present along the western side. The majority of the urban development is situated outside of the floodplain extent, on the eastern side.

This reach of Felltimber Creek has been subject to active bed deepening processes, evident through the presence of multiple small head-cuts (Figure 4-14). Bank erosion is present in only isolated locations. Woody weeds, primarily willows are contributing to both bed and bank stability within this reach. The creek typically lacks in-stream geomorphic diversity, influenced through the bed deepening processes, in-stream willow presence and absence of in-channel large woody debris.



Figure 4-14 Head-cut present in the Golf Course Reach.

#### 4.3.3.1 Vegetation Assessment

The original native riparian vegetation within this reach is likely to have been EVC68 Creepline Grassy Woodland. The characteristic Red Gum, including remnant River Red Gums and Silver Wattle are still present, however some of this vegetation, for example the remnant River Red Gums within Albert Terrill Reserve, are in very poor health. The native riparian corridor is mixed with a range of exotic weeds and garden escapes dominated by willow and blackberry (Figure 4-15). Observations within this reach included:

- The presence of an ibis rookery towards the downstream end of the reach, adjacent to the end of Lawrence Street.
- Tree felling within the riparian zone at the southern end of Golfinks Avenue.
- Selective woody weed removal that did not include the mature parent tree (seed source).



Figure 4-15 Typical section of the Felltimber Creek reserve, situated between residential development and golf course.

#### 4.3.3.2 Trajectory and Management Implications

- Active bed deepening processes are evident within the section of Felltimber Creek. Any structural works undertaken within this reach should aim to manage this process. Widespread bank erosion associated with the bed deepening processes is not evident.
- The existing willows are contributing to the bed form and channel stability within this reach. Any willow management works undertaken within this reach will need to consider the role the willows provide in relation to channel stability. Conversely, as the willows age, they will have an increasing tendency to collapse into the channel, potentially contributing to bank instabilities.
- Without intervention, the exotic vegetation in this reach is likely to outcompete the native vegetation. There is evidence of woody weed control in discrete areas, however a programmed whole of reach approach should be undertaken to ensure coordinated effectiveness.

#### 4.3.4 Lower Reach

The Lower Reach of Felltimber Creek flows through Moorefield Park and Wodonga TAFE. The upstream boundary of the Lower Reach is Parkers Road and the downstream boundary is defined as the Hume Freeway.

##### 4.3.4.1 Physical Condition

The Lower Reach of Felltimber Creek can be broadly defined as partly confined system, surrounded by typical urban development features and infrastructure including shared paths, car parks, multiple road crossings and a levy on the eastern bank adjacent Wodonga TAFE (Figure 4-16). Additionally, a stormwater treatment wetland is present in Moorefield Park on the western side of the creek.



Within this reach the creek has historically deepened and widened (Figure 4-17), with several discrete bank erosion sites evident towards the downstream extent (Figure 4-18). A failed weir is present within the channel adjacent the TAFE carpark. The weir has been outflanked which appears to have re-initiated bed deepening upstream. Rock beaching has been placed at discrete locations to manage bank erosion (Figure 4-19).

There is an increase in geomorphic diversity (including shallow pools and bars) and woody habitat within the Lower Reach of Felltimber Creek, which is partially attributed to the increased sinuosity and continuous riparian vegetation corridor.

During the site assessment milky white water was seen to be discharging from a stormwater pipe into Felltimber Creek. It was not clear what had contaminated the water.



**Figure 4-16** Looking downstream at the levy along the right bank at Wodonga TAFE.



**Figure 4-17** Felltimber Creek has deepened, evidenced by the exposed River Red Gum roots in this image.



**Figure 4-18** Bank erosion within the Lower Reach of Felltimber Creek.



Figure 4-19 Looking upstream at rock beaching work within the lower section of Felltimber Creek, adjacent Wodonga TAFE.

#### 4.3.4.2 Vegetation Assessment

The original native vegetation of this lower reach has been mapped as EVC56 Floodplain Riparian Woodland. This change in EVC is driven by the creek expanding into a wider floodplain area. This EVC is described as “An open woodland to 20 m tall usually dominated by Red Gum Eucalyptus spp. over a medium to tall shrub layer with a ground layer consisting of amphibious and aquatic herbs and sedges. This EVC typically occurs along the banks and floodplains of the larger meandering rivers and major creeks, often in conjunction with one or more floodplain wetland communities. Elevation and rainfall are relatively low, and soils are fertile alluviums subject to periodic flooding and inundation” (DELWP 2018b).

This reach contains an abundance of large Red Gum and Silver Wattle. The upstream section adjacent to Morefield Park Drive (Figure 4-20) has continuous broad woody vegetation cover surrounding the creek. There is also an abundance of woody tree weeds including Weeping Willow, Box Elder and Desert Ash.

The downstream section adjacent to the TAFE has had extensive levels of weed control, yet despite this effort, woody weeds, mostly Ash, are continuing to invade closer to the freeway. The tree canopy is taller and denser compared to the upstream reaches and the ground layer is dominated by exotic Kikuyu and Soursob (Figure 4-21).



**Figure 4-20** Felltimber Creek adjacent to Morefield Park Drive showing the woody riparian vegetation comprises a mixture of native and exotic species.



**Figure 4-21** Felltimber Creek adjacent Wodonga TAFE showing exotic groundcover.



#### 4.3.4.3 Trajectory and Management Implications

- **Active bed deepening processes are evident within the section of Felltimber Creek. Any structural works undertaken within this reach should aim to manage this process. Widespread bank erosion associated with the bed deepening processes is not evident.**
- **There is an increase in in-stream geomorphic diversity (including shallow pools and bars) and woody habitat within the Lower Reach of Felltimber Creek, which is partially attributed to the increased sinuosity and continuous riparian vegetation corridor. In-stream geomorphic diversity is generally lacking in other reaches of Felltimber Creek and as such should be retained in this reach.**
- **This reach comprises a continuous mature native woody vegetation overstorey and understorey layer, however the groundcover is dominated by colonising exotic species. Without on-going management intervention, both woody weeds and groundcover weeds have the potential to further colonise the riparian zone within this reach.**

## 4.4 Huon Creek

The upper catchment of Huon Creek is defined by steep undulating hills to the south-east of Wodonga. The catchment is largely cleared agricultural land, with increasing pressure from urbanisation in the lower catchment. Castle Creek and Huon Creek join to form House Creek a short distance downstream of Huon Creek Road. For the purposes of this Water Action Plan, Huon Creek has been divided into three reaches (Figure 4-22), namely:

- Upper Reach.
- Mid Reach.
- Lower Reach.

A condition summary map is provided in Appendix A.

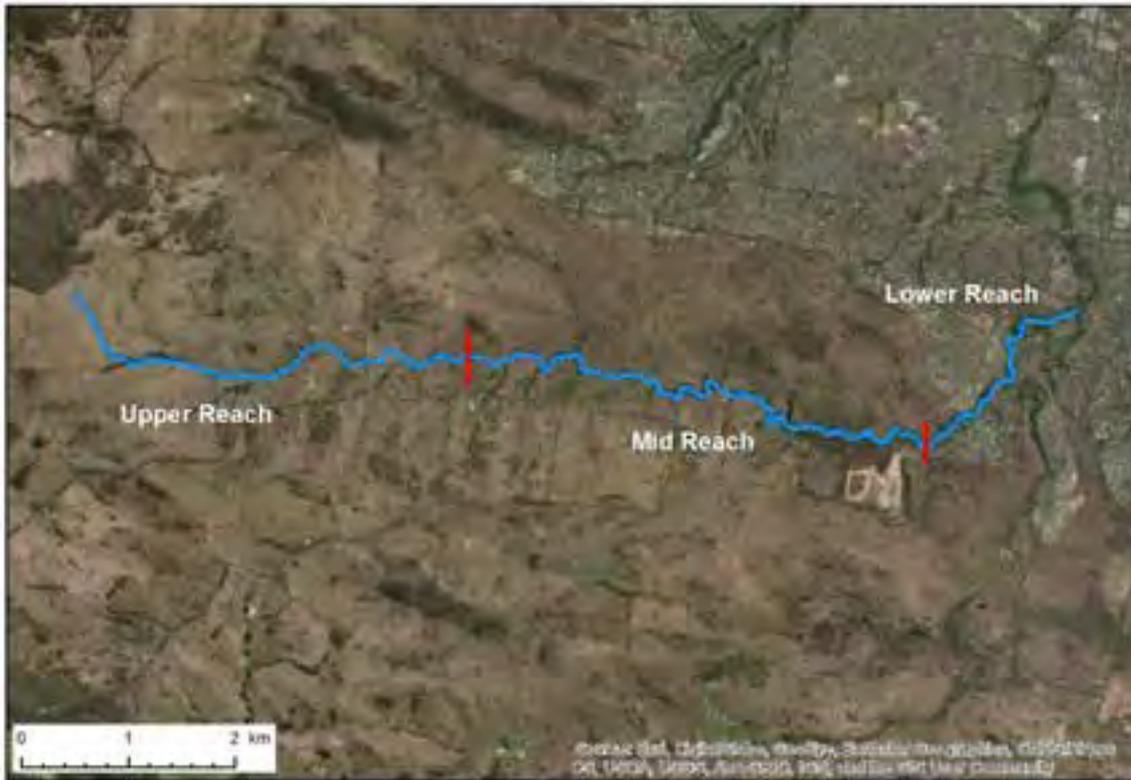


Figure 4-22 Huon Creek reaches.

#### 4.4.1 Upper Reach

The Upper Reach of Huon Creek extends through to approximately 800m downstream of Gilberts Road (Figure 4-22).

##### 4.4.1.1 Physical Condition

The catchment of the Upper Reach consists of steep cleared hill slopes that are used for grazing. The upper reach of Huon Creek is located within a confined valley, comprising occasional bedrock outcrops which controls the lateral and vertical adjustment of the channel (Figure 4-23). This reach is an ephemeral stream with a steep longitudinal gradient. Despite the occasional bedrock controls, discontinuous deepening is present within this reach (Figure 4-24).

Discrete bank erosion is present on outside bends where bedrock and riparian vegetation is absent. The bank erosion is likely to be exacerbated by the bed deepening process that are occurring in this reach. Unrestricted stock access to Huon Creek is also contributing to bank instabilities with stock tracks evident within the bed and banks.

A number of steep tributaries and gullies flow into the Upper Reach of Huon Creek. Several of these gullies are actively deepening. The deepening process will be exacerbated by a lack of vegetation and stock access. Stock have formed compacted tracks across the gullies that can initiate or contribute to gully erosion.

Channel and catchment instabilities in the Upper Reach of Huon Creek are a sediment source for the Huon Creek system. Most of the sediment inputs into this reach of Huon Creek will be transported into downstream reaches.



Scouring has occurred on the downstream side of the crossing at Gilbert Road (Figure 4-25). The scouring has likely developed due to high exit velocities through the culvert, cascading flows when the crossing is being over topped and a lack of rock armouring of the channel bed and bank around the crossing. The scouring has led to undermining which has the potential to impact upon the integrity of the crossing.



**Figure 4-23** Exposed bedrock located downstream of Gilberts Road.



**Figure 4-24** A small head-cut located upstream of the Gilbert Road crossing.



Figure 4-25 Undermining of the Gilberts Road crossing.

#### 4.4.1.2 Vegetation Condition

The land use in and around the riparian zone is predominantly grazing. The EVC mapping suggest this reach and surrounds is an (EVC47) Valley Grassy Forest, however the creek line and immediate riparian zone is more likely to have once been representative of (EVC68) Creek line Grassy Woodland. The reach is characterised by scattered to patchy canopy trees with few shrubs, causing breaks in longitudinal continuity throughout.

Willows are scattered throughout the reach and are the dominant woody weed species. Most of the Willows are Weeping Willows, which fortunately do not have the propensity to spread like the other willow species.

#### 4.4.1.3 Trajectory and Management Implications

- Regular impingements against the valley margin in addition to bedrock outcropping in the bed through this reach of suggest that the creek will be relatively resistant to erosion.
- Discontinuous gully erosion in headwater tributaries has limited potential to worsen due to it being positioned at the top of the catchment.
- Erosion derived from this section of the catchment will be transported into downstream reaches.
- The undermining of the Gilberts Road crossing threatens the integrity of the crossing.

#### 4.4.2 Mid Reach

The Mid Reach of Huon Creek extends from approximately 800m downstream of Gilberts Road to the rear of 136 Huon Creek Road, Wodonga (the edge of the current urban development extent) (Figure 4-22).



#### 4.4.2.1 Physical Condition

The Mid Reach of the Huon Creek transitions from the confined valley to a partially confined valley setting. There is some development occurring and proposed development planned within the lower catchment of the Mid Reach.

The Mid Reach of Huon Creek has been subject to historic bed deepening processes and associated channel widening. Subsequently, the creek channel is over-enlarged (Figure 4-26). Bank erosion is commonly positioned on outside bends with deposition occurring on the opposite inside bend. Erosion on outside bends is typically associated with meander development and is exacerbated where there is a lack of vegetation. This erosion process can occur in conjunction with, or independently of, the bed deepening processes. Some outside bends within this reach have been armoured with rock to prevent further erosion and meander development (Figure 4-27).

There is a significant volume of sand depositing in-stream in the downstream section of the reach. This indicates that there is currently any oversupply of sediment in the downstream section of this reach. The stream bed generally lacks diverse bed morphology and large woody debris. The instream geomorphic features that are present in the mid reach include ledges, in-stream sandbars and inset floodplain pockets.

Fencing is present along sections of the Mid Reach of Huon Creek, however there is evidence of stock access in most areas.



Figure 4-26 Over enlarged channel located within the Mid Reach of Huon Creek.



Figure 4-27 Rock beaching located on an outside bend.

#### 4.4.2.2 Vegetation Assessment

Grazing is the dominant land use within this reach and most of the reach is unfenced from grazing pressures. The original Ecological Vegetation Class (EVC) is mapped as EVC68 Creepline Grassy Woodland (DELWP 2018a) and remnant woody vegetation is patchy to continuous throughout the reach. Exotic trees, including willows and Poplar (Figure 4-27) are also abundant within this reach and often planted on outside bends. The native and exotic trees provide an almost continuous cover along both banks. There is limited native understorey, however Common Reed was observed instream in a few locations where grazing pressure was low or absent. Common Reed is highly palatable to stock when young.

#### 4.4.2.3 Trajectory and Management Implications

- Further development is planned within the Huon Creek catchment. Water Sensitive Urban design techniques and appropriate riparian vegetation management is required to minimise changes to downstream hydrology, hydraulics, channel stability and sediment transport rates.
- This reach is in the process of reattaining bed and bank stability. As such, widespread hard engineering works aimed at managing bank erosion are generally not required.
- Meander migration is a natural process where the outside bend of the channel erodes, and deposition occurs on the inside bend. This process is likely to become the dominant process in the future. The erosion will be exacerbated in areas where there is a lack of riparian vegetation and unrestricted stock access.
- As this reach begins to regain stability, a portion of sediment derived from the upstream reach will deposit in this reach in the form of point bars, benches and inset floodplain surfaces.
- Woody vegetation has a stable to declining condition trajectory as there is limited native vegetation recruitment and exotic trees will continue to expand their distribution if not controlled.



- **Unrestricted stock grazing is impacting upon the presence and distribution of Common Reed.**

### 4.4.3 Lower Reach

The Lower Reach of Huon Creek extends from the rear of 136 Huon Creek Road, Wodonga (the edge of the current urban development extent) to the confluence Castle/House Creek (Figure 4-22).

#### 4.4.3.1 Physical Condition

The Lower Reach of the Huon Creek is a partly confined creek. The surrounding land is dominated by urban development with park lands and reserves along much of the left bank and freehold land along much of the right bank. A review of aerial imagery shows that development has occurred within the catchment over the last fifteen years and further developments are proposed.

The dominant geomorphic process occurring in the Lower Reach of Huon Creek is aggradation as a result of erosion in the upper catchment. The oversupply of sand has resulted in the raising of the bed level and a loss of geomorphic variability (Figure 4-28) with a uniform bed profile present across most of the reach. Some of the sand is being transported further downstream as evident by the sand splay in House Creek at the confluence of Huon Creek (Figure 4-29). Only isolated bank instabilities were observed in this reach.

Erosion surrounding a concrete apron on stormwater outfall was observed on the right bank downstream of footbridge at Veronica Egan Park (Figure 4-30). The concrete apron has cracked and is undermined.

A stormwater treatment pond is located adjacent left bank of Huon Creek near Clarendon Avenue. It is assumed that the stormwater pond receives stormwater from the adjacent development prior to discharging the treated stormwater into Huon Creek.



Figure 4-28 Deposited sand creating a uniform bed profile in the Lower Reach of Huon Creek.



Figure 4-29 Sand being transported through Huon Creek and being deposited in House Creek.



Figure 4-30 Looking upstream at erosion around a stormwater outlet on Huon Creek at Veronica Egan Park.



#### 4.4.3.2 Vegetation Condition

This reach is adjacent to urban development and is heavily infested with woody weeds. The weed levels tend to reduce in a downstream direction as urban development matures and parkland management tends to increase. Many of the woody weeds infesting the waterway have originated from the gardens of houses off Huon Creek Road and Cambourne Court. If weeds are to be effectively controlled in this reach, the seeding parent plants will need to be controlled in the adjacent freehold properties. The owners of new properties located on the waterway should be encouraged not to plant invasive species near the riparian corridor.

There has been considerable landscaping work and weed management downstream of Yarralumla Drive, within David Winterbottom Park and David Bayne Park. However, large infestations of Willow remain along with a range of other woody species including Poplar and Box Elder. There is a large patch of native Common Reed that has colonised a low-lying area of the floodplain off the left bank of Huon Creek (Figure 4-31). This feature provides a unique habitat in the middle of the urban area, however is viewed by some residents as an issue.



Figure 4-31 Location and photograph of Common Reed wetland.

The invasive perennial aquatic weed, Parrot's Feather (*Myriophyllum aquaticum*) was observed in a small patch (3m<sup>2</sup>), approximately 10m upstream from the Castle Creek confluence. One other infestation was observed mid-way down House Creek. This plant forms dense stands that can impede water and cause entanglement. Parrot's Feather spreads by stem fragments (seed is not produced in Australia (Sainty & Jacobs 2003)). A more thorough survey of the lower end of Huon Creek and the entire House Creek should be undertaken to identify infestations and an eradication program implemented while infestation levels are low.



Figure 4-32 Close up view of Parrot's Feather at the downstream end of Huon Creek.

#### 4.4.3.3 Trajectory and Management Implications

- The supply of sediment into this reach is depositing in-stream and impacting upon channel capacity and in-stream diversity. The management of sediment will require intervention within the upstream reaches, where the sediment is sourced from.
- The structural integrity of the stormwater outlet at Veronica Egan Park is threatened. Without intervention, the structure is expected to fail in the short to medium term, which will lead to further bank erosion.
- The section of this reach upstream of Yarralumla Drive is heavily infested with exotic species, many of which are seeding. The condition of this upstream section will continue to decline if significant levels of weed control are not implemented. The cooperation of adjacent landholders to control invasive weeds on freehold land is also required to reduce the level of effort required to keep on top of woody weeds in this reach.
- The current level of weed management and landscaping in David Winterbottom and David Bayne provides this lower section of creek with an improving condition trajectory. Condition will improve vastly if willow removal and revegetation with indigenous species continues.
- To improve the native habitat and woody vegetation continuity along the creek, revegetation works should follow weed control, particularly in the uppermost section of the reach where native tree cover is scarce.
- The aquatic weed Parrot's Feather, located at the bottom end of Huon Creek has the potential spread downstream into House Creek from detached fragments. One other infestation was observed mid-way down House Creek. Eradication of this plant from Huon Creek should be a priority to ensure downstream propagation does not occur.



## 4.5 Castle Creek

The Castle Creek catchment is defined by steep undulating hills to the south of Wodonga. The catchment is largely cleared agricultural land, with increasing pressure from urbanisation in the lower catchment. Castle Creek and Huon Creek join to form House Creek a short distance downstream of Huon Creek Road. For the purposes of this Water Action Plan Castle Creek has been split into three reaches, namely:

- Upper Reach.
- Mid Reach.
- Lower Reach.

A condition summary map is provided in Appendix A.



Figure 4-33 Castle Creek reaches.

### 4.5.1 Upper Reach

#### 4.5.1.1 Physical Condition

The Upper Reach of Castle Creek has a steep catchment that has been cleared for grazing. The creek has a steep longitudinal gradient and is generally confined by the surrounding hillslope (Figure 4-34). The channel is likely to be subject to discontinuous bed deepening that will be limited by bedrock impingements (Figure 4-35).

Similar to adjoining upper catchment areas, several tributaries that feed into the Upper Reach of Castle Creek are subject to discontinuous gully erosion that is likely to be exacerbated by the lack of vegetation and impacts associated with unrestricted stock access (Figure 4-36). Gully erosion within this catchment is likely to be a sediment source for downstream reaches.



**Figure 4-34** Confined Valley of the Upper Reach of Castle Creek.



**Figure 4-35** Bedrock steps that are present the Upper Reach of Castle Creek will limit channel adjustment.



Figure 4-36 The bank damage and erosion caused by cattle and gully erosion in the Upper Reach of Castle Creek.

#### 4.5.1.2 Vegetation Assessment

The land use in and around the riparian zone is predominantly grazing. The EVC mapping suggests this reach and surrounds is an EVC47 Valley Grassy Forest, however the creek line and immediate riparian zone is more likely to have once been representative of EVC68 Creekline Grassy Woodland. The vegetation within this reach is variable, but there are large sections of this reach that have little or no native woody vegetation within the riparian zone. There are more trees adjacent to the creek in the steep areas at the downstream section of the reach, however, the immediate creek line margin has discontinuous cover.

#### 4.5.1.3 Trajectory and Management Implications

- **Gully erosion within this reach will be contributing sediment into downstream reaches. A review of aerial photography indicates that the gully erosion has been and continues to be prevalent within this reach.**
- **Dispersive soils are likely to be present within this reach. Dispersive soils are vulnerable to tunnel, sheet and gully erosion processes.**
- **The steep and confined nature of the creek itself contributes to the efficient transfer of sediment into downstream reaches.**
- **Future channel adjustments within the creek itself will be limited by the presence of bedrock impingements/outcrops.**
- **This reach is generally poor condition and is unlikely to improve without stock grazing management, revegetation and weed control.**



## 4.5.2 Mid Reach

The Mid Reach of Castle Creek extends from where the valley widens to near the corner of Memorial Drive and Castle Creek Road (Figure 4-33).

### 4.5.2.1 Physical Condition

The Mid Reach of Castle Creek forms as the valley widens and the creek system becomes partially confined. The catchment within the Mid Reach transitions from cleared agricultural land to a sprawling urban environment. The longitudinal gradient of the Mid Reach of Castle Creek is far less steep compared to the Upper Reach.

A review of aerial photography indicates that within this reach, the channel has undergone considerable adjustment including, channel straightening (evident through the presence of two meander cut-offs), channel deepening and bank erosion, including channel widening. In the upstream section of the reach, the channel is over enlarged with inset floodplain pockets present (Figure 4-37). A bed rock outcrop is present

Bank instabilities are evident in a number of locations. The instabilities are exacerbated through increased channel capacity, the absence of riparian vegetation and unrestricted stock access.

The lower half of the reach has significantly more riparian vegetation present, albeit predominately comprising introduced species. The vegetation appears to be contributing to the channel stability. A number of pools are present within the channel.



Figure 4-37 Looking upstream at an over enlarged section of Castle Creek with an inset floodplain pocket.



#### 4.5.2.2 Vegetation Assessment

The EVC mapping suggests this reach would have originally been occupied by EVC56 Floodplain Riparian Woodland. This change in EVC from the upper reach is driven by the creek becoming larger and opening out into a larger floodplain.

There are very few native canopy trees remaining adjacent to the current widened creek channel. Remnant riparian trees were either cleared from the floodplain or have previously fallen into the creek as the channel has eroded and laterally migrated across the floodplain. Native shrubs are virtually absent, and willows are the dominant woody weeds within the reach (Figure 4-38).



Figure 4-38 Reach location and photo showing lack of natives and presence of willows.

#### 4.5.2.3 Trajectory and Management Implications

- Further development is planned within the Castle Creek catchment. Water Sensitive Urban design techniques and appropriate riparian vegetation management is required to minimise changes to downstream hydrology, hydraulics, channel stability and sediment transport rates.
- The extent and nature of erosion within this reach requires further investigation. A review of aerial photography indicates the channel may have been artificially straightened.
- However, it is likely that this reach is in the process of reattaining bed and bank stability. As such, widespread hard engineering works aimed at managing bank erosion are generally not required.
- This reach has a declining vegetation condition trajectory as there is very scarce native vegetation cover and willows are likely to continue spreading if left uncontrolled. This reach requires stock grazing management, weed control and revegetation to help stabilise the banks and restore stream health and habitat.

#### 4.5.3 Lower Reach

The Lower Reach of Castle Creek stretches from near the corner of Memorial Drive and Castle Creek Road to the confluence with Huon Creek and the start of House Creek a short distance downstream of Huon Creek Road (Figure 4-33).