APPENDIX

I

Terrestrial and Aquatic Ecology

Part 3 of 4

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT

IR_1536

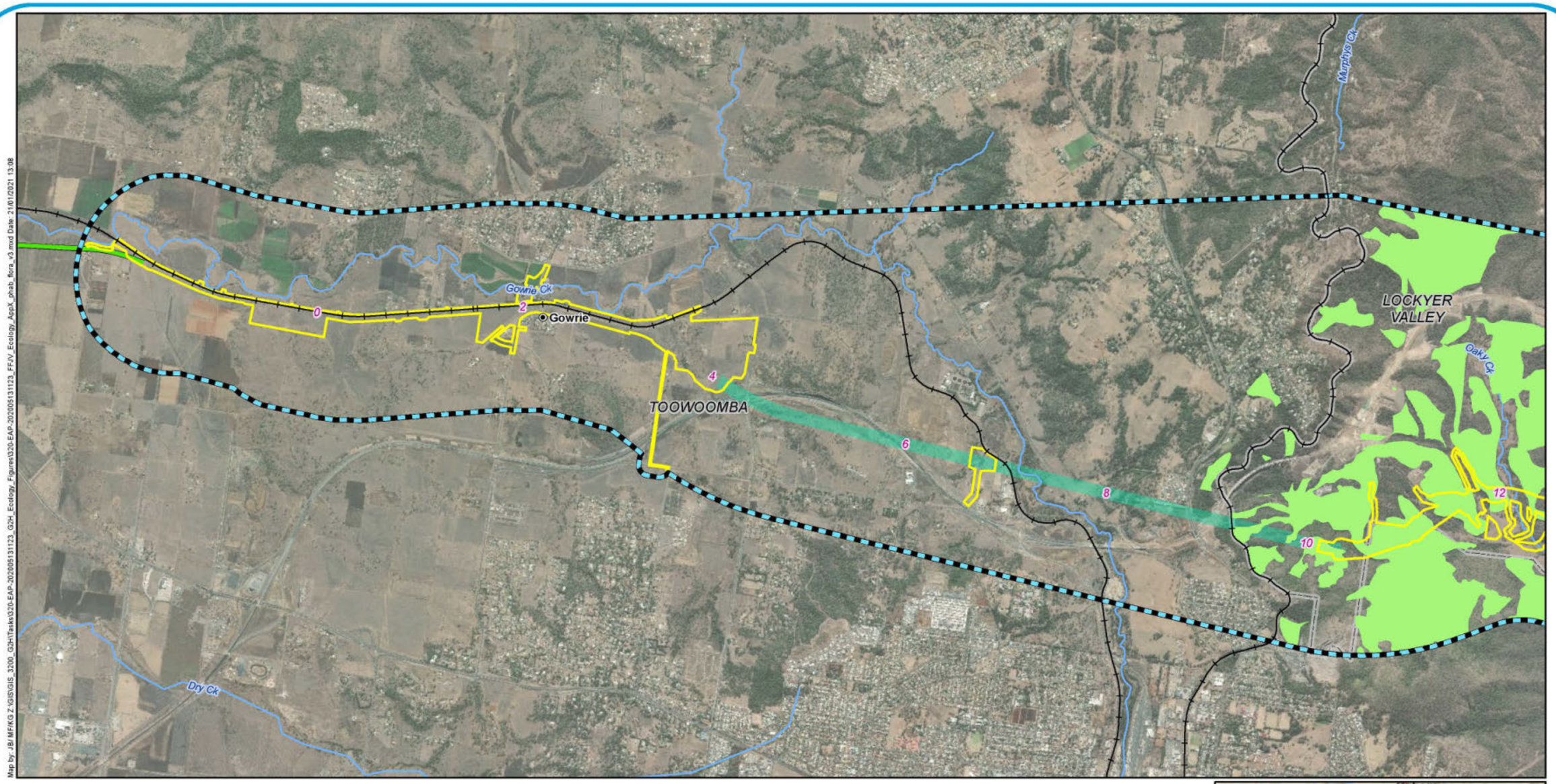
APPENDIX

I

Terrestrial and Aquatic Ecology

Appendix G Predicted habitat mapping

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT



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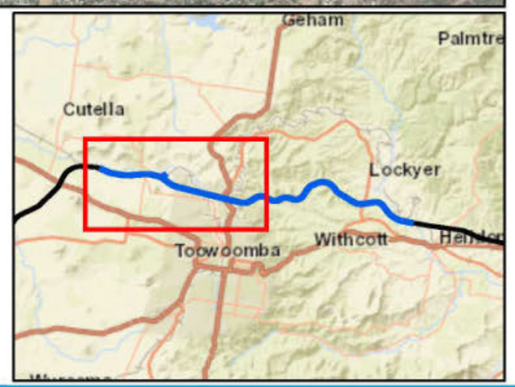
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



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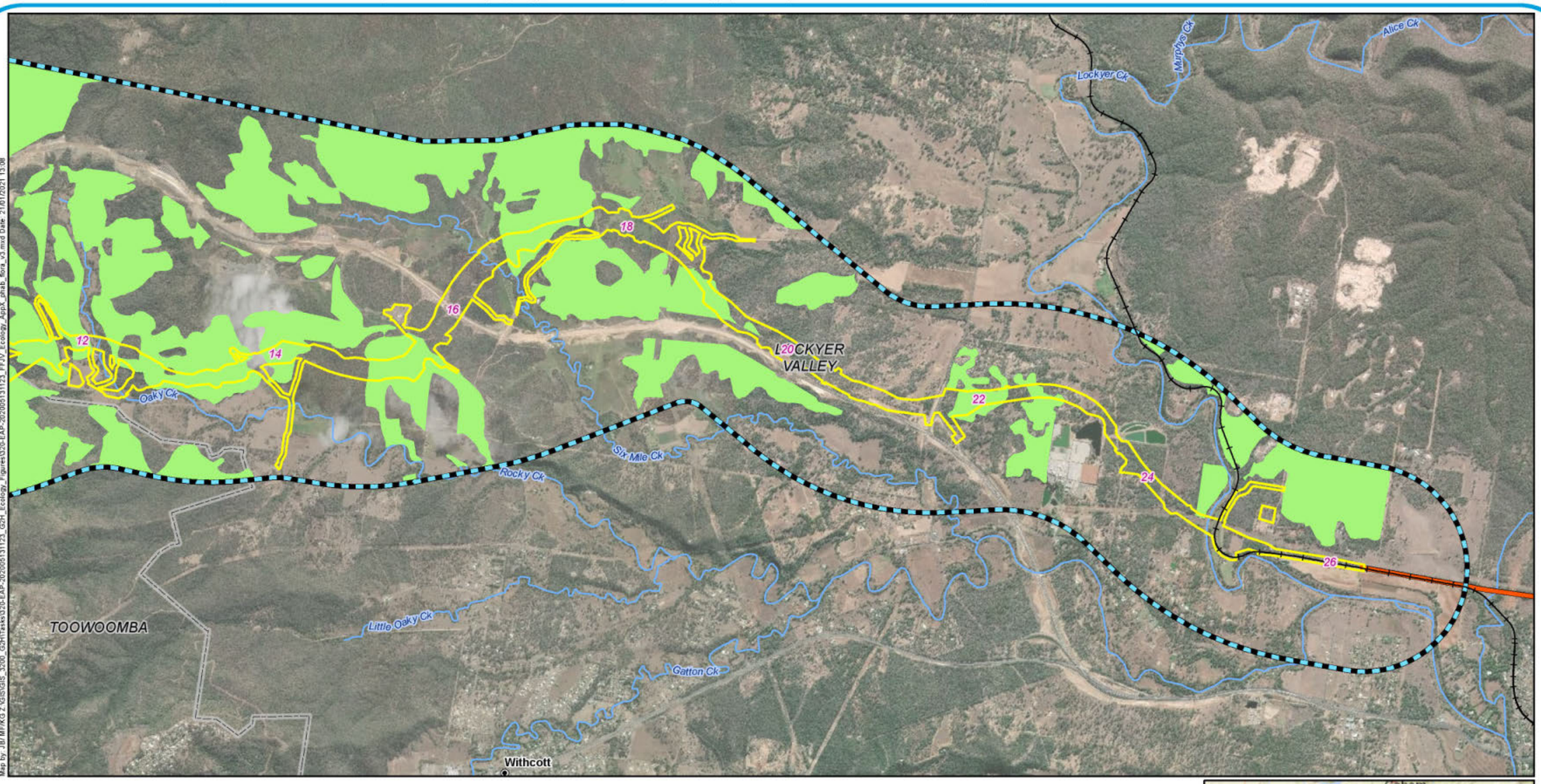
Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Callitris baileyi* (Baileys cypress)

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



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Legend

- 5 Chainage (km)
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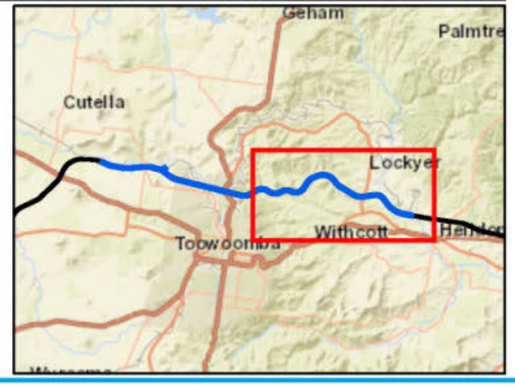
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Callitris baileyi* (Baileys cypress)

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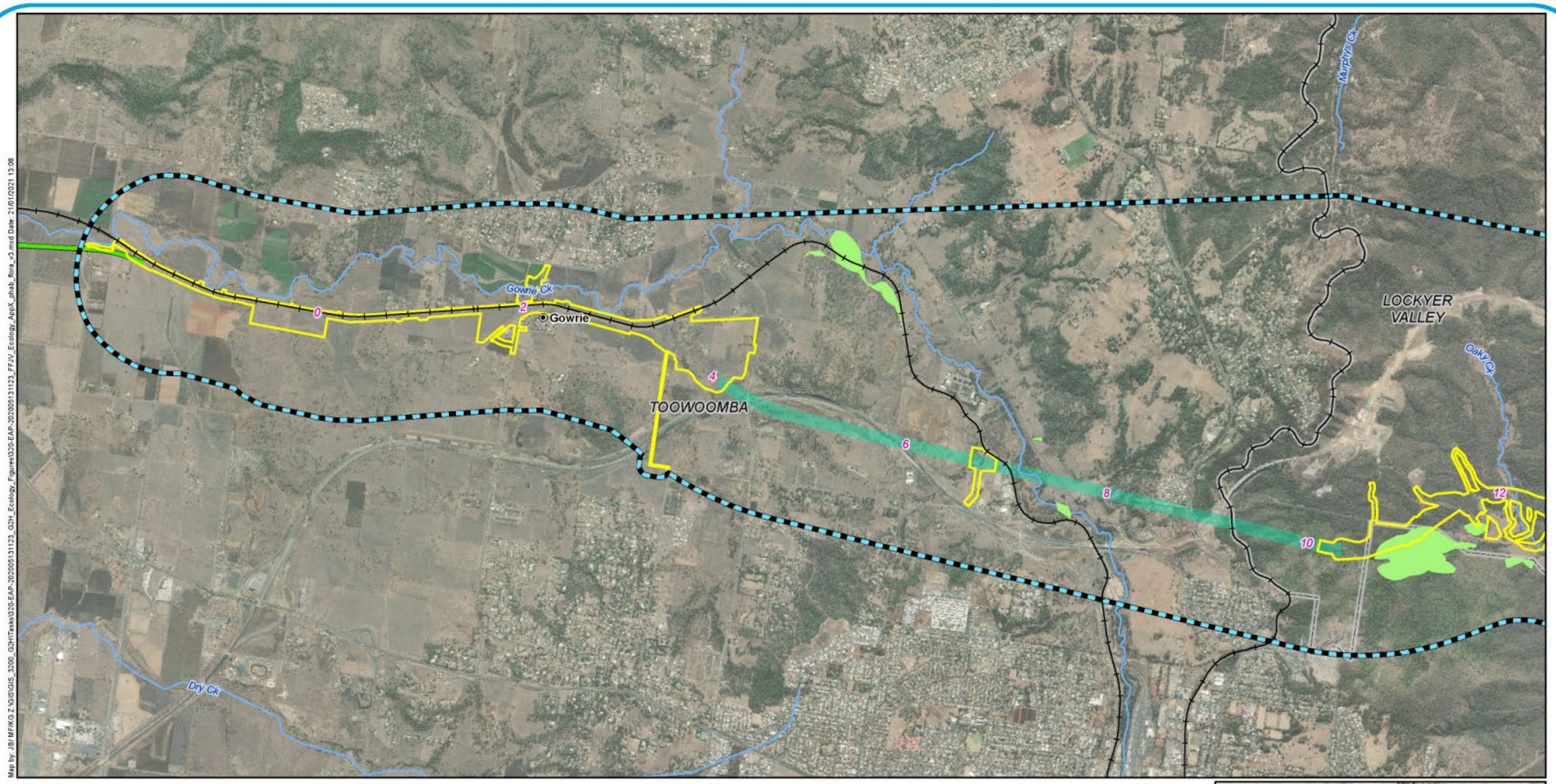

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- 5 Chainage (km)
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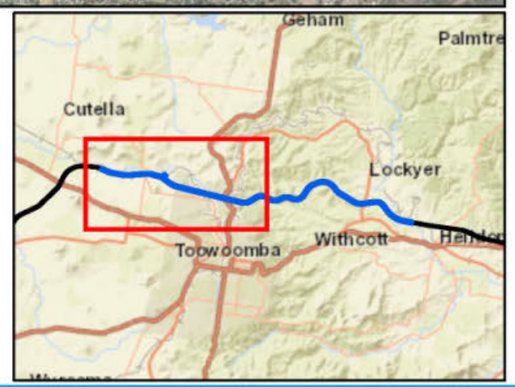
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



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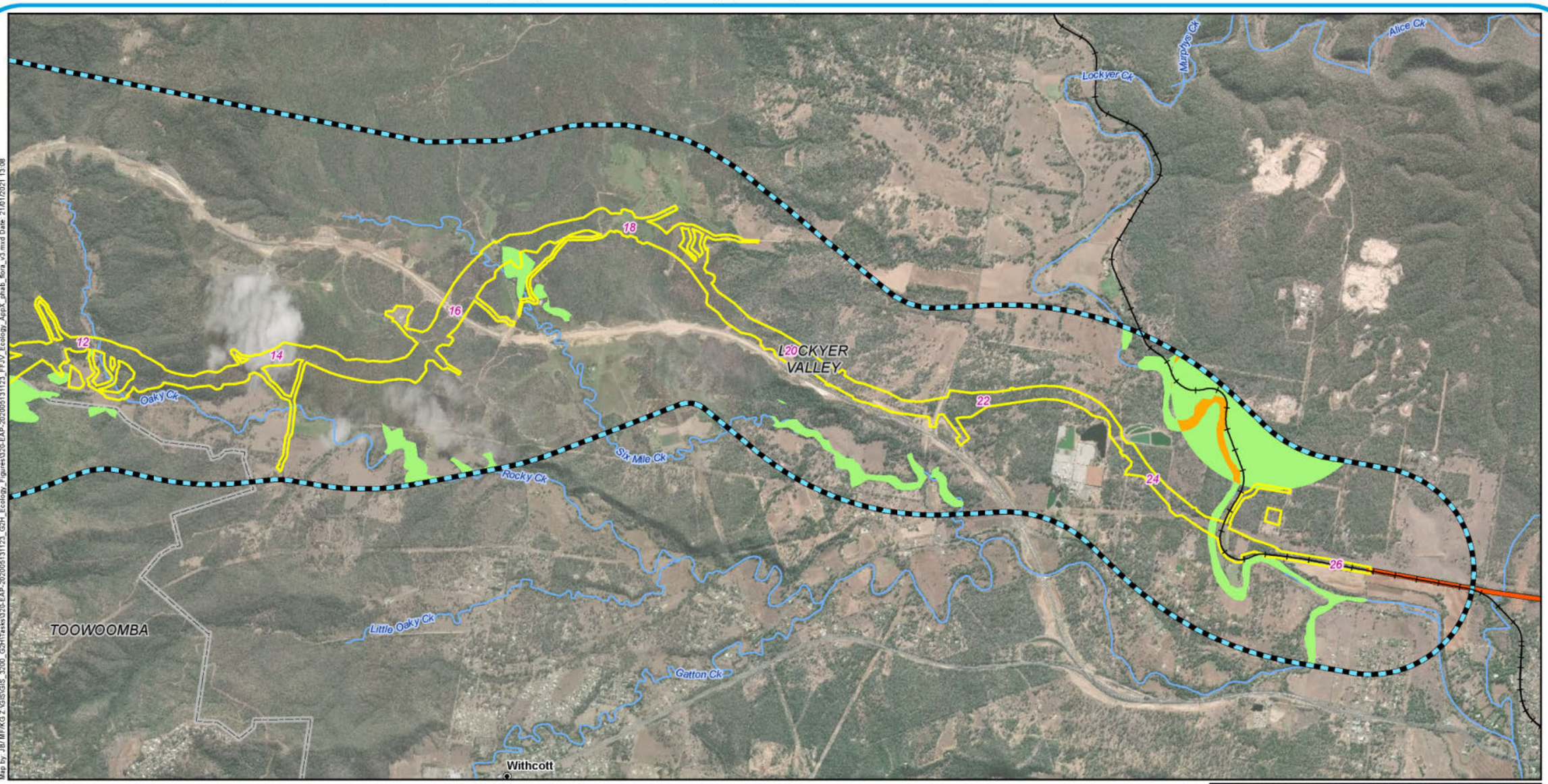
Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Caustis blakei subsp. macrantha* (A sedge)

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



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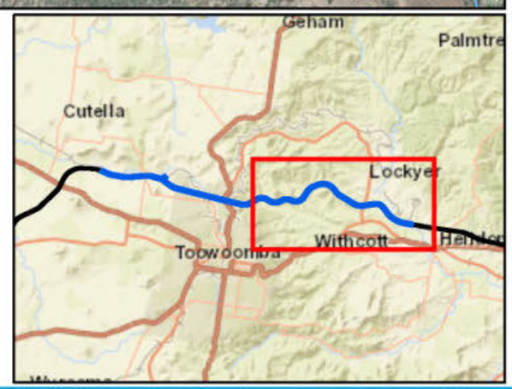
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Essential
- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Caustis blakei subsp. macrantha* (A sedge)

Map by: JB/ MF/KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_flora_v3.mxd Date: 21/01/2021 13:09

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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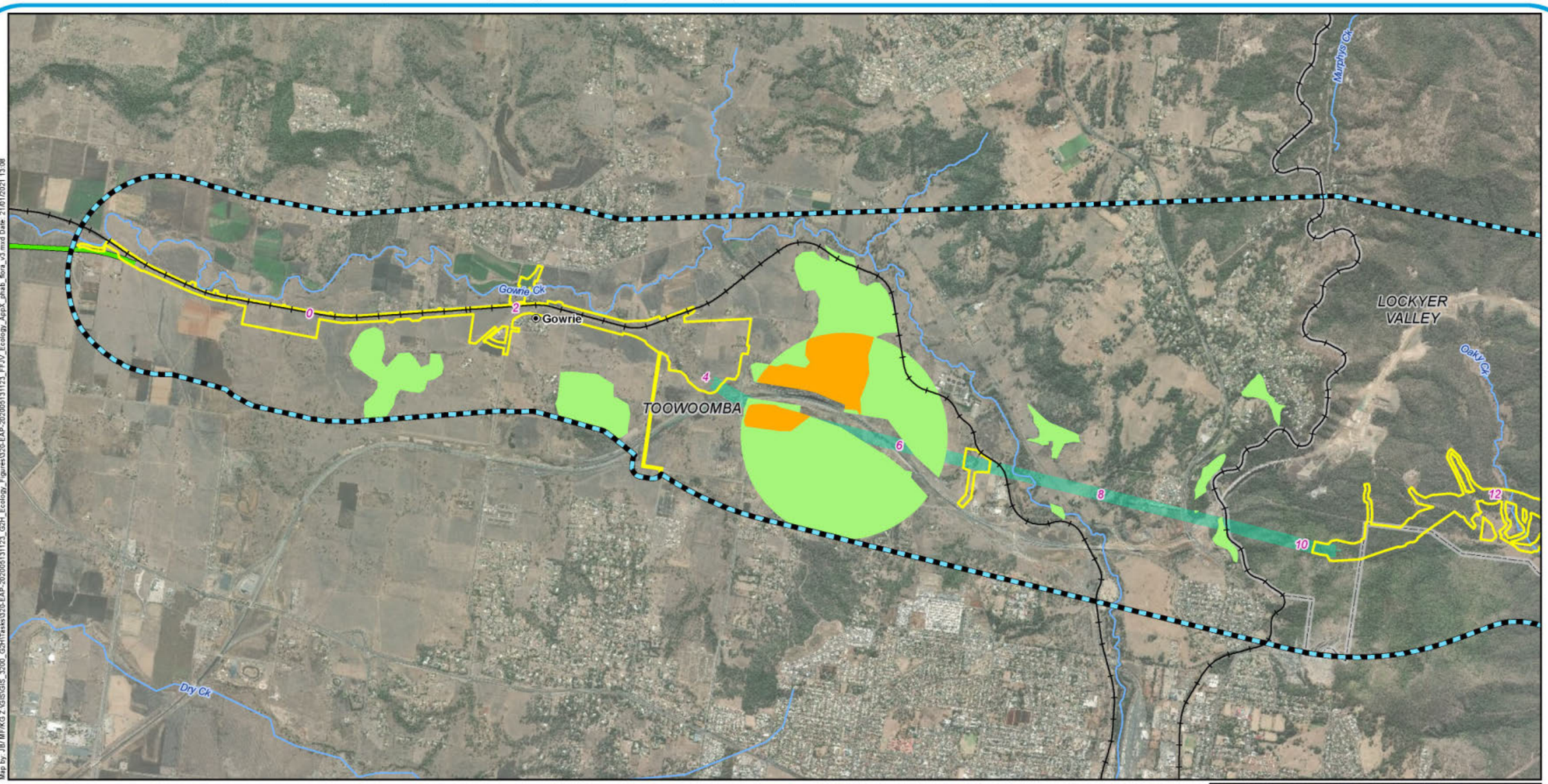

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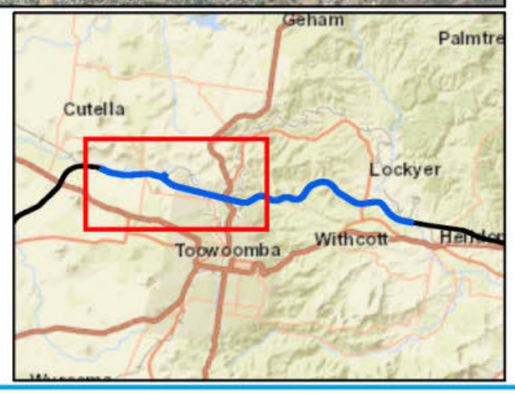
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Essential
- General



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Future Freight
Integrating Community, Environment and Engineering

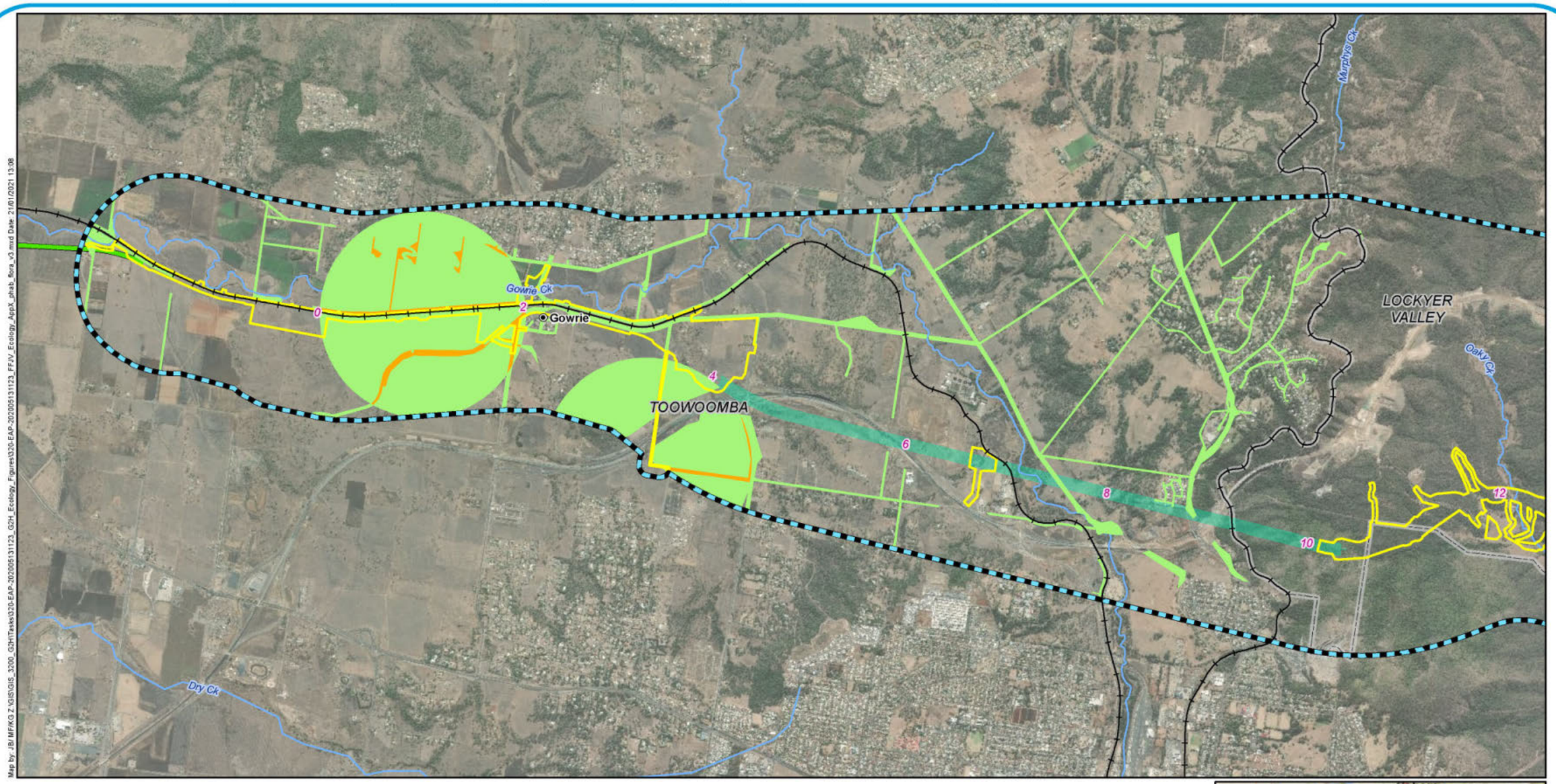
Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Cyperus clarus* (A sedge)

Map by: JB/ MF/KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_flora_v3.mxd Date: 21/01/2021 13:09

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



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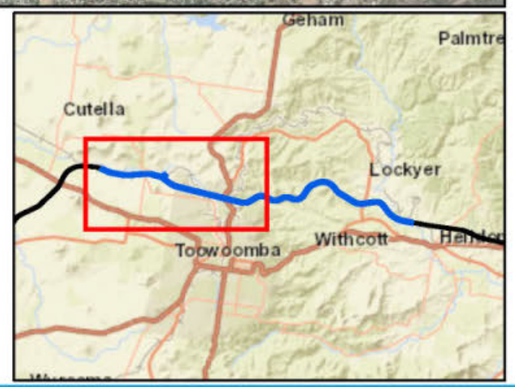
Habitat

- Essential
- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Digitaria porrecta* (Finger panic grass)

Map by: JB/ MF/KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_flora_v3.mxd Date: 21/01/2021 13:09

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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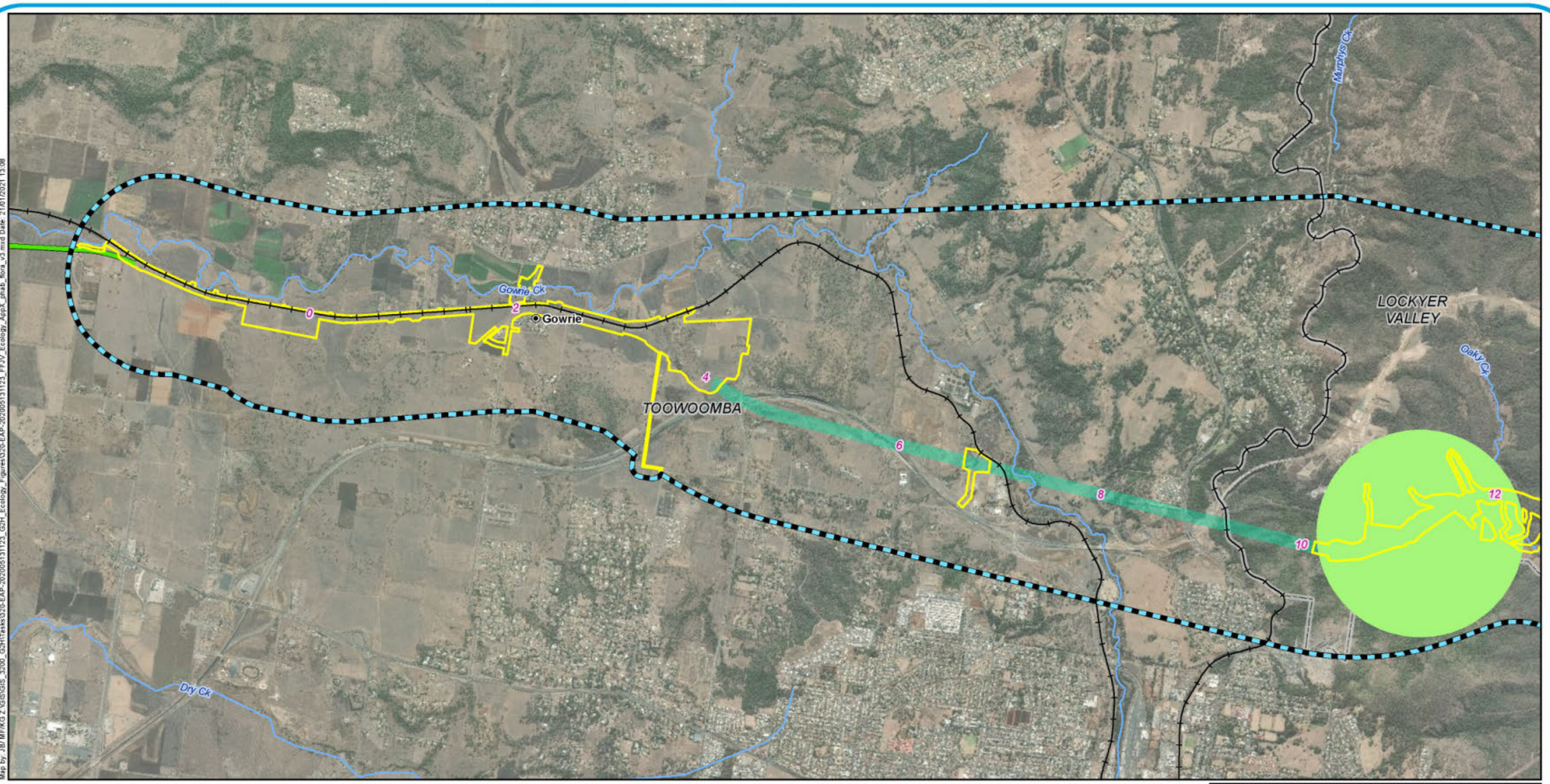

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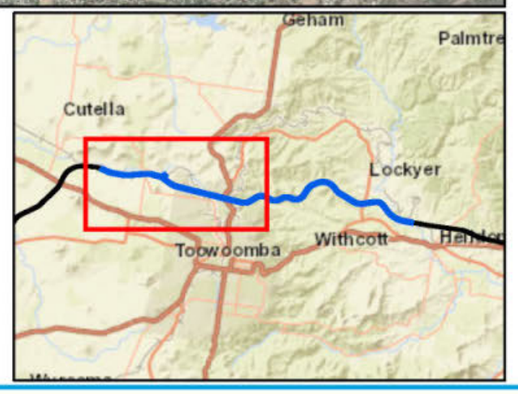
Habitat

- General



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Future Freight
Integrating Community, Environment and Engineering

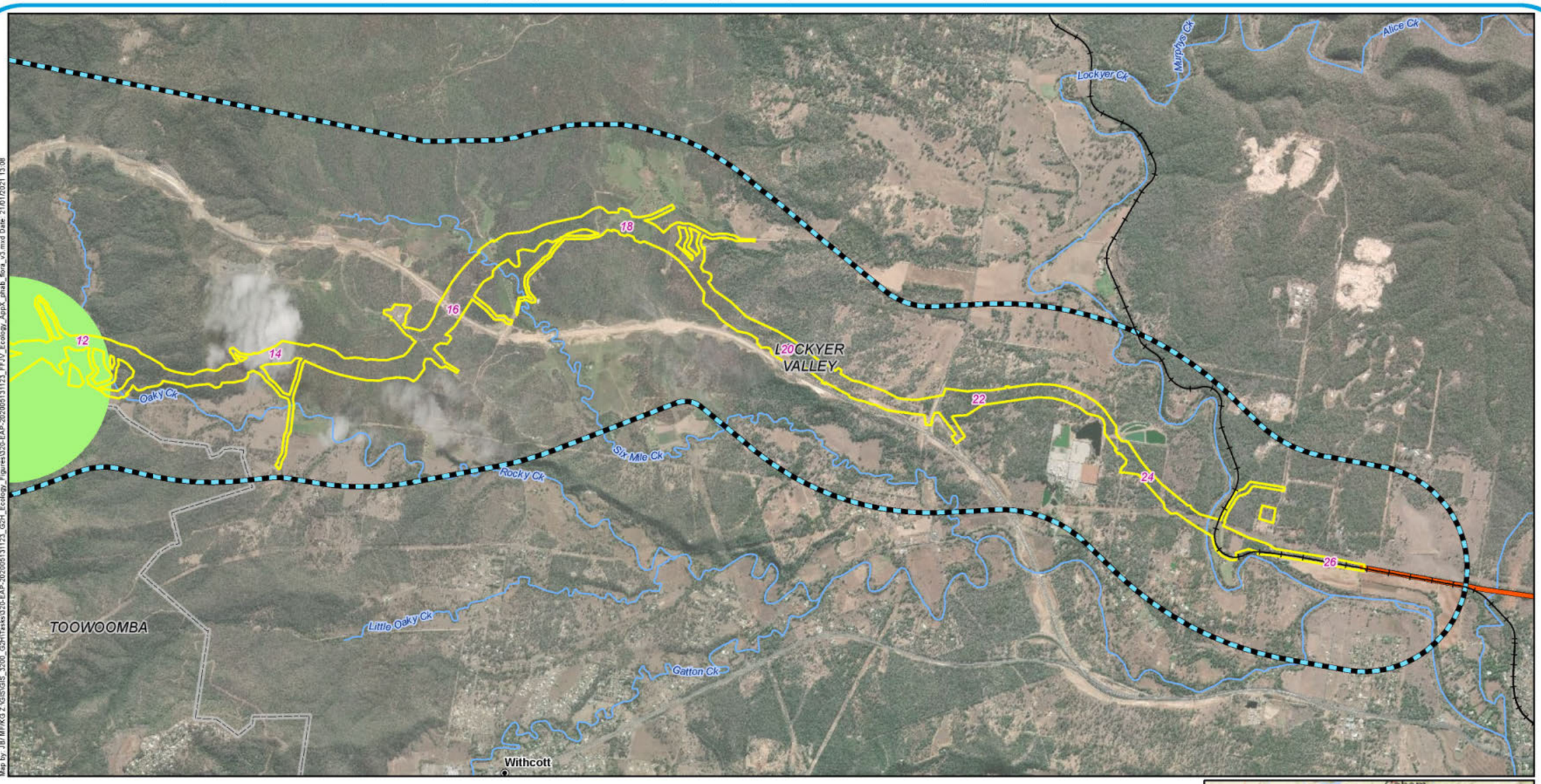
Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Marsdenia coronata* (Slender milkvine)

Map by: JB/ MF/KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_flora_v3.mxd Date: 21/01/2021 13:10

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



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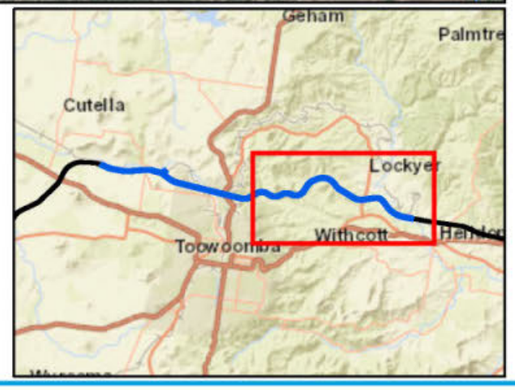
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 3
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Marsdenia coronata* (Slender milkvine)

Map by: JB/ MF/KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_flora_v3.mxd Date: 21/01/2021 13:10

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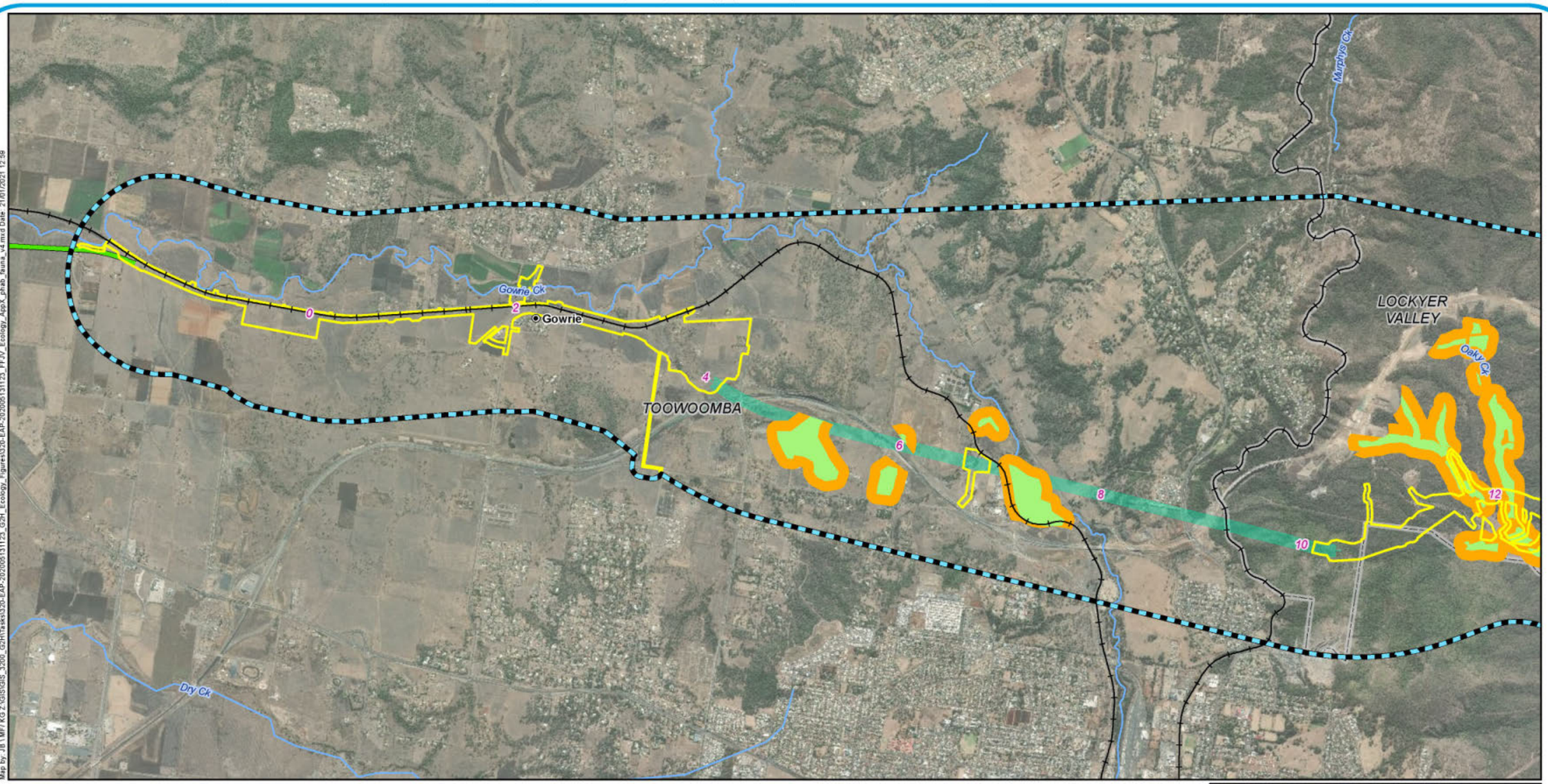

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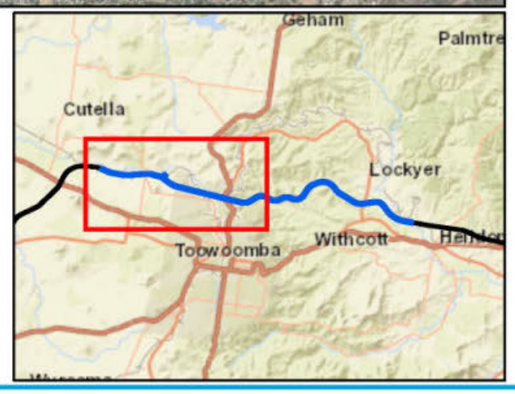
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



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0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Actitis hypoleucos* (Common sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:00

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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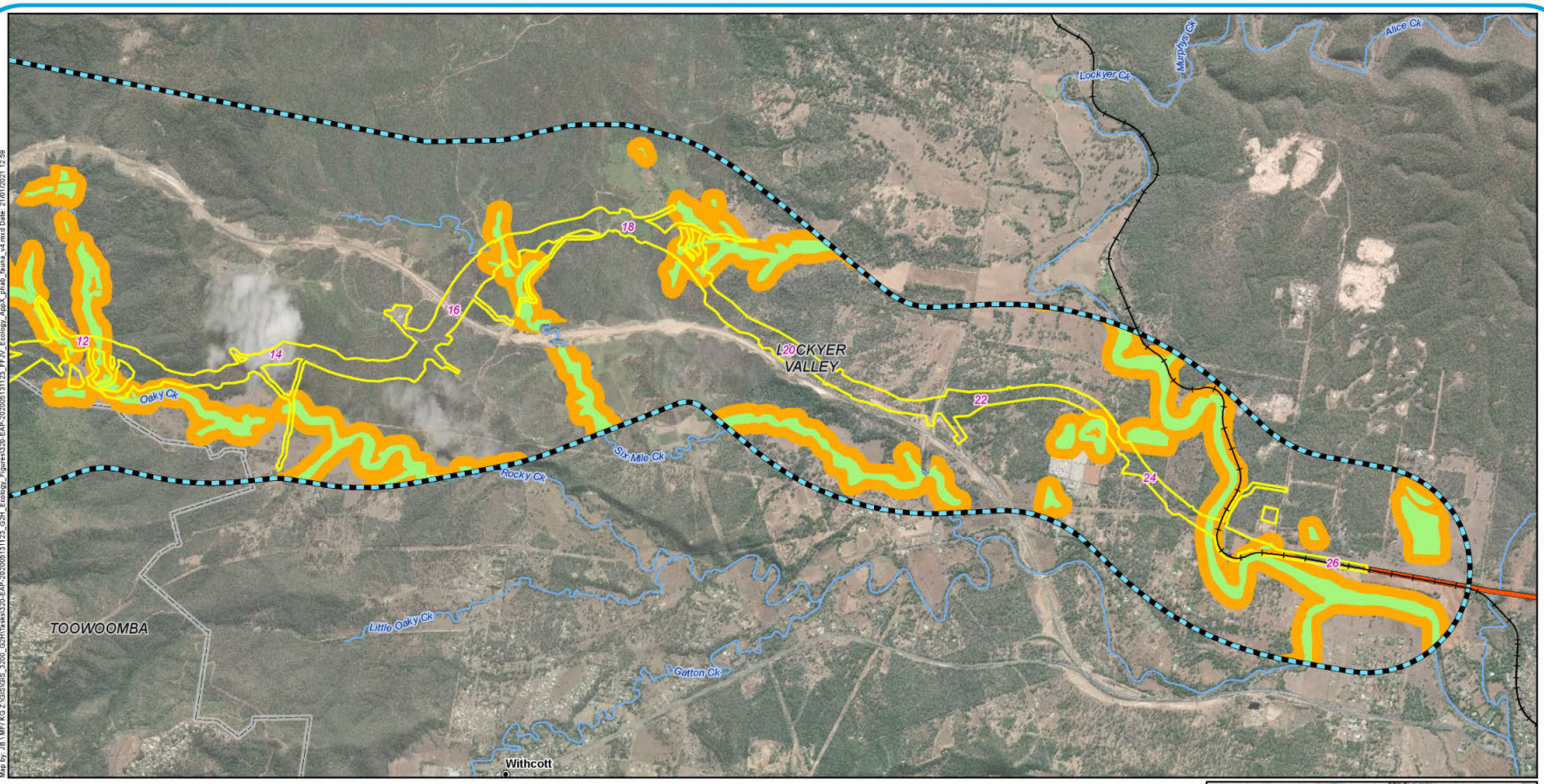

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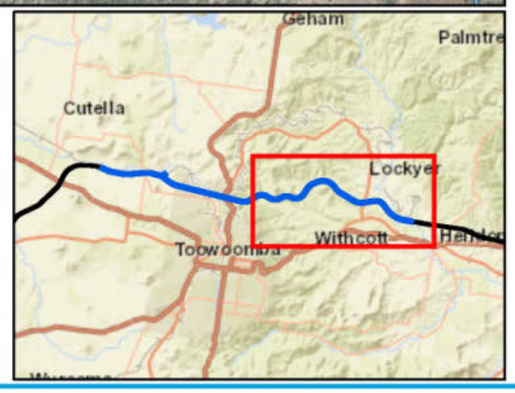
- Ecology study area

Habitat

- Important habitat
- Potential habitat



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0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Actitis hypoleucos* (Common sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:01

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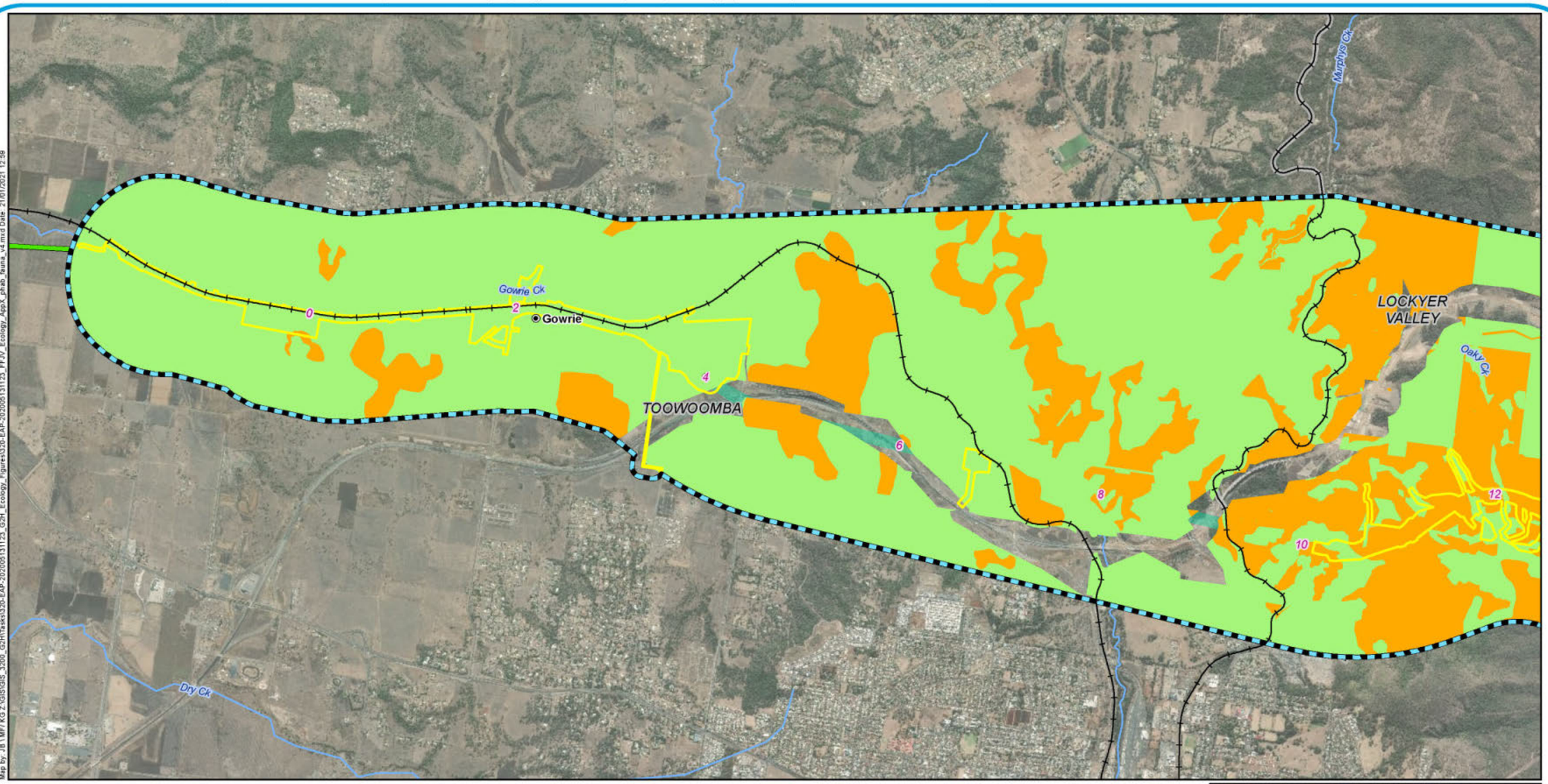
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



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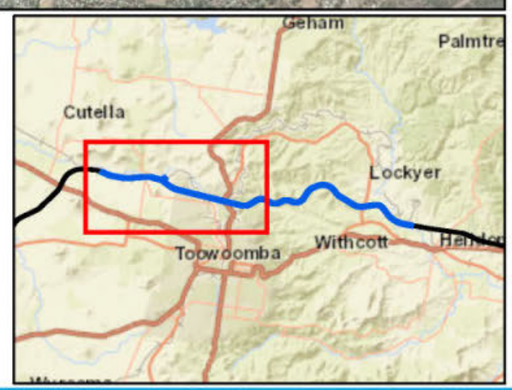
Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Apus pacificus* (Fork-tailed swift)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:01

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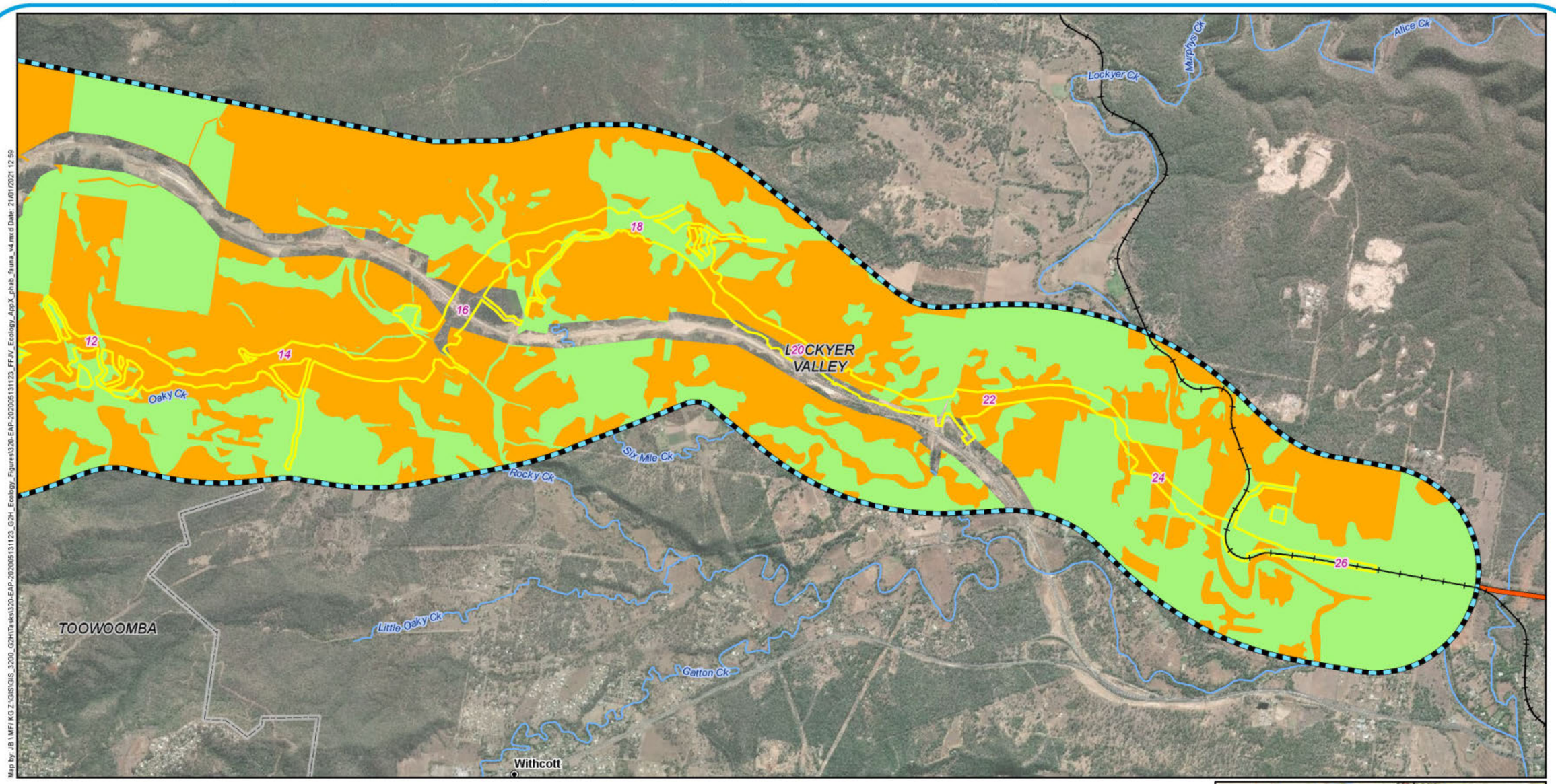
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



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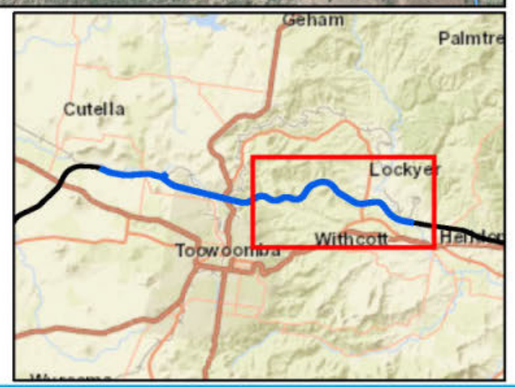
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



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0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Apus pacificus* (Fork-tailed swift)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:01

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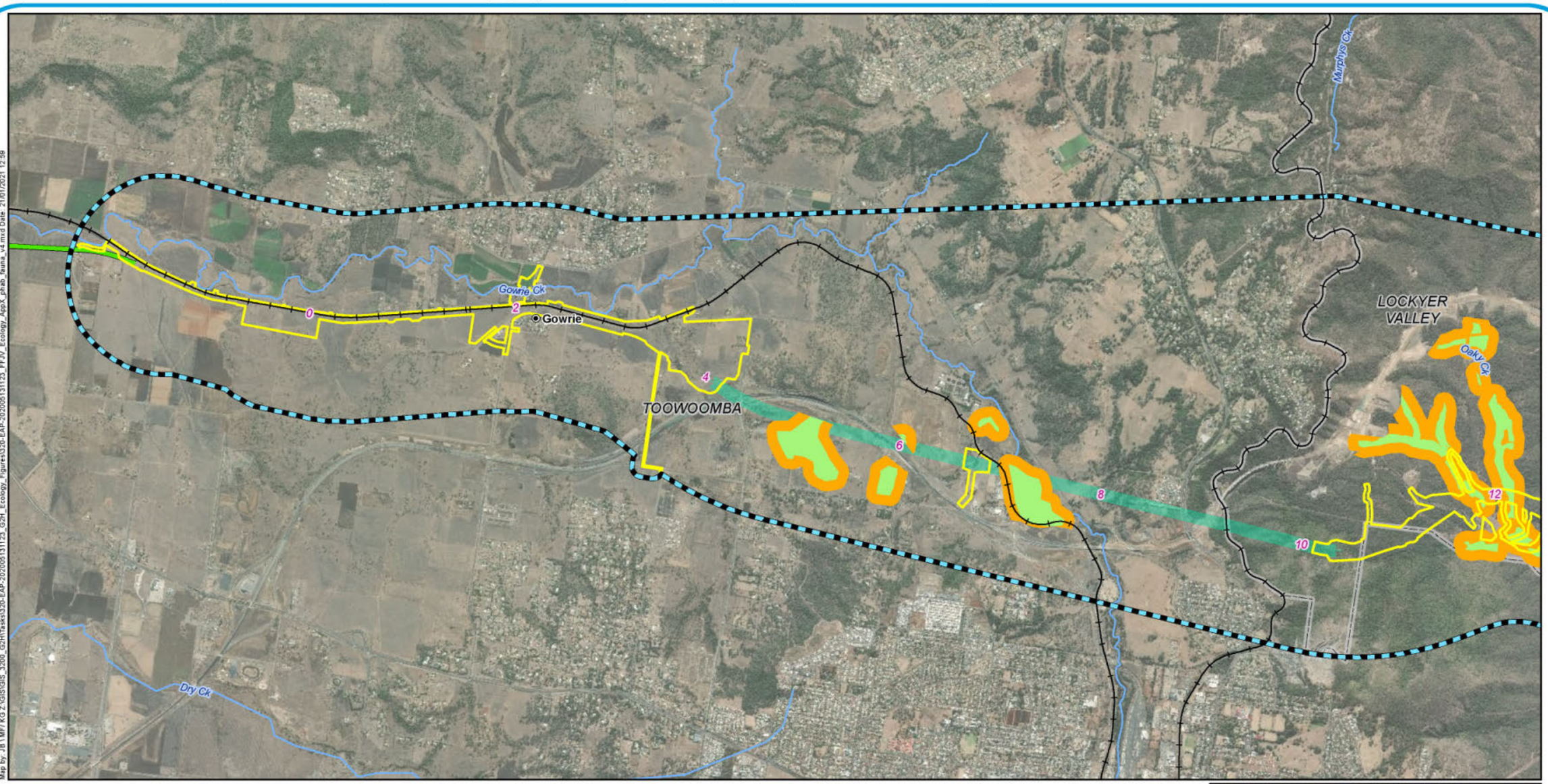
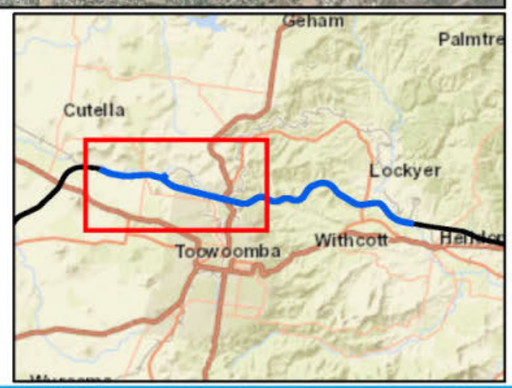


Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calidris acuminata* (Sharp-tailed sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:01

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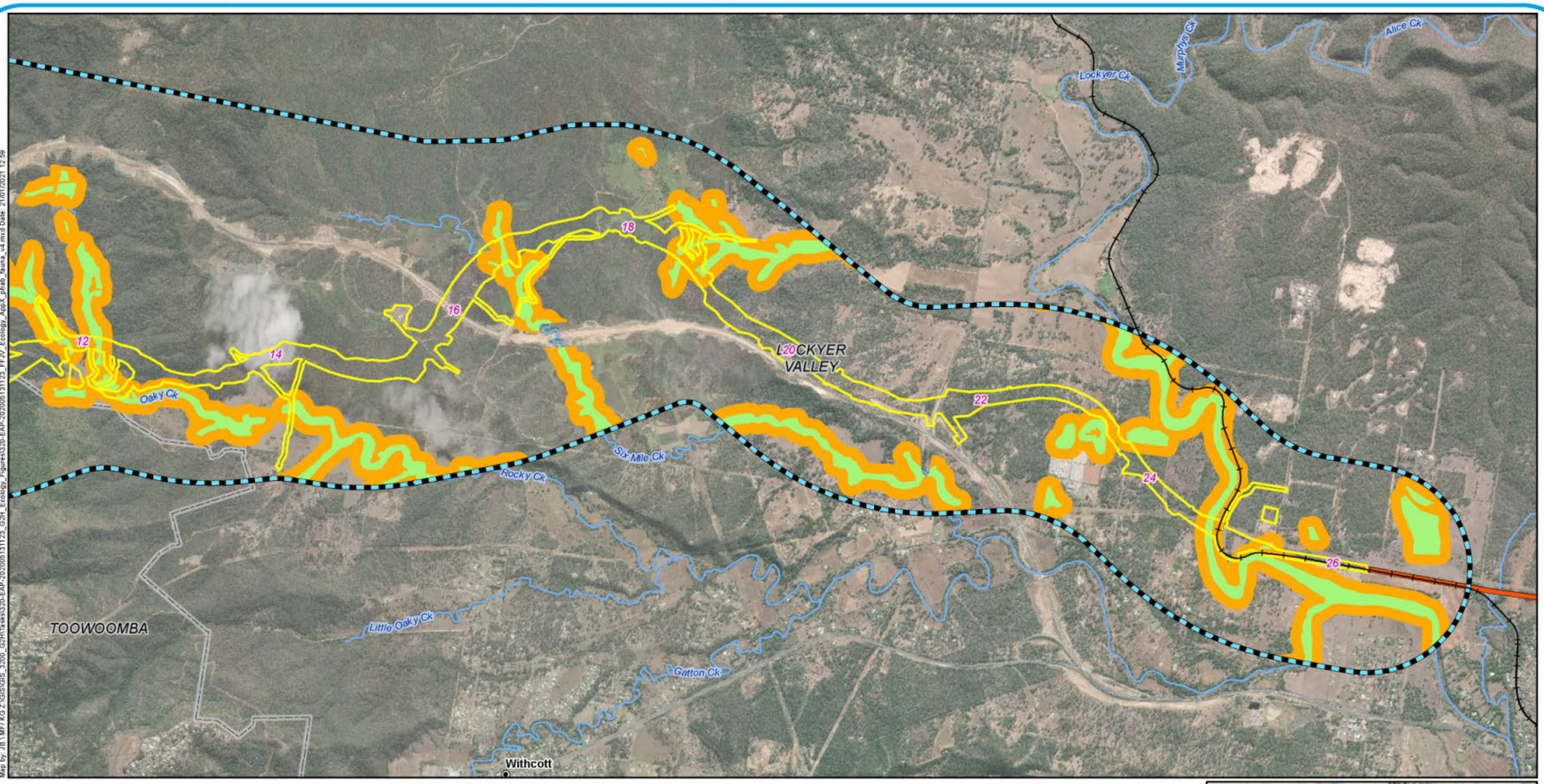

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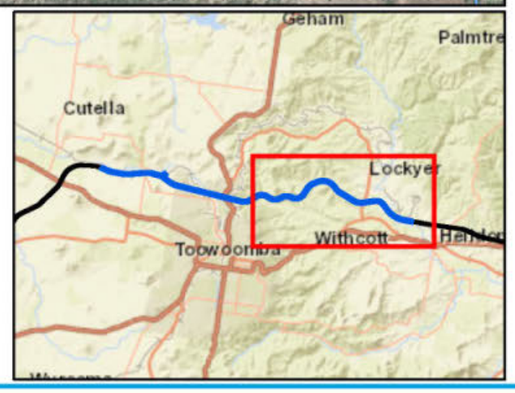
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calidris acuminata* (Sharp-tailed sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:02

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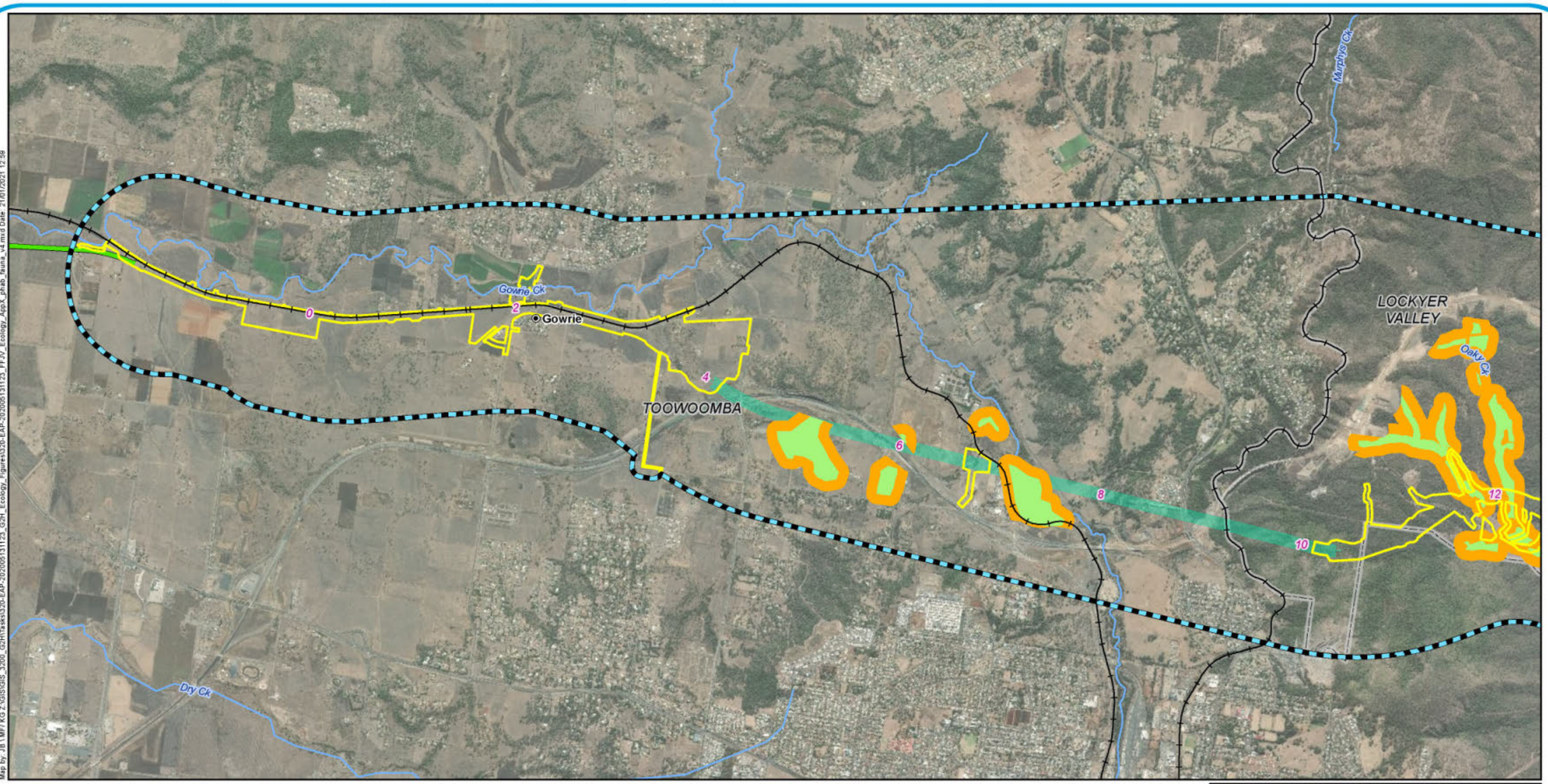
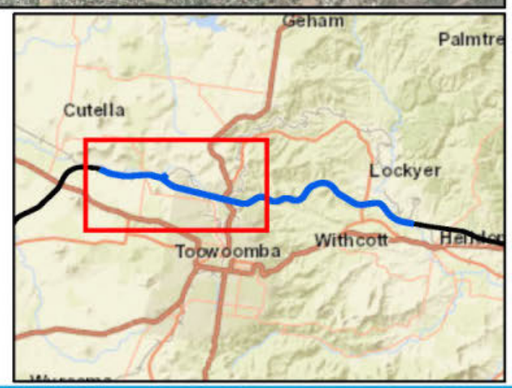


Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calidris melanotos* (Pectoral sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:02

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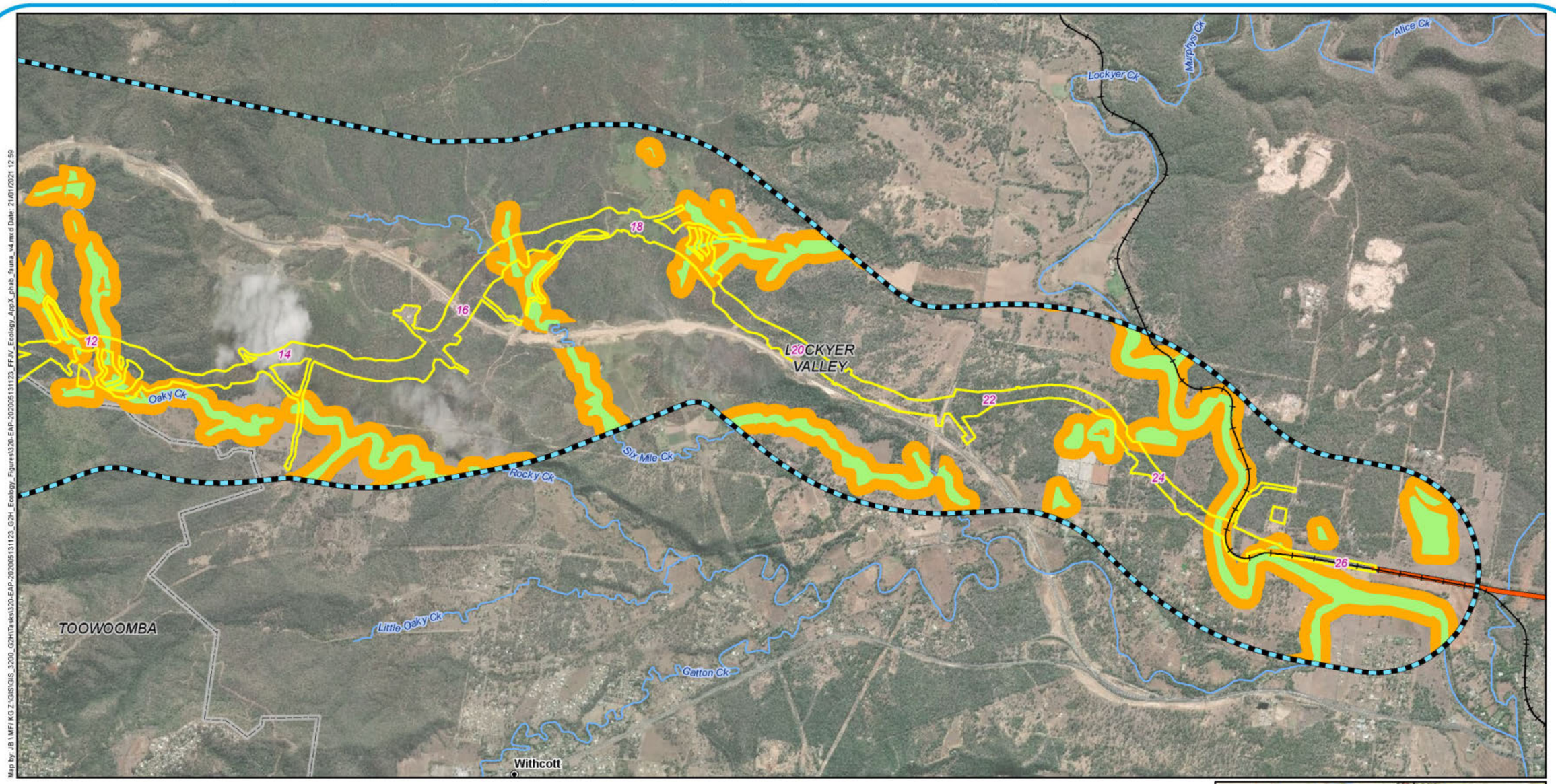

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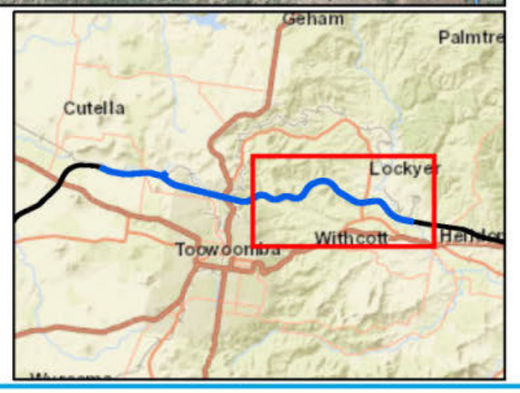
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calidris melanotos* (Pectoral sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:02

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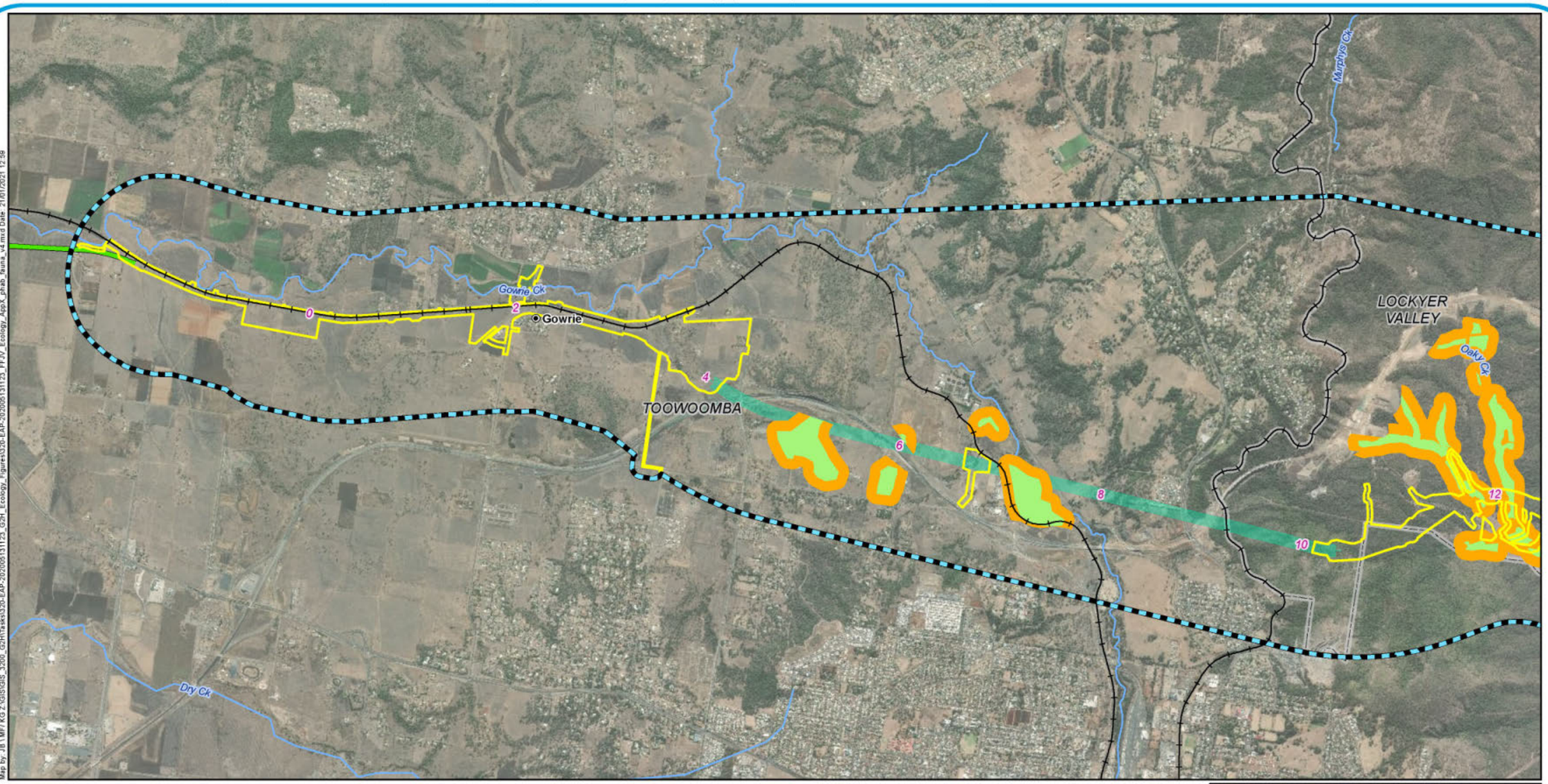

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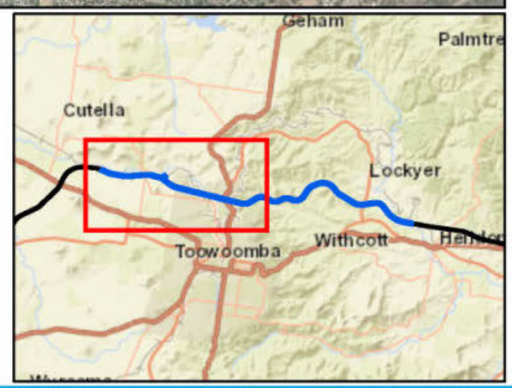
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



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0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calidris ruficollis* (Red-necked stint)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:02

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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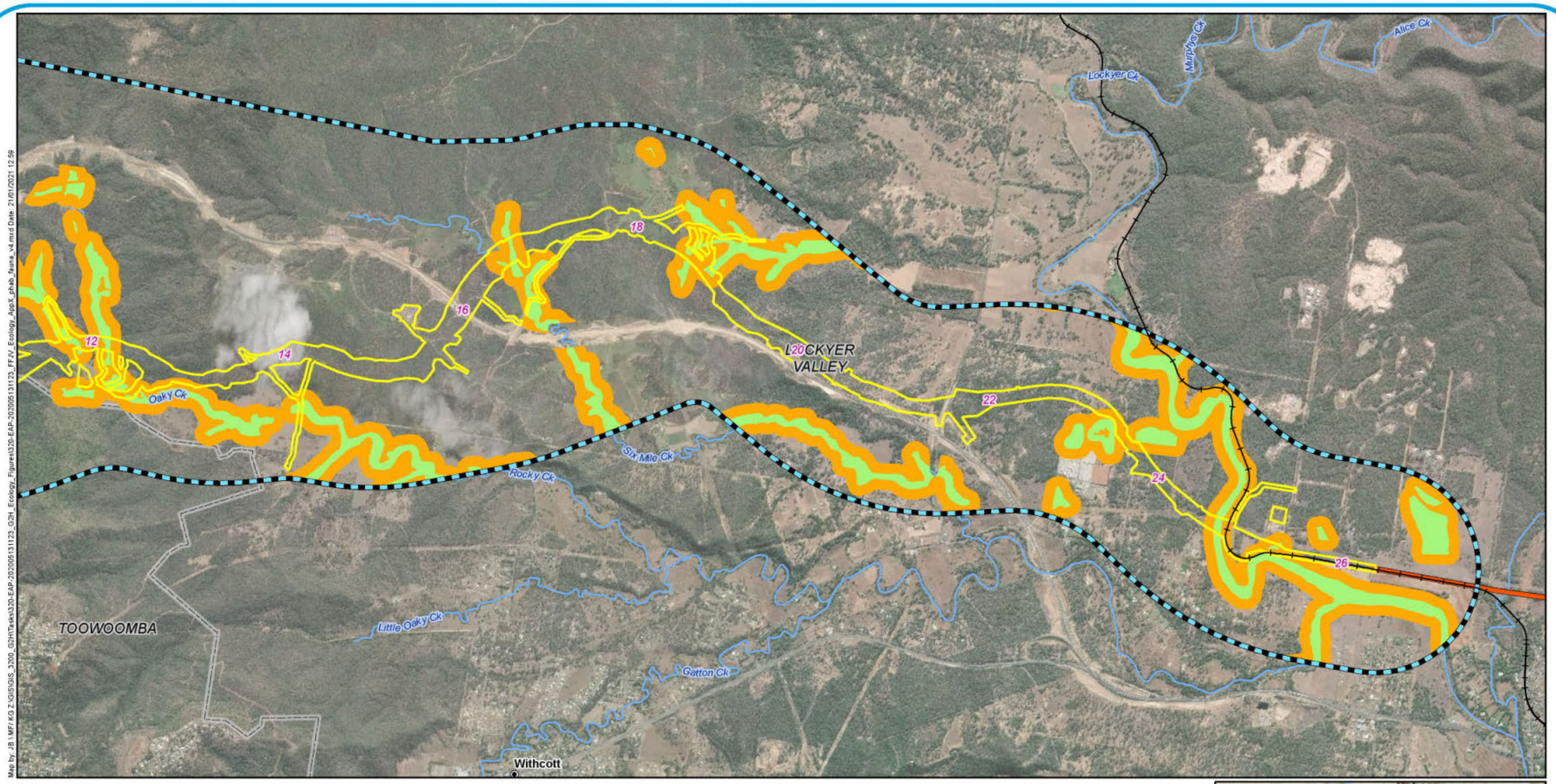

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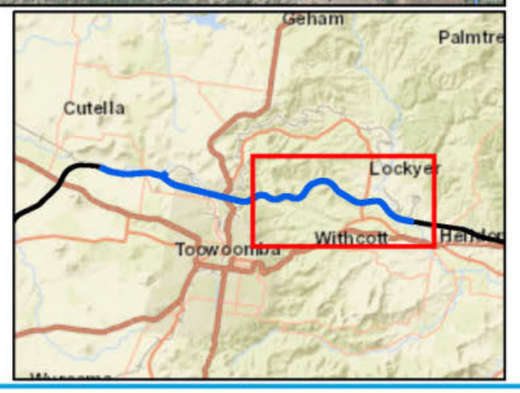
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calidris ruficollis* (Red-necked stint)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:02

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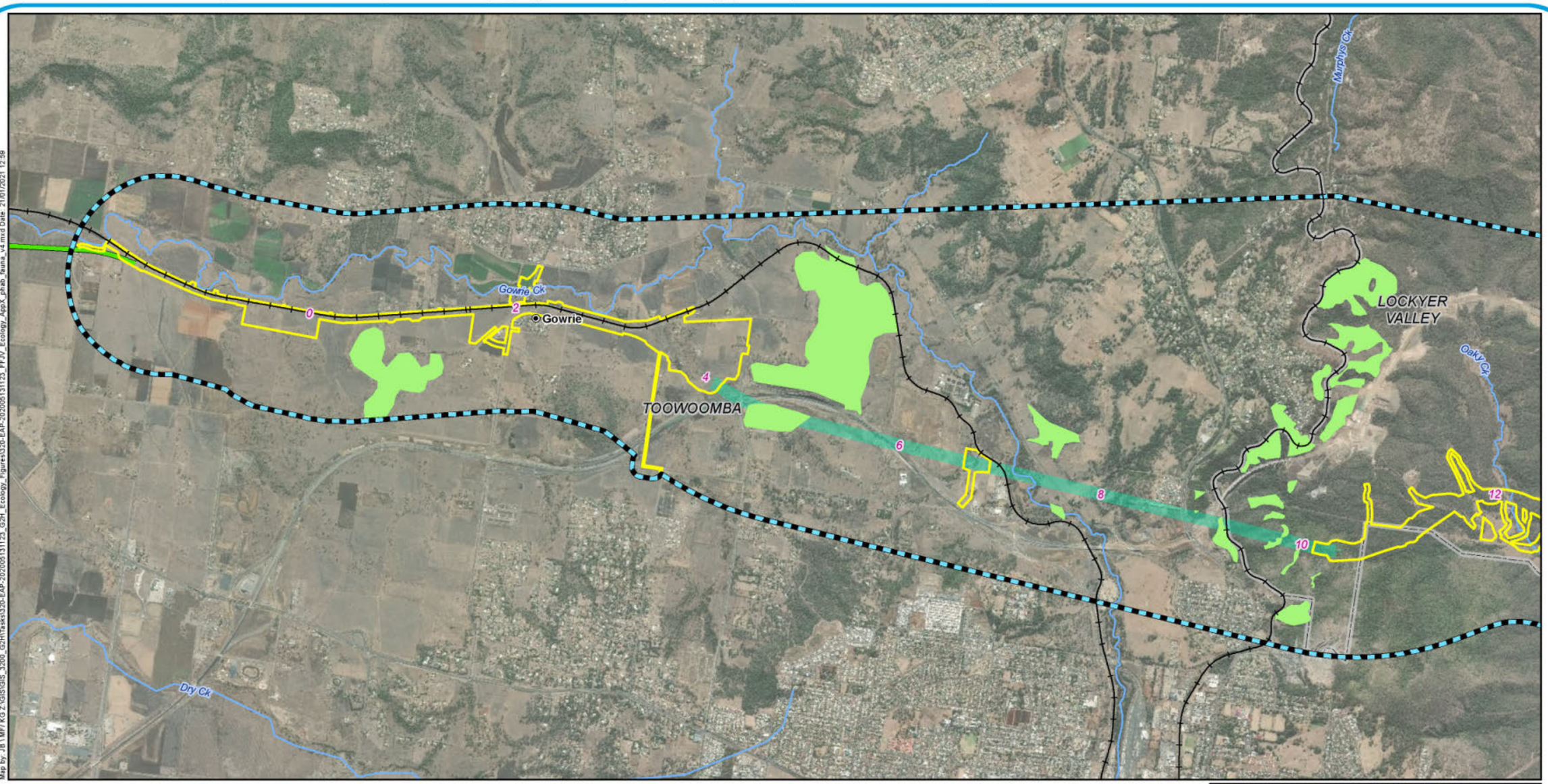

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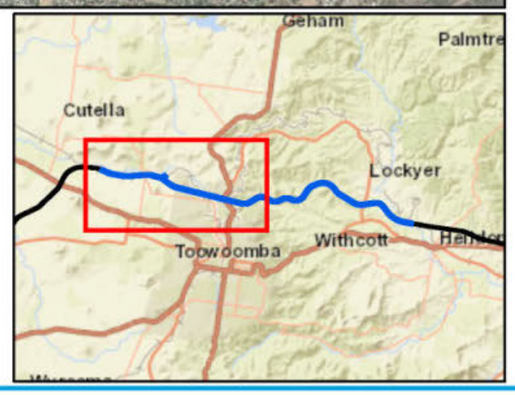
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calyptorhynchus lathami lathami* (Glossy black-cockatoo (eastern))

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:02

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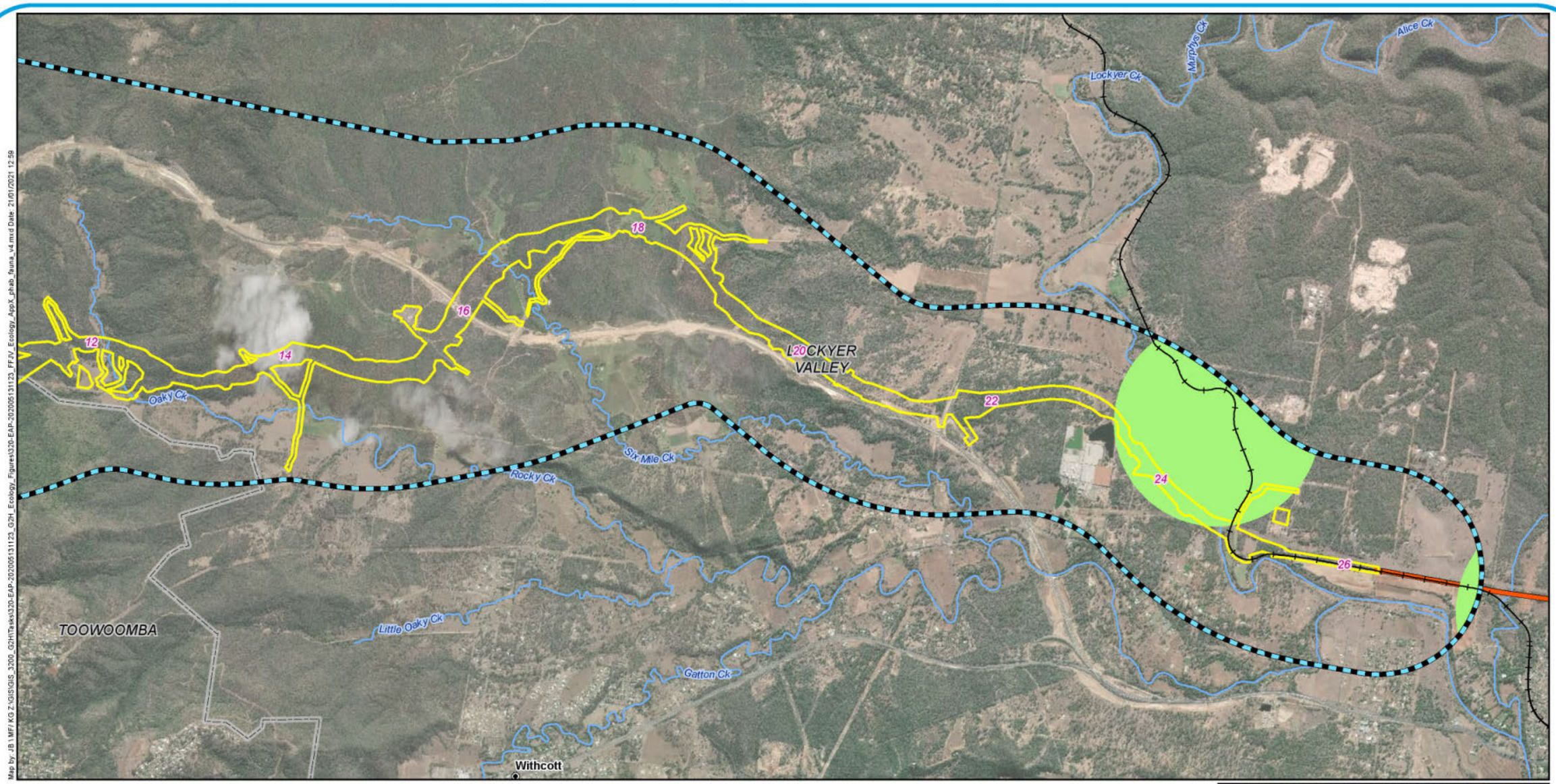

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Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- General

A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Calyptorhynchus lathami lathami* (Glossy black-cockatoo (eastern))

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:03

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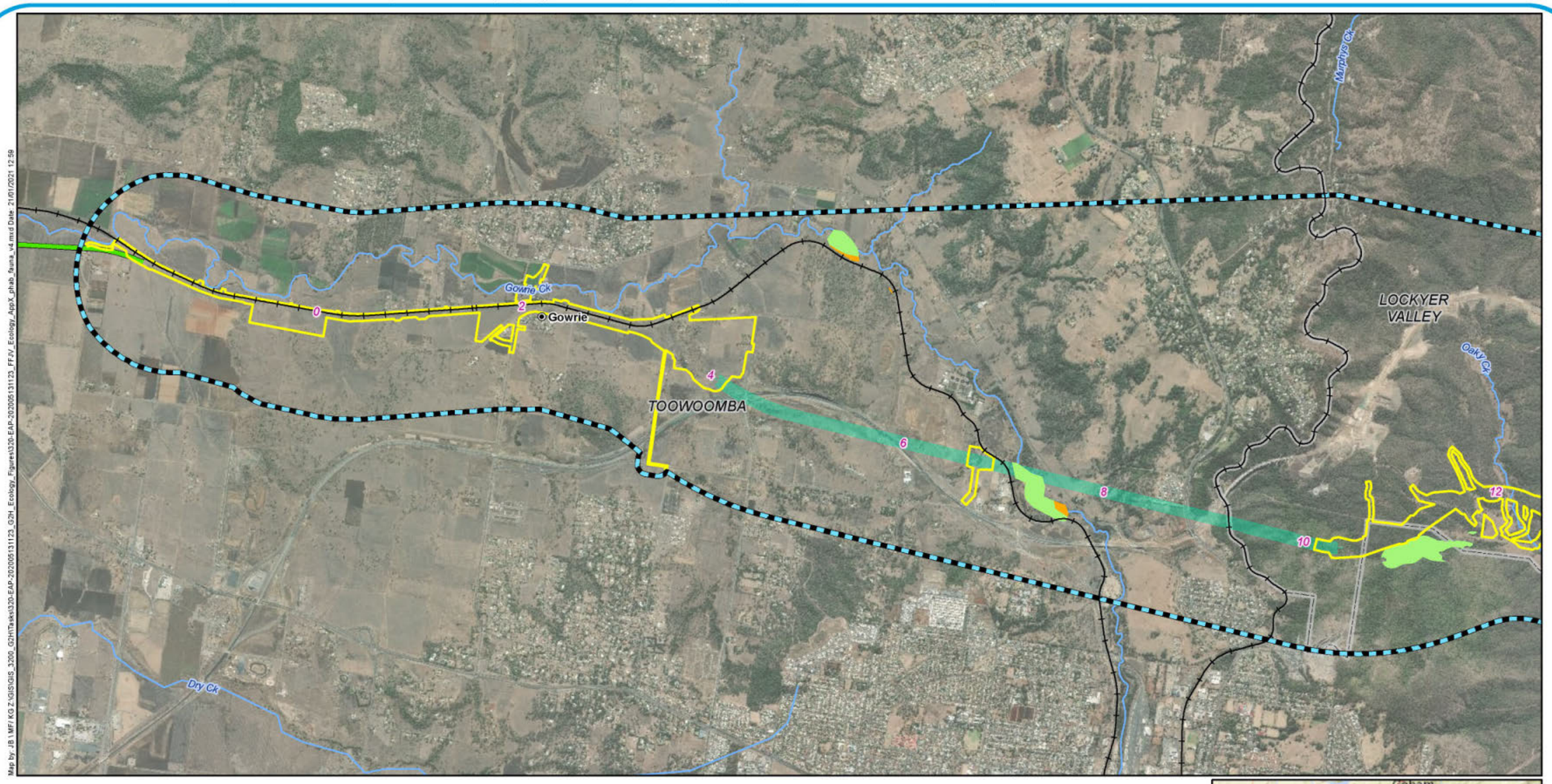

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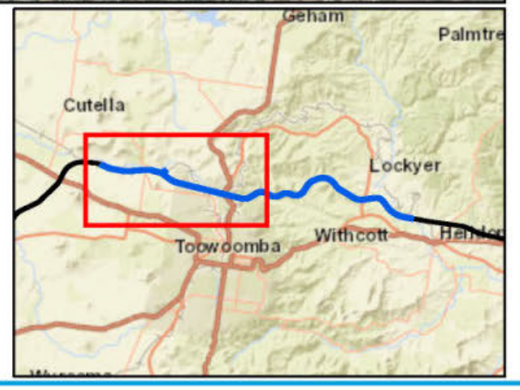
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Cuculus optatus* (Oriental cuckoo)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:03

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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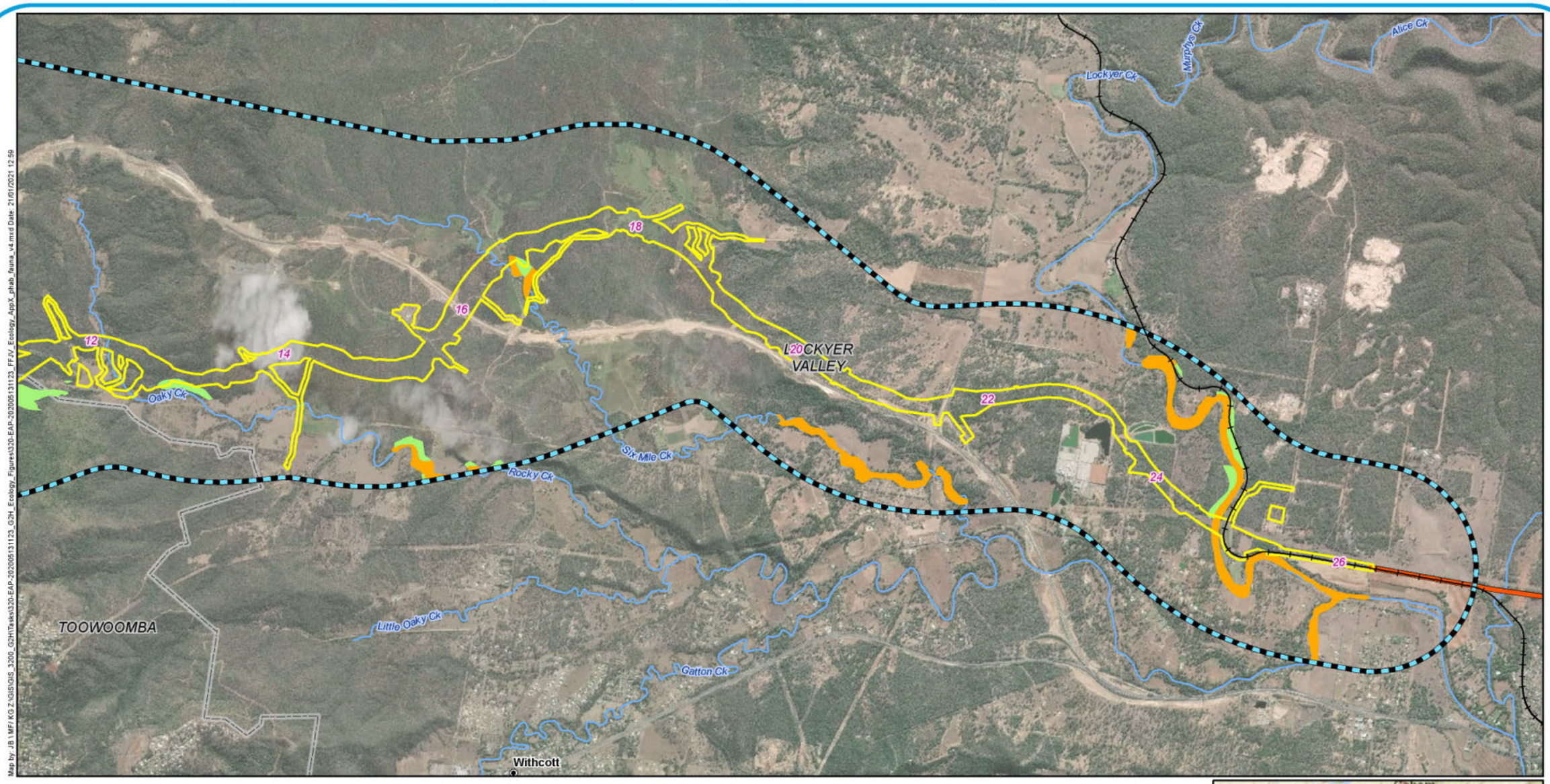

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Legend

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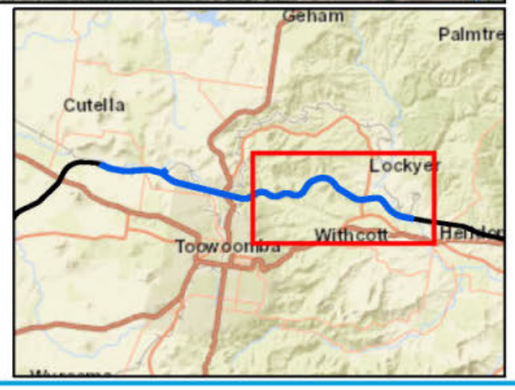
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Cuculus optatus* (Oriental cuckoo)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:03

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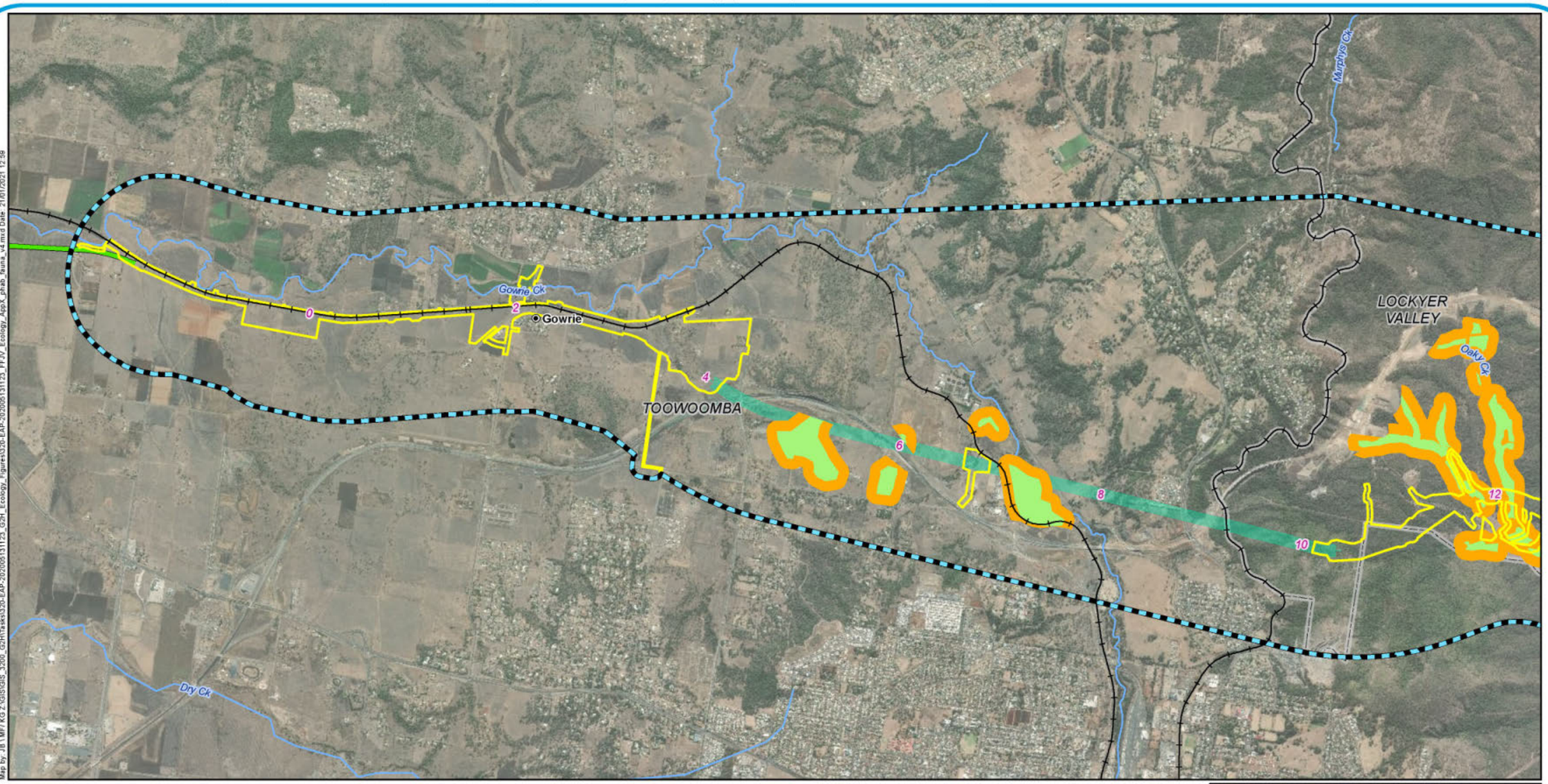

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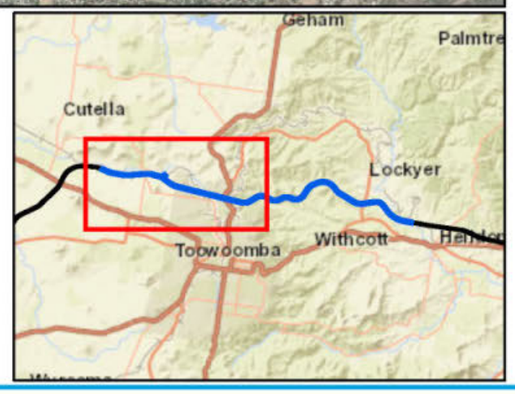
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Gallinago hardwickii* (Lathams snipe)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:03

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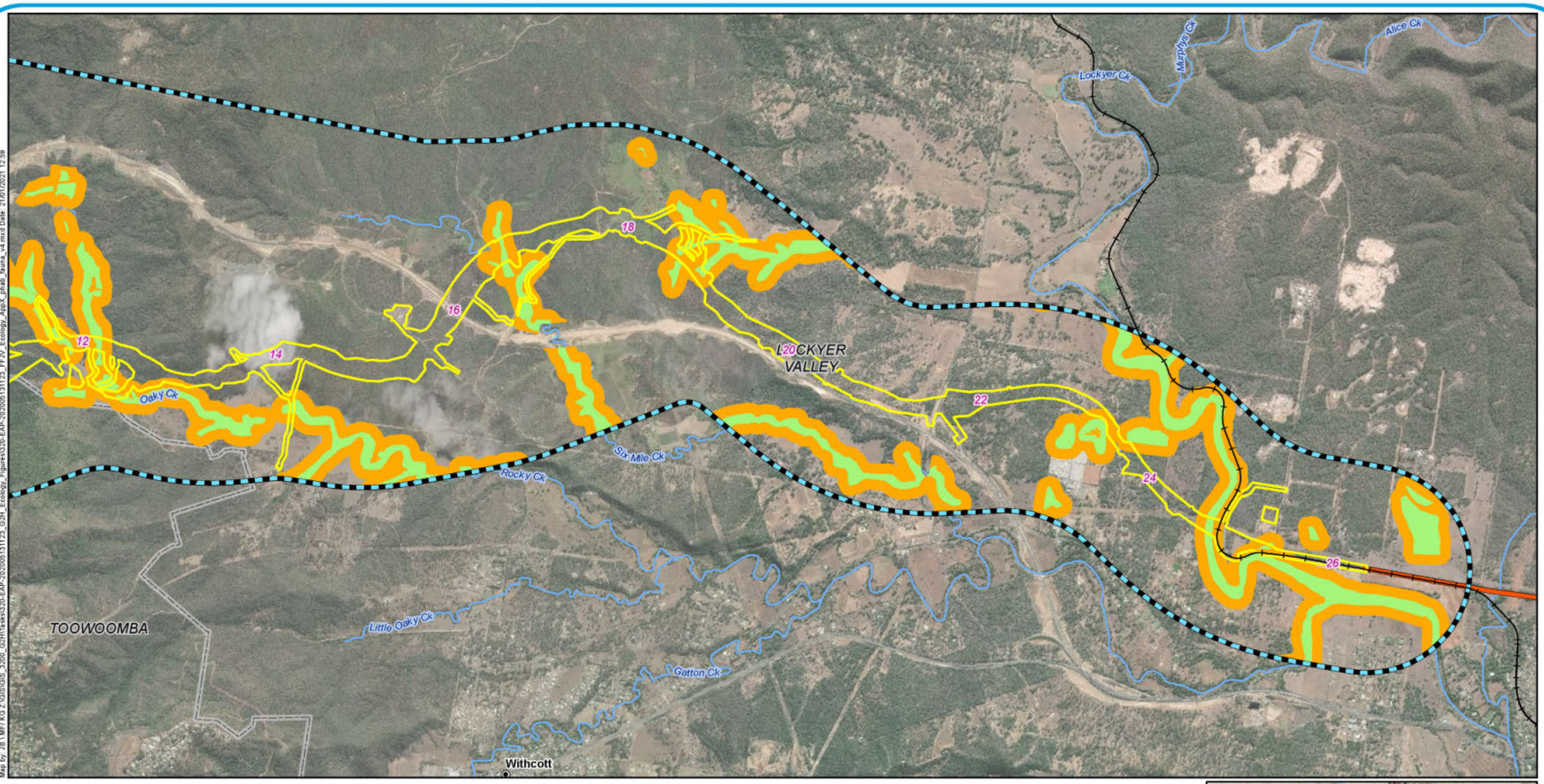

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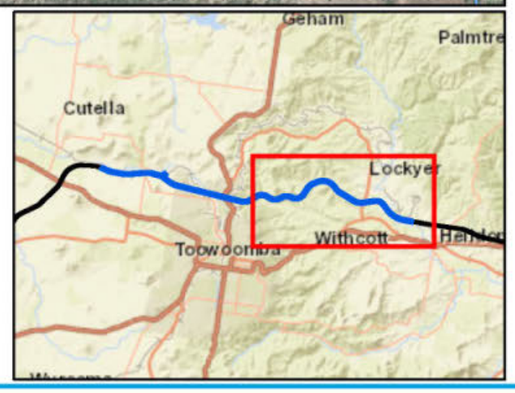
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Gallinago hardwickii* (Lathams snipe)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:03

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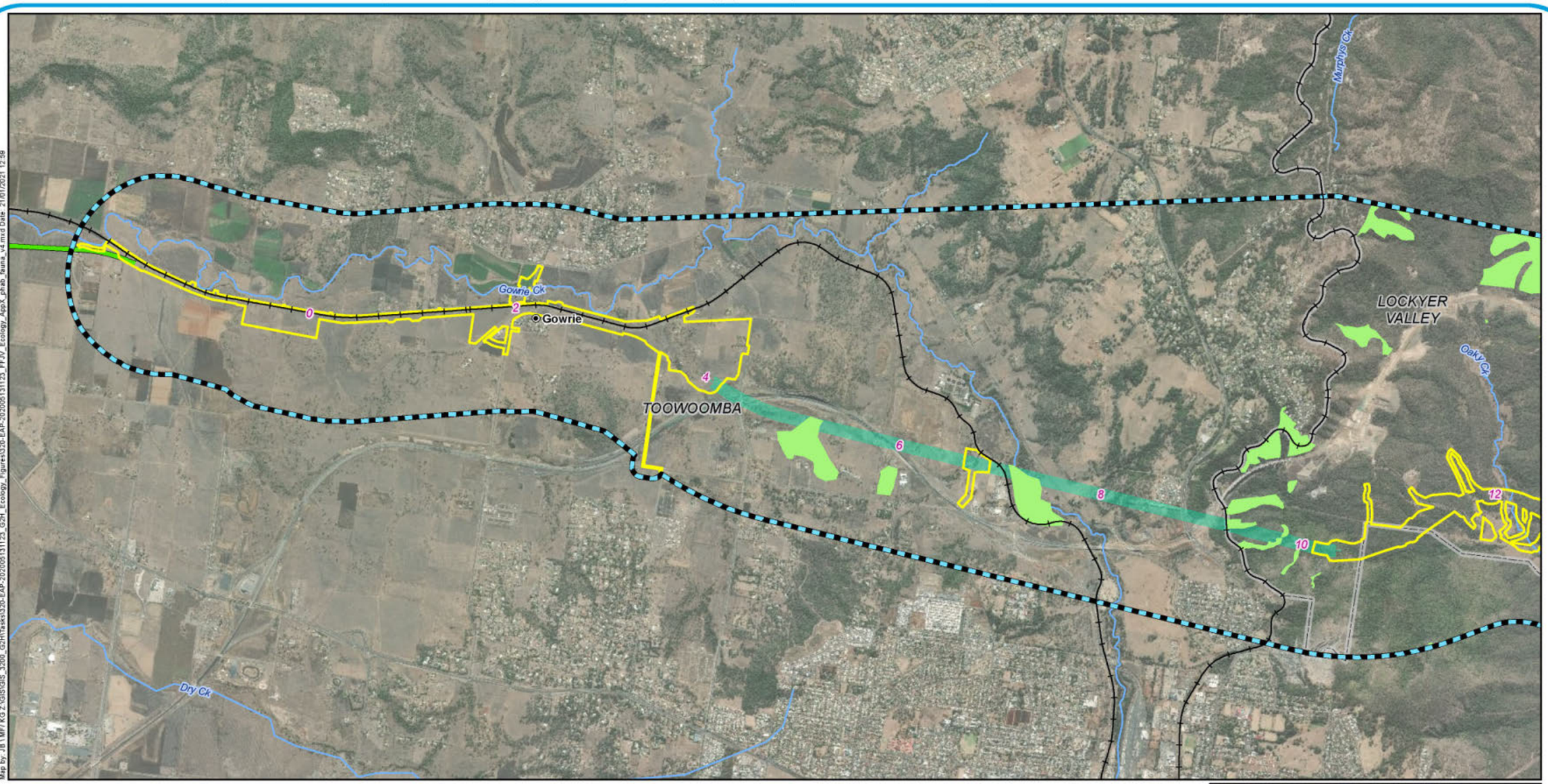

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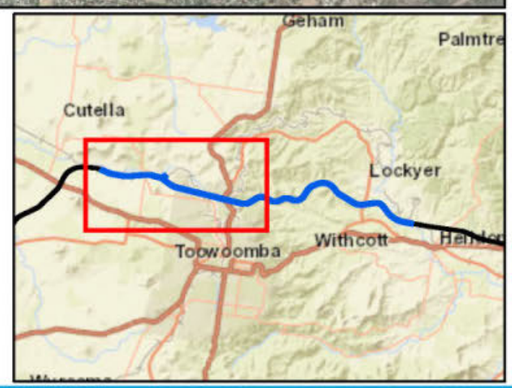
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



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0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Hemiaspis damelii* (Grey snake)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:04

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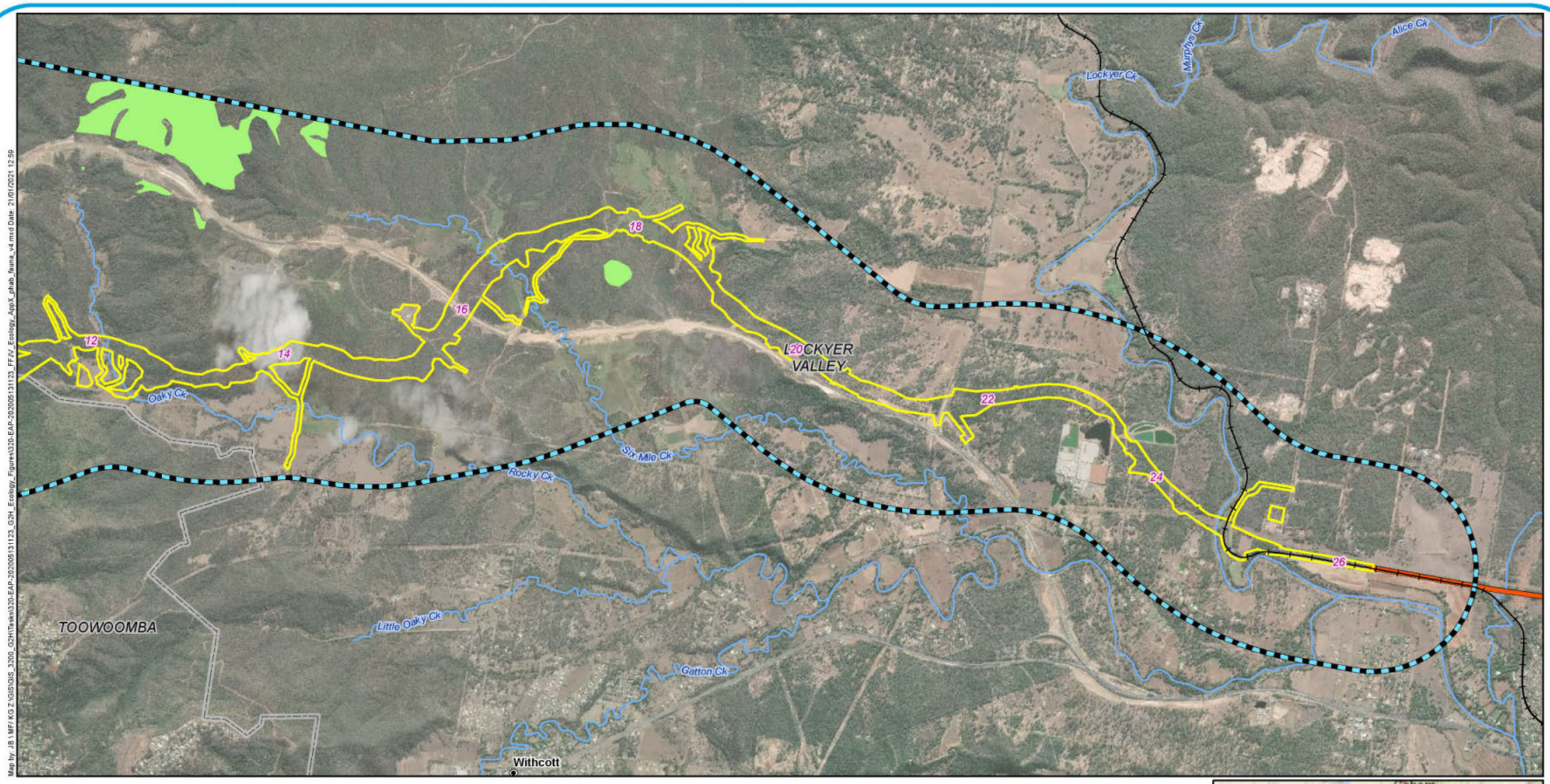
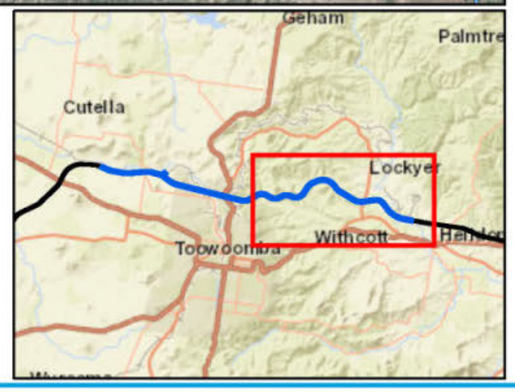


Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- General



A3 scale: 1:40,000

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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Hemiaspis damelii* (Grey snake)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:04

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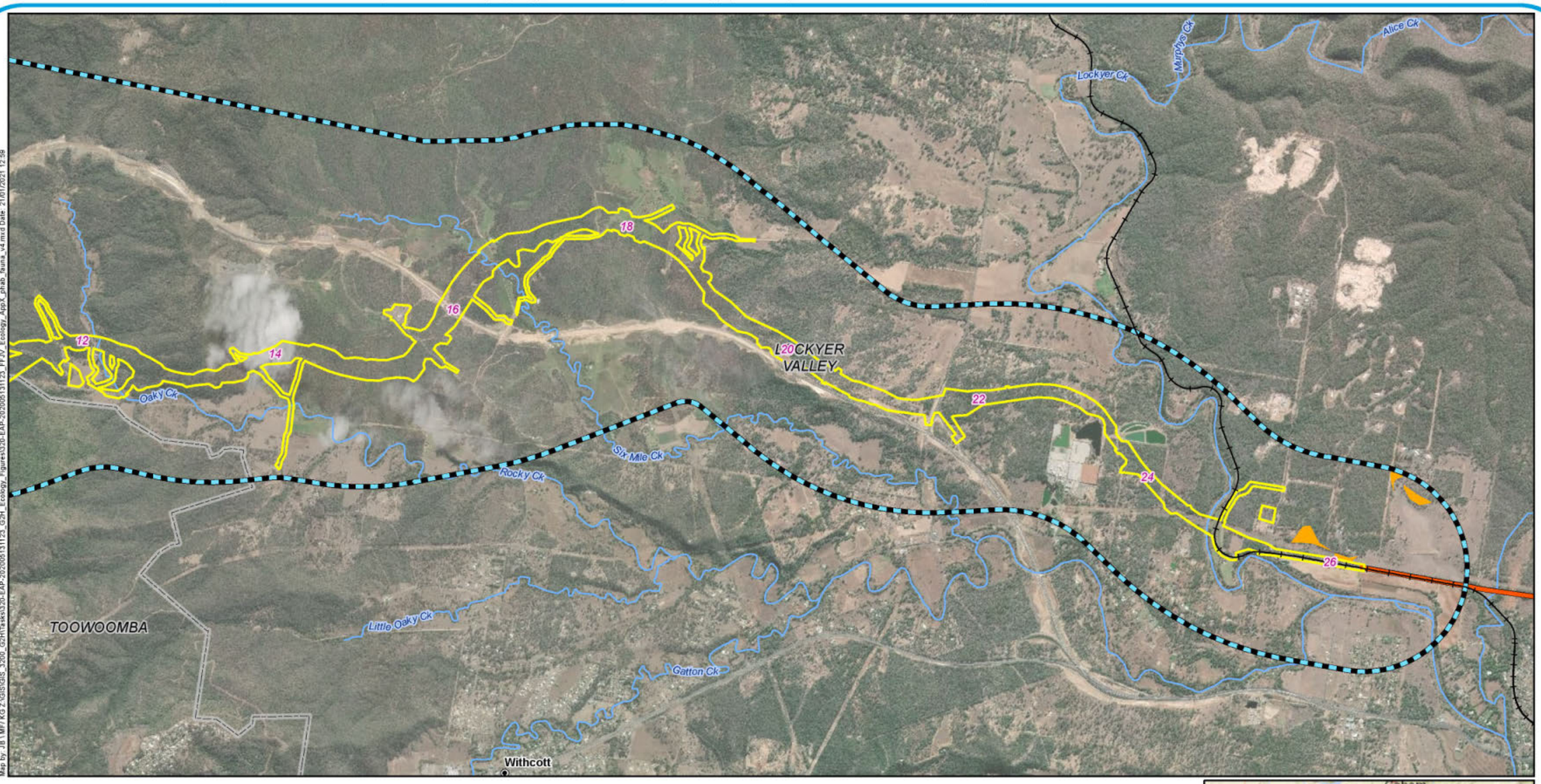
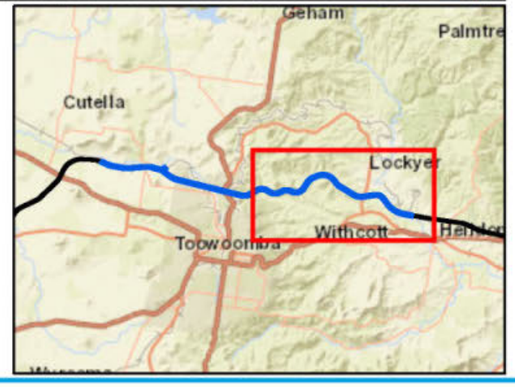


Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Hydroprogne caspia* (Caspian tern)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:04

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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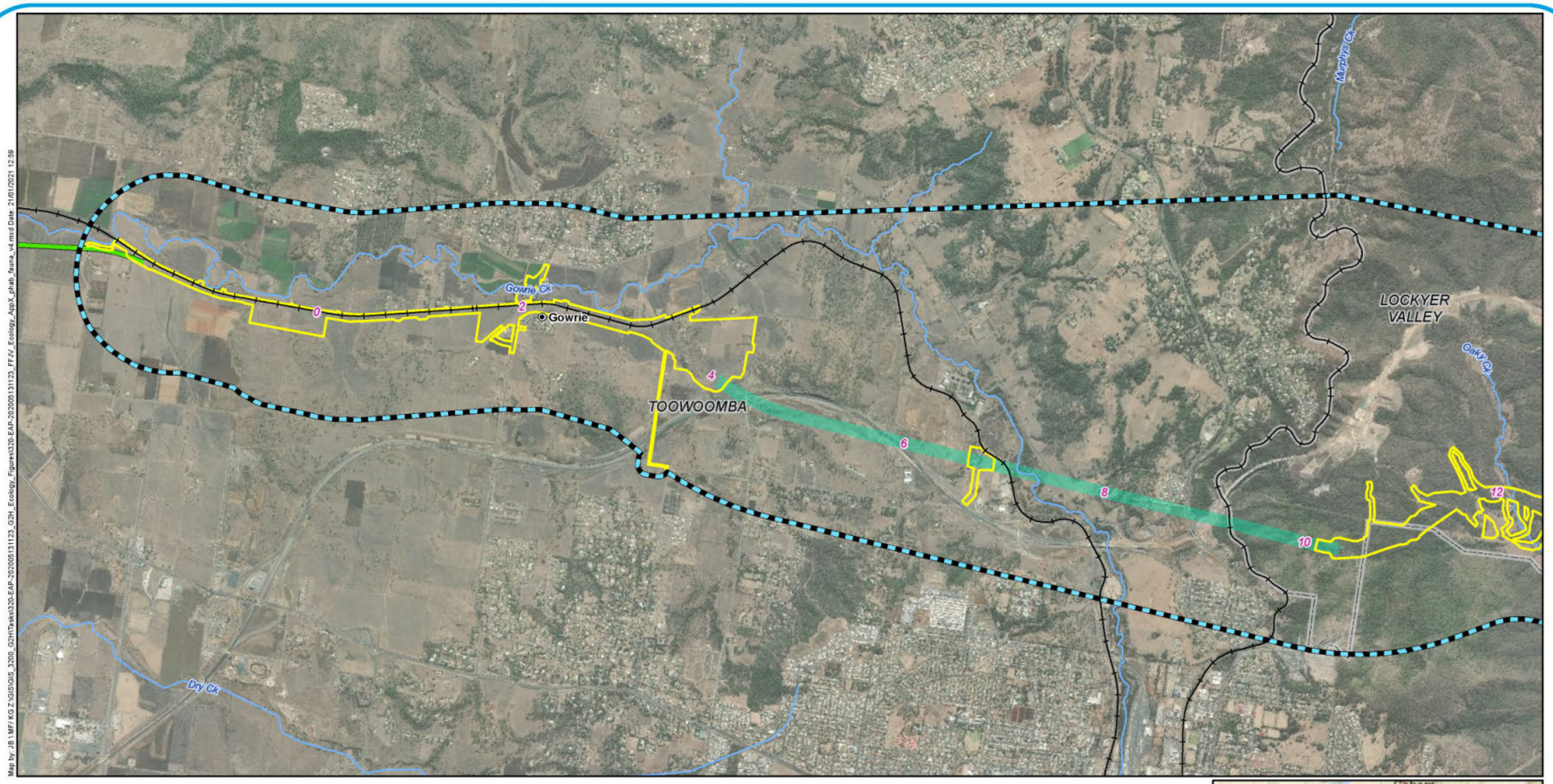

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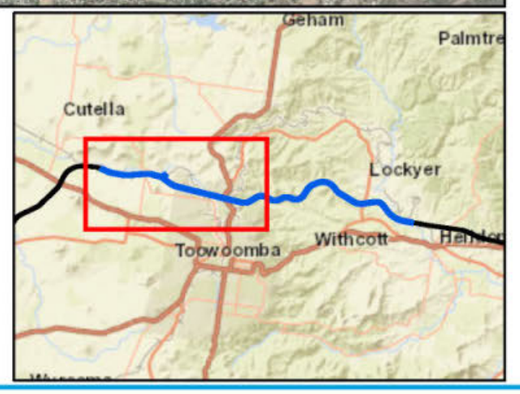
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Hydroprogne caspia* (Caspian tern)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:04

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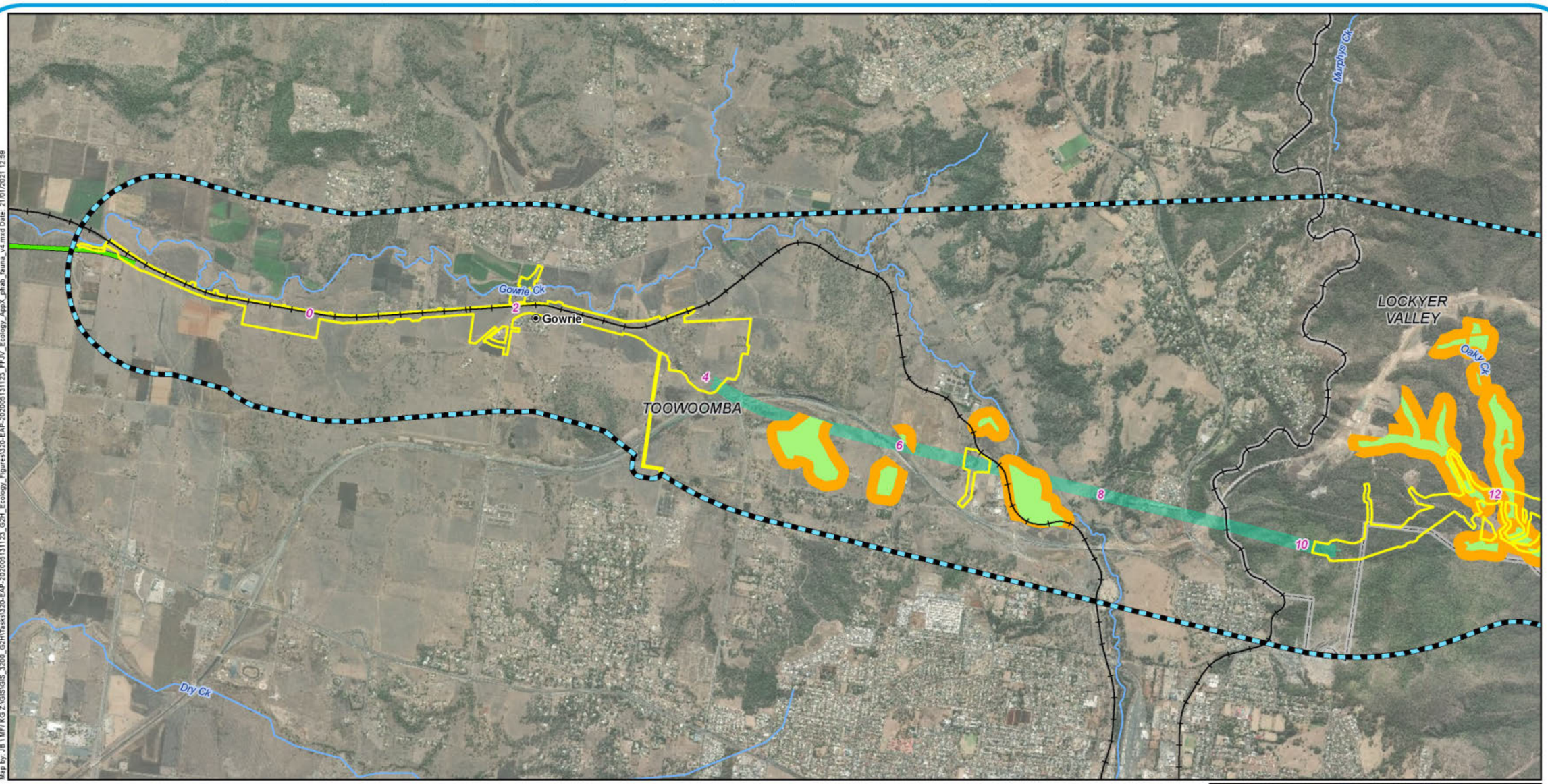

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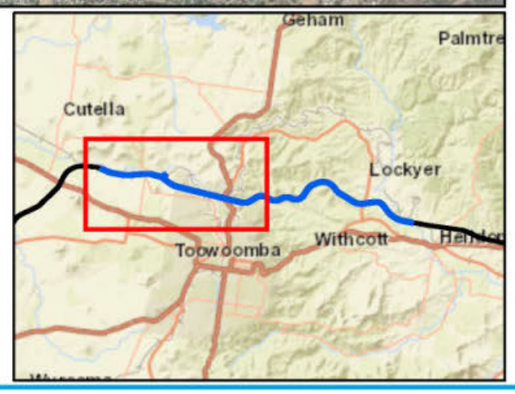
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



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0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Limosa limosa* (Black-tailed godwit)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:04

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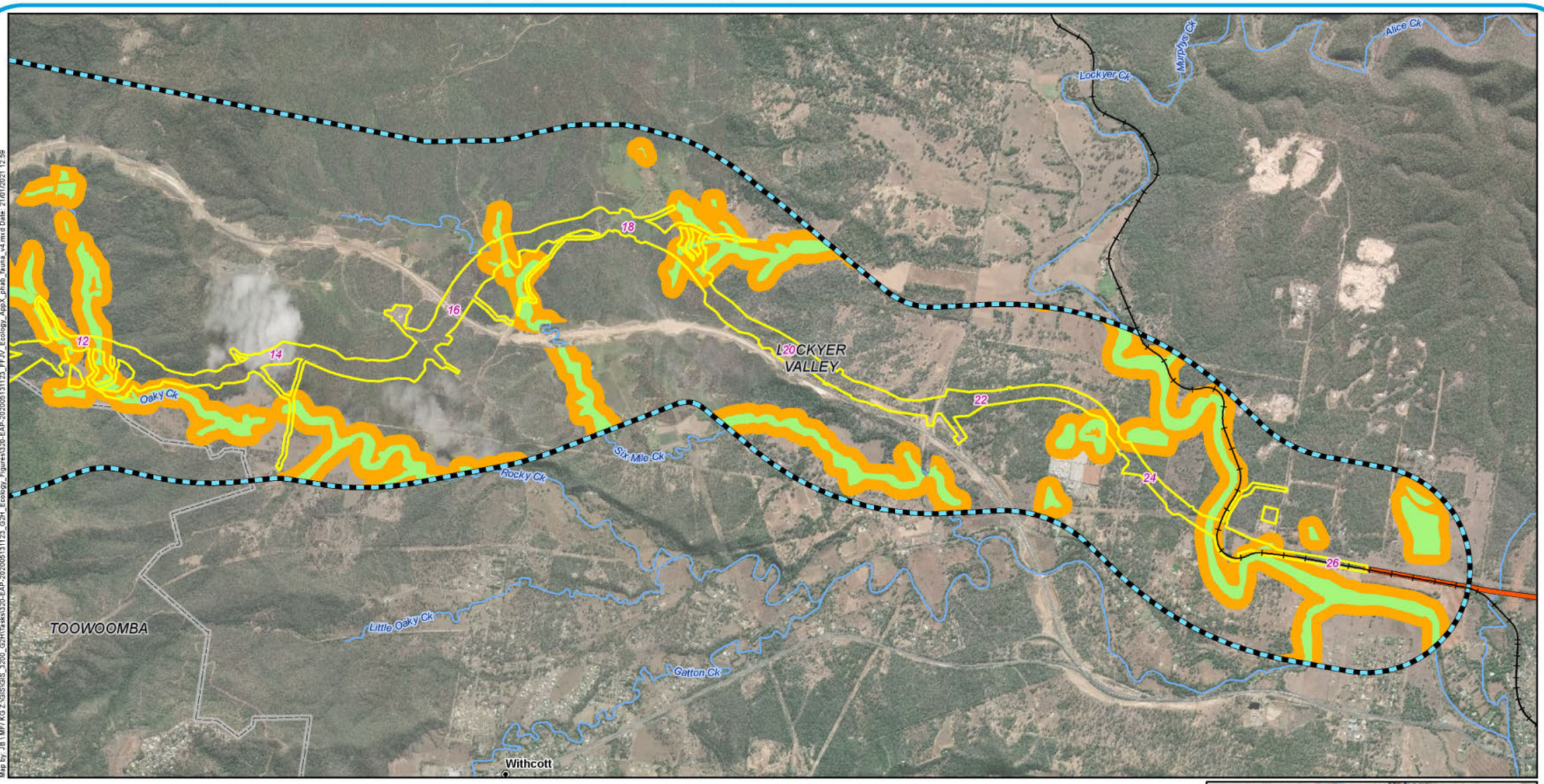

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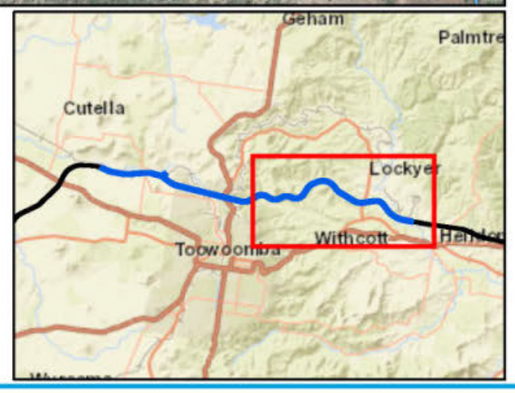
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

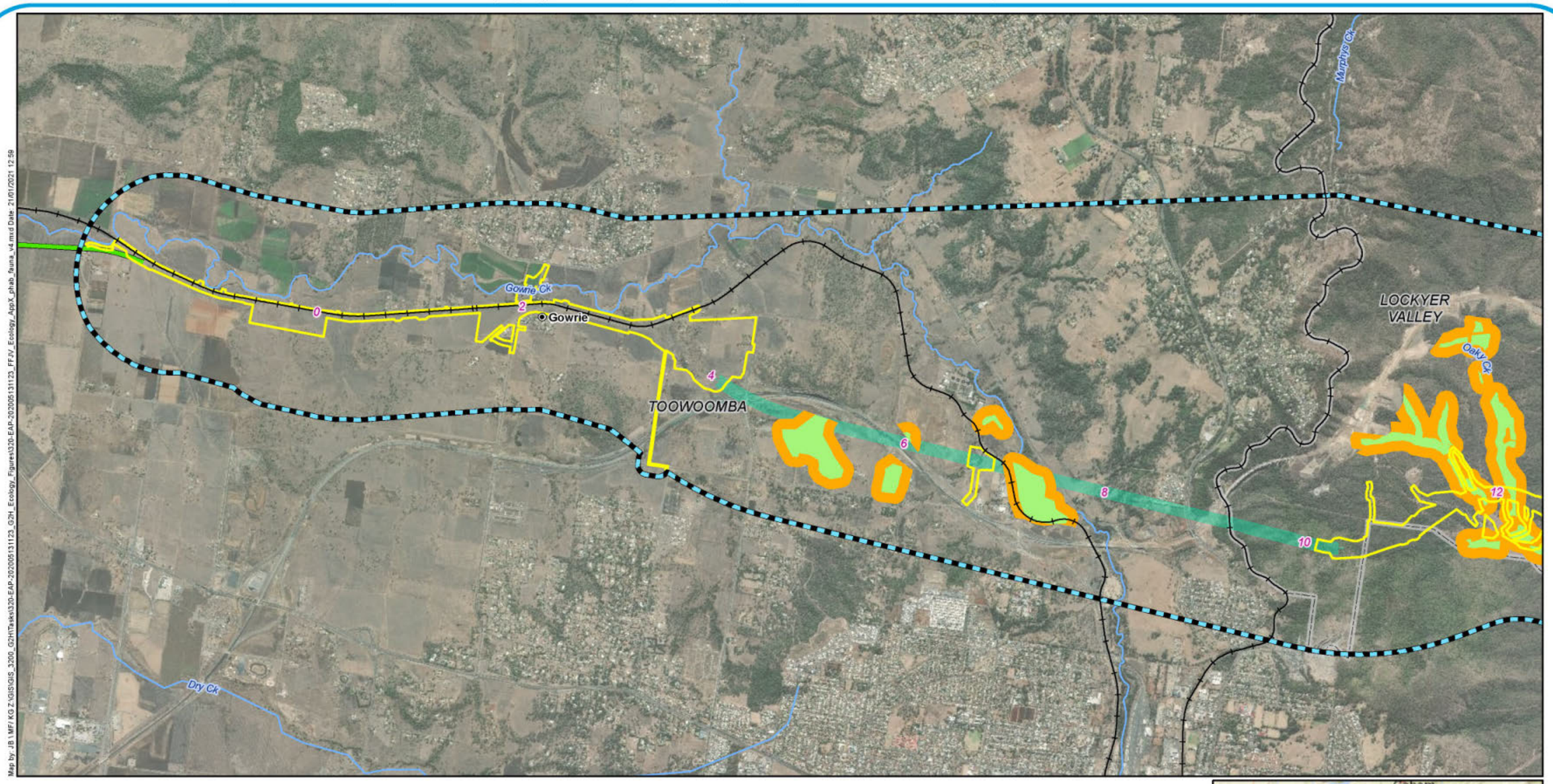
Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Limosa limosa* (Black-tailed godwit)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:05



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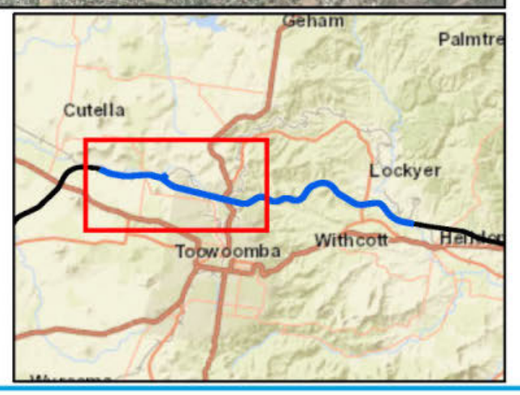
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Motacilla flava* (Yellow wagtail)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:05

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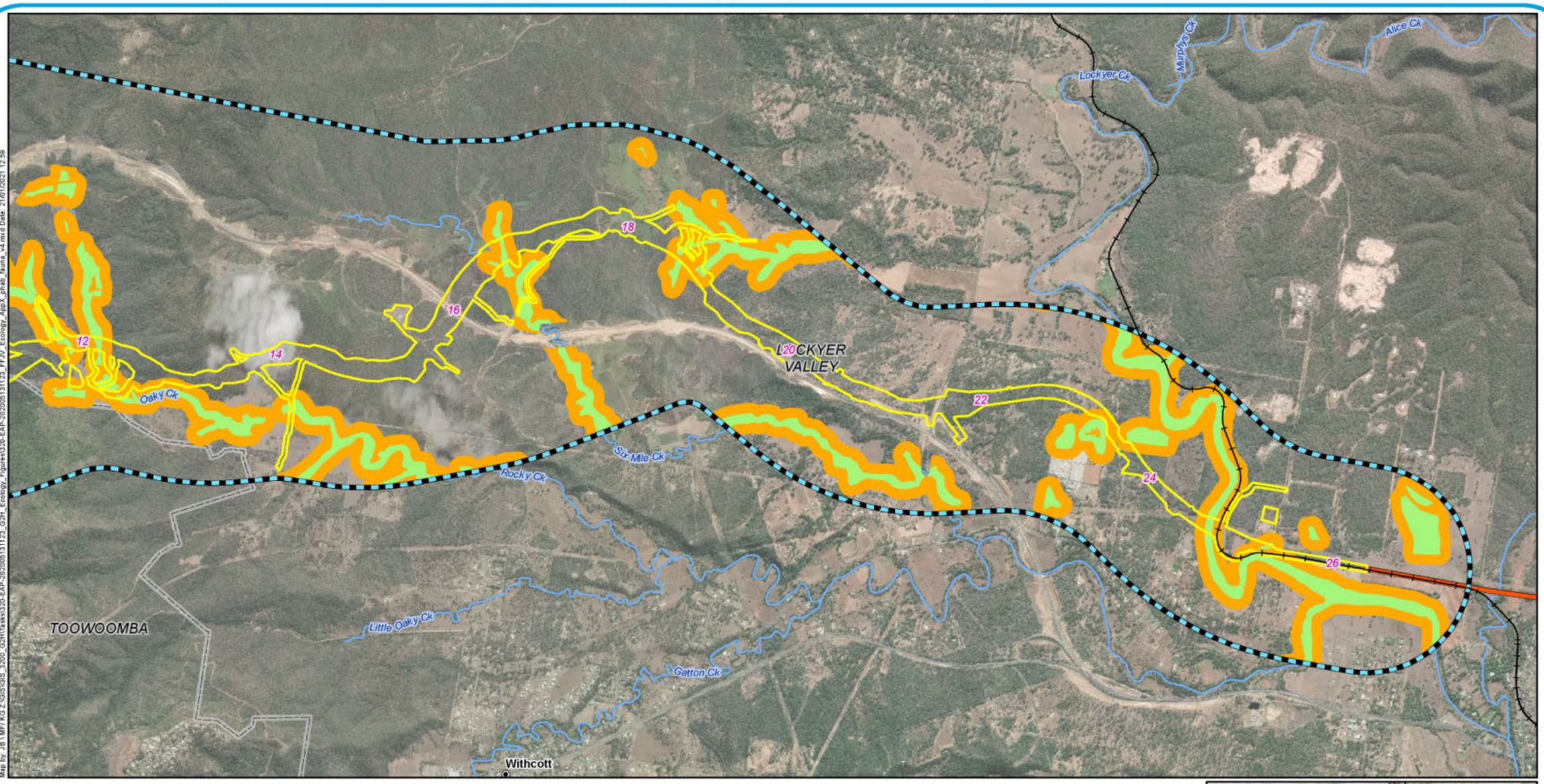

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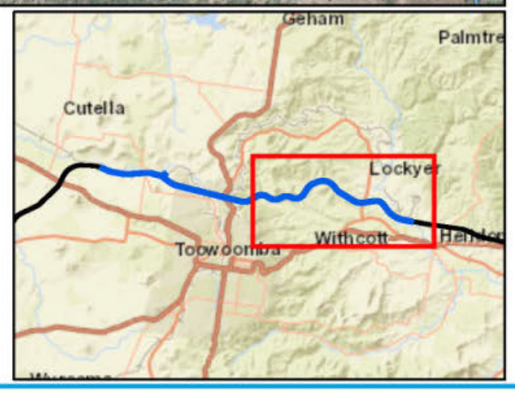
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Motacilla flava* (Yellow wagtail)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:05

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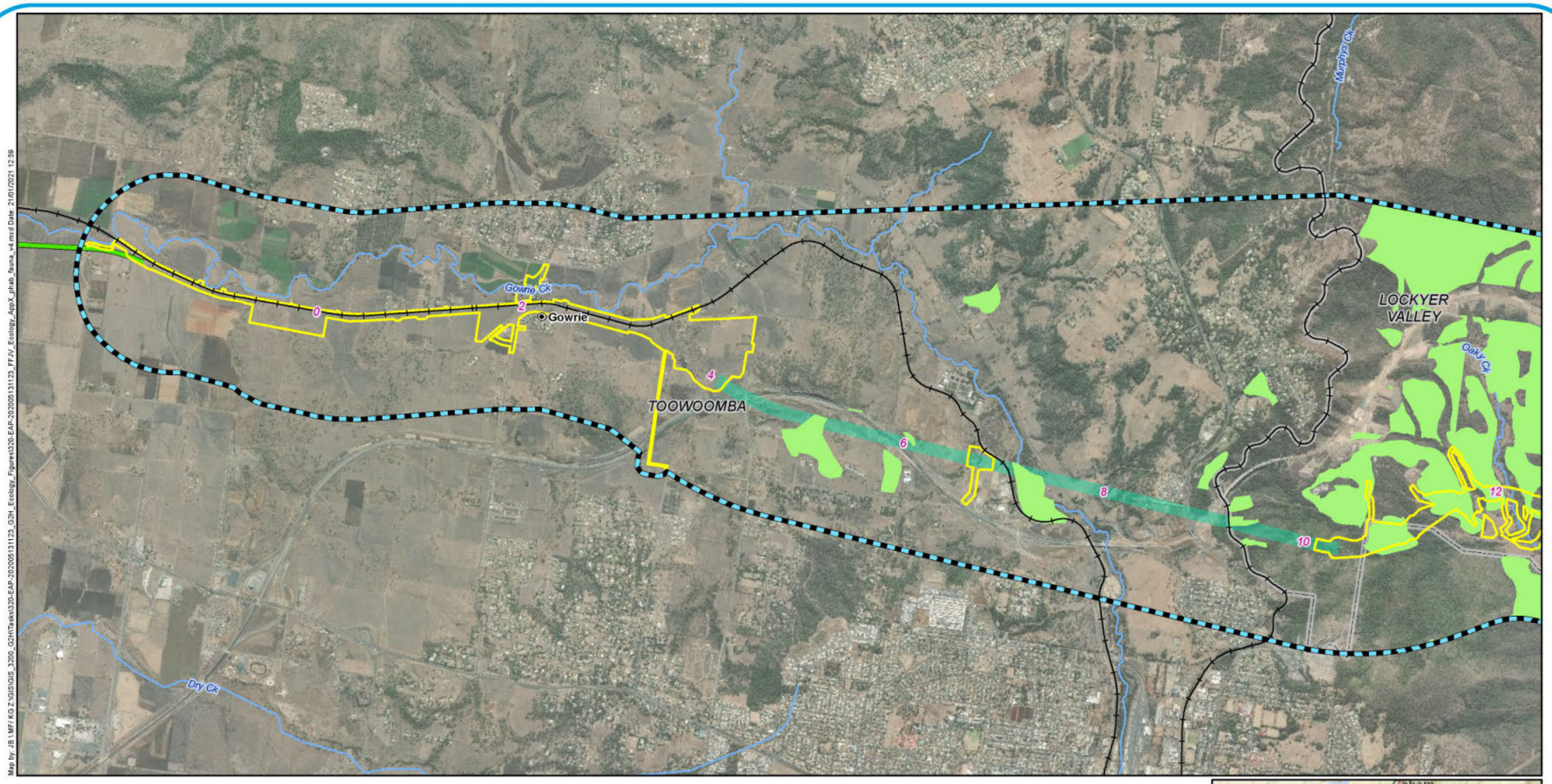

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- 5 Chainage (km)
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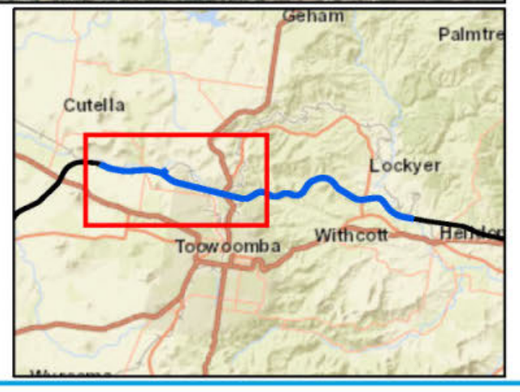
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Ninox strenua* (Powerful owl)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:05

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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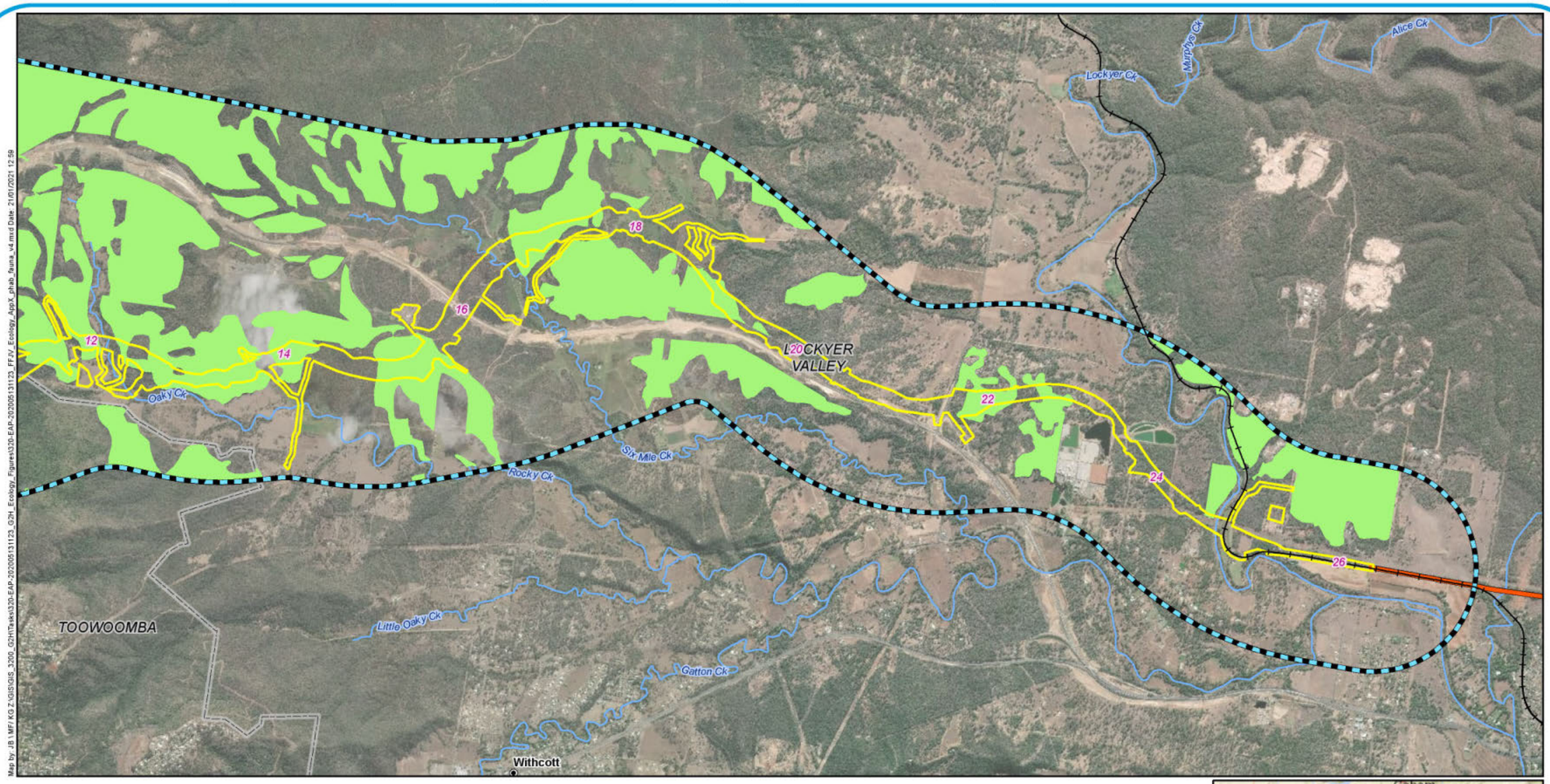

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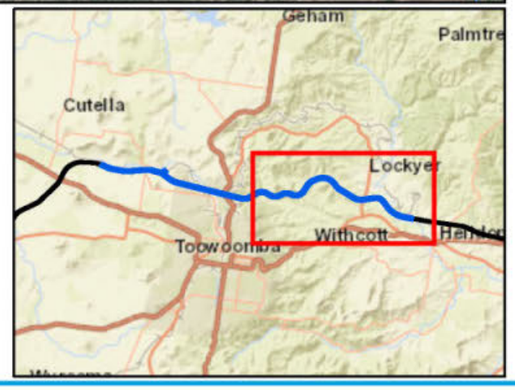
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- General



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

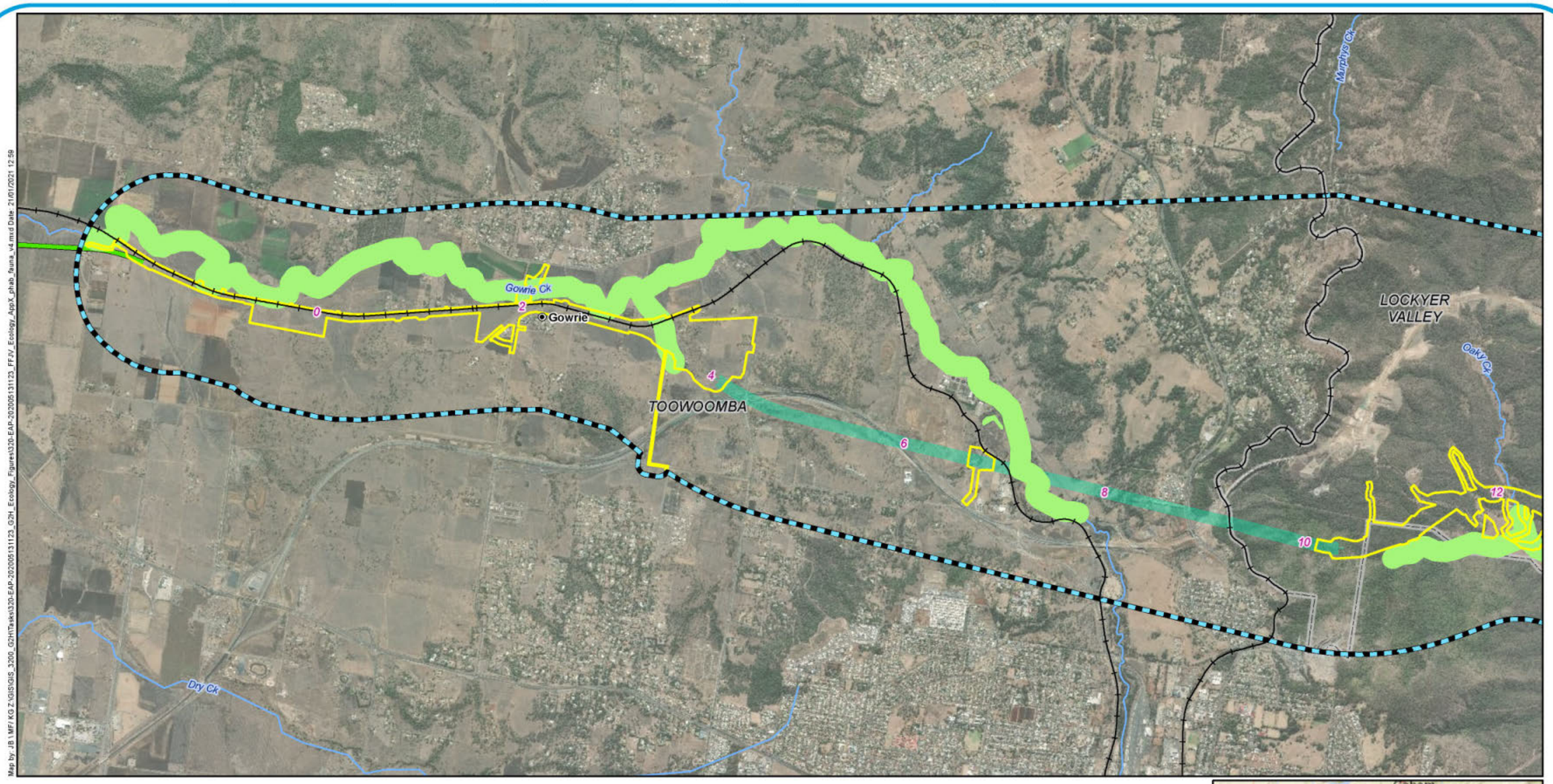
Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Ninox strenua* (Powerful owl)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:06



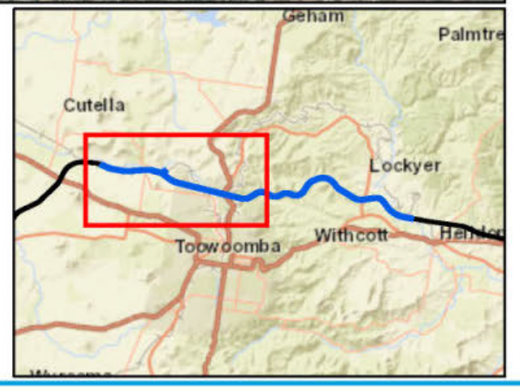
Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 12:59

Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



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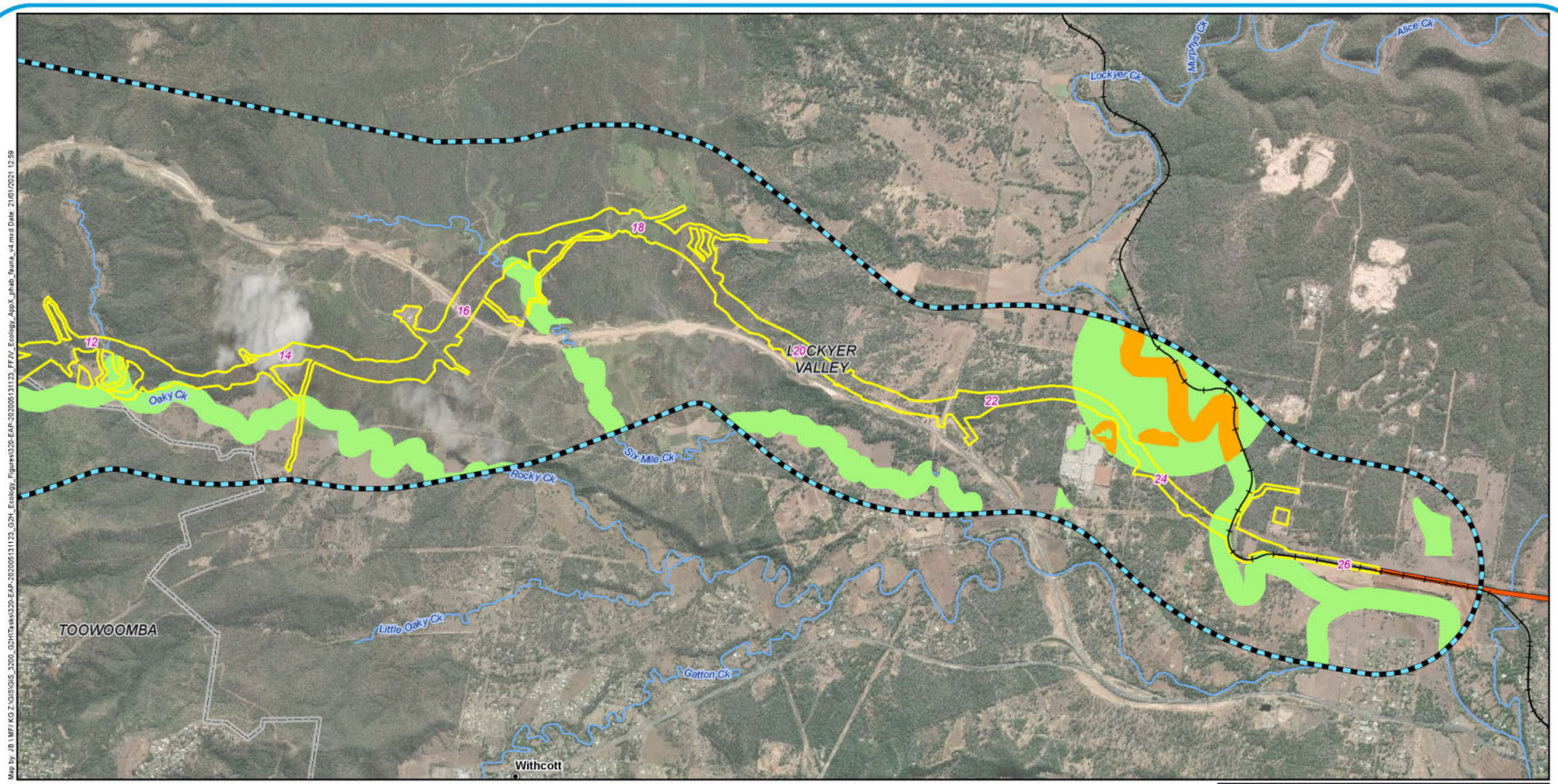
Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Ornithorhynchus anatinus* (Platypus)

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



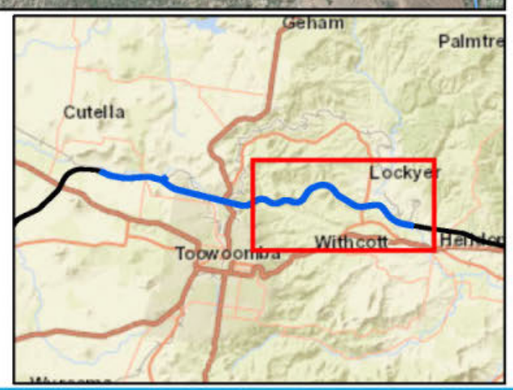
Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 12:59

Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Essential
- General



A3 scale: 1:40,000

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Integrating Community, Environment and Engineering

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Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Ornithorhynchus anatinus* (Platypus)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:06

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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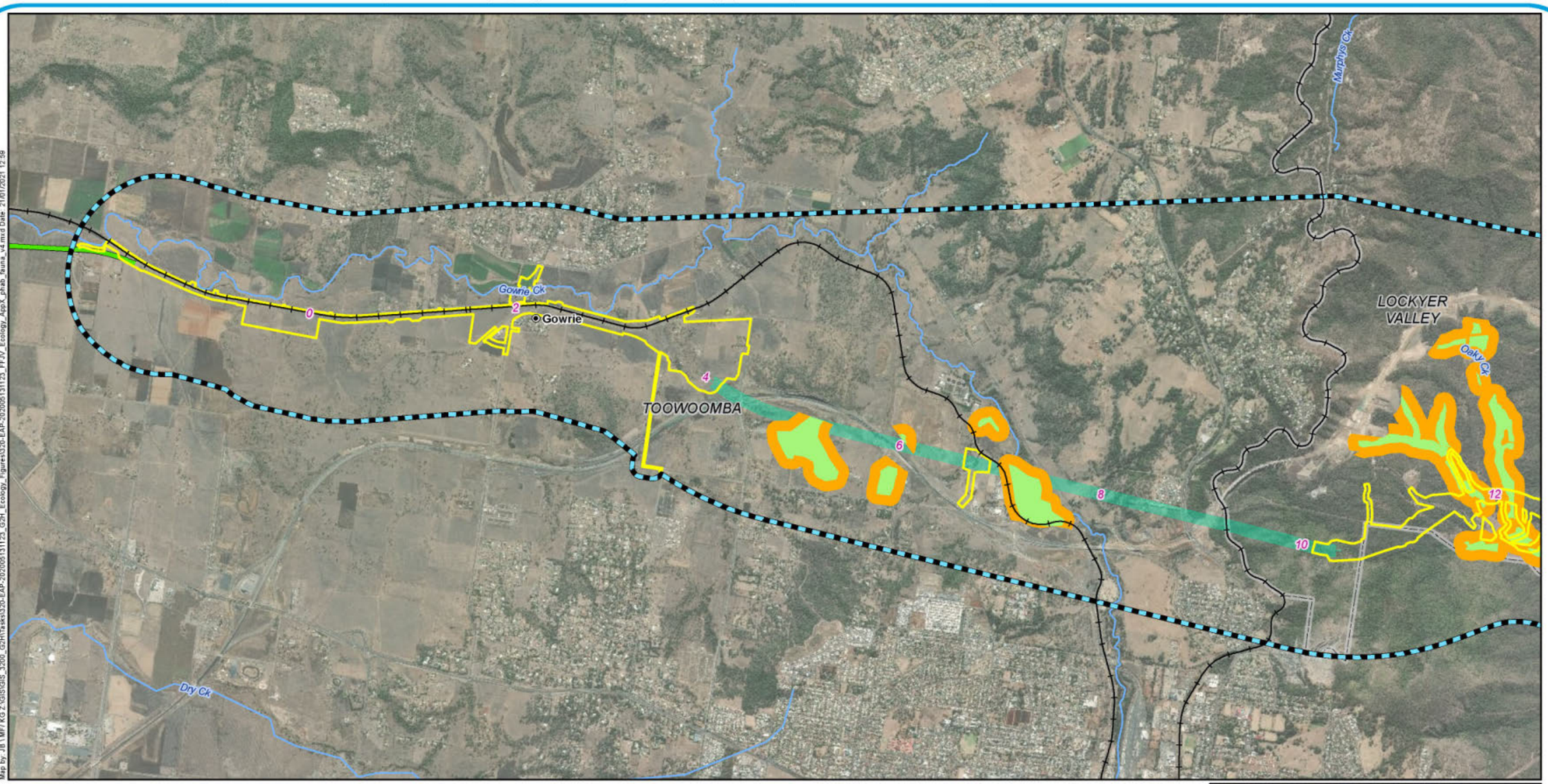

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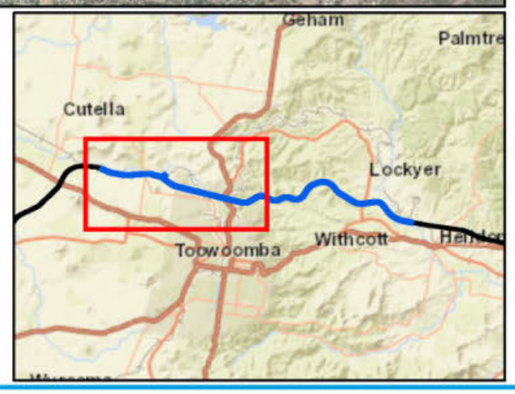
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Plegadis falcinellus* (Glossy ibis)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:06

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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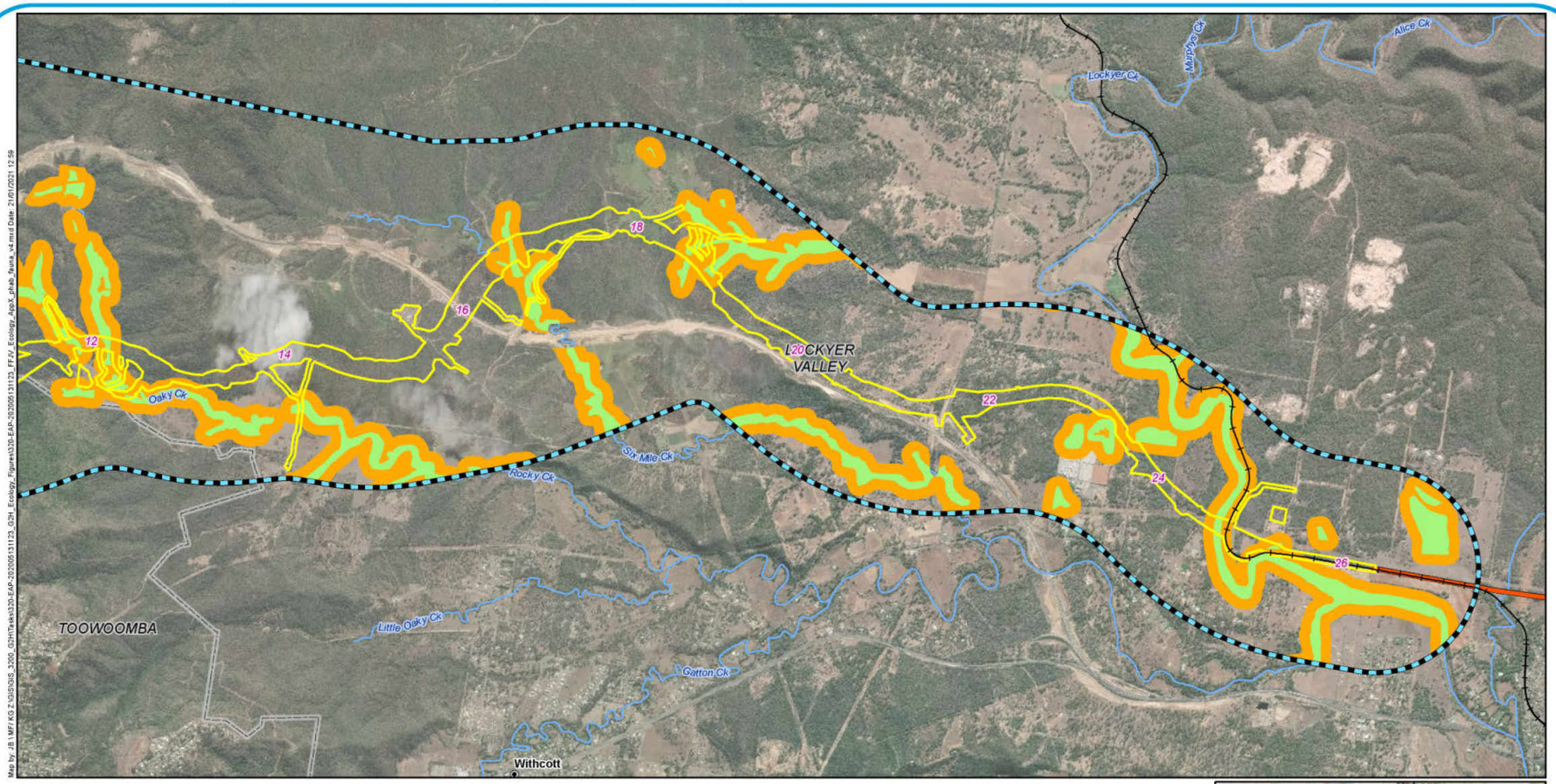

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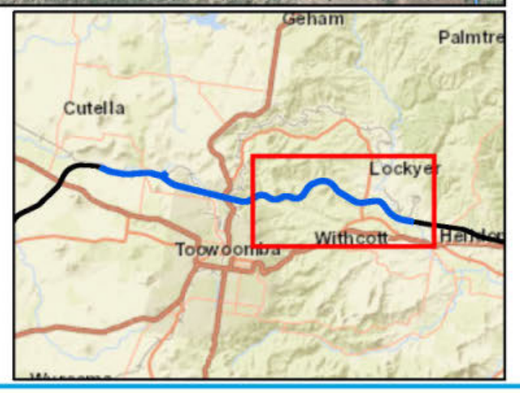
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Plegadis falcinellus* (Glossy ibis)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:07

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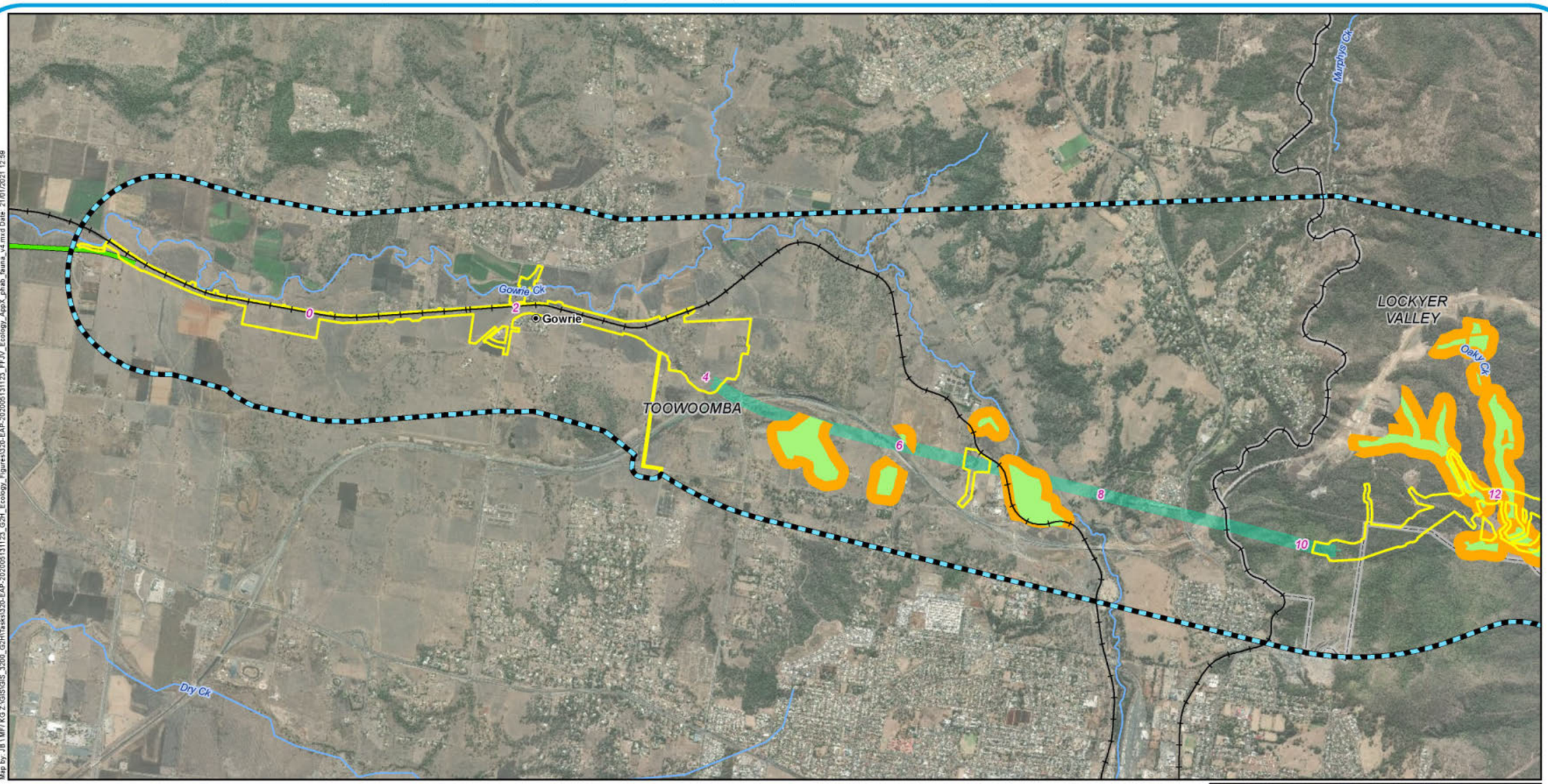

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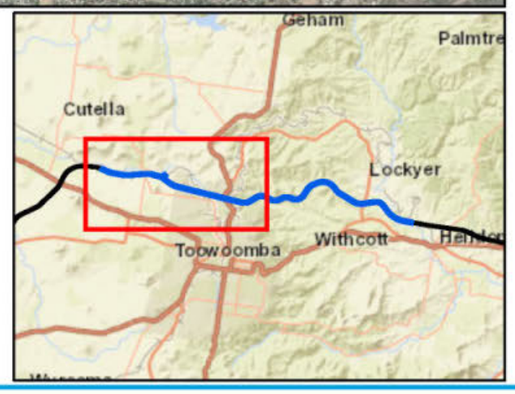
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000
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Future Freight
Integrating Community, Environment and Engineering

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Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Pluvialis fulva* (Pacific golden plover)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:07

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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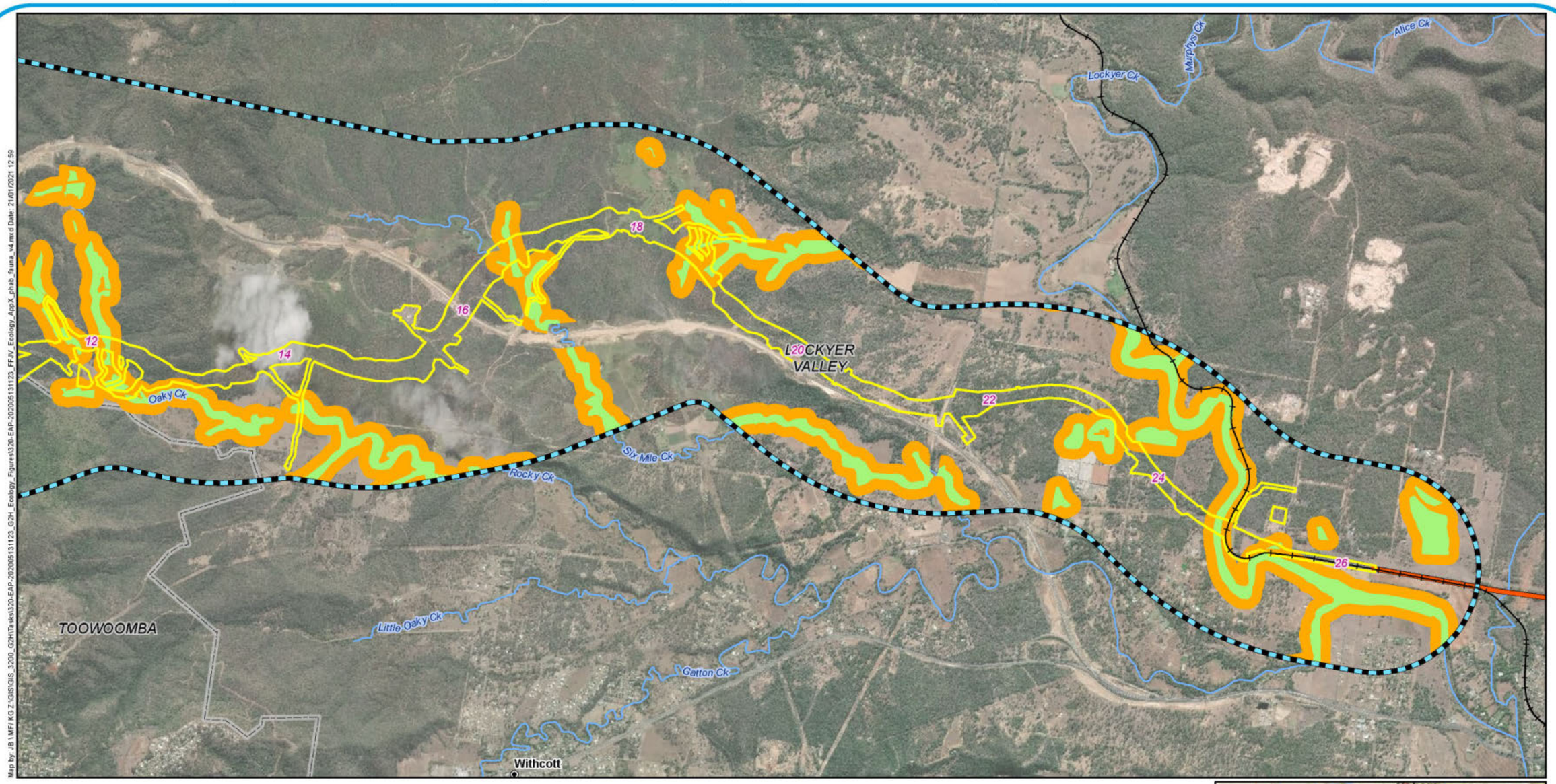

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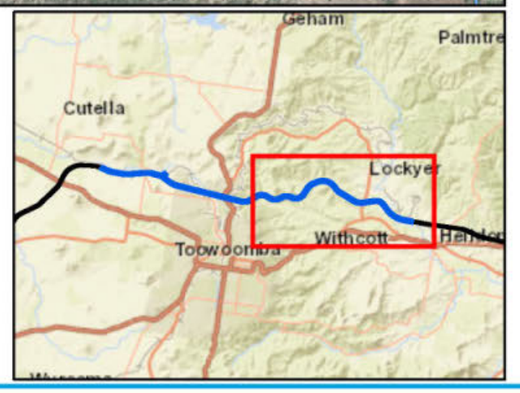
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Pluvialis fulva* (Pacific golden plover)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:07

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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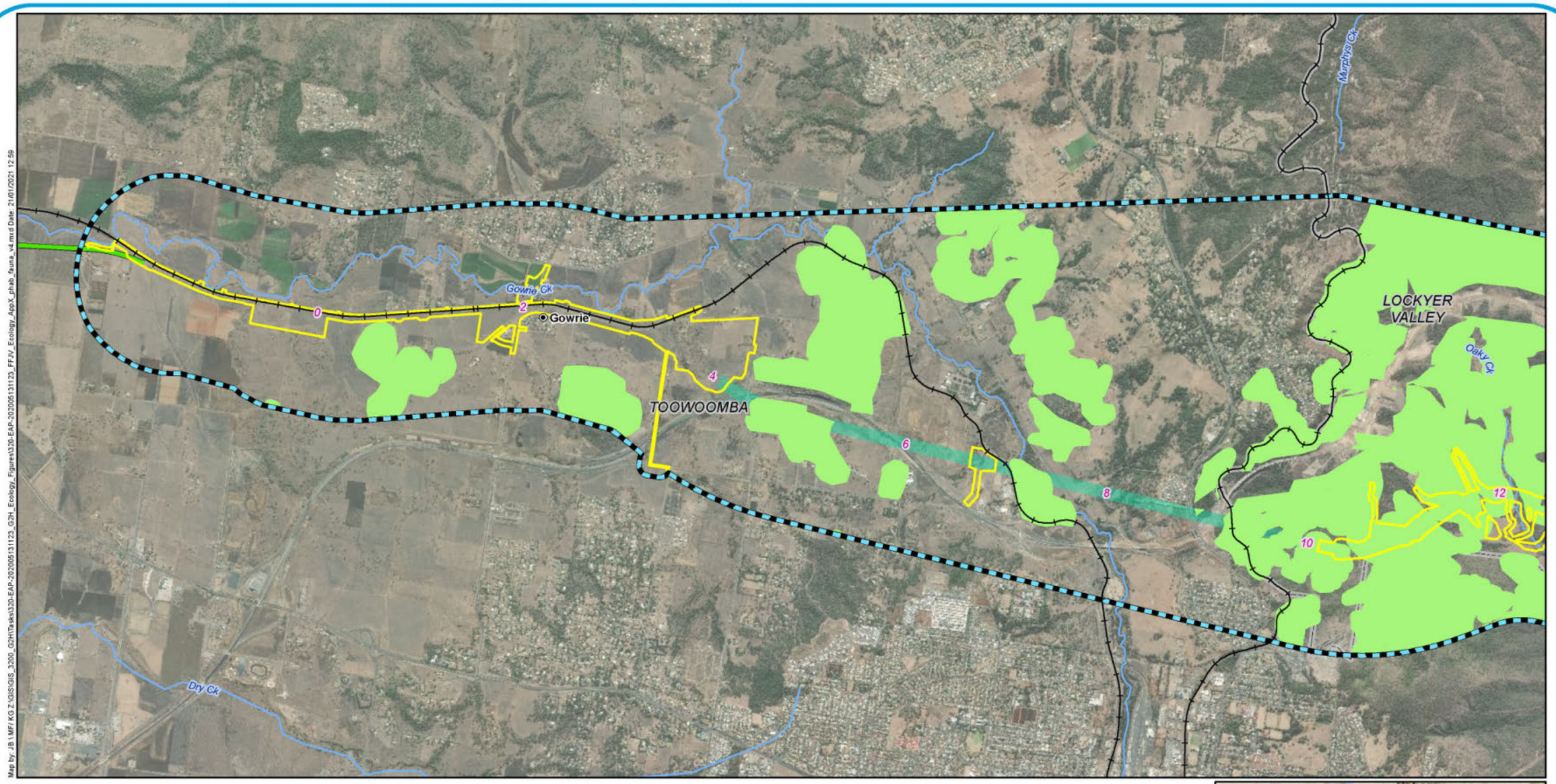

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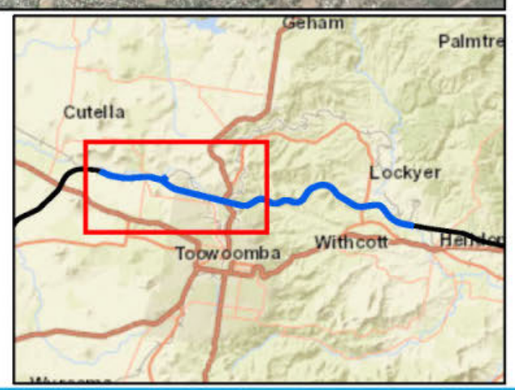
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Tachyglossus aculeatus* (short-beaked echidna)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:07

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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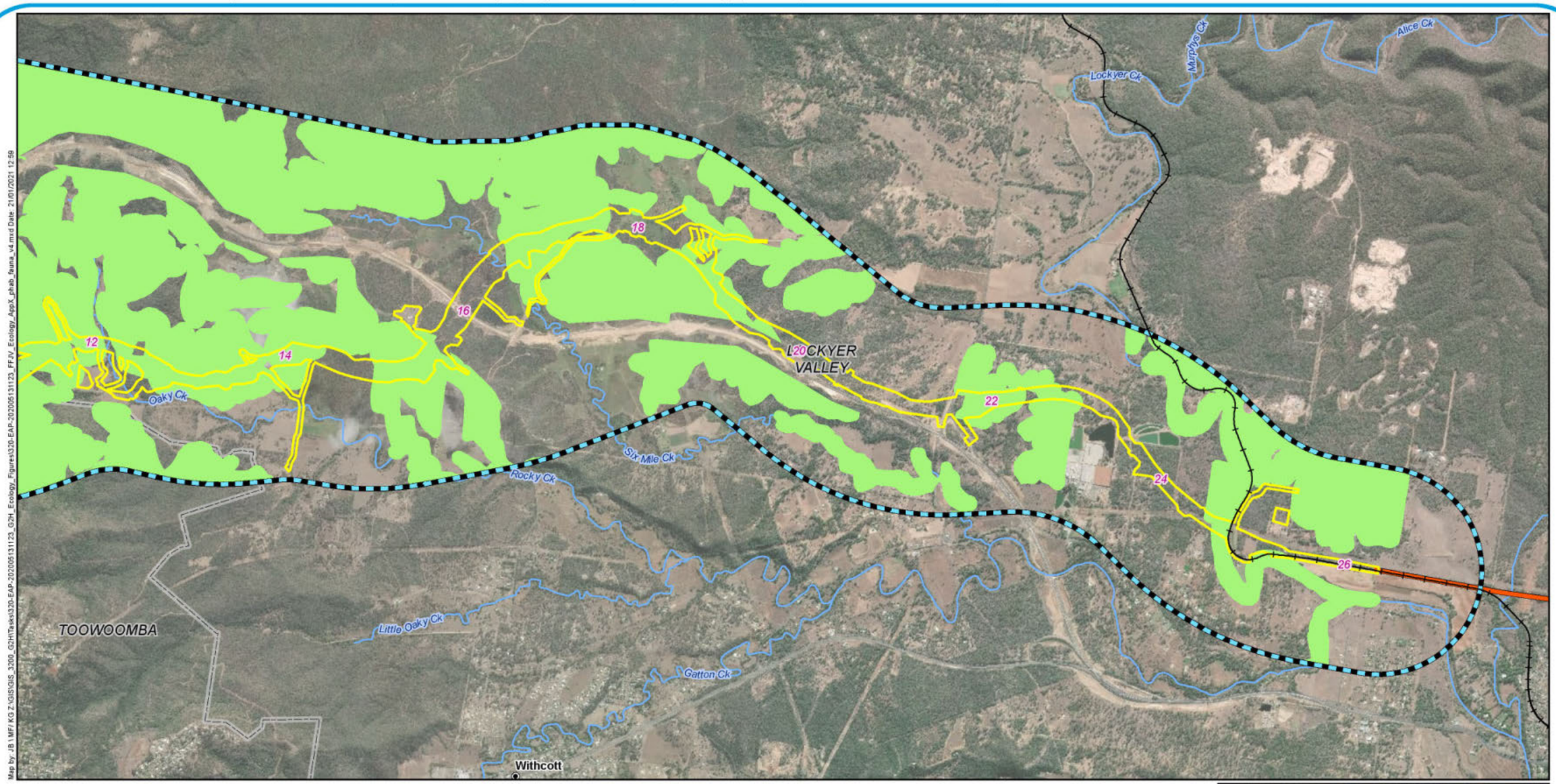

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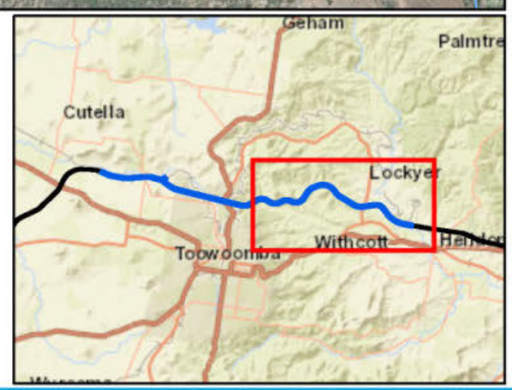
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- General



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Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Tachyglossus aculeatus* (short-beaked echidna)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:07

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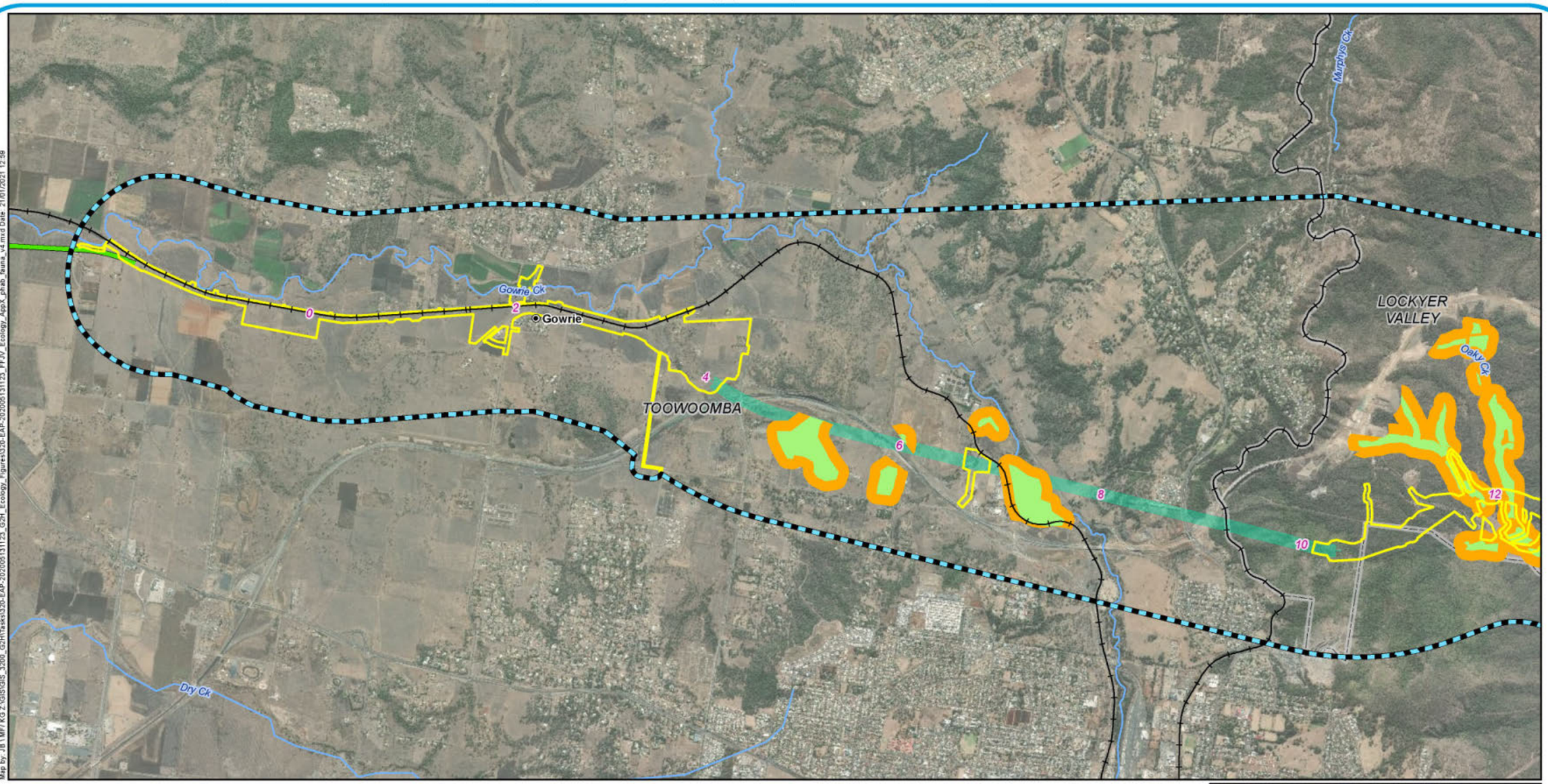

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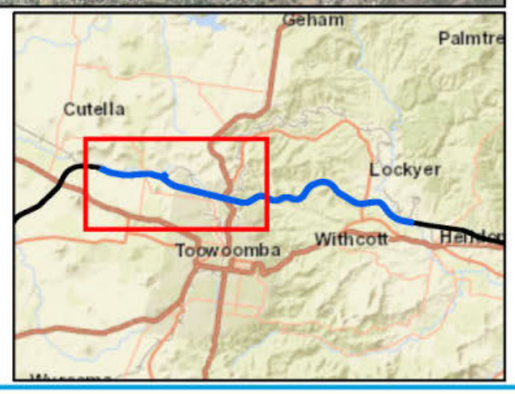
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000
0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Tringa nebularia* (common greenshank)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:08

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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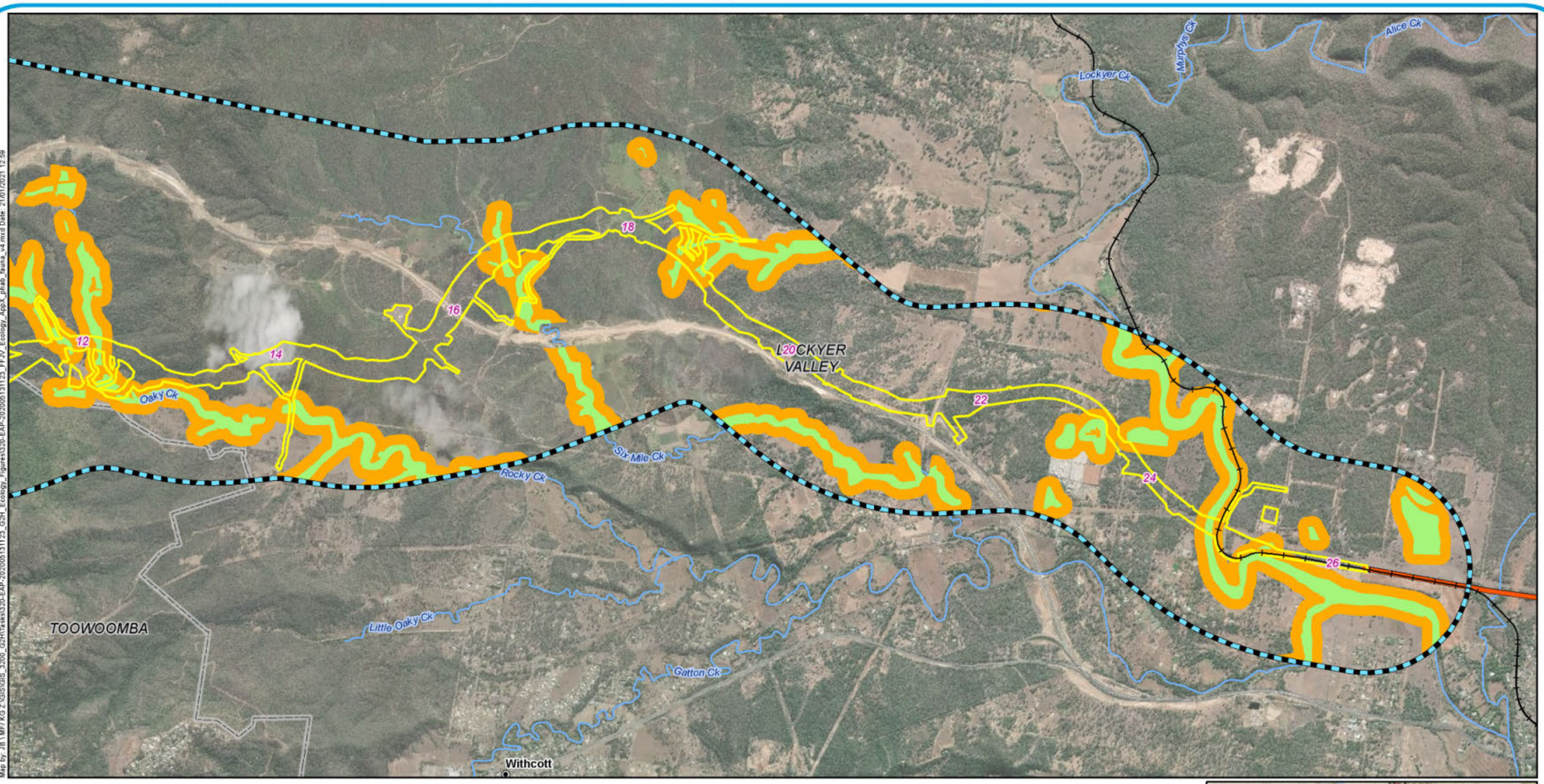

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Legend

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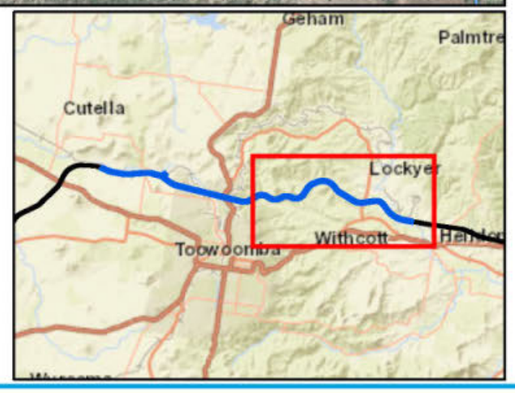
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Tringa nebularia* (common greenshank)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:08

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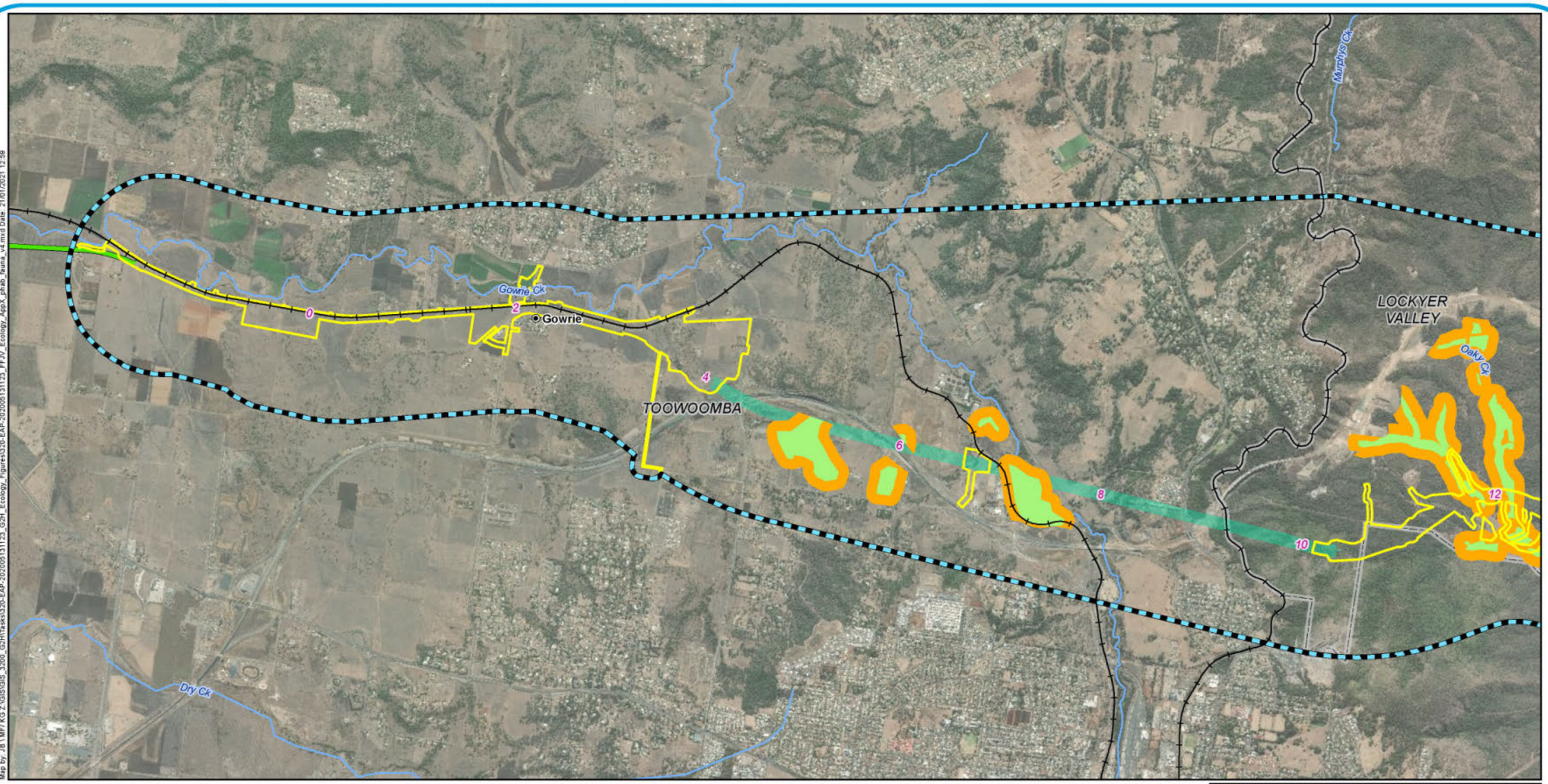

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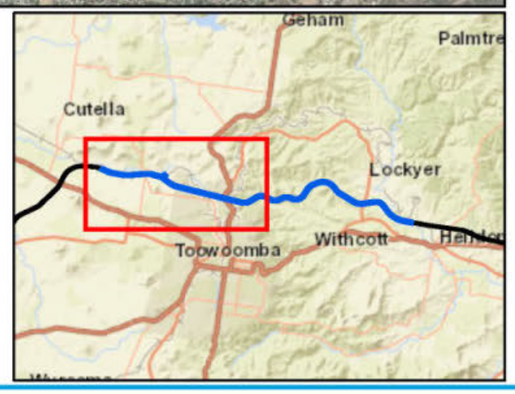
Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- B2G project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area
- Tunnel

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
Integrating Community, Environment and Engineering

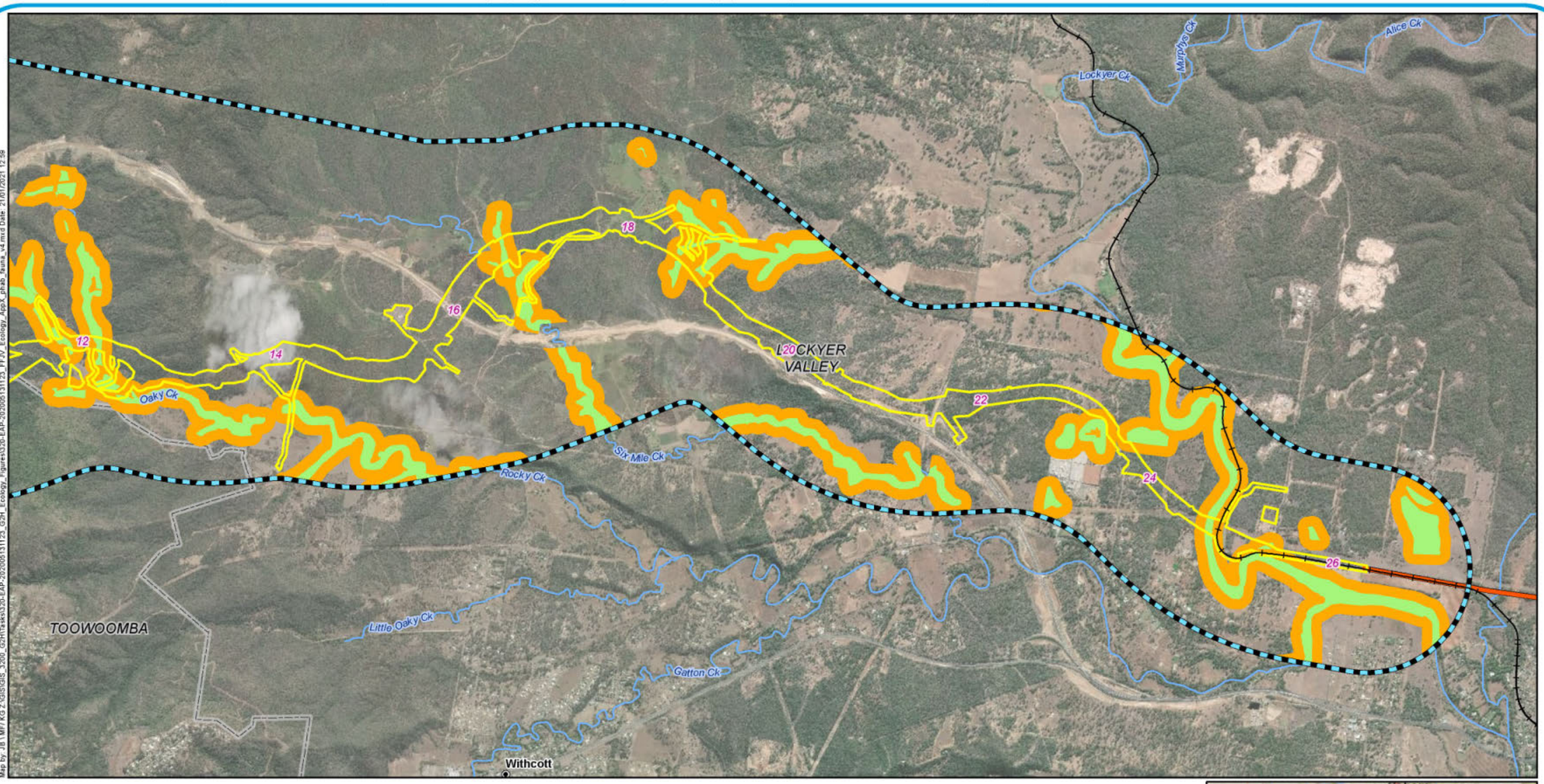
Issue date: 21/01/2021 Version: 4
Coordinate System: GDA 1994 MGA Zone 56

ARTC Inland Rail Study: Gowrie to Helidon

Predicted Habitat: *Tringa stagnatilis* (Marsh sandpiper)

Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 13:08

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



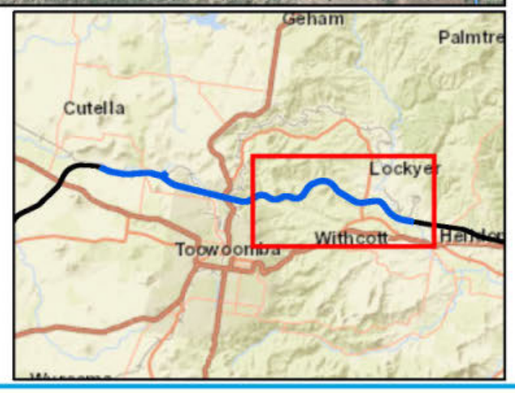
Map by: JB \ MF/ KG Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202005131123_G2H_Ecology_Figures\320-EAP-202005131123_FFJV_Ecology_AppX_phab_fauna_v4.mxd Date: 21/01/2021 12:59

Legend

- 5 Chainage (km)
- Localities
- Existing rail (operational)
- Watercourses
- H2C project alignment
- Local Government Areas
- EIS disturbance footprint (surface disturbance only)
- Ecology study area

Habitat

- Important habitat
- Potential habitat



A3 scale: 1:40,000

0 0.5 1 1.5 2 2.5km

Future Freight
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APPENDIX

I

Terrestrial and Aquatic Ecology

Appendix H Aquatic ecology survey sites

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT

Appendix H
Aquatic Ecology Survey Sites

Site	Description	Photo
1A	The site is located on Gowrie Creek, upstream of the Project alignment. Artificial bank protection measures present, which include concrete box culverts with the bridge crossing.	
2A	The site is located on Gowrie Creek, at the proposed Project alignment waterway crossing location. The site was disturbed by the destruction of a road bridge as well as local impacts include grazing by horses and litter from flood debris including sheet metal.	
3A	The site is located on Gowrie Creek, downstream of the Project alignment. The site is adjacent to the rail corridor and the Toowoomba Second Range Crossing.	

Site	Description	Photo
4A	The site is located on Oaky/Rocky Creek, downstream of the Project alignment. The creek was dry at the time of assessment. There were no artificial bank protection measures present. Debris were present from flood events including old cars, wire, metal posts, asbestos sheeting.	
5A	The site is located on Oaky/Rocky Creek, downstream of the Project alignment. The creek was dry at the time of assessment. Vegetation was located within the creek bed. Riparian zone was highly disturbed.	
6A	The site is located on Rocky Creek, downstream of the Project alignment. A significant density of macrophytes were present, principally Typha. The site was disturbed by the bed level crossing and culvert.	

Site	Description	Photo
7A (alt)	The site was located on Six Mile Creek, downstream of the Project alignment. Banks were eroded which is potentially affected by stock access.	
8A	The site was located on an un-named tributary off Lockyer Creek, upstream of the Project alignment. Fences and metal sheeting were present along the width of the creek. The creek was dry at the time of assessment.	
9A	The site was located on Lockyer Creek, upstream of the Project alignment in a road crossing over a bridge. Bank stability was potentially affected by cleared vegetation and stock access. Rocks were present along the bank.	

Site	Description	Photo
10A	The site is located on Rocky Creek, upstream of the Project alignment. Artificial measures include the bridge with rock/wall layers for bank protection measures.	
H2C 11A	Site was located on the Lockyer Creek, downstream of the Project alignment. No artificial bank protection measure was present. There was lots of floating aquatic vegetation present on the surface of the water.	

short bull corellas

AUSRIVAS Physical Assessment Protocol Field Data Sheets **Page 1** **Site No.** G2H 1A **Date** 19.09.17

Date 19.09.17 Site No. 1A Time 1000 Recorder's Name JS + LL

River Name Gowrie Creek Location Cranley

Weather Fine + Sunny Rain in last week? Y [ ] N [x]

Photograph numbers and details Leesa's Iphone N, S, E, W

Latitude: deg min sec Longitude: deg min sec

GPS Name and Datum Site 1A.

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

refer to photo's

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site _____ (m)

Notes

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

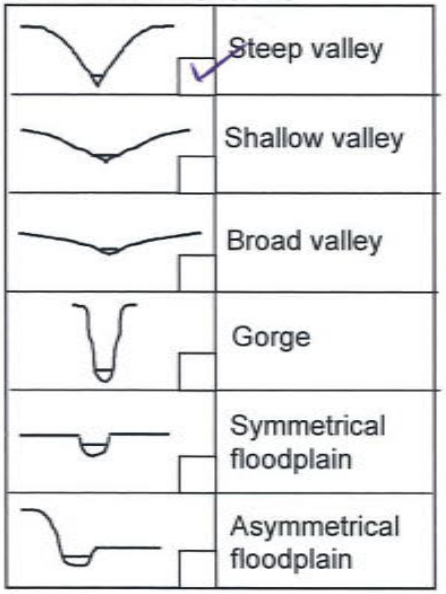
Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ Water sample taken?		
Total nitrogen ☐ Water sample taken?		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

Choose one category only



- ☑ Steep valley
- ☐ Shallow valley
- ☐ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☑ Road
- ☑ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☑ Discharge pipe intake pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☑ Grazing further downstream
- ☐ Litter
- ☐ Recreation
- ☐ Other

Description Creek crossing adjacent to current TSRC construction + rail corridor
Blue rock from retaining wall fallen into creek downstream of bridge

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☑	☑	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Floodplain width NA _____ _____ Average _____ (m)

Floodplain features

Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Riparian zone composition

Assess for whole sampling site

	% Cover		Vegetation Description
Trees (>10m in height)	0	May total more than 100%	
Trees (<10m in height)	1%		
Shrubs	5%		Broad leaf privet,
Grasses / ferns / sedges	80%		lucerne, plantago, stinking roger. Scotch thistle. sorgum.

↓ Dominant species are grazing sp.

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

		Left bank	Right bank
None		[ ]	[ ]
Isolated / scattered		[✓]	[✓]
Regularly spaced		[ ]	[ ]
Occasional clumps		[ ]	[ ]
Semi-continuous		[ ]	[ ]
Continuous		[ ]	[ ]

Shading of channel

[✓] < 5% [ ] 6 – 25% [ ] 26 – 50% [ ] 51 – 75% [ ] > 76%

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [✓]

If no, record regeneration category

[ ] Abundant (>5% cover) and healthy
[ ] Present
[ ] Very limited (<1% cover)

Extent of trailing bank vegetation

[ ] nil [✓] moderate
[ ] slight [ ] extensive

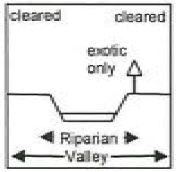
Native and exotic riparian vegetation

% Native 20
% Exotic 80
Total 100%

Overall vegetation disturbance rating

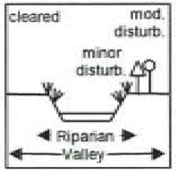
Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

Extreme disturbance [✓]



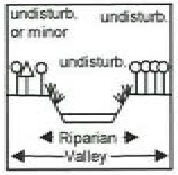
Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)
Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

High disturbance [ ]



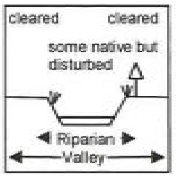
Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain
Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

Low disturbance [ ]



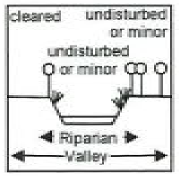
Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.
Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

Very high disturbance [ ]



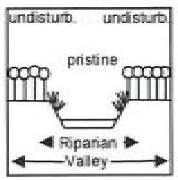
Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.
Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

Moderate disturbance [ ]



Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate
Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

Very low disturbance [ ]



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition
Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

* Blocked culvert by debris refs photo.

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☑	☑	☑
Good passage	☑	☑	☑
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) rock barrier gravel deposition + fallen rocks from retaining wall

Type of bars

Choose one or more categories

- ☐ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☑ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☑ High flow deposits

Extent of bars

% of streambed forming a bar of any type 10 %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [✓] Gravel [✓]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

☐ No modifications		☑	Reinforced retaining wall
☐ Desnagged		☐	Revegetated
☐ Dams and diversions		☐	Infilled
☐ Resectioned		☐	Berms or embankments
☐ Straightened	Signs of work still	☐	Recently channelised
☐ Realigned	Works old and revegetated	☐	Channelised in the past

Channel shape

Choose one category only

☐ U shaped	☐ Flat U shaped	☐ Deepened U shape	☑ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

	Left bank	Right bank
Concave	☐	☑
Convex	☐	☐
Stepped	☐	☐
Wide lower bench	☑	☐
Undercut	☐	☐

Bank slope
Choose one category for each bank

	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☐	☑
Moderate 30 - 60°	☑	☐
Low 10 - 30°	☐	☐
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☑ Stock access
- ☐ Human access
- ☑ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☑ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 0
Right Bank 0

Artificial bank protection measures
Choose one or more categories

- ☐ None
- ☐ Fence structures
- ☐ Levee banks
- ☑ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other Metal Fencing @ base of rock batter).
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☑ absent ☐ light ☐ moderate ☐ profuse

Water oils
☑ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours
☑ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ anaerobic ☐ other _____

Water odours
☑ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ other _____

Turbidity (visual assessment)
☐ Clear ☑ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:
☑ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☐ Dry ☐ No flow ☐ Low ☑ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☑ Bridge ☑ Box Culvert ☐ Other

Description photo underneath

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

0 % Notes on visibility clear/good

Extent of bedform features

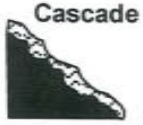
Total % composition for all features must equal 100%

Waterfall — Height >1m, Gradient >60°

artificial from culvert

1 % of site
0.5 Est. Av. Length (m)
1 Est. Av. Height (m)
70 Est. Av. Gradient (°)

Cascade — Step Height <1m, Gradient 5-60°, Strong currents



_____ % of site
_____ Est. Av. Length (m)
_____ Est. Av. Height (m)
_____ Est. Av. Gradient (°)

Rapid — Gradient 3-5°, Strong currents, Rocks break surface

_____ % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Riffle — Gradient 1-3°, Moderate currents, Surface unbroken but unsmooth

10 % of site
10 Est. Av. Length (m)
0.20 Est. Av. Depth (m)
2M Est. Av. Width (m)

Glide — Gradient 1-3°, Small currents, Surface unbroken and smooth

_____ % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Run — Gradient 1-3°, Small but distinct & uniform current, Surface unbroken

90 % of site
75 Est. Av. Length (m)
0.5 Est. Av. Depth (m)
4 Est. Av. Width (m)

Pool — Area where stream widens or deepens and current declines

10 % of site
2 Est. Av. Length (m)
0.2 Est. Av. Depth (m)
2 Est. Av. Width (m)

Backwater — A reasonable sized (>20% of channel width) cut-off section away from

_____ % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 20

% cover of emergent macrophytes 20
% cover of floating macrophytes 1
% cover of submerged macrophytes 1

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	
Crassula (Crassula) N	☐	
Cyperus (Sedge) I/N	☐	
Eleocharis (Spikerush) N	☐	
Juncus (Rush) I/N	✓	1
Paspalum (Water Couch) N	✓	4
Phragmites (Common Reed) N	☐	
Ranunculus (Buttercup) I	☐	
Scirpus (Clubrush) N	☐	
Triglochin (Water Ribbon) N	☐	
Typha (Cumbungi) N	✓	15
Other _____	☐	
Other _____	☐	
Other _____	☐	

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	
Chara (Stonewart) N	☐	
Elodea (Canadian Pondweed) I	☐	
Myriophyllum (Water Milfoil) I/N	☐	
Nitella (Stonewart) N	☐	
Potamogeton (Pondweed) N	☐	
Triglochin (Water Ribbon) N	☐	
Vallisneria (Ribbonweed) N	☐	
Other _____	☐	
Other _____	☐	
Other _____	☐	

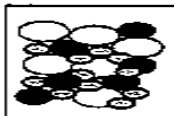
Floating macrophytes

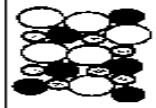
	Present	%
Azolla (Azolla) N	☐	
Callitriche (Starwart) I	☐	
Other _____	☐	
Other _____	☐	
Other _____	☐	

Overall % cover of native macrophyte taxa 20
Overall % cover of ~~native~~ exotic macrophyte taxa _____

Total should equal overall % cover of macrophytes from above

Bed compaction
Choose one category only


Tightly packed, armoured
Array of sediment sizes, overlapping, tightly packed and very hard to dislodge


Packed, unarmoured
Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate

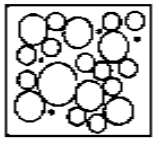

Moderate compaction
Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate

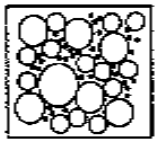

Low compaction (1)
Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily

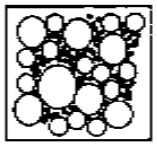

Low compaction (2)
Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

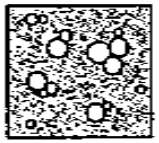
Sediment matrix
Choose one category only


Bedrock

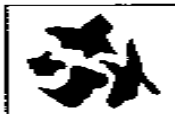

Open framework
0-5% fine sediment, high availability of interstitial spaces


Matrix filled contact framework
5-32% fine sediment, moderate availability of interstitial spaces


Framework dilated
32-60% fine sediment, low availability of interstitial spaces


Matrix dominated
>60% fine sediment, interstitial spaces virtually absent

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only


Very angular


Angular


Sub-angular


Rounded


Well rounded


Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← **Stable** → **Unstable - depositing**

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or concrete; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. G2H 1A Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable. 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.	Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.	Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.	Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. GOH 1A Date 19.09.17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat; and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 (2) 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. G2H 1A Date 19.09.17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable, many eroded areas, 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars
SCORE Left bank	10 9	8 7 6	(5) 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	(5) 4 3	2 1 0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.
SCORE Left bank	10 9	8 7 6	(5) 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	(5) 4 3	2 1 0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.	Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.	Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.	Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 (0)
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 (0)

TOTAL LOW GRADIENT HABITAT SCORE [ ]

* Site subject to flooding. Height up to 4m

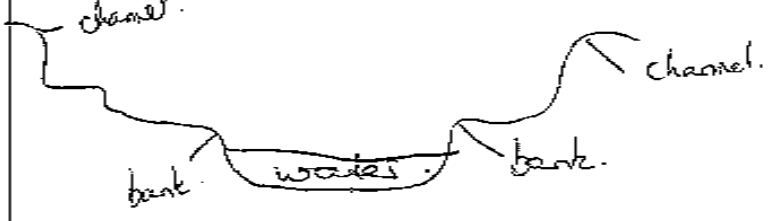
G24

 Site No. 1A. Date 19.09.17

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.
Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch



The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section

Cross-section number 1 of ____

Type of bedform at the cross-section
☐ Riffle ☒ Run ☐ Pool ☐ Cascade ☐ Other ____

Bankfull channel width (m) (=total of boxes A+B+C) ____
Stream width at the water mark (m) 4 A
Stream width at the water surface (m) 4

Bank height (m) 1

Bank width (m) 0.5 B

Vertical distance between the water surface and the water mark (m) at flow

Horizontal distances (m)

Vertical water depths (cm)

Bank height (m) 1m

0.5 C Bank width (m)

at flow Vertical distance between the water surface and the water mark (m)

Notes on cross-section measurement Taken at base normal flow.

Riparian zone width

Left bank 0 (m) Right bank 0 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock	0	0
Boulder (>256mm)	5	5
Cobble (64-256mm)	30	30
Pebble (16-64mm)	20	20
Gravel (2-16mm)	10	10
Sand (0.06-2mm)	15	15
Fines (silt and clay, <0.06mm)	20	20
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	0
Boulder (>256mm)	5
Cobble (64-256mm)	15
Pebble (16-64mm)	20
Gravel (2-16mm)	20
Sand (0.06-2mm)	15
Fines (silt and clay <0.06mm)	25

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover
☐ <10% ☑ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover
☐ <10% ☑ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. GZH 1A Date 19.09.17

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____

Stream width at the water mark (m) ____ A

Stream width at the water surface (m) ____

Bank height (m) ____

Bank width (m) ____ B

Vertical distance between the water surface and the water mark (m) ____

Horizontal distances (m) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Vertical water depths (cm) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Bank height (m) ____

Bank width (m) ____ C

Vertical distance between the water surface and the water mark (m) ____

Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. G2H 1A Date 19.09.17

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number ____ of ____

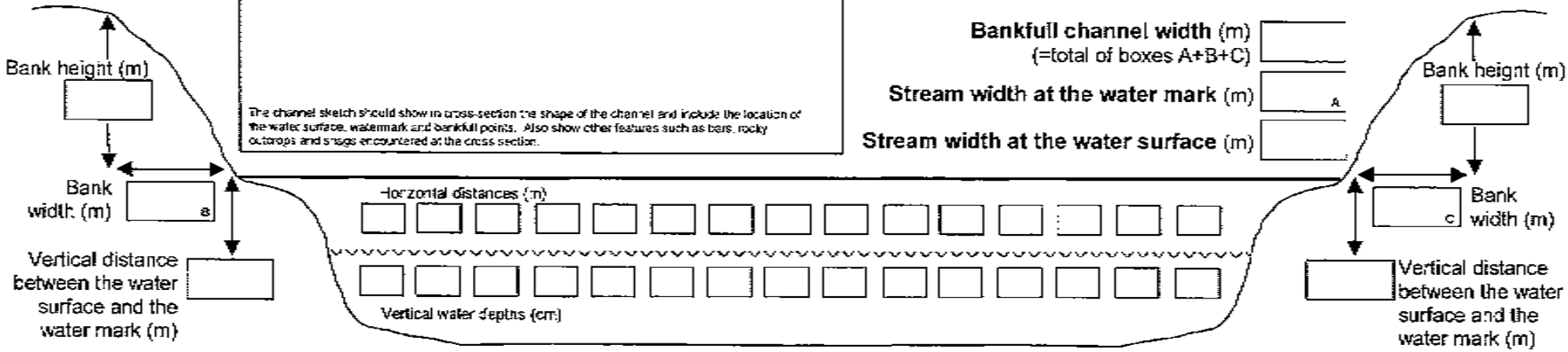
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____

Stream width at the water mark (m) ____ A

Stream width at the water surface (m) ____



Notes on cross-section measurement

Riparian zone width

Left bank ____ (m) Right bank ____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets Page 1 Site No. G2H 2a Date 19.09.17

Date 19/09/17 Site No. 2a (G2H) Time 1:30pm Recorder's Name L+JS

River Name Gornie Creek Location

Weather Warm/Sunny Rain in last week? Y [ ] N [✓]

Photograph numbers and details Iphone (Leesa) N, E, S, W

Latitude: deg min sec Longitude: deg min sec

GPS Name and Datum Site 2a

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

See photo's

* Platypus sighting
* carpet phyton skin
* Appropiate turtle habitat.
* Water dragon.
* Pale headed rosella

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100 (m)

Notes

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY

see surface water sheet.

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ (Water sample taken?)		
Total nitrogen ☐ (Water sample taken?)		

ALKALINITY

Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

Choose one category only

- ☒ Steep valley
- ☐ Shallow valley
- ☐ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☐ Road
- ☐ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☒ Grazing horses
- ☒ Litter flood debris sheet metal etc.
- ☐ Recreation
- ☐ Other

Description _____

Floodplain width _____ _____ _____ Average _____ (m)

Floodplain features

Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☒	☒	Grazing (native or non-native pasture) * horses riding for the disabled
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☒	☒	Recreation
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

	% Cover	Vegetation Description
Trees (>10m in height)	20%	Camphor laurel, E. tereticornis (D).
Trees (<10m in height)	10%	Juv. canopies
Shrubs	5%	Allocasuarina
Grasses / ferns / sedges	50%	~~Rhodes~~ Tall chloris (D)

May total more than 100%

Shading of channel

☐ < 5% ☒ 6 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☒ moderate
☐ slight ☐ extensive

Native and exotic riparian vegetation

% Native 70% > Total 100%
% Exotic 30%

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☐	☐
Regularly spaced	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☒	☒
Continuous	☐	☐

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [X]

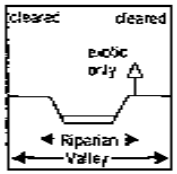
If no, record regeneration category

☐ Abundant (>5% cover) and healthy
☐ Present
☒ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

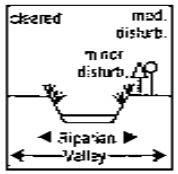
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

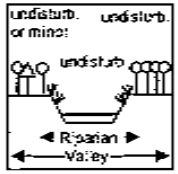
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

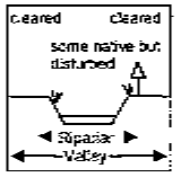
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

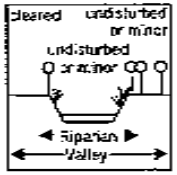
Very high disturbance ☐



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

Moderate disturbance ☒

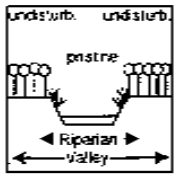


Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared and on ONE side, native vegetation on the other in reasonably undisturbed state

note → Both sides

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☑	☑	☐
Good passage	☐	☐	☑
Unrestricted passage	☐	☐	☐

Type and height of barrier(s): _____

Type of bars

Choose one or more categories

- ☐ Bars absent
- ☐ Side/point bars VEGETATED
- ☒ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type 10 %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [ ] Gravel [✓]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

☒ No modifications		☐ Reinforced	
☐ Desnagged		☐ Revegetated	
☐ Dams and diversions		☐ Infilled	
☐ Resectioned		☐ Berms or embankments	
☐ Straightened		Signs of work still	☐ Recently channelised
☐ Realigned		Works old and revegetated	☐ Channelised in the past

Channel shape

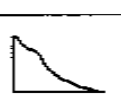
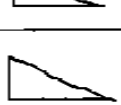
Choose one category only

☐ U shaped	☒ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

	Left bank	Right bank
 Concave	☒	☒
 Convex	☐	☐
 Stepped	☐	☐
 Wide lower bench	☐	☐
 Undercut	☐	☐

Bank slope
Choose one category for each bank

	Left bank	Right bank
 Vertical 80 - 90°	☐	☐
 Steep 60 - 80°	☐	☐
 Moderate 30 - 60°	☒	☒
 Low 10 - 30°	☐	☐
 Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☒ Stock access
- ☐ Human access
- ☐ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☒ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 15%.

Right Bank 0%.

Artificial bank protection measures
Choose one or more categories

- ☒ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other _____
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☒ absent ☐ light ☐ moderate ☐ profuse

Water oils
☒ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☒ anaerobic ☐ other _____

Water odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☒ other organic

Turbidity (visual assessment)
☐ Clear ☒ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:
☒ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

* dusty, leafy floating algae on water surface.

Water level at the time of sampling
☐ Dry ☐ No flow ☐ Low ☒ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site n/a.
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☐ Culvert ☐ Other

Description _____

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

0 % Notes on visibility —

Extent of bedform features

Total % composition for all features must equal 100%

Waterfall — Height >1m, Gradient >60°

0 % of site
_____ Est. Av. Length (m)
_____ Est. Av. Height (m)
_____ Est. Av. Gradient (°)

Cascade — Step Height <1m, Gradient 5-60°, Strong currents

0 % of site
_____ Est. Av. Length (m)
_____ Est. Av. Height (m)
_____ Est. Av. Gradient (°)

Rapid — Gradient 3-5°, Strong currents, Rocks break surface

0 % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Riffle — Gradient 1-3°, Moderate currents, Surface unbroken but unsmooth

10 % of site
10 Est. Av. Length (m)
0.2 Est. Av. Depth (m)
1m Est. Av. Width (m)

Glide — Gradient 1-3°, Small currents, Surface unbroken and smooth

0 % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Run — Gradient 1-3°, Small but distinct & uniform current, Surface unbroken

90 % of site
90m Est. Av. Length (m)
0.8 Est. Av. Depth (m)
5 Est. Av. Width (m)

Pool — Area where stream widens or deepens and current declines

0 % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Backwater — A reasonable sized (>25% of channel width) cut-off section away from

0 % of site
_____ Est. Av. Length (m)
_____ Est. Av. Depth (m)
_____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 15

% cover of emergent macrophytes 15%
% cover of floating macrophytes _____
% cover of submerged macrophytes _____

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I		
Crassula (Crassula) N		
Cyperus (Sedge) I/N		
Eleocharis (Spikerush) N		
Juncus (Rush) I/N		
Paspalum (Water Couch) N		
Phragmites (Common Reed) N		
Ranunculus (Buttercup) I		
Scirpus (Clubrush) N		
Triglochin (Water Ribbon) N		
Typha (Cumbungi) N	✓	15%
Other _____		
Other _____		
Other _____		

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N		
Chara (Stonewart) N		
Elodea (Canadian Pondweed) I		
Myriophyllum (Water Milfoil) I/N		
Nitella (Stonewart) N		
Potamogeton (Pondweed) N		
Triglochin (Water Ribbon) N		
Vallisneria (Ribbonweed) N		
Other _____		
Other _____		
Other _____		

Floating macrophytes

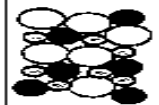
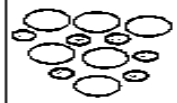
	Present	%
Azolla (Azolla) N		
Callitriche (Starwart) I		
Other _____		
Other _____		
Other _____		

Overall % cover of native macrophyte taxa 15%
Overall % cover of ~~native~~ exotic macrophyte taxa _____

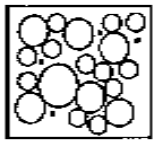
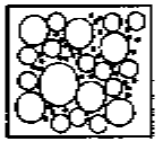
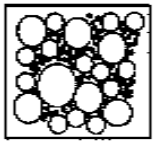
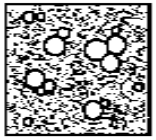
Total should equal overall % cover of macrophytes from above

 Site No. GZH 2A. Date 19-09-17

Bed compaction
Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate X
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix
Choose one category only

	Bedrock
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces X
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular X
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← Stable → Unstable - depositing

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material. X	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation. (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel, or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural construction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion, high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		

TOTAL HIGH GRADIENT HABITAT SCORE

Site No. G2H 2A Date 19-09-17

USEPA Habitat Assessment — Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	**Good**	**Fair**	**Poor**
1. **Epifaunal substrate / available cover**	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
2. **Pool substrate characterization**	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
3. **Pool variability**	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 (0)
4. **Sediment deposition**	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. **Channel flow status**	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. **Channel alteration**	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																	
	Excellent					Good					Fair				Poor			
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line				Channel straight; waterway has been channelized for a long distance.			
SCORE	20	19	18	17	16	15	14	13	12	11	(10)	9	8	7	6	5	4	3	2	1	0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal, little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable. 30-50% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 50-100% of bank has erosion scars.			
SCORE	Left bank		10		9	8		(7)		6	5		4		3	2		1		0	
SCORE	Right bank		10		9	8		(7)		6	5		4		3	2		1		0	
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the stream bank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.			
SCORE	Left bank		10		9	8		7		(6)	5		4		3	2		1		0	
SCORE	Right bank		10		9	8		7		(6)	5		4		3	2		1		0	
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.			
SCORE	Left bank		10		9	8		7		6	5		4		3	2		(1)		0	
SCORE	Right bank		10		9	8		7		6	5		4		3	2		(1)		0	

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. G2H 2A. Date 19.09.17

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of ____

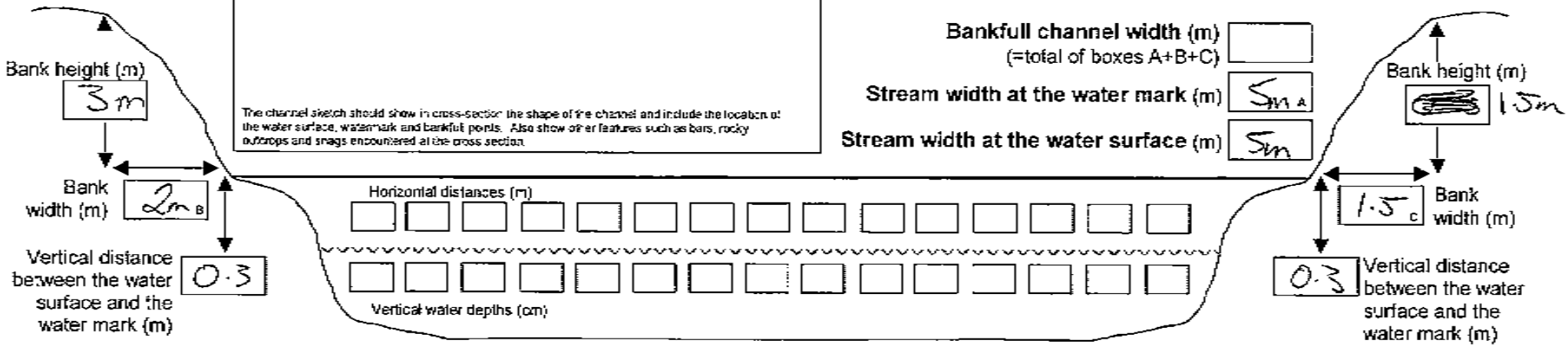
Type of bedform at the cross-section

☐ Riffle ☒ Run ☐ Pool ☐ Cascade ☐ Other ____

Bankfull channel width (m) (=total of boxes A+B+C)

Stream width at the water mark (m) 5m A

Stream width at the water surface (m) 5m



Notes on cross-section measurement

Riparian zone width

Left bank 4 (m) Right bank 4 (m)

Bank material Assess % composition for each bank

	Left bank	Right bank
Bedrock	20	0
Boulder (>256mm)	5%	5%
Cobble (64-256mm)	10%	10%
Pebble (16-64mm)	5%	5%
Gravel (2-16mm)	35%	70%
Sand (0.06-2mm)	10%	10%
Fines (silt and clay, <0.06mm)	15%	20%

Total 100% each

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	30%
Boulder (>256mm)	
Cobble (64-256mm)	10%
Pebble (16-64mm)	10
Gravel (2-16mm)	30%
Sand (0.06-2mm)	10%
Fines (silt and clay <0.06mm)	10%

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☒ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☒ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☒ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☒ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

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Cross-section sketch

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Cross-section number _____ of _____

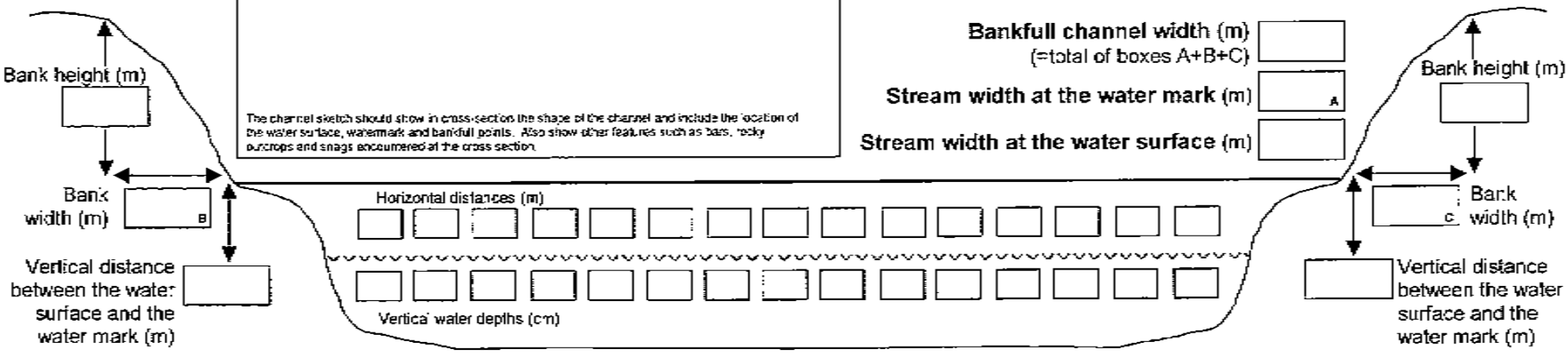
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Cross-section sketch

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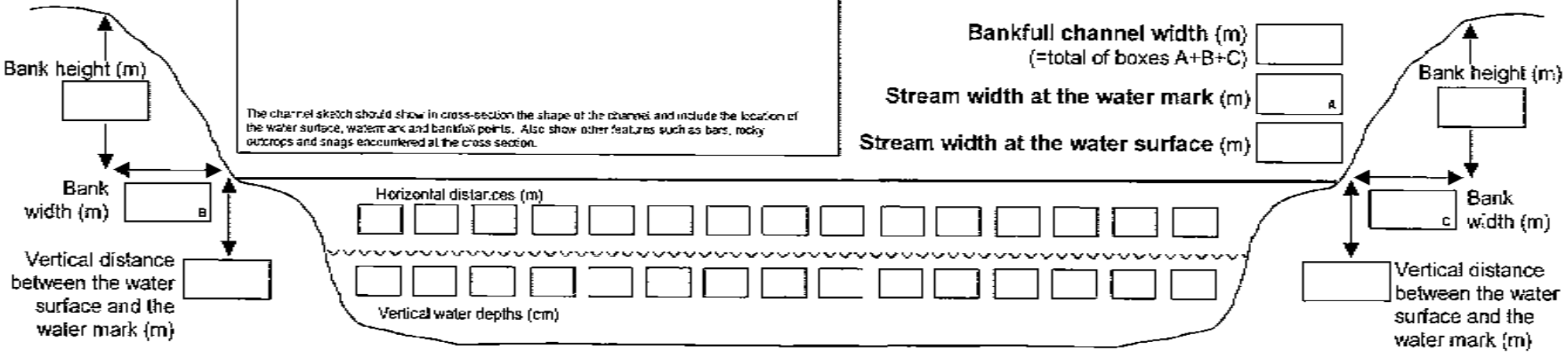
Cross-section number _____ of _____

Type of bedform at the cross-section
☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐
Stream width at the water mark (m) ☐ A
Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets Page 1 Site No. 3A Date 19.09.17

Date 19.09.17 Site No. 3A Time 1645 Recorder's Name LL + JS

River Name Gaweesie Location Gravely.

Weather Fine + sunny. Rain in last week? Y [ ] N [ ]

Photograph numbers and details Refer Leesa's iphone U, E, S, W

Latitude: deg min sec Longitude: deg min sec

GPS Name and Datum Site 3A

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features. Left bank is facing downstream.

Refer to photos.

Adjacent to Prices area. (TSRC environ zone)

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100 (m)

Notes

Superb flora when White-Wreath gorgeous.

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

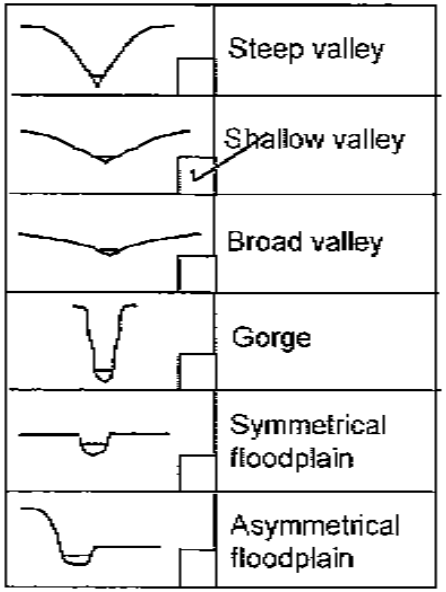
BASIC WATER CHEMISTRY

See surface water notes

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ (Water sample taken?)		
Total nitrogen ☐ (Water sample taken?)		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

Choose one category only



- ☐ Steep valley
- ☑ Shallow valley
- ☐ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☑ Road
- ☐ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☐ Grazing
- ☐ Litter
- ☐ Recreation
- ☐ Other

Description Overhead pipeline + easement. Adjacent to rail corridor + Nexus TSRC

Floodplain width

_____ _____ _____ Average _____ (m)

Floodplain features

Choose one or more features when present

- ☑ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☐	☐	Grazing (native or non-native pasture)
☒	☑	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

May total more than 100%

	% Cover	Vegetation Description
Trees (>10m in height)	5%	Casuarina.
Trees (<10m in height)	20%	Privet, Weeping bottlebrush
Shrubs	15%	Weeping bottle brush
Grasses / ferns / sedges	80%	Sweet tea, lucerne, grass weed
		Picris in area.

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☑	☑
Regularly spaced	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☐	☐
Continuous	☐	☐

Shading of channel

☐ < 5% ☑ 6 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☐ moderate

☑ slight ☐ extensive

Native and exotic riparian vegetation

% Native 40

% Exotic 60

Total 100%

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [☑]

If no, record regeneration category

☐ Abundant (>5% cover) and healthy

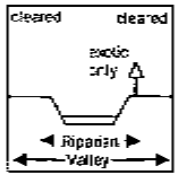
☐ Present

☑ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

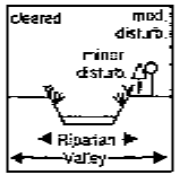
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

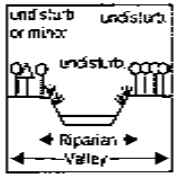
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

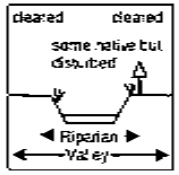
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

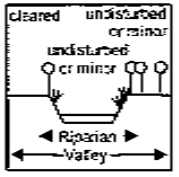
Very high disturbance ☑



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

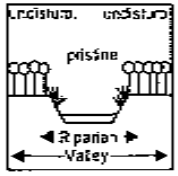
Moderate disturbance ☐



Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other in reasonably undisturbed state

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage
Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☑	☑	☐
Good passage	☐	☐	☑
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) Rocks. ~0.2m

Type of bars
Choose one or more categories

- ☐ Bars absent
- ☐ Side/point bars VEGETATED
- ☑ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars
% of streambed forming a bar of any type 10 %

Dominant sediment particle size on bars
Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [✓] Silt/clay [ ] or _____mm

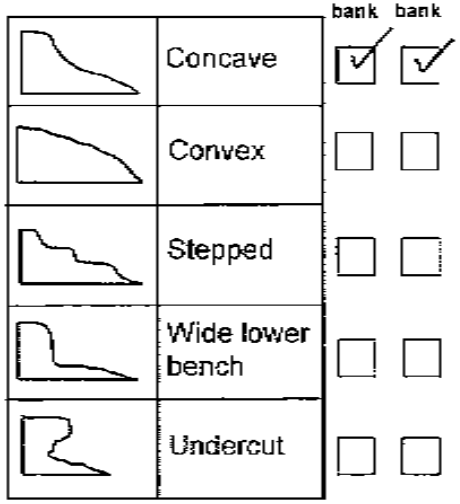
Channel modifications Choose one or more categories

☑ No modifications		☐	Reinforced
☐ Desnagged		☐	Revegetated
☐ Dams and diversions		☐	Infilled
☐ Resectioned		☐	Berms or embankments
☐ Straightened	Signs of work still	☐	Recently channelised
☐ Realigned	Works old and revegetated	☐	Channelised in the past

Channel shape Choose one category only

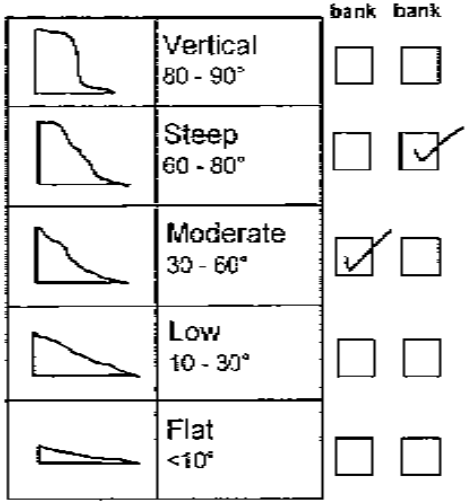
☐ U shaped	☑ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank



	Left bank	Right bank
Concave	☑	☑
Convex	☐	☐
Stepped	☐	☐
Wide lower bench	☐	☐
Undercut	☐	☐

Bank slope
Choose one category for each bank



	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☐	☑
Moderate 30 - 60°	☑	☐
Low 10 - 30°	☐	☐
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☐ Stock access
- ☐ Human access
- ☐ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☑ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 15%

Right Bank 0

Artificial bank protection measures
Choose one or more categories

- ☑ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other _____
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils

☑ absent ☐ light ☐ moderate ☐ profuse

Water oils

☑ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours

☑ normal/none ☐ sewage ☐ petroleum ☐ chemical

☑ anaerobic ☐ other _____

Water odours

☐ normal/none ☐ sewage ☐ petroleum ☐ chemical

☑ other organic

Turbidity (visual assessment)

☐ Clear ☑ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:

☑ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling

☐ Dry ☐ No flow ☑ Low ☐ Baseflow or near baseflow

☐ High ☐ Flood (can't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☐ Culvert ☑ Other

Description overhead pipelin

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

0 % Notes on visibility _____

Extent of bedform features

Total % composition for all features must equal 100%

Height >1m Gradient >60°	Waterfall	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Height (m) ____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	Cascade	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Height (m) ____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	Rapid	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	Riffle	10 % of site 10 Est. Av. Length (m) 0.2 Est. Av. Depth (m) 0.8 Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	Glide	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	Run	90 % of site 90 Est. Av. Length (m) 0.2 Est. Av. Depth (m) 3m Est. Av. Width (m)
Area where stream widens or deepens and current declines	Pool	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	Backwater	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 0

% cover of emergent macrophytes ____

% cover of floating macrophytes ____

% cover of submerged macrophytes ____

} Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I		
Crassula (Crassula) N		
Cyperus (Sedge) I/N		
Eleocharis (Spikerush) N		
Juncus (Rush) I/N		
Paspalum (Water Couch) N		
Phragmites (Common Reed) N		
Ranunculus (Buttercup)		
Scirpus (Clubrush) N		
Triglochin (Water Ribbon) N		
Typha (Cumbungi) N		
Other ____		
Other ____		
Other ____		

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N		
Chara (Stonewart) N		
Elodea (Canadian Pondweed) I		
Myriophyllum (Water Milfoil) I/N		
Nitella (Stonewart) N		
Potamogeton (Pondweed) N		
Triglochin (Water Ribbon) N		
Vallisneria (Ribbonweed) N		
Other ____		
Other ____		
Other ____		

Floating macrophytes

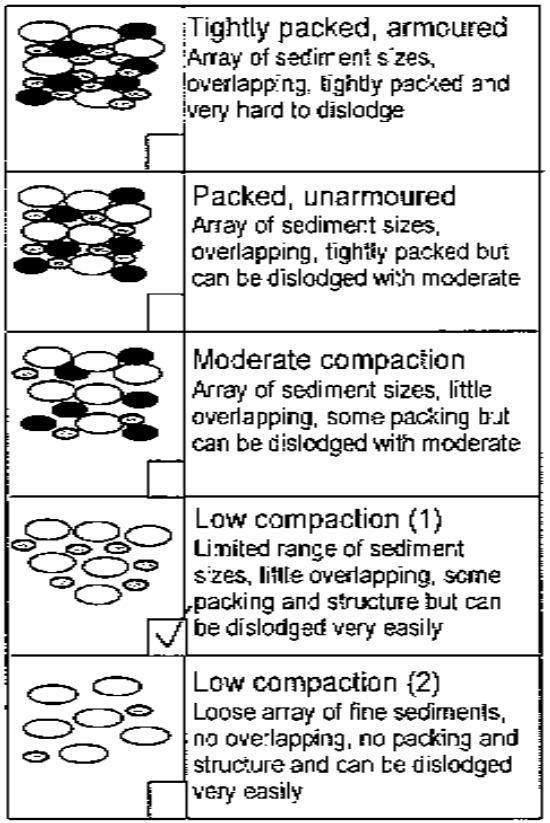
	Present	%
Azolla (Azolla) N		
Callitriche (Starwart) I		
Other ____		
Other ____		
Other ____		

Overall % cover of native macrophyte taxa ____

Overall % cover of native macrophyte taxa ____

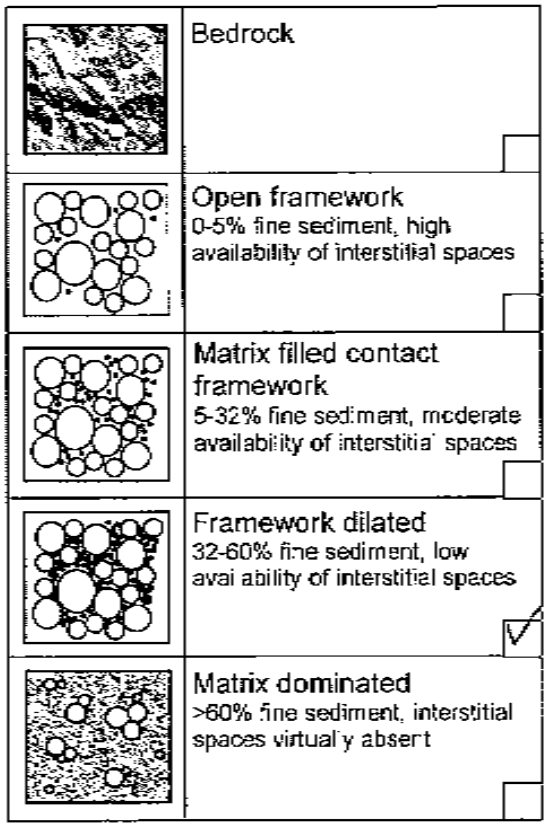
} Total should equal overal. % cover of macrophytes from above

Bed compaction
Choose one category only



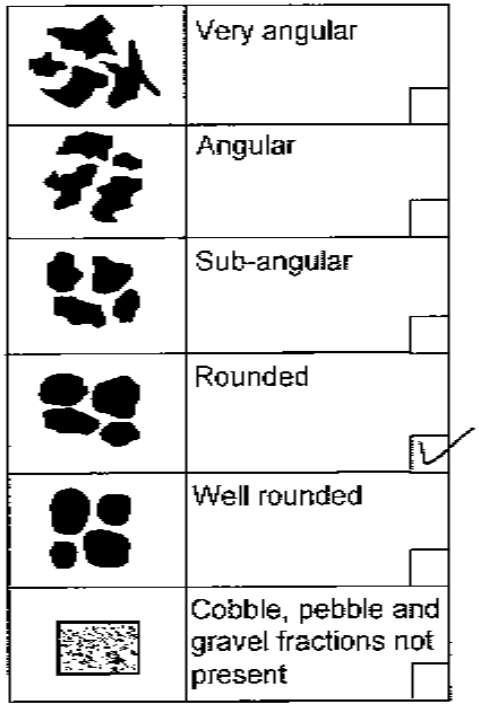
- Tightly packed, armoured — Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
- Packed, unarmoured — Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
- Moderate compaction — Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
- Low compaction (1) — Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily ✓
- Low compaction (2) — Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix
Choose one category only



- Bedrock
- Open framework — 0-5% fine sediment, high availability of interstitial spaces
- Matrix filled contact framework — 5-32% fine sediment, moderate availability of interstitial spaces
- Framework dilated — 32-60% fine sediment, low availability of interstitial spaces ✓
- Matrix dominated — >60% fine sediment, interstitial spaces virtually absent

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only



- Very angular
- Angular
- Sub-angular
- Rounded ✓
- Well rounded
- Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← Stable → Unstable - depositing

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow. ✓	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																	
	Excellent					Good					Fair					Poor		
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend, bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles, poor habitat; distance between riffles divided by the width of the stream is a ratio of >25				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-50% of bank in reach has areas of erosion, high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0			
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.				
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0			
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.				
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0			

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. 3A Date 19.09.17

USEPA Habitat Assessment **LOW GRADIENT STREAMS** Page 1 of 2
Circle a score for each parameter

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 **6**	5 4 3 2 1 0
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 **7** 6	5 4 3 2 1 0
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 **2** 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel, or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	**15** 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment — **LOW GRADIENT STREAMS** — Page 2 of 2

Circle a score for each parameter

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	(6)	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.						
SCORE	Left bank	10	9			8	(7)		6		5		4		3	2		1			0	
SCORE	Right bank	10	9			8	(7)		6		5		4		3	2		1			0	
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.						
SCORE	Left bank	10	9			8		7		6	5		(4)		3	2		1			0	
SCORE	Right bank	10	9			8		7		6	5		(4)		3	2		1			0	
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.						
SCORE	Left bank	10	9			8		7		6	5		4		3	2		(1)			0	
SCORE	Right bank	10	9			8		7		6	5		4		3	2		(1)			0	

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. 3A. Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of _____

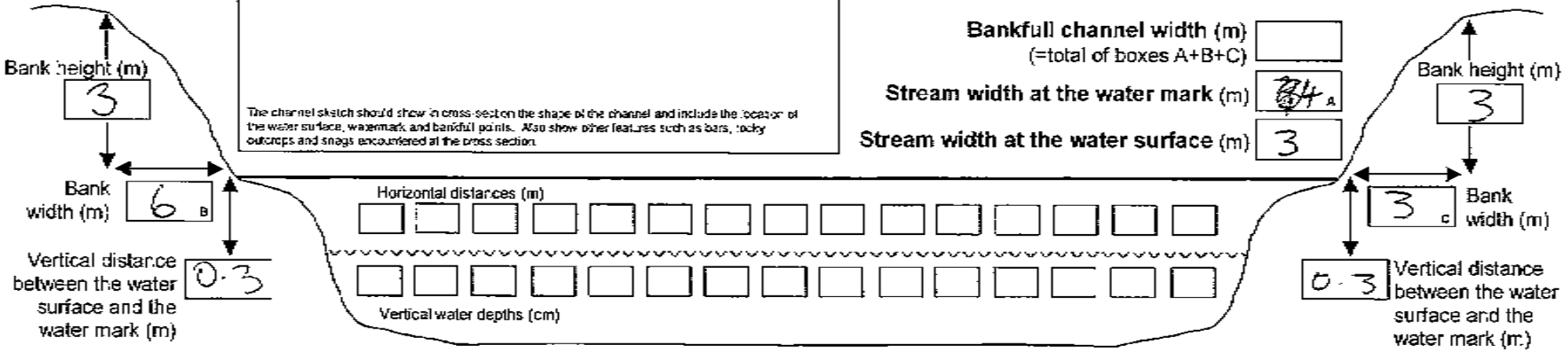
Type of bedform at the cross-section

☐ Riffle ☒ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) _____

Stream width at the water mark (m) 3.4 A

Stream width at the water surface (m) 3



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank 0.1 (m) Right bank 0.2 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock	15	20
Boulder (>256mm)	5	5
Cobble (64-256mm)	20	20
Pebble (16-64mm)	10	10
Gravel (2-16mm)	5	5
Sand (0.06-2mm)	10	10
Fines (silt and clay, <0.06mm)	30	30
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	-
Boulder (>256mm)	10
Cobble (64-256mm)	-
Pebble (16-64mm)	-
Gravel (2-16mm)	10
Sand (0.06-2mm)	10
Fines (silt and clay <0.06mm)	70
	Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☑ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section

Cross-section number _____ of _____

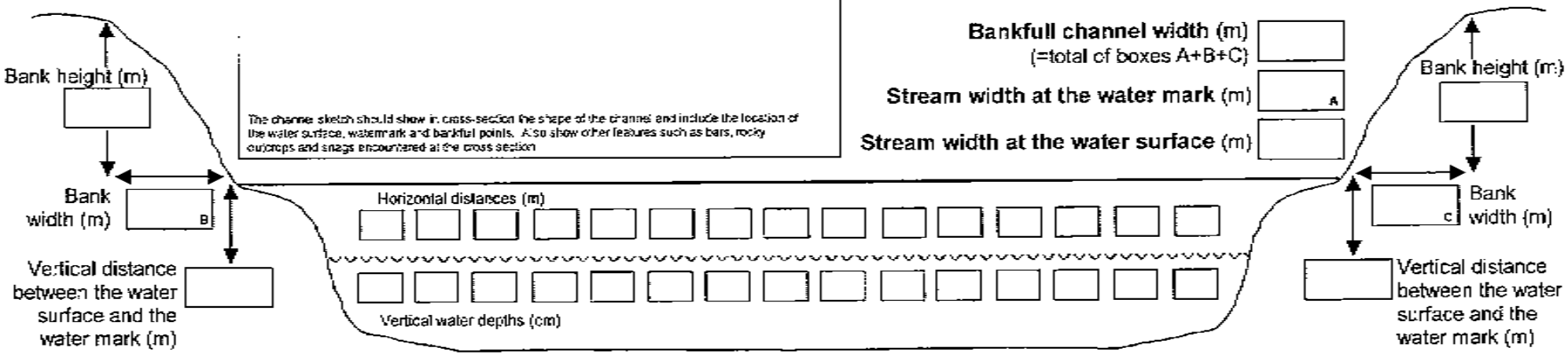
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____

Stream width at the water mark (m) ____ A

Stream width at the water surface (m) ____



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		

Total 100% each

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

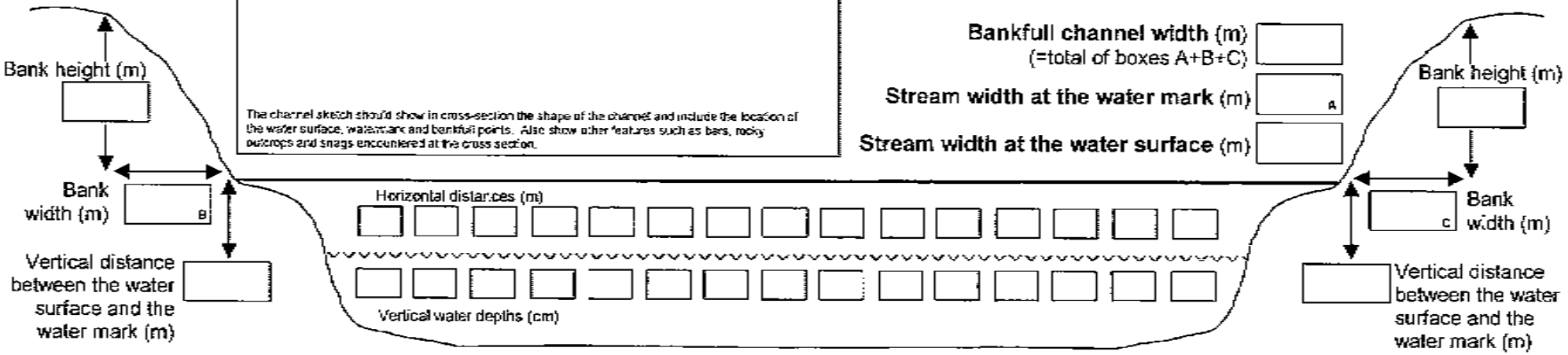
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets Page 1 Site No. 9A. Date 20.09.17

Date 20.09.17 Site No. _____ Time 1330 Recorder's Name GS + LL

River Name Lockyer Creek. Location 9A

Weather Fine + sunny. Rain in last week? Y [ ] N [X] Photograph numbers and details Leesa's iPhone - U, E, S, W.

Latitude: deg min sec Longitude: deg min sec

GPS Name and Datum 9A

PLANFORM SKETCH OF SITE
Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

See photos -

Fauna species

White faced herons
welcome swallows
water dragons
rainbow lorikeets
Little Black cormorant
Grebes.

Hollow present ~ 30cm diameter.

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100 (m)

Notes

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY

See Surface water sheet.

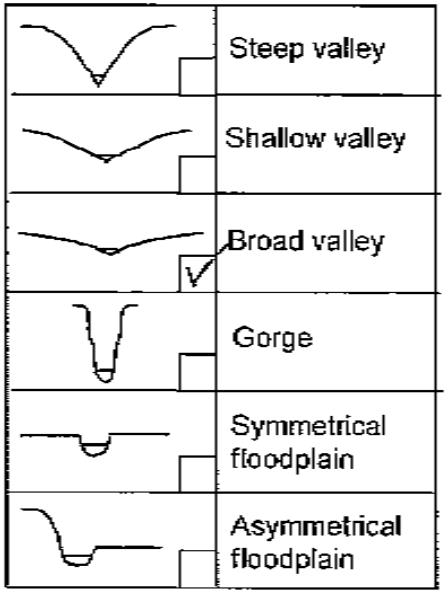
		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ (Water sample taken?)		
Total nitrogen ☐ (Water sample taken?)		

ALKALINITY

Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

Choose one category only



- ☐ Steep valley
- ☐ Shallow valley
- ☑ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☑ Road
- ☑ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☑ Grazing
- ☑ Litter
- ☐ Recreation
- ☐ Other

Description _____

Floodplain width ____ ____ ____ Average 250 (m)

To confirm on aerial

Floodplain features

Choose one or more features when present

- ☐ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☑ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☑	☑	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

	% Cover	Vegetation Description
Trees (>10m in height)	0 %	
Trees (<10m in height)	0 %	
Shrubs	10 %	weeping bottlebrush
Grasses / ferns / sedges	95 %	pasture grasses

May total more than 100%

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☑	☑
Regularly spaced	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☐	☐
Continuous	☐	☐

Shading of channel

☑ < 5% ☐ 6 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☐ moderate
☑ slight ☐ extensive

Native and exotic riparian vegetation

% Native 10 %
% Exotic 90 %
Total 100%

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [X]

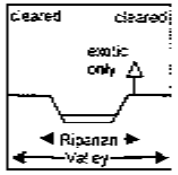
If no, record regeneration category

☑ Abundant (>5% cover) and healthy
☐ Present
☐ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

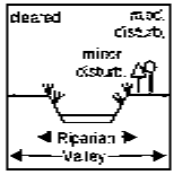
Extreme disturbance ☑



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

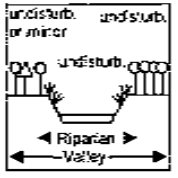
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

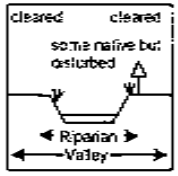
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

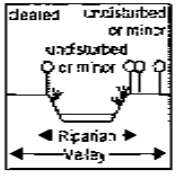
Very high disturbance ☐



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

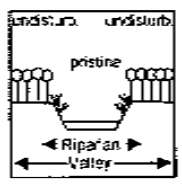
Moderate disturbance ☐



Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage
Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☐	☐	☐
Good passage	☑	☑	☑
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) _____

Type of bars
Choose one or more categories

- ☑ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type 0 %

~~**Dominant sediment particle size on bars**~~

Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [ ] Silt/clay [ ] or _____ mm

Channel modifications Choose one or more categories

☑ No modifications		☐ Reinforced	
☐ Desnagged		☐ Revegetated	
☐ Dams and diversions		☐ Infilled	
☐ Resectioned		☐ Berms or embankments	
☐ Straightened	Signs of work still	☐ Recently channelised	
☐ Realigned	Works old and revegetated	☐ Channelised in the past	

Channel shape Choose one category only

☐ U shaped	☑ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

	Left bank	Right bank
Concave	☐	☐
Convex	☑	☑
Stepped	☐	☐
Wide lower bench	☐	☐
Undercut	☐	☐

Bank slope
Choose one category for each bank

	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☐	☐
Moderate 30 - 60°	☑	☐
Low 10 - 30°	☐	☑
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☐ Stock access
- ☐ Human access
- ☑ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☑ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bed-rock outcrops

% bedrock outcrops Left bank 0
Right Bank 0

Artificial bank protection measures
Choose one or more categories

- ☐ None
- ☐ Fence structures
- ☐ Levee banks
- ☑ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other _____
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

associated with bridge

Sediment oils
☑ absent ☐ light ☐ moderate ☐ profuse

Water oils
☑ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours
☑ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ anaerobic ☐ other _____

Water odours
☑ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ other _____

Turbidity (visual assessment)
☐ Clear ☐ Slight ☑ Turbid ☐ Opaque

Is water clarity reduced by:
☑ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☐ Dry ☐ No flow ☐ Low ☑ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories
☐ Major ☐ Minor weir ☐ Ford ☑ Bridge ☐ Culvert ☐ Other
Description Lockyer Siding Road

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter
0 % Notes on visibility _____

Extent of bedform features

Total % composition for all features must equal 100%

Height >1m Gradient >60°	Waterfall 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Height (m) ____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	Cascade 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Height (m) ____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	Rapid 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	Riffle 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	Glide 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	Run 	100 % of site 100 Est. Av. Length (m) 1.5 Est. Av. Depth (m) 3 Est. Av. Width (m)
Area where stream widens or deepens and current declines	Pool 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	Backwater 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 40

% cover of emergent macrophytes ~~80~~ 30

% cover of floating macrophytes 05

% cover of submerged macrophytes 05

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	
Crassula (Crassula) N	☐	
Cyperus (Sedge) I/N	✓	5%
Eleocharis (Spikerush) N	☐	
Juncus (Rush) I/N	✓	25%
Paspalum (Water Couch) N	☐	
Phragmites (Common Reed) N	☐	
Ranunculus (Buttercup) I	☐	
Scirpus (Clubrush) N	☐	
Triglochin (Water Ribbon) N	☐	
Typha (Cumbungi) N	☐	
Other _____	☐	
Other _____	☐	
Other _____	☐	

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	
Chara (Stonewart) N	☐	
Elodea (Canadian Pondweed) I	✓	5%
Myriophyllum (Water Milfoil) I/N	☐	
Nitella (Stonewart) N	☐	
Potamogeton (Pondweed) N	☐	
Triglochin (Water Ribbon) N	☐	
Vallisneria (Ribbonweed) N	☐	
Other _____	☐	
Other _____	☐	
Other _____	☐	

Floating macrophytes

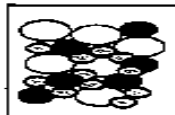
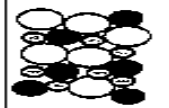
	Present	%
Azolla (Azolla) N	☐	
Callitriche (Starwart) I	☐	
Other *Nymphaea gigantea*	✓	5%
Other _____	☐	
Other _____	☐	

Overall % cover of native macrophyte taxa 30%

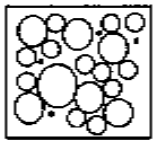
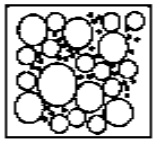
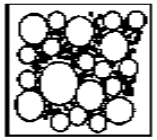
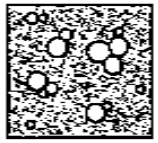
Overall % cover of ~~native~~ exotic macrophyte taxa 10%

Total should equal overall % cover of macrophytes from above

Bed compaction
Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate ✓
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix
Choose one category only

	Bedrock
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces ✓
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular ✓
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← **Stable** → **Unstable - depositing**

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material. ✓	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel, or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																	
	Excellent					Good					Fair					Poor					
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0			
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident, almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.				
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0			
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.				
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0			

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. 9A Date 20/9/17

USEPA Habitat Assessment Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16 15 14 13 12 **11**		10 9 8 7 6	5 4 3 2 1 0
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16 15 14 **13** 12 11		10 9 8 7 6	5 4 3 2 1 0
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16 **15** 14 13 12 11		10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 **18** 17 16 15 14 13 12 11		10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16 **15** 14 13 12 11		10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	**19** 18 17 **16** 15 14 13 12 11		10 9 8 7 6	5 4 3 2 1 0

bridge

Continued over

Site No. QA Date 20/9/17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas)					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	(6)	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-900% of bank has erosional scars.						
SCORE	Left bank	10	9			(8)		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			(8)		7		6	5		4		3	2		1		0		
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common. less than one-half of the potential plant stubble height remaining					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high vegetation has been removed to 5 centimetres or less in average stubble height.						
SCORE	Left bank	10	9			(8)		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			(8)		7		6	5		4		3	2		1		0		
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <5 metres; little or no riparian vegetation is present because of human activities.						
SCORE	Left bank	10	9			8		7		6	5		4		3	2		(1)		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		(1)		0		

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. 9A Date 20/9/17

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.
Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

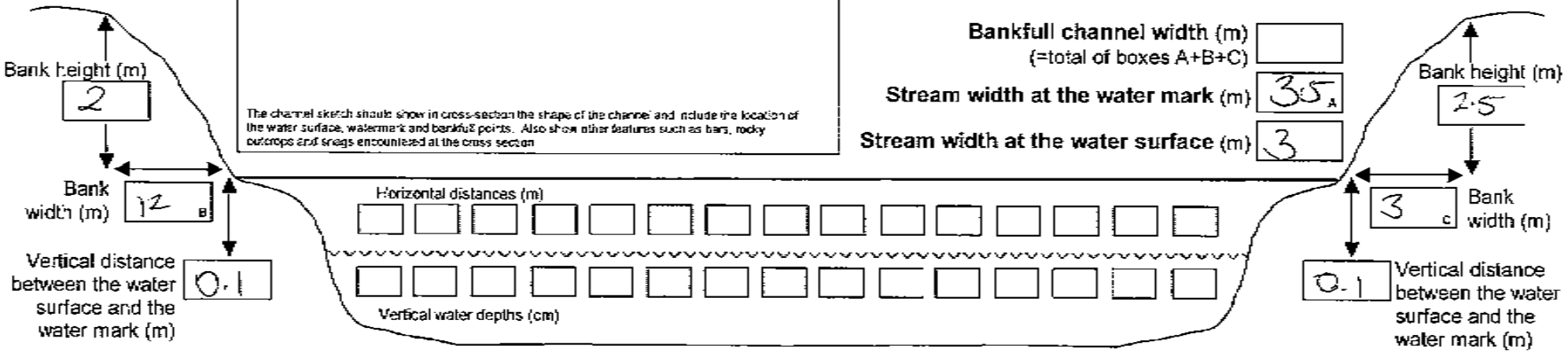
Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section

Cross-section number 1 of 1

Type of bedform at the cross-section
☐ Riffle ☑ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C)
Stream width at the water mark (m) 3.5 A
Stream width at the water surface (m) 3



Notes on cross-section measurement

Riparian zone width
Left bank 15 (m) Right bank 15 (m)

Bank material
Assess % composition for each bank

	Left bank	Right bank
Bedrock	0	0
Boulder (>256mm)	0	10
Cobble (64-256mm)	10	10
Pebble (16-64mm)	0	0
Gravel (2-16mm)	5	5
Sand (0.06-2mm)	5	5
Fines (silt and clay, <0.06mm)	80	70
	100	100

Total 100% each

Substrate composition
Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	0
Boulder (>256mm)	0
Cobble (64-256mm)	0
Pebble (16-64mm)	10
Gravel (2-16mm)	20
Sand (0.06-2mm)	10
Fines (silt and clay <0.06mm)	50

Total 100%

Filamentous algae cover
Assess in the area 5m either side of the cross section
☐ <10% ☐ 10–35% ☑ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

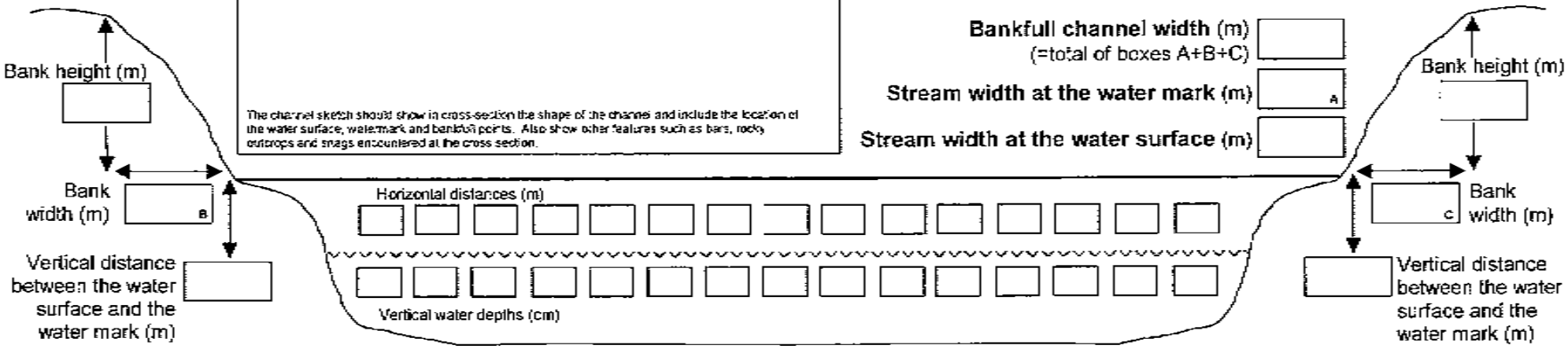
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____

Stream width at the water mark (m) ____ A

Stream width at the water surface (m) ____



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area defined 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

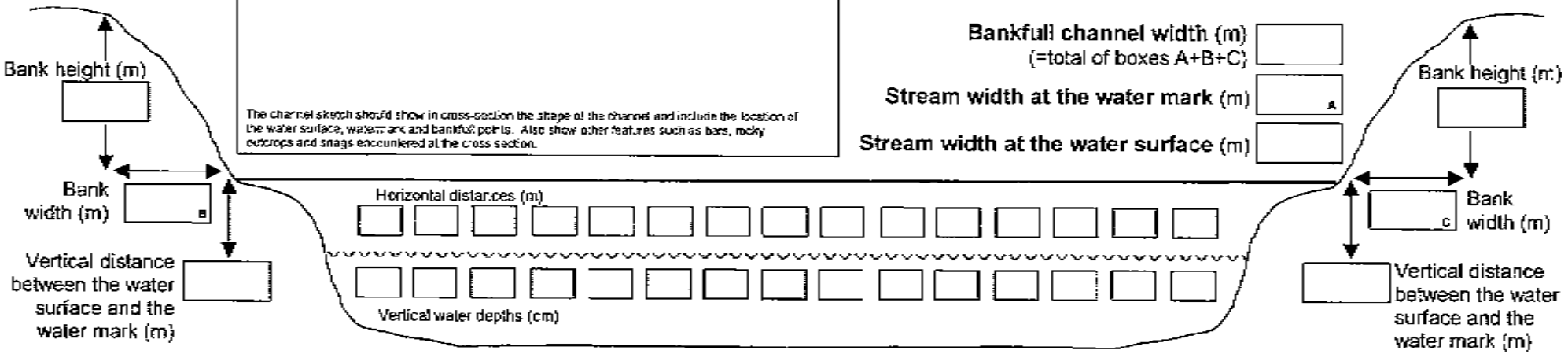
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets **Page 1** **Site No.** 6A **Date** 20/9/17

Date 20/9/17 Site No. 6A 6B 6C Time 3:30pm Recorder's Name LL + AS

River Name Rocky Creek Location

Weather Fine + Sunny Rain in last week? Y [ ] N [X] Photograph numbers and details Leesa's iphone

Latitude: deg min sec Longitude: deg min sec

GPS Name and Datum

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features. Left bank is facing downstream.

refer to photos.

Fauna
red back fairy wren.
willy wag-tail
Red-neck wallaby.
Pied cormorant

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100m (m)

Notes

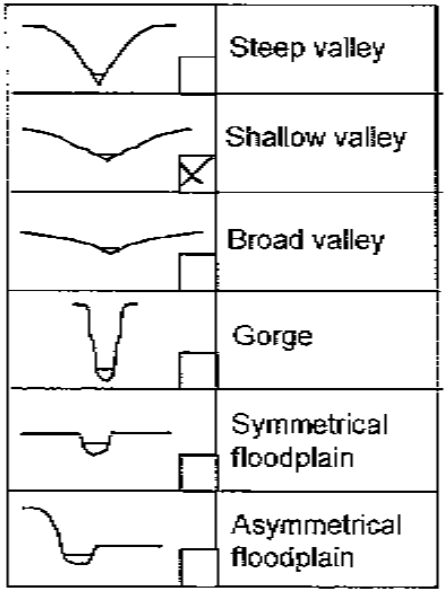
BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY
See Surface water

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ Water sample taken?		
Total nitrogen ☐ Water sample taken?		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape
Choose one category only



- ☐ Steep valley
- ☒ Shallow valley
- ☐ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams
Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☒ Road – bed level crossing
- ☒ Bridge / culvert / wharf – 1 RCP 300 cm
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☐ Grazing
- ☒ Litter
- ☐ Recreation
- ☐ Other

Description _____

Floodplain width _____ _____ _____ Average _____ (m)

Floodplain features
Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse
Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☐	☐	Grazing (native or non-native pasture)
☒	☒	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

	% Cover	Vegetation Description
Trees (>10m in height)	25%	Bluegum, E. Cladocalyx
Trees (<10m in height)	20%	C. glauca
Shrubs	60%	lantana
Grasses / ferns / sedges	80%	Pastoral species

(May total more than 100%)

Shading of channel

☐ < 5% ☑ 6 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☐ moderate
☒ slight ☐ extensive

Native and exotic riparian vegetation

% Native 40%
% Exotic 60%
Total 100%

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☐	☐
Regularly spaced	☐	☐
Occasional clumps	☒	☐
Semi-continuous	☐	☒
Continuous	☐	☐

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [X]

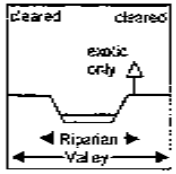
If no, record regeneration category:

☐ Abundant (>5% cover) and healthy
☐ Present
☒ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

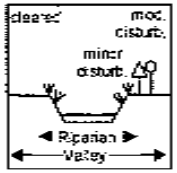
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

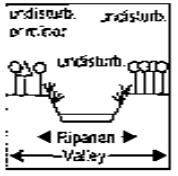
High disturbance ☒



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

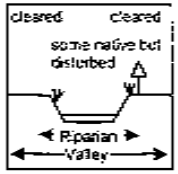
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

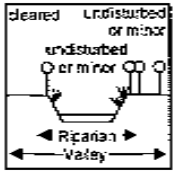
Very high disturbance ☐



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

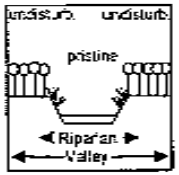
Moderate disturbance ☐



Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage
Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☒	☒	☐
Very restricted passage	☐	☐	☒
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☐	☐	☐
Good passage	☐	☐	☐
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) _____

Type of bars
Choose one or more categories

- ☒ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars
% of streambed forming a bar of any type 0 %

~~Dominant sediment particle size on bars~~
Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications Choose one or more categories

☒	No modifications	☐	Reinforced
☐	Desnagged	☐	Revegetated
☐	Dams and diversions	☐	Infilled
☐	Resectioned	☐	Berms or embankments
☐	Straightened	Signs of work still	Recently channelised
☐	Realigned	Works old and revegetated	Channelised in the past

Channel shape Choose one category only

☐ U shaped	☒ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

	Left bank	Right bank
Concave	☐	☐
Convex	☒	☐
Stepped	☐	☐
Wide lower bench	☐	☐
Undercut	☐	☒

Bank slope
Choose one category for each bank

	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☐	☒
Moderate 30 - 60°	☐	☐
Low 10 - 30°	☒	☐
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☐ Stock access
- ☐ Human access
- ☒ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☒ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 0
Right Bank 0

Artificial bank protection measures
Choose one or more categories

- ☒ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other _____
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☒ absent ☐ light ☐ moderate ☐ profuse

Water oils
☒ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours
☒ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ anaerobic ☐ other _____

Water odours
☒ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ other _____

Turbidity (visual assessment)
☐ Clear ☐ Slight ☒ Turbid ☐ Opaque

Is water clarity reduced by:
☒ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☐ Dry ☒ No flow ☐ Low ☐ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☒ Culvert ☒ Other

Description road, red track crossing
Bed defined by placed blue rock ford in places

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

0 % Notes on visibility _____

Extent of bedform features

Total % composition for all features must equal 100%

Waterfall (Height >1m, Gradient >60°)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Height (m)
____ Est. Av. Gradient (°)

Cascade (Step Height <1m, Gradient 5-60°, Strong currents)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Height (m)
____ Est. Av. Gradient (°)

Rapid (Gradient 3-5°, Strong currents, Rocks break surface)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Depth (m)
____ Est. Av. Width (m)

Riffle (Gradient 1-3°, Moderate currents, Surface unbroken but unsmooth)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Depth (m)
____ Est. Av. Width (m)

Glide (Gradient 1-3°, Small currents, Surface unbroken and smooth)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Depth (m)
____ Est. Av. Width (m)

Run (Gradient 1-3°, Small but distinct & uniform current, Surface unbroken)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Depth (m)
____ Est. Av. Width (m)

Pool (Area where stream widens or deepens and current declines)
10 % of site
5 Est. Av. Length (m)
0.5 Est. Av. Depth (m)
1 Est. Av. Width (m)

Backwater (A reasonable sized (>20% of channel width) cut-off section away from)
____ % of site
____ Est. Av. Length (m)
____ Est. Av. Depth (m)
____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Remainder of reach dry

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 90%

% cover of emergent macrophytes 90%
% cover of floating macrophytes ____
% cover of submerged macrophytes ____

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I		
Crassula (Crassula) N		
Cyperus (Sedge) I/N		
Eleocharis (Spikerush) N		
Juncus (Rush) I/N		
Paspalum (Water Couch) N		
Phragmites (Common Reed) N		
Ranunculus (Buttercup) I		
Scirpus (Clubrush) N		
Triglochin (Water Ribbon) N		
Typha (Cumbungi) N	X	90%
Other ____		
Other ____		
Other ____		

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N		
Chara (Stonewart) N		
Elodea (Canadian Pondweed) I		
Myriophyllum (Water Milfoil) I/N		
Nitella (Stonewart) N		
Potamogeton (Pondweed) N		
Triglochin (Water Ribbon) N		
Vallisneria (Ribbonweed) N		
Other ____		
Other ____		
Other ____		

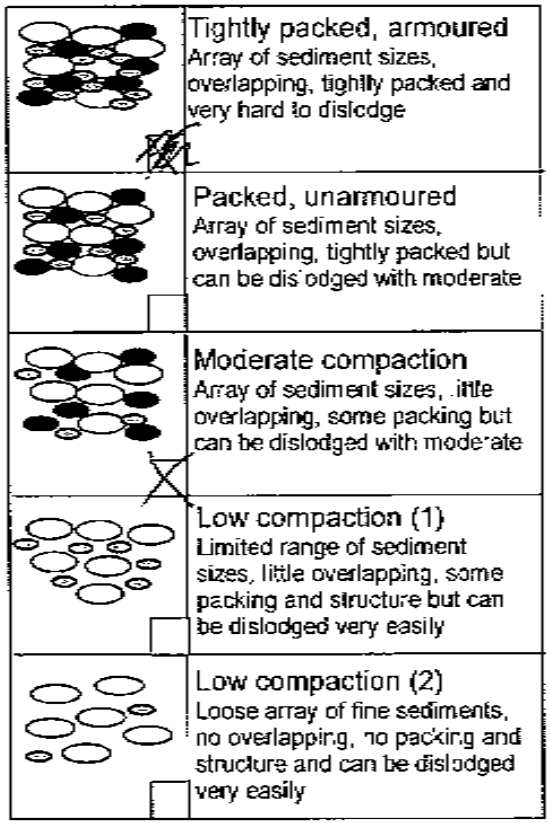
Floating macrophytes

	Present	%
Azolla (Azolla) N		
Callitriche (Starwart) I		
Other ____		
Other ____		
Other ____		

Overall % cover of native macrophyte taxa 90%
Overall % cover of native macrophyte taxa ____

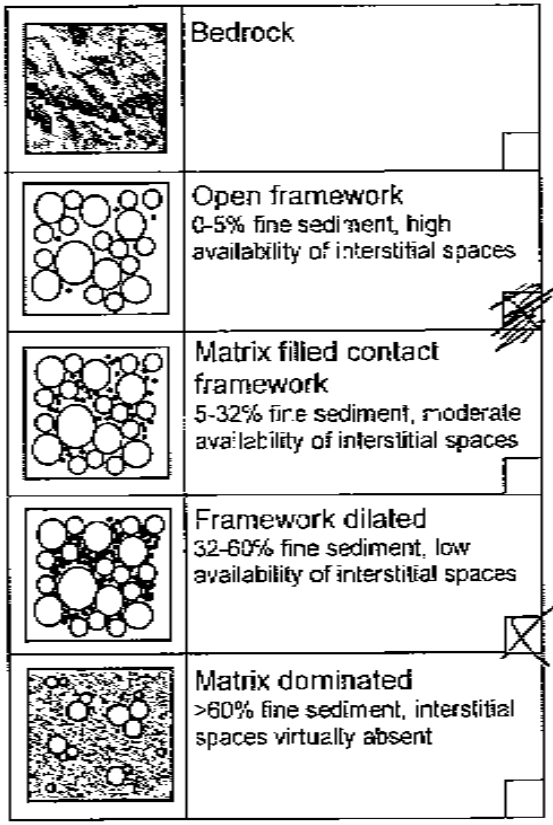
Total should equal overall % cover of macrophytes from above

Bed compaction
Choose one category only



- Tightly packed, armoured — Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
- Packed, unarmoured — Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
- Moderate compaction — Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
- Low compaction (1) — Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
- Low compaction (2) — Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

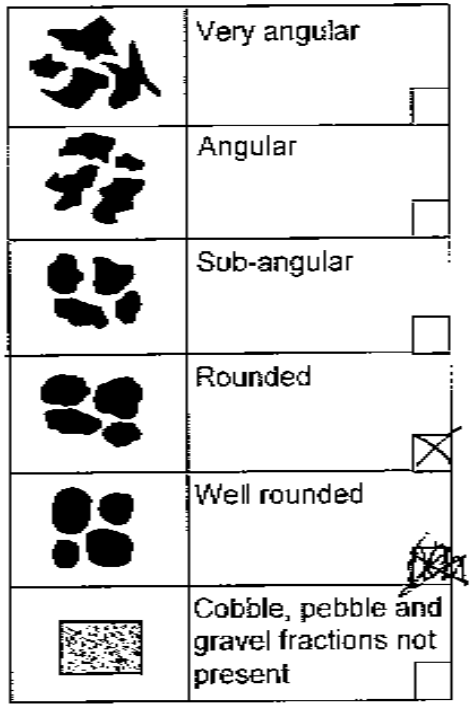
Sediment matrix
Choose one category only



- Bedrock
- Open framework — 0-5% fine sediment, high availability of interstitial spaces
- Matrix filled contact framework — 5-32% fine sediment, moderate availability of interstitial spaces
- Framework dilated — 32-60% fine sediment, low availability of interstitial spaces
- Matrix dominated — >60% fine sediment, interstitial spaces virtually absent

Blue rock placed from road works

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only



- Very angular
- Angular
- Sub-angular
- Rounded
- Well rounded
- Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← Stable → Unstable - depositing

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-50% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 50-100% of bank has erosional scars.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.	Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.	Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.	Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0

TOTAL HIGH GRADIENT HABITAT SCORE

Site No. GA 6211 Date 20/9/17

USEPA Habitat Assessment
Circe a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 (2) 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present; usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

weed present

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE	Left bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE	Right bank 10 9	8 7 (6)	5 4 3	2 1 0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.
SCORE	Left bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE	Right bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.	Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.	Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.	Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.
SCORE	Left bank 10 9	8 7 6	5 4 (3)	2 1 0
SCORE	Right bank 10 9	8 7 6	(5) 4 3	2 1 0

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. 6A Date 20.09.17.

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of 1

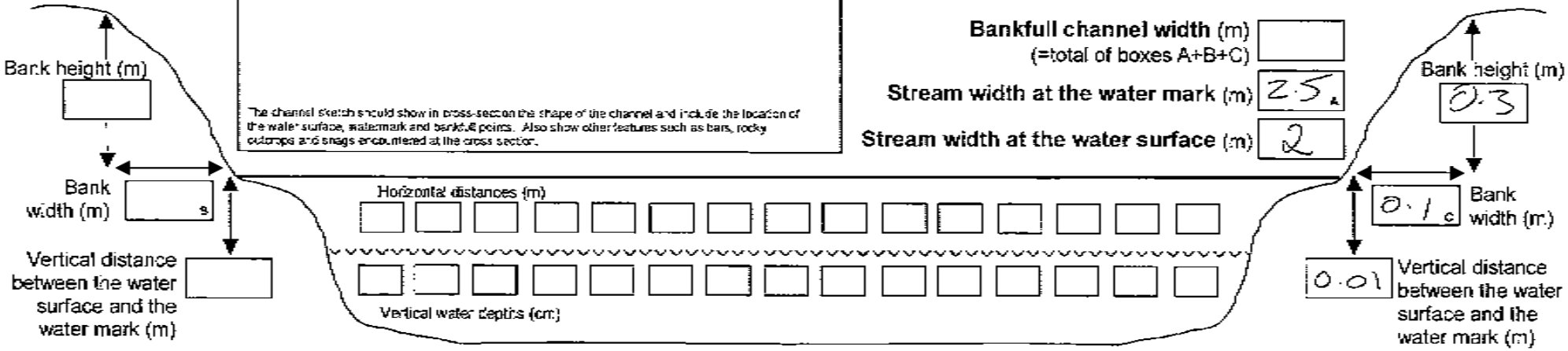
Type of bedform at the cross-section

☐ Riffle ☐ Run ☒ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C)

Stream width at the water mark (m) 2.5 A

Stream width at the water surface (m) 2



Notes on cross-section measurement

Riparian zone width

Left bank 6 (m) Right bank 10 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock	0	0
Boulder (>256mm)	0	0
Cobble (64-256mm)	10	10
Pebble (16-64mm)	10	10
Gravel (2-16mm)	5	5
Sand (0.06-2mm)	5	5
Fines (silt and clay, <0.06mm)	70	70
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	0
Boulder (>256mm)	0
Cobble (64-256mm)	10
Pebble (16-64mm)	20
Gravel (2-16mm)	5
Sand (0.06-2mm)	5
Fines (silt and clay <0.06mm)	60

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☑ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.
Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

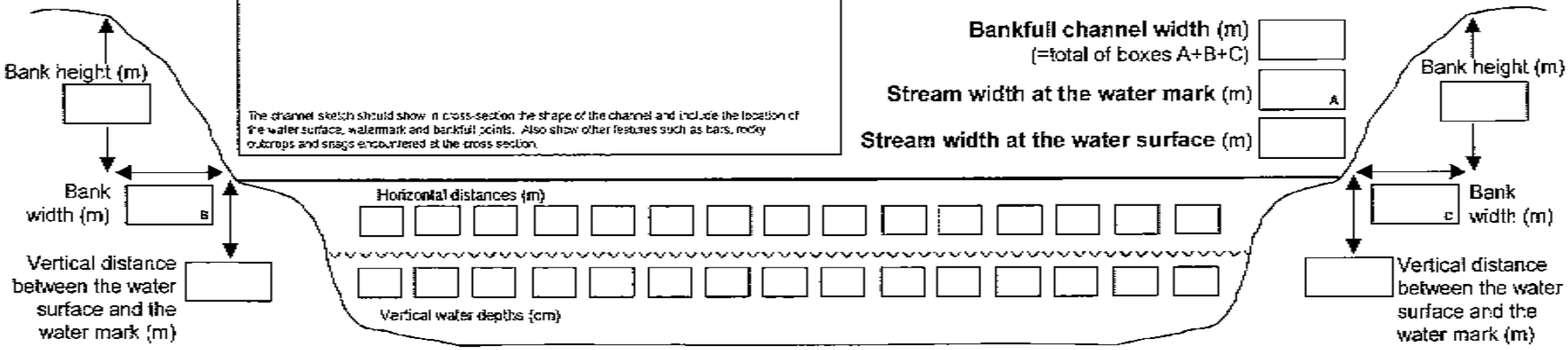
Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

Type of bedform at the cross-section
☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____
Stream width at the water mark (m) ____ A
Stream width at the water surface (m) ____



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number ____ of ____

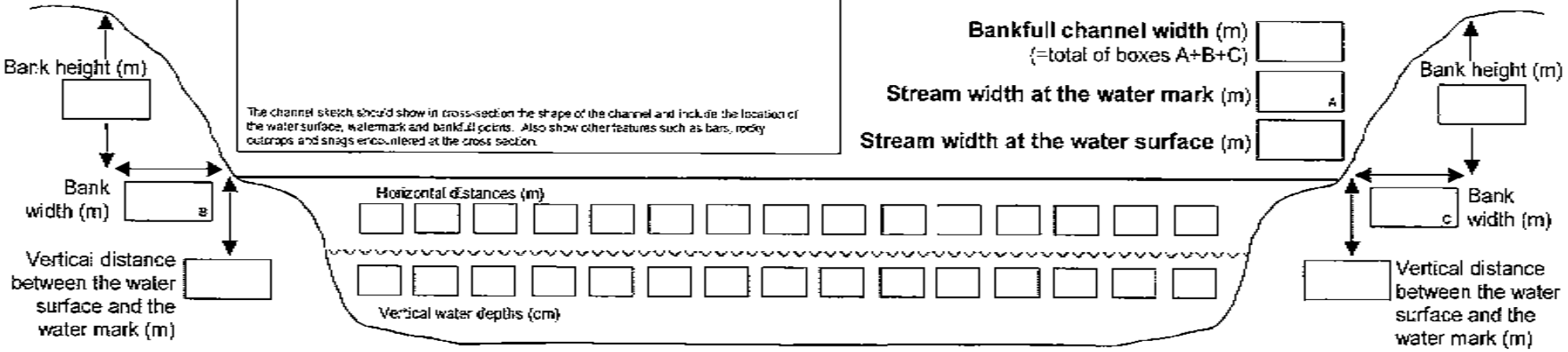
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets Page 1 Site No. 4A Date 21.09.17

Date 21.09.17 Site No. 4A. Time 0900 Recorder's Name JS + LL

River Name Rocky Creek Location Ballard

Weather Fine + Sunny. Rain in last week? Y [ ] N [X]

Photograph numbers and details refer LL iphone NESW.

	deg	min	sec		deg	min	sec
Latitude:	27	31	06	Longitude:	151	59	05

GPS Name and Datum

PLANFORM SKETCH OF SITE
Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features. Left bank is facing downstream.

See photo's.

Notes
White-throated gerygone.
Laughing kookaburra
Willie wag-tail

Hollow bearing stags present
~5-10 cm diameter

Arboreal → land holder.
Feral deer
Koala.
Pied currawong.

LENGTH OF SAMPLING SITE
Bankfull width _____ (m)
x 10
Length of sampling site 100 (m)

Notes
Debris from floods in the creek including old cars, wire, metal posts, asbestos sheeting.
Dog at time of survey.
Landholder noted Rocky Creek holds a light stream in heavy rainfall events.

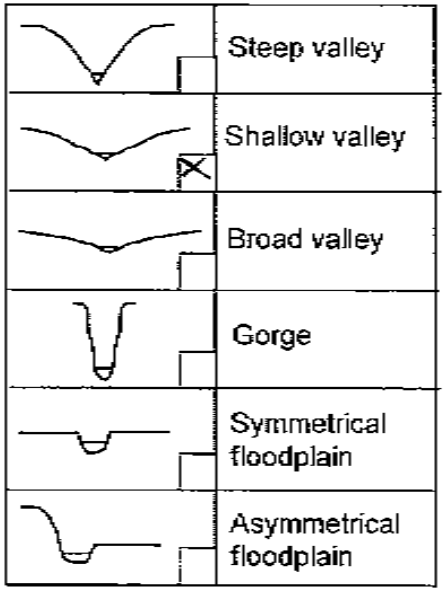
BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a). AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY
no water.

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ Water sample taken?		
Total nitrogen ☐ Water sample taken?		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape
Choose one category only



Local impacts on streams
Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☐ Road
- ☐ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☒ Grazing
- ☒ Litter – flood debris
- ☐ Recreation
- ☐ Other

Description _____

Floodplain width ____ ____ ____ Average 0 (m)

Floodplain features
Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse
Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☒	☒	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

May total more than 100%

	% Cover	Vegetation Description
Trees (>10m in height)	25 %	Blue gum, Eucalypt, C. trachyphloia.
Trees (<10m in height)	20%	Casuarina's.
Shrubs	10%	Melaleuca bracteata, lantana
Grasses / ferns / sedges	~ 60%	Pasture grasses

(leaf litter ~30%, bareground 10%).

Shading of channel

☐ < 5% ☐ 6 – 25% ☒ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☒ moderate

☐ slight ☐ extensive

Native and exotic riparian vegetation

% Native 80%.

% Exotic 20%. } Total 100%

(1) L. canaa.

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☐	☐
Regularly spaced	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☒	☒
Continuous	☐	☐

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [X]

If no, record regeneration category

☐ Abundant (>5% cover) and healthy

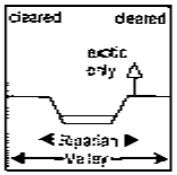
☐ Present

☒ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

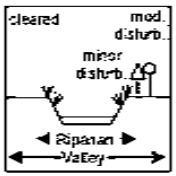
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

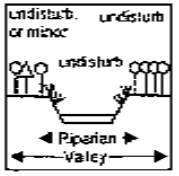
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

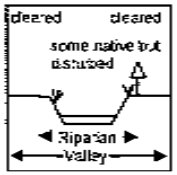
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

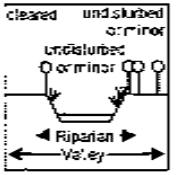
Very high disturbance ☐



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

Moderate disturbance ☒

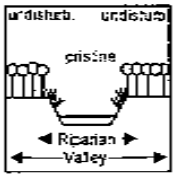


Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other in reasonably undisturbed state

↓ note grazing on both sides

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☐	☐	☐
Good passage	☑	☑	☑
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) _____

Type of bars

Choose one or more categories

- ☑ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type 0 %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

☑ No modifications		☐ Reinforced	
☐ Desnagged		☐ Revegetated	
☐ Dams and diversions		☐ Infilled	
☐ Resectioned		☐ Berms or embankments	
☐ Straightened	Signs of work still	☐ Recently channelised	
☐ Realigned	Works old and revegetated	☐ Channelised in the past	

Channel shape

Choose one category only

☐ U shaped	☐ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☑ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

	Left bank	Right bank
Concave	☐	☐
Convex	☐	☐
Stepped	☒	☒
Wide lower bench	☐	☐
Undercut	☐	☐

Bank slope
Choose one category for each bank

	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☒	☐
Moderate 30 - 60°	☐	☒
Low 10 - 30°	☐	☐
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☑ Stock access
- ☑ Human access
- ☐ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☐ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description erosion of bank evident from flood event + some ~~the~~ debris creating bank instability

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 10 %
Right Bank 10 %

Artificial bank protection measures
Choose one or more categories

- ☑ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other barbed wire fence only
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☐ absent ☐ light ☐ moderate ☐ profuse

Water oils
☐ none ☐ flecks ☐ globs ☐ sheen ☒ slick

Sediment odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ anaerobic ☐ other _____

Water odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ other _____

Turbidity (visual assessment)
☐ Clear ☐ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:
☐ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☒ Dry ☐ No flow ☐ Low ☐ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☐ Culvert ☐ Other

Description None

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

0 % Notes on visibility No large woody debris - Watercourse dry @ time of assessment.

Extent of bedform features – Dry.

Total % composition for all features must equal 100%

Height >1m Gradient >60°	Waterfall 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	Cascade 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	Rapid 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	Riffle 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	Glide 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	Run 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Area where stream widens or deepens and current declines	Pool 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	Backwater 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 0

% cover of emergent macrophytes _____

% cover of floating macrophytes _____

% cover of submerged macrophytes _____

} Total should equal overall % cover of macrophytes

Plants are present in the creek bed however they are not aquatic species eg lantana.

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	_____
Crassula (Crassula) N	☐	_____
Cyperus (Sedge) I/N	☐	_____
Eleocharis (Spikerush) N	☐	_____
Juncus (Rush) I/N	☐	_____
Paspalum (Water Couch) N	☐	_____
Phragmites (Common Reed) N	☐	_____
Ranunculus (Buttercup) I	☐	_____
Scirpus (Clubrush) N	☐	_____
Triglochin (Water Ribbon) N	☐	_____
Typha (Cumbungi) N	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	_____
Chara (Stonewart) N	☐	_____
Elodea (Canadian Pondweed) I	☐	_____
Myriophyllum (Water Milfoil) I/N	☐	_____
Nitella (Stonewart) N	☐	_____
Potamogeton (Pondweed) N	☐	_____
Triglochin (Water Ribbon) N	☐	_____
Vallisneria (Ribbonweed) N	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Floating macrophytes

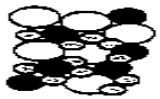
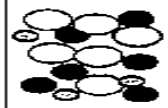
	Present	%
Azolla (Azolla) N	☐	_____
Callitriche (Starwart) I	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Overall % cover of native macrophyte taxa _____

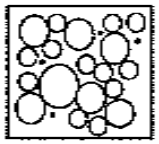
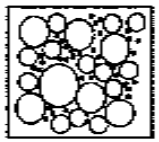
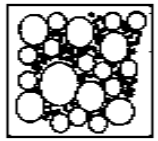
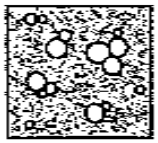
Overall % cover of native macrophyte taxa _____

} Total should equal overall % cover of macrophytes from above

Bed compaction
Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix
Choose one category only

	Bedrock
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← Stable → Unstable - depositing

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a relatively natural state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous placement of boulders or other large, natural obstruction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. 4A Date 21·09·17

USEPA Habitat Assessment — **LOW GRADIENT STREAMS** — Page 1 of 2

Circle a score for each parameter

Habitat parameter	Condition category			
	Excellent	**Good**	**Fair**	**Poor**
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 **19** 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 **13** 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 **0**
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 **0**
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Dry.

Continued over

Site No. 4A Date 21.09.17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																	
	Excellent					Good					Fair					Poor		
7. **Channel sinuosity**	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.		
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	(8)	7	6	5	4	3	2	1	0
8. **Bank stability** (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
SCORE	Left bank	10	9			(8)	7	6			5	4	3			2	1	0			
SCORE	Right bank	10	9			(8)	7	6			5	4	3			2	1	0			
9. **Vegetative protection** (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.		
SCORE	Left bank	10	9			8	7	6			(5)	4	3			2	1	0			
SCORE	Right bank	10	9			8	7	6			(5)	4	3			2	1	0			
10. **Riparian zone score** (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.		
SCORE	Left bank	10	9			8	7	6			5	4	3			(2)	1	0			
SCORE	Right bank	10	9			8	7	6			5	4	(3)			2	1	0			

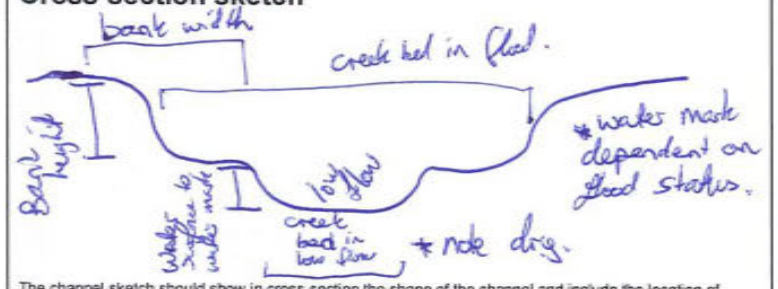
TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. 4A Date 21.09.17.

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.
Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch



The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of 1

Type of bedform at the cross-section
☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☒ Other Dry.

Bankfull channel width (m) (=total of boxes A+B+C)

Stream width at the water mark (m) A

Stream width at the water surface (m)

Bank height (m) average – 2

Bank width (m) 6 B

Vertical distance between the water surface and the water mark (m) 1m

Horizontal distances (m)

Vertical water depths (cm)

Bank height (m) 2

2 C Bank width (m)

1m Vertical distance between the water surface and the water mark (m)

Notes on cross-section measurement

Riparian zone width

Left bank 4 (m) Right bank 6 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock	10%	10%
Boulder (>256mm)	5%	5%
Cobble (64-256mm)	20%	20%
Pebble (16-64mm)	10%	10%
Gravel (2-16mm)	10%	10%
Sand (0.06-2mm)	10%	100%
Fines (silt and clay, <0.06mm)	35%	35%
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	0%
Boulder (>256mm)	5%
Cobble (64-256mm)	25%
Pebble (16-64mm)	15%
Gravel (2-16mm)	10%
Sand (0.06-2mm)	10%
Fines (silt and clay <0.06mm)	35%

Total 100%

Dry.

Assess in the area 5m either side of the cross section

Filamentous algae cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

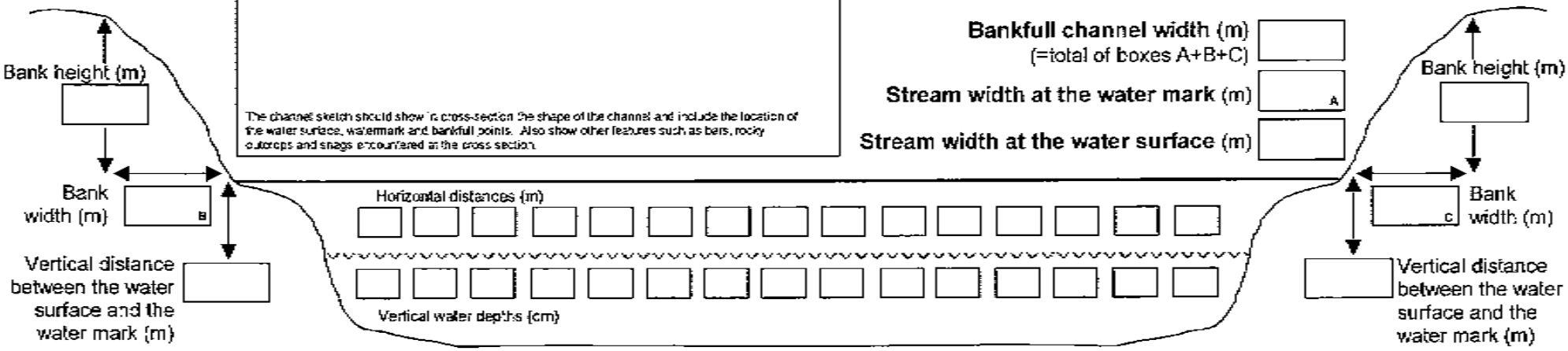
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number ____ of ____

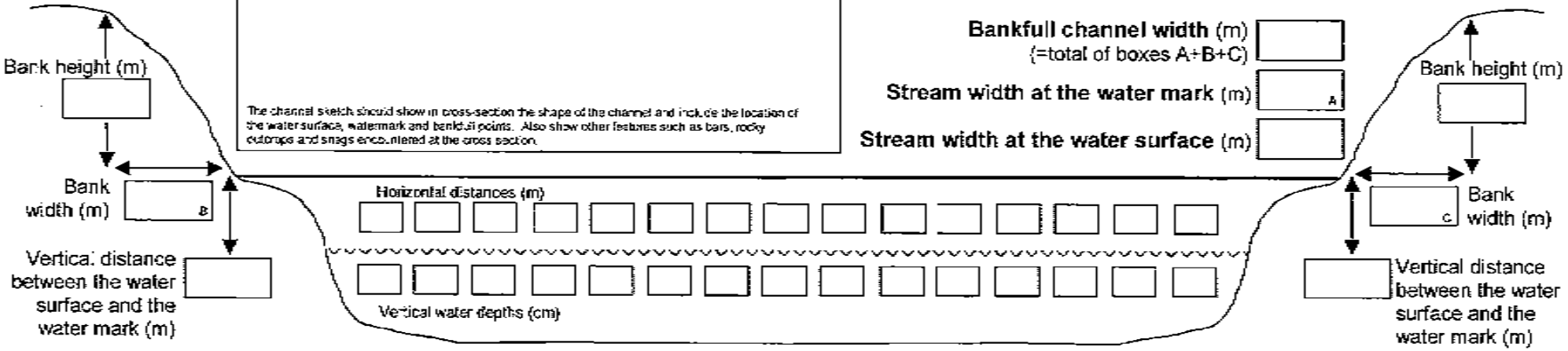
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets **Page 1** **Site No.** 5A. **Date** 21.09.17

Date 21.09.17. Site No. 5A. Time 1130 Recorder's Name JS + LL

River Name Rocky Creek Location Ballard.

Weather Fine + sunny. Rain in last week? Y [ ] N [X]

Photograph numbers and details LL iPhone Photo point 1 on bench, creek bed in high flow/flood events. Photo point 2 in creek bed.

	deg	min	sec		deg	min	sec
Latitude:	27	31	21	Longitude:	151	59	48

GPS Name and Datum

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

Fauna

Straw-necked ibis.
Masked lapwing
Cane toad. (KTP)
Goanna.

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100 (m)

Notes

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY

dry.

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ Water sample taken?		
Total nitrogen ☐ Water sample taken?		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

Choose one category only

- ☐ Steep valley
- ☒ Shallow valley
- ☐ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☐ Road
- ☐ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☒ Grazing
- ☐ Litter
- ☐ Recreation
- ☐ Other

Description _____

Floodplain width

_____ _____ _____ Average 0 (m)

Floodplain features

Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☒	☒	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

	% Cover	Vegetation Description
Trees (>10m in height)	15%	Blue gum, C. tachpholia
Trees (<10m in height)	20%	Casuarina glauca
Shrubs	10%	Lantana
Grasses / ferns / sedges	50%	Red natal grass, lomandra

May total more than 100%

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☐	☐
Regularly spaced	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☒	☒
Continuous	☐	☐

Shading of channel

☐ < 5% ☐ 6 – 25% ☒ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☒ moderate

☐ slight ☐ extensive

Native and exotic riparian vegetation

% Native 90

% Exotic 10

Total 100%

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [X]

If no, record regeneration category

☐ Abundant (>5% cover) and healthy

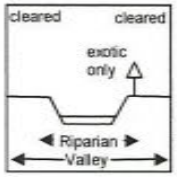
☒ Present

☐ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

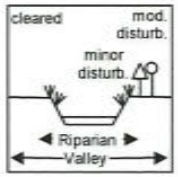
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

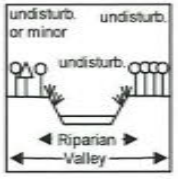
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

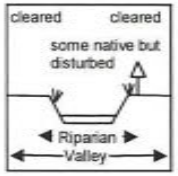
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

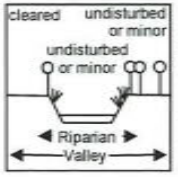
Very high disturbance ☐



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

Moderate disturbance ☒

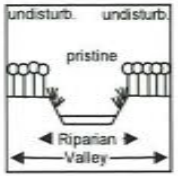


Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

cleared on both sides of valley

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☐	☐	☐
Partly restricted passage	☒	☒	☐
Good passage	☐	☐	☒
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) logs ~ 1m high

Type of bars

Choose one or more categories

- ☒ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type 0 %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [ ] ~~Gravel [ ]~~
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

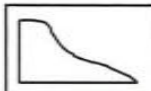
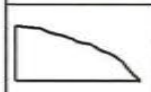
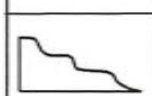
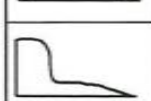
- ☒ No modifications
- ☐ Desnagged
- ☐ Dams and diversions
- ☐ Resectioned
- ☐ Straightened
- ☐ Realigned
- ☐ Reinforced
- ☐ Revegetated
- ☐ Infilled
- ☐ Berms or embankments
- ☐ Signs of work still
- ☐ Recently channelised
- ☐ Works old and revegetated
- ☐ Channelised in the past

Channel shape

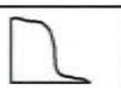
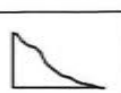
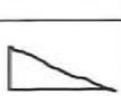
Choose one category only

- ☐ U shaped
- ☐ Flat U shaped
- ☐ Deepened U shape
- ☐ Widened or infilled
- ☒ Two stage
- ☐ Multi stage
- ☐ Box
- ☐ Wide box
- ☐ V shaped
- ☐ Trapezoid
- ☐ Concrete V
- ☐ Pipe or culvert

Bank shape
Choose one category for each bank

		Left bank	Right bank
	Concave	X	
	Convex		
	Stepped		X
	Wide lower bench		
	Undercut		

Bank slope
Choose one category for each bank

		Left bank	Right bank
	Vertical 80 - 90°	X	
	Steep 60 - 80°		
	Moderate 30 - 60°		X
	Low 10 - 30°		
	Flat <10°		

Factors affecting bank stability
Choose one or more categories

- [ ] None
- [ ] Mining
- [ ] Runoff
- [x] Stock access
- [ ] Human access
- [ ] Ford, culvert or bridge
- [ ] Feral animals
- [ ] Other
- [ ] Cleared vegetation
- [ ] Irrigation draw-down
- [ ] Reservoir releases
- [ ] Seepage
- [ ] Flow and waves
- [ ] Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 0%.
Right Bank 0%.

Artificial bank protection measures
Choose one or more categories

- [x] None
- [ ] Fence structures
- [ ] Levee banks
- [ ] Rock or wall layer
- [ ] Rip rap
- [ ] Fenced human access
- [ ] Other
- [ ] Fenced stock watering points
- [ ] Vegetation plantings
- [ ] Logs strapped to bank
- [ ] Concrete channel lining

Sediment oils Dry
- [x] absent [ ] light [ ] moderate [ ] profuse

Water oils
- [ ] none [ ] flecks [ ] globs [ ] sheen [ ] slick

Sediment odours
- [ ] normal/none [ ] sewage [x] petroleum [ ] chemical
- [ ] anaerobic [ ] other _____

Water odours
- [ ] normal/none [ ] sewage [ ] petroleum [ ] chemical
- [ ] other _____

Turbidity (visual assessment)
- [ ] Clear [ ] Slight [ ] Turbid [ ] Opaque

Is water clarity reduced by:
- [ ] Suspended material (e.g mud, clay, organics)
- [ ] Dissolved material (e.g plant leachates)

Water level at the time of sampling
- [x] Dry [ ] No flow [ ] Low [ ] Baseflow or near baseflow
- [ ] High [ ] Flood (don't sample)

Artificial features at the sampling site n/a.
Choose one or more categories

- [ ] Major [ ] Minor weir [ ] Ford [ ] Bridge [ ] Culvert [ ] Other

Description _____

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

20 % Notes on visibility Clear. Creek dry

Extent of bedform features

Total % composition for all features must equal 100%

Dry

Height >1m Gradient >60°	**Waterfall** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	**Cascade** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	**Rapid** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	**Riffle** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	**Glide** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	**Run** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Area where stream widens or deepens and current declines	**Pool** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	**Backwater** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes _____

* Veg. within creek bed. Not aquatic species / macrophyte. Ie casuarina's, banksia etc. Melaleuca.

% cover of emergent macrophytes _____

% cover of floating macrophytes _____

% cover of submerged macrophytes _____

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	_____
Crassula (Crassula) N	☐	_____
Cyperus (Sedge) I/N	☐	_____
Eleocharis (Spikerush) N	☐	_____
Juncus (Rush) I/N	☐	_____
Paspalum (Water Couch) N	☐	_____
Phragmites (Common Reed) N	☐	_____
Ranunculus (Buttercup) I	☐	_____
Scirpus (Clubrush) N	☐	_____
Triglochin (Water Ribbon) N	☐	_____
Typha (Cumbungi) N	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	_____
Chara (Stonewart) N	☐	_____
Elodea (Canadian Pondweed) I	☐	_____
Myriophyllum (Water Milfoil) I/N	☐	_____
Nitella (Stonewart) N	☐	_____
Potamogeton (Pondweed) N	☐	_____
Triglochin (Water Ribbon) N	☐	_____
Vallisneria (Ribbonweed) N	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Floating macrophytes

	Present	%
Azolla (Azolla) N	☐	_____
Callitriche (Starwart) I	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Overall % cover of native macrophyte taxa _____

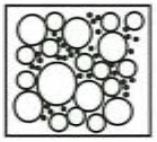
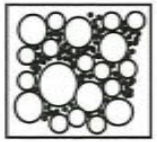
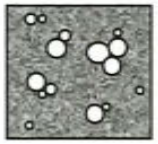
Overall % cover of native macrophyte taxa _____

Total should equal overall % cover of macrophytes from above

Bed compaction
Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix
Choose one category only

	Bedrock
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity
Choose one category only
Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating Choose one category only

Unstable - eroding ← **Stable** → **Unstable - depositing**

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.	Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.	Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.	Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.
SCORE Left bank	10 9	8 7 6	5 4 3	2 1 0
SCORE Right bank	10 9	8 7 6	5 4 3	2 1 0

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. SA Date 21-09-17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).					30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).					10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.					Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.					
SCORE	(20)	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.					Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.					All mud or clay or sand bottom; little or no root mat; no submerged vegetation.					Hard-pan clay or bedrock; no root mat or vegetation.					
SCORE	20	19	18	17	16	15	14	13	12	11	(10)	9	8	7	6	5	4	3	2	1	0	
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.					Majority of pools large-deep; very few shallow.					Shallow pools much more prevalent than deep pools.					Majority of pools small-shallow or pools absent.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	(0)	
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.					Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.					Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.					Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.					
SCORE	(20)	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.					Water fills >75% of the available channel; or <25% of channel substrate is exposed.					Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.					Very little water in channel and mostly present as standing pools.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	(0)	
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	(20)	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	

Dry

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																			
	Excellent					Good					Fair					Poor					
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE	Left bank	10	9			8		7		6	5		4		3	2			1		0
SCORE	Right bank	10	9			8		7		6	5		4		3	2			1		0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.				
SCORE	Left bank	10	9			8		7		6	5		4		3	2			1		0
SCORE	Right bank	10	9			8		7		6	5		4		3	2			1		0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.				
SCORE	Left bank	10	9			8		7		6	5		4		3	2			1		0
SCORE	Right bank	10	9			8		7		6	5		4		3	2			1		0

TOTAL LOW GRADIENT HABITAT SCORE [ ]

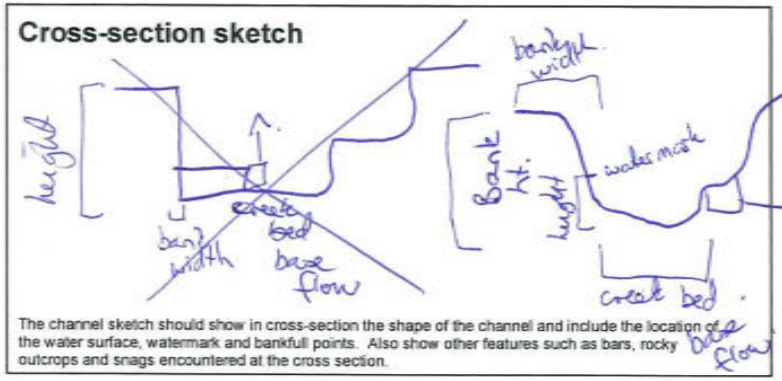
 Site No. 5a. Date 21.09.17.

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch



The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of 1

Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☒ Other Dry.

Bankfull channel width (m) (=total of boxes A+B+C)

Stream width at the water mark (m) 10 A

Stream width at the water surface (m) —

Bank height (m) 4.

Bank width (m) 1m B

Vertical distance between the ~~water~~ ~~surface~~ and the water mark (m) 1.5

creek bed.

Horizontal distances (m)

Vertical water depths (cm)

Bank height (m) 4

5 C Bank width (m)

1m Vertical distance between the ~~water~~ ~~surface~~ and the water mark (m) creek bed

Notes on cross-section measurement

Riparian zone width

Left bank 3 (m) Right bank 7 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock	0	0
Boulder (>256mm)	5	5
Cobble (64-256mm)	40	40
Pebble (16-64mm)	10	10
Gravel (2-16mm)	5	5
Sand (0.06-2mm)	5.	5
Fines (silt and clay, <0.06mm)	35.	35
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	0
Boulder (>256mm)	0
Cobble (64-256mm)	~~40~~ 60
Pebble (16-64mm)	5
Gravel (2-16mm)	5
Sand (0.06-2mm)	5.
Fines (silt and clay <0.06mm)	25

Total 100%

Assess in the area 5m either side of the cross section

0 **Filamentous algae cover** ☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

0 **Periphyton cover** ☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

0 **Moss cover** ☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

0 **Detritus cover** ☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

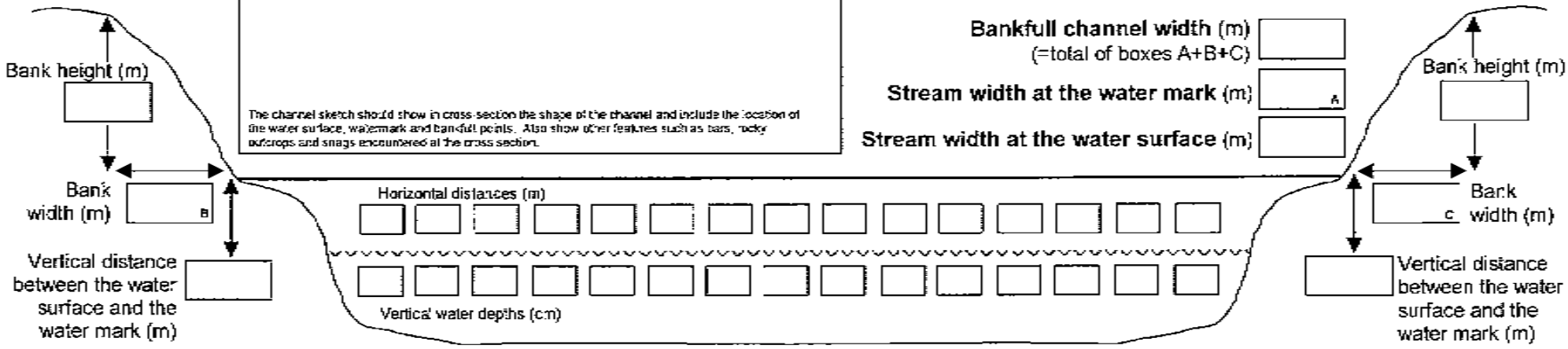
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____

Stream width at the water mark (m) ____ A

Stream width at the water surface (m) ____



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

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Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

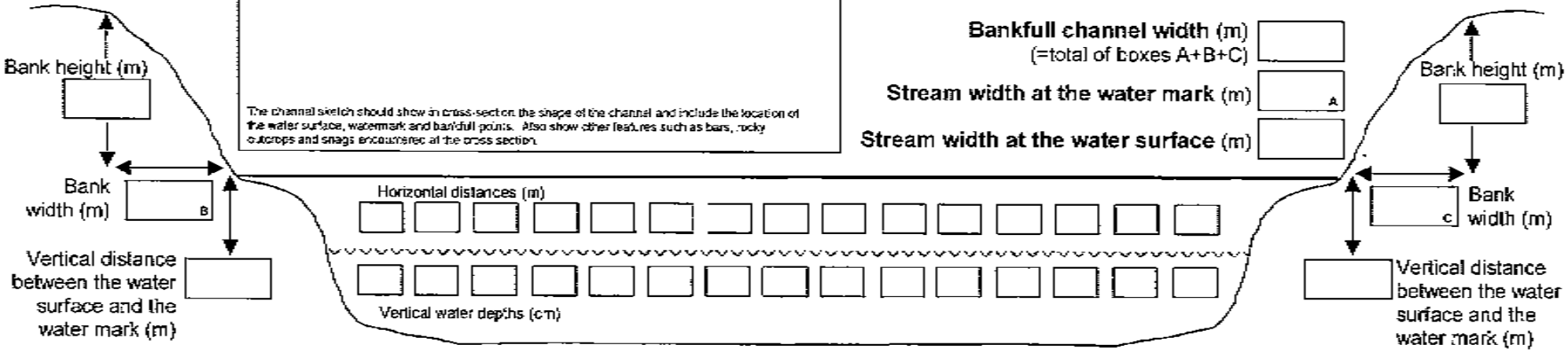
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets **Page 1** **Site No.** 8A **Date** 21.09.17

Date 21.09.17 Site No. 8A Time 1400 Recorder's Name JS + LL

River Name _____ Location Withcott.

Weather Fine + sunny. Rain in last week? Y [ ] N [X]

Photograph numbers and details refers LL iphone N, E, S, W.

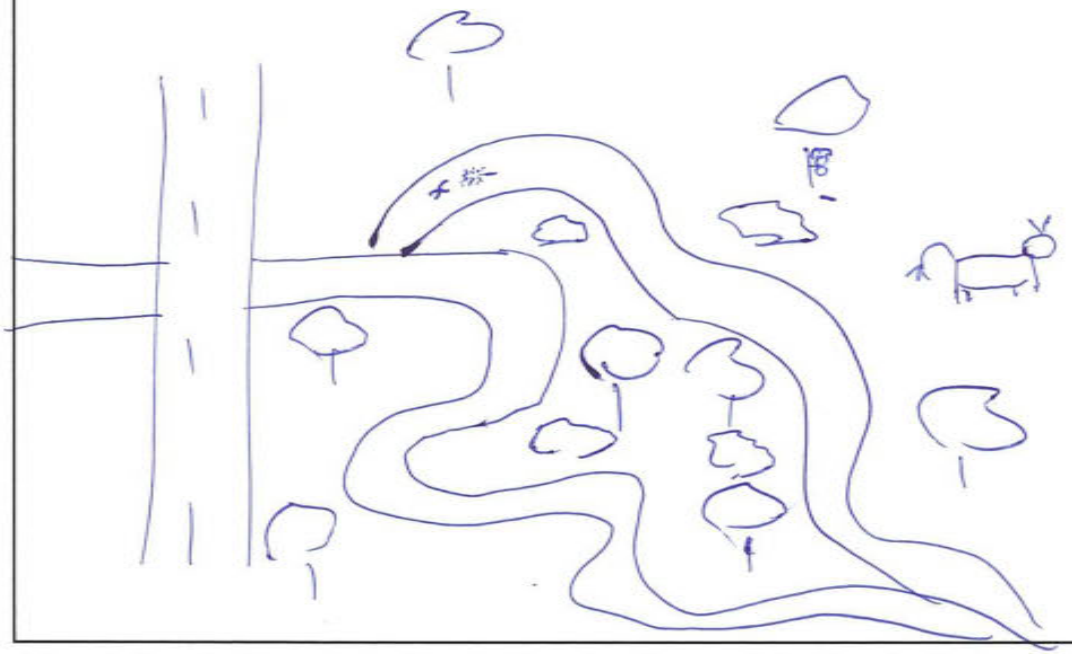
	deg	min	sec		deg	min	sec
Latitude:	27	30	27	Longitude:	152	03	25

GPS Name and Datum _____

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

Refers to photos.



LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100 (m)

Notes

Koala Scat

Echidna Scat

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY

dry

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus (☐ Water sample taken?)		
Total nitrogen (☐ Water sample taken?)		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

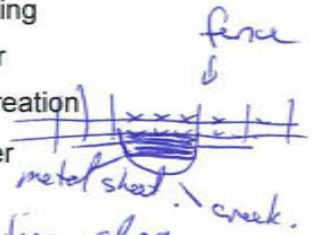
Choose one category only

- ☐ Steep valley
- ☐ Shallow valley
- ☒ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☐ Road
- ☐ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☒ Grazing
- ☐ Litter
- ☐ Recreation
- ☒ Other



Description fences + metal sheeting along width of creek at fence crossings

Floodplain width

_____ _____ _____ Average ~100 (m)

Floodplain features

Choose one or more features when present

- ☐ Sampling site has no distinct floodplain
- ☒ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☒	☒	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other _____

Riparian zone composition

Blue gum dominated floodplain.

Assess for whole sampling site

May total more than 100%

	% Cover	Vegetation Description
Trees (>10m in height)	30%	Blue Gum, E. cretata, C. tessellaris.
Trees (<10m in height)	—	—
Shrubs	20%	Lantana.
Grasses / ferns / sedges	70	Pasture grasses - grazed.

Shading of channel

☐ < 5% ☐ 6 – 25% ☐ 26 – 50% ☒ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☐ moderate

☒ slight ☐ extensive

Native and exotic riparian vegetation

% Native 80% } Total 100%

% Exotic 20%.

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☐	☐
Regularly spaced	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☒	☒
Continuous	☐	☐

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [X]

If no, record regeneration category

☐ Abundant (>5% cover) and healthy

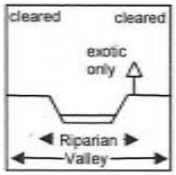
☐ Present

☒ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

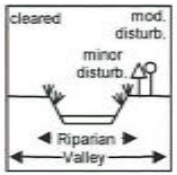
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

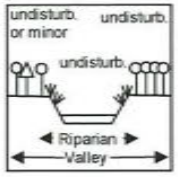
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

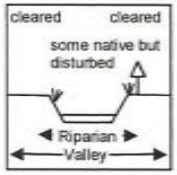
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

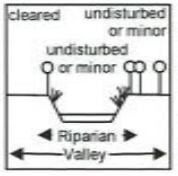
Very high disturbance ☒



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

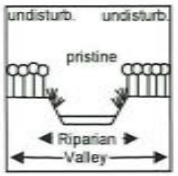
Moderate disturbance ☐



Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Riparian zone consists of canopy only (Blue gums) with Lantana shrub.

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☐	☐	☐
Moderately restricted passage	☑	☑	☐
Partly restricted passage	☐	☐	☑
Good passage	☐	☐	☐
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) Build up of debris in creek ~1m. Sheet metal at fence creek crossings ~2m.

Type of bars

Choose one or more categories

- ☒ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type _____ %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

☒	No modifications	☐	Reinforced
☐	Desnagged	☐	Revegetated
☐	Dams and diversions	☐	Infilled
☐	Resectioned	☐	Berms or embankments
☐	Straightened	Signs of work still	Recently channelised
☐	Realigned	Works old and revegetated	Channelised in the past

Channel shape

Choose one category only

☒ U shaped	☐ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

	Left bank	Right bank
Concave	☒	☒
Convex	☐	☐
Stepped	☐	☐
Wide lower bench	☐	☐
Undercut	☐	☐

Bank slope
Choose one category for each bank

	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☑	☐
Moderate 30 - 60°	☐	☑
Low 10 - 30°	☐	☐
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☒ Stock access
- ☐ Human access
- ☐ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☒ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 0
Right Bank 0

Artificial bank protection measures
Choose one or more categories

- ☒ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other _____
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☐ absent ☐ light ☐ moderate ☐ profuse

Water oils
☐ none ☐ flecks ☐ globs ☐ sheen ☒ slick

Sediment odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ anaerobic ☐ other _____

Water odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ other _____

Turbidity (visual assessment)
☐ Clear ☐ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:
☐ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☒ Dry ☐ No flow ☐ Low ☐ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☐ Culvert ☒ Other

Description Fence + metal sheeting at location along creek.

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

30 % Notes on visibility _____

Extent of bedform features

Total % composition for all features must equal 100%

Height >1m Gradient >60°	**Waterfall** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Height (m) ____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	**Cascade** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Height (m) ____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	**Rapid** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	**Riffle** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	**Glide** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	**Run** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
Area where stream widens or deepens and current declines	**Pool** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	**Backwater** 	____ % of site ____ Est. Av. Length (m) ____ Est. Av. Depth (m) ____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes ____0____

% cover of emergent macrophytes ____

% cover of floating macrophytes ____

% cover of submerged macrophytes ____

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	____
Crassula (Crassula) N	☐	____
Cyperus (Sedge) I/N	☐	____
Eleocharis (Spikerush) N	☐	____
Juncus (Rush) I/N	☐	____
Paspalum (Water Couch) N	☐	____
Phragmites (Common Reed) N	☐	____
Ranunculus (Buttercup) I	☐	____
Scirpus (Clubrush) N	☐	____
Triglochin (Water Ribbon) N	☐	____
Typha (Cumbungi) N	☐	____
Other _____	☐	____
Other _____	☐	____
Other _____	☐	____

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	____
Chara (Stonewart) N	☐	____
Elodea (Canadian Pondweed) I	☐	____
Myriophyllum (Water Milfoil) I/N	☐	____
Nitella (Stonewart) N	☐	____
Potamogeton (Pondweed) N	☐	____
Triglochin (Water Ribbon) N	☐	____
Vallisneria (Ribbonweed) N	☐	____
Other _____	☐	____
Other _____	☐	____
Other _____	☐	____

Floating macrophytes

	Present	%
Azolla (Azolla) N	☐	____
Callitriche (Starwart) I	☐	____
Other _____	☐	____
Other _____	☐	____
Other _____	☐	____

Overall % cover of native macrophyte taxa ____

Overall % cover of native macrophyte taxa ____

Total should equal overall % cover of macrophytes from above

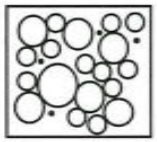
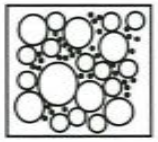
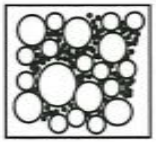
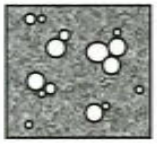
Bed compaction

Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix

Choose one category only

	Bedrock
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity

Choose one category only

Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating

Choose one category only

Unstable - eroding ← **Stable** → **Unstable - depositing**

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40–70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. **Frequency of riffles (or bends)**	Occurrence of riffles relatively frequent, ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural construction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8. **Bank stability** (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		
9. **Vegetative protection** (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		
10. **Riparian zone score** (score each bank)	Width of riparian zone >18 metres; human activities (i.e., roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.					
SCORE	Left bank	10	9			8		7		6	5		4		3	2		1		0		
SCORE	Right bank	10	9			8		7		6	5		4		3	2		1		0		

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. 8A Date 21.09.17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).					30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).					10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.					Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.					Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.					All mud or clay or sand bottom; little or no root mat; no submerged vegetation.					Hard-pan clay or bedrock; no root mat or vegetation.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.					Majority of pools large-deep; very few shallow.					Shallow pools much more prevalent than deep pools.					Majority of pools small-shallow or pools absent.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.					Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.					Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.					Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.					Water fills >75% of the available channel; or <25% of channel substrate is exposed.					Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.					Very little water in channel and mostly present as standing pools.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	**Good**	**Fair**	**Poor**
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE	Left bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE	Right bank 10 9	8 7 (6)	5 4 3	2 1 0
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.
SCORE	Left bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE	Right bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.	Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.	Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.	Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.
SCORE	Left bank 10 9	8 7 6	5 4 3	2 (1) 0
SCORE	Right bank 10 9	8 7 6	5 4 3	2 (1) 0

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. 8A Date 21.09.07

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.
Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of 1

Type of bedform at the cross-section
☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☒ Other Dy.

Bankfull channel width (m) (=total of boxes A+B+C)

Stream width at the water mark (m) 1.5 A

Stream width at the water surface (m)

Bank height (m) 3

Bank width (m) 2 B

Vertical distance between the ~~water~~ surface and the water mark (m) 0.3

great bed.

Horizontal distances (m)

Vertical water depths (cm)

Bank height (m) 1m

0.5 C Bank width (m)

0.1 Vertical distance between the ~~water~~ surface and the water mark (m)

great bed.

Notes on cross-section measurement

Riparian zone width

Left bank 1 (m) Right bank 1 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock	0	0
Boulder (>256mm)	0	0
Cobble (64-256mm)	10	10
Pebble (16-64mm)	0	0
Gravel (2-16mm)	0	0
Sand (0.06-2mm)	10	10
Fines (silt and clay, <0.06mm)	80	80
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	0
Boulder (>256mm)	0
Cobble (64-256mm)	10
Pebble (16-64mm)	5
Gravel (2-16mm)	10
Sand (0.06-2mm)	40
Fines (silt and clay <0.06mm)	35

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, water mark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

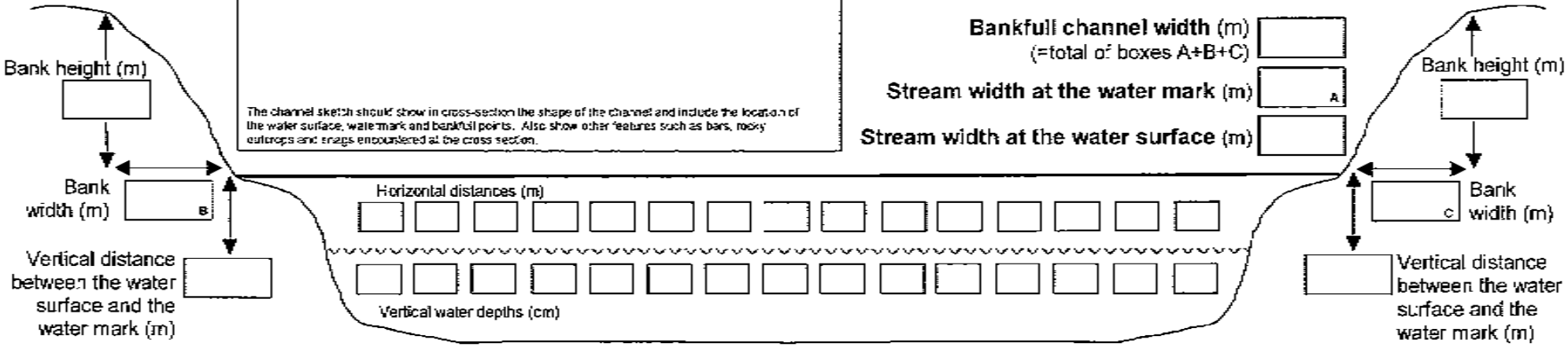
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

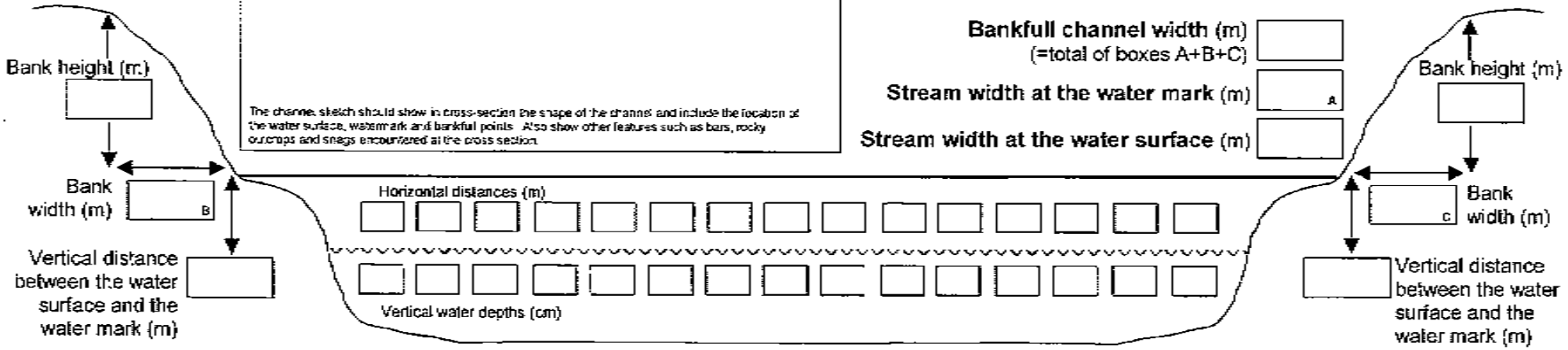
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets **Page 1** **Site No.** GZH 10A **Date** 22/9/17

GZH

Date 22/9/17 Site No. 10A alt Time 9.00am Recorder's Name LL + JS

River Name Rocky Creek Location postman's Ridge Rd - postmans Ridge

Weather Clear Sunny Rain in last week? Y [ ] N [Y] Photograph numbers and details 12 iphone 11 E SW

Latitude: deg min sec Longitude: deg min sec

GPS Name and Datum

PLANFORM SKETCH OF SITE

Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

Refer to photos

Native rainbow → see photo
Glassfish.

Purple swamp hens
Welcome Swallows
Pied Comrat
Turtles seen : 10 cm diameter
2nd - 30cm diameter short Neck.

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100 (m)

Notes

* Bridge crossing for Postmans Ridge Rd.
* Access track to creek. Litter present.

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY
Refer to surface water sheet

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ Water sample taken?		
Total nitrogen ☐ Water sample taken?		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape
Choose one category only

- ☐ Steep valley
- ☒ Shallow valley
- ☐ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams
Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☒ Road Postmans Ridge Rd.
- ☒ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☐ Grazing
- ☒ Litter
- ☐ Recreation
- ☐ Other

Description _____

Floodplain width _____ _____ _____ Average _____ (m)

Floodplain features
Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse
Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☐	☐	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☐	☐	Cropped Rainfed [ ][ ] Irrigated [ ][ ]
☒	☒	Rural ~~Urban~~ residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation
☐	☐	Other Road reserve.

Riparian zone composition

Assess for whole sampling site

	% Cover	Vegetation Description
Trees (>10m in height)	5%	Casuarina glauca.
Trees (<10m in height)	10%.	Casuarina glauca.
Shrubs	5%.	Weeping bottle brush.
Grasses / ferns / sedges	70%.	Typha, tall chloris Juncus, Sida subsicata.

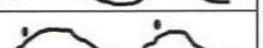
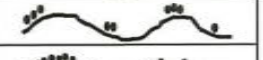
May total more than 100%

Shading of channel note ~10% shading from bridge.

☐ < 5% ☑ 6 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ > 76%

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

		Left bank	Right bank
None		☐	☐
Isolated / scattered		☐	☐
Regularly spaced		☐	☐
Occasional clumps		☑	☑
Semi-continuous		☐	☐
Continuous		☐	☐

Extent of trailing bank vegetation

☐ nil ☐ moderate

☐ slight ☒ extensive

Native and exotic riparian vegetation

% Native 90%.

% Exotic 10%.

Total 100%

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [✓]

If no, record regeneration category

☐ Abundant (>5% cover) and healthy

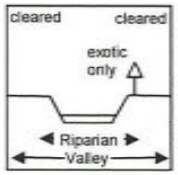
☐ Present

☑ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

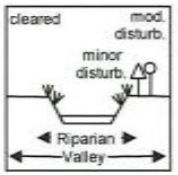
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

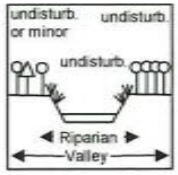
High disturbance ☐



Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

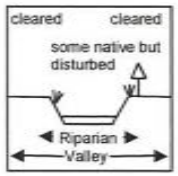
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

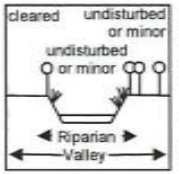
Very high disturbance ☒



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

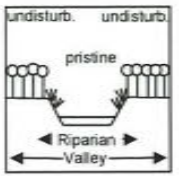
Moderate disturbance ☐



Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

bedrock on banks basking habitat for turtles

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☒	☒	☐
Moderately restricted passage	☐	☐	☒
Partly restricted passage	☐	☐	☐
Good passage	☐	☐	☐
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) bedrock + extensive typha clumps ~ ?m.

Type of bars

Choose one or more categories

- ☒ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type 0 %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

☒ No modifications		☒ Reinforced bridge.	
☐ Desnagged		☐ Revegetated	
☐ Dams and diversions		☐ Infilled	
☐ Resectioned		☐ Berms or embankments	
☐ Straightened	Signs of work still	☐ Recently channelised	
☐ Realigned	Works old and revegetated	☐ Channelised in the past	

Channel shape

Choose one category only

☒ U shaped	☐ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Turbidity high causing low vis. can't see bottom.

Bank shape
Choose one category for each bank

	Left bank	Right bank
Concave	☑	☑
Convex	☐	☐
Stepped	☐	☐
Wide lower bench	☐	☐
Undercut	☐	☐

Bank slope
Choose one category for each bank

	Left bank	Right bank
Vertical 80 - 90°	☐	☐
Steep 60 - 80°	☐	☐
Moderate 30 - 60°	☑	☐
Low 10 - 30°	☐	☑
Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☐ Stock access
- ☑ Human access
- ☑ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☐ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description _____

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 20%.
Right Bank 10%.

Artificial bank protection measures
Choose one or more categories

- ☐ None
- ☐ Fence structures
- ☐ Levee banks
- ☑ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other associate with bridge
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☑ absent ☐ light ☐ moderate ☐ profuse

Water oils
☑ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Sediment odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☑ anaerobic ☐ other Stagnet pool.

Water odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☑ other stagnet pool.

Turbidity (visual assessment)
☐ Clear ☐ Slight ☑ Turbid ☐ Opaque

Is water clarity reduced by:
☑ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☐ Dry ☑ No flow ☐ Low ☐ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☑ Bridge ☐ Culvert ☐ Other

Description Postmans Ridge Rd.

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

2 % Notes on visibility _____

Extent of bedform features

Total % composition for all features must equal 100%

Height >1m Gradient >60°	**Waterfall** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	**Cascade** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	**Rapid** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	**Riffle** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	**Glide** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	**Run** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Area where stream widens or deepens and current declines	**Pool** 	100 % of site 100m Est. Av. Length (m) 1m Est. Av. Depth (m) 4m Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	**Backwater** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes 70%

% cover of emergent macrophytes 40

% cover of floating macrophytes 1

% cover of submerged macrophytes 30.

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	
Crassula (Crassula) N	☐	
Cyperus (Sedge) I/N	☐	
Eleocharis (Spikerush) N	☐	
Juncus (Rush) I/N	✓	10
Paspalum (Water Couch) N	☐	
Phragmites (Common Reed) N	☐	
Ranunculus (Buttercup) I	☐	
Scirpus (Clubrush) N	☐	
Triglochin (Water Ribbon) N	☐	
Typha (Cumbungi) N	✓	30
Other _____	☐	
Other _____	☐	
Other _____	☐	

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	
Chara (Stonewart) N	☐	
Elodea (Canadian Pondweed) I	✓	30.
Myriophyllum (Water Milfoil) I/N	☐	
Nitella (Stonewart) N	☐	
Potamogeton (Pondweed) N	☐	
Triglochin (Water Ribbon) N	☐	
Vallisneria (Ribbonweed) N	☐	
Other _____	☐	
Other _____	☐	
Other _____	☐	

Floating macrophytes

	Present	%
Azolla (Azolla) N	☐	
Callitriche (Starwart) I	☐	
Other _____	☐	
Other _____	☐	
Other _____	☐	

Overall % cover of native macrophyte taxa 40

Overall % cover of native macrophyte taxa 30.

Total should equal overall % cover of macrophytes from above

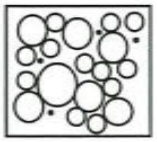
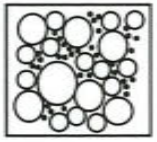
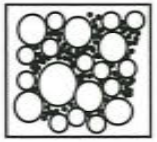
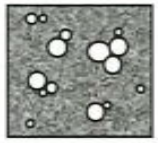
Bed compaction

Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge X
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix

Choose one category only

	Bedrock X
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity

Choose one category only

Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present X

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating

Choose one category only

Unstable - eroding ← **Stable** → **Unstable - depositing**

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material. X	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge acutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0				
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0				
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.					
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0				
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0				
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.					
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0				
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0				

TOTAL HIGH GRADIENT HABITAT SCORE

Site No. _____ Date _____

USEPA Habitat Assessment — **LOW GRADIENT STREAMS** — Page 1 of 2

Circle a score for each parameter

Habitat parameter	Condition category				
	Excellent	Good	Fair	Poor	
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.	
SCORE	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.	
SCORE	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1 0	
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 **6**	5 4 3 2 1 0	
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 **3** 2 1 0	
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	
SCORE	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	

bridge.

Continued over

Site No. 10A Date 22-09-17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.						
SCORE	Left bank	10	9			8		7		6	5		4		3	2			1		0	
SCORE	Right bank	10	9			8		7		6	5		4		3	2			1		0	
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.						
SCORE	Left bank	10	9			8		7		6	5		4		3	2			1		0	
SCORE	Right bank	10	9			8		7		6	5		4		3	2			1		0	
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.						
SCORE	Left bank	10	9			8		7		6	5		4		3	2			1		0	
SCORE	Right bank	10	9			8		7		6	5		4		3	2			1		0	

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.
Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).
Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

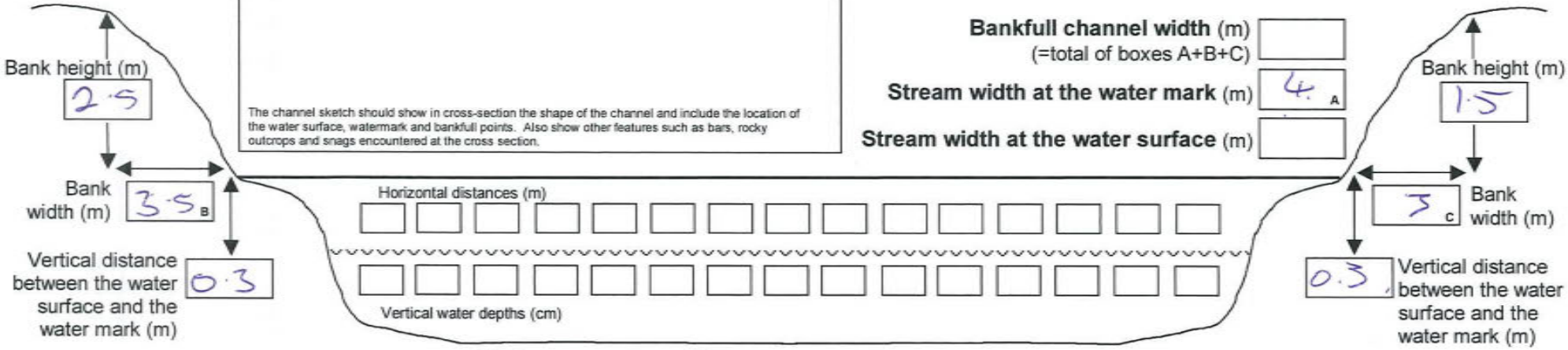
Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of 1

Type of bedform at the cross-section
☐ Riffle ☐ Run ☑ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) _____
Stream width at the water mark (m) 4. A
Stream width at the water surface (m) _____



Notes on cross-section measurement

Riparian zone width
Left bank 1 (m) Right bank 2 (m)

Bank material
Assess % composition for each bank

	Left bank	Right bank
Bedrock	5	5
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)	5	5
Fines (silt and clay, <0.06mm)	90	90.

Total 100% each

Substrate composition
Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	80
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	5
Fines (silt and clay <0.06mm)	15

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover
☐ <10% ☐ 10–35% ☐ 35-65% ☑ 65-90% ☐ >90%

Periphyton cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover
☑ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

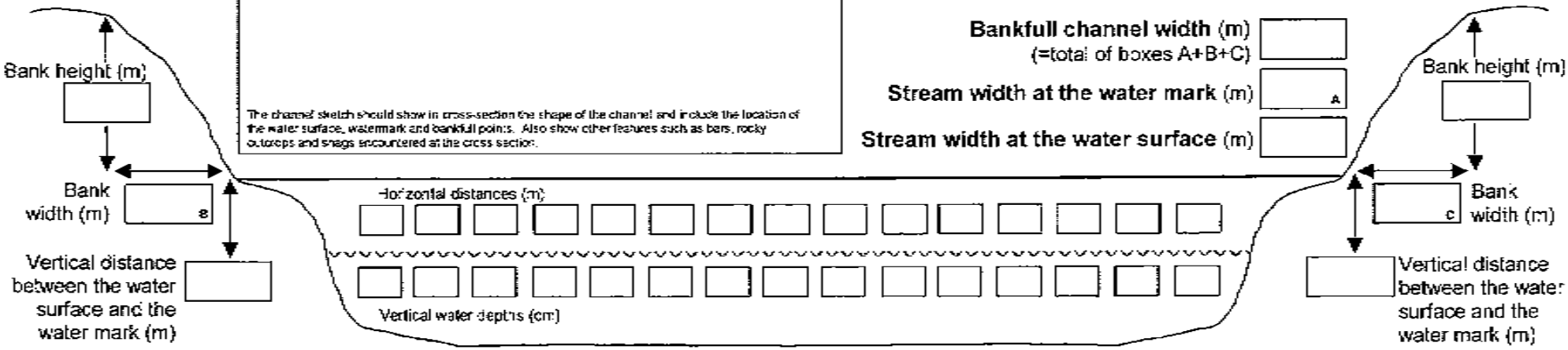
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ____

Stream width at the water mark (m) ____ A

Stream width at the water surface (m) ____



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	
	Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

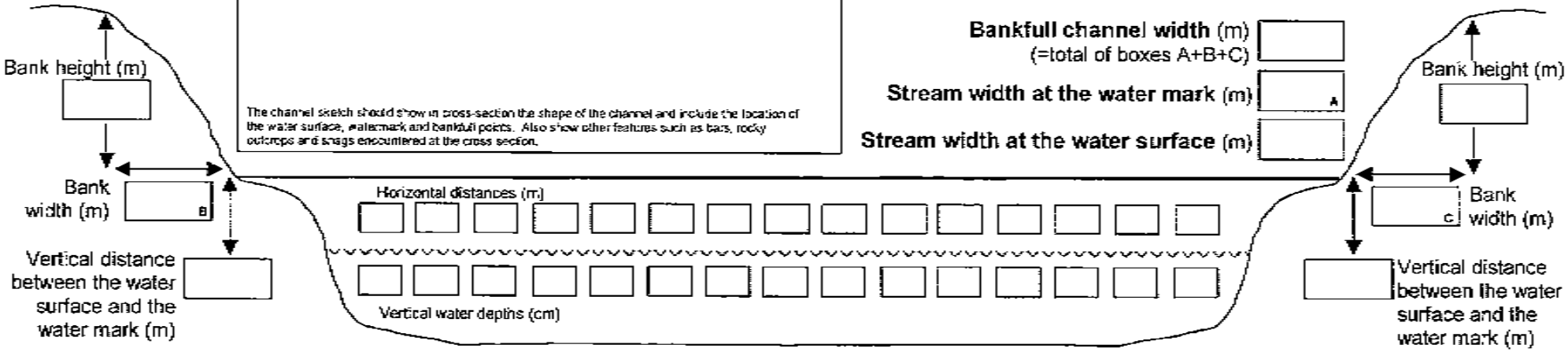
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

AUSRIVAS Physical Assessment Protocol Field Data Sheets **Page 1** **Site No.** 7A alt **Date** 22.09.17

Date 22.09.17 Site No. 7a alt Time 1100 Recorder's Name LL + JS

River Name _____ Location _____

Weather Fine + Sunny. Rain in last week? Y [ ] N [X]

Photograph numbers and details Refer LL iphone
NESW

Latitude: deg 27 min 31 sec 33 Longitude: deg 152 min 02 sec 19"

GPS Name and Datum _____

PLANFORM SKETCH OF SITE
Including bedform types, location of cross-sections, access points, landmarks and natural or artificial channel or floodplain features.
Left bank is facing downstream.

Refer to photos

LENGTH OF SAMPLING SITE

Bankfull width _____ (m)

x 10

Length of sampling site 100. (m)

Notes

Bed level road crossing for Six Mile Creek.
Overhead power lines. Power liner cross creek. Signs of historical clearing for power easement.

BEFORE LEAVING THE SITE, CHECK DATA SHEETS TO ENSURE THAT ALL VARIABLES HAVE BEEN RECORDED [ ] Y

Acknowledgments - The content and layout of these data sheets are derived from the sheets used in the River Habitat Audit Procedure (Anderson, 1993a), AUSRIVAS, the Index of Stream Condition (Ladson and White, 1999 and DNRE Victoria) and the River Habitat Survey (Raven *et al.*, 1998).

BASIC WATER CHEMISTRY

Dry

		Units
Temperature		°c
Conductivity		
Dissolved Oxygen		mg l^{-1}
Dissolved Oxygen Sat.		%
pH		
Turbidity		
Total phosphorus ☐ Water sample taken?		
Total nitrogen ☐ Water sample taken?		
ALKALINITY		
Amount of water		ml
Amount of H_2SO_4		ml
Alkalinity		mg l^{-1}

Valley shape

Choose one category only

- ☐ Steep valley
- ☐ Shallow valley
- ☒ Broad valley
- ☐ Gorge
- ☐ Symmetrical floodplain
- ☐ Asymmetrical floodplain

Local impacts on streams

Choose one or more categories and describe the detail of each

- ☐ Sand or gravel mining
- ☐ Other mining
- ☒ Road
- ☒ Bridge / culvert / wharf
- ☐ Ford / ramp
- ☐ Discharge pipe
- ☐ Forestry activities
- ☐ Sugar mill
- ☐ Irrigation run-off or pipe outlet
- ☐ Sewage effluent
- ☐ Channel straightening
- ☐ River improvement works
- ☐ Water extraction
- ☐ Dredging
- ☐ Grazing
- ☐ Litter
- ☐ Recreation
- ☐ Other

Description Red level crossing for Six Mile Ck road crossing
2 RCP ~0.5m diameter under road.

Floodplain width _____ _____ _____ Average _____ (m)

Floodplain features

Choose one or more features when present

- ☒ Sampling site has no distinct floodplain
- ☐ Oxbows / billabongs
  Body of water occupying a former river meander, isolated by a shift in the stream channel
- ☐ Remnant channels
  Formed during a previous hydrological regime. May be infilled with sediment
- ☐ Flood channels
  A channel that distributes water onto the floodplain and off the floodplain during floods
- ☐ Scroll systems
  Short, crescentic strips or patches formed along the inner bank of a stream meander
- ☐ Splays
  Small alluvial fan formed where an overloaded stream breaks through a levee and deposits material on the floodplain
- ☐ Floodplain scours
  Scour holes formed by the concentrated clearing and digging action of flowing water
- ☐ No floodplain features present
  Floodplain present at the sampling site but does not contain any of the above features

Local landuse

Choose one category for each bank

Left	Right	
☐	☐	Native forest
☐	☐	Native grassland (not grazed)
☐	☒	Grazing (native or non-native pasture)
☐	☐	Exotic grassland (lawns etc., no grazing)
☐	☐	Forestry Native [ ][ ] Pine [ ][ ]
☒	☐	Cropped Rainfed [ ][ ] Irrigated [☒][ ]
☐	☐	Urban residential
☐	☐	Commercial
☐	☐	Industrial or intensive agricultural
☐	☐	Recreation present camp facilities
☐	☐	Other _____

Riparian zone composition

Assess for whole sampling site

Cas. glauca.

	% Cover	Vegetation Description
Trees (>10m in height)	10 %.	Blue gum, E. cebras, C. tracky.
Trees (<10m in height)	5 %.	A. excelsa.
Shrubs	25 %.	Lantana camara.
Grasses / ferns / sedges	95 %.	Lomandra M, Guinea grass,

May total more than 100%

Longitudinal extent of riparian vegetation

Choose one category for each bank. Do not include ground layer except where site is in native grassland.

	Left bank	Right bank
None	☐	☐
Isolated / scattered	☐	☐
Regularly spaced	☐	☐
Occasional clumps	☑	☑
Semi-continuous	☐	☐
Continuous	☐	☐

Shading of channel

☐ < 5% ☒ 6 – 25% ☐ 26 – 50% ☐ 51 – 75% ☐ > 76%

Extent of trailing bank vegetation

☐ nil ☐ moderate

☐ slight ☒ extensive

Native and exotic riparian vegetation

% Native 15

% Exotic 85

Total 100%

Regeneration of native woody vegetation

Is the sampling site in undisturbed forest?

Y [ ] N [✓]

If no, record regeneration category

☐ Abundant (>5% cover) and healthy

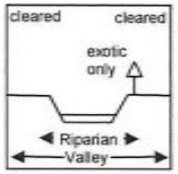
☐ Present

☑ Very limited (<1% cover)

Overall vegetation disturbance rating

Choose one category only. Sites with valley vegetation cleared on BOTH sides, but with riparian vegetation in good condition should be scored in the high disturbance category. Words within the drawings summarise the detailed text about the state of the riparian and valley vegetation for each category.

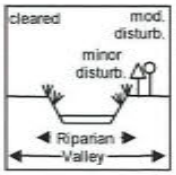
Extreme disturbance ☐



Riparian vegetation – absent or severely reduced. Vegetation is extremely disturbed (ie. dominated by exotic species with native species rare or completely absent)

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

High disturbance ☒

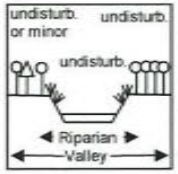


Riparian vegetation – moderately disturbed by stock or through the intrusion of exotic species, although some native species remain

Valley vegetation – agriculture and/or cleared land ONE side, native vegetation on the other side clearly disturbed or with a high percentage of introduced species present

cleared both sides

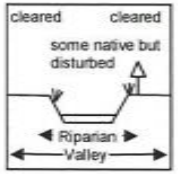
Low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in relatively good condition with few exotic species present. Any disturbance present is relatively minor.

Valley vegetation – native vegetation present on BOTH sides of the river, with a virtually intact canopy and few exotic species

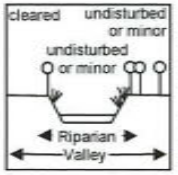
Very high disturbance ☐



Riparian vegetation – some native vegetation present, but it is severely modified BOTH sides by grazing or the intrusion of exotic species. Native species severely reduced in number and cover.

Valley vegetation – agriculture and/or cleared land BOTH sides. Plants present are virtually all exotic species (willows, pines etc.)

Moderate disturbance ☒

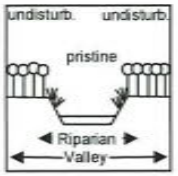


Riparian vegetation – native vegetation on BOTH sides with canopy intact or with native species widespread and common in the riparian zone. The intrusion of exotic species is minor and of moderate

Valley vegetation – agriculture and/or cleared land on ONE side, native vegetation on the other in reasonably undisturbed state

Both sides

Very low disturbance ☐



Riparian vegetation – native vegetation present on BOTH sides of the river and in an undisturbed state. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Valley vegetation – native vegetation present on BOTH sides of the river with an intact canopy. Exotic species are absent or rare. Representative of natural vegetation in excellent condition

Physical barriers to local fish passage

Choose one category for each flow condition

	Base flow	Low flow	High flow
No passage	☐	☐	☐
Very restricted passage	☑	☑	☐
Moderately restricted passage	☐	☐	☑
Partly restricted passage	☐	☐	☐
Good passage	☐	☐	☐
Unrestricted passage	☐	☐	☐

Type and height of barrier(s) Six mile creek rd.
Sed level crossing ~ 1m high
2x RCP culverts ~ 1m diameter.
Fence crossing along creek with caught debris

Type of bars

Choose one or more categories

- ☒ Bars absent
- ☐ Side/point bars VEGETATED
- ☐ Side/point bars UNVEGETATED
- ☐ Mid-channel bars VEGETATED
- ☐ Mid-channel bars UNVEGETATED
- ☐ Bars around obstructions
- ☐ Braided channel
- ☐ Infilled channel
- ☐ High flow deposits

Extent of bars

% of streambed forming a bar of any type 0 %

Dominant sediment particle size on bars

Boulder/cobble [ ] Pebble [ ] Gravel [ ]
Sand [ ] Silt/clay [ ] or _____mm

Channel modifications

Choose one or more categories

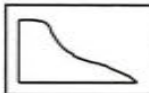
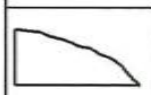
☐ No modifications		☐ Reinforced	
☐ Desnagged		☐ Revegetated	
☐ Dams and diversions		☐ Infilled	
☐ Resectioned		☐ Berms or embankments	
☒ Straightened slightly due to road crossing	Signs of work still	☐ Recently channelised	
☐ Realigned	Works old and revegetated	☐ Channelised in the past	

Channel shape

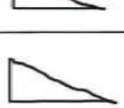
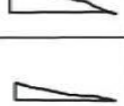
Choose one category only

☐ U shaped	☒ Flat U shaped	☐ Deepened U shape	☐ Widened or infilled	☐ Two stage	☐ Multi stage
☐ Box	☐ Wide box	☐ V shaped	☐ Trapezoid	☐ Concrete V	☐ Pipe or culvert

Bank shape
Choose one category for each bank

		Left bank	Right bank
	Concave	☐	☐
	Convex	☒	☒
	Stepped	☐	☐
	Wide lower bench	☐	☐
	Undercut	☐	☐

Bank slope
Choose one category for each bank

		Left bank	Right bank
	Vertical 80 - 90°	☐	☐
	Steep 60 - 80°	☐	☐
	Moderate 30 - 60°	☒	☒
	Low 10 - 30°	☐	☐
	Flat <10°	☐	☐

Factors affecting bank stability
Choose one or more categories

- ☐ None
- ☐ Mining
- ☐ Runoff
- ☒ Stock access
- ☐ Human access
- ☒ Ford, culvert or bridge
- ☐ Feral animals
- ☐ Other
- ☐ Cleared vegetation
- ☐ Irrigation draw-down
- ☐ Reservoir releases
- ☐ Seepage
- ☐ Flow and waves
- ☐ Drainpipes

Description bed level rd crossing

Bedrock outcrops
Assess % of each bank covered by bedrock outcrops

% bedrock outcrops Left bank 0
Right Bank 0

Artificial bank protection measures
Choose one or more categories

- ☒ None
- ☐ Fence structures
- ☐ Levee banks
- ☐ Rock or wall layer
- ☐ Rip rap
- ☐ Fenced human access
- ☐ Other
- ☐ Fenced stock watering points
- ☐ Vegetation plantings
- ☐ Logs strapped to bank
- ☐ Concrete channel lining

Sediment oils
☐ absent ☐ light ☐ moderate ☐ profuse

Water oils
☐ none ☐ flecks ☐ globs ☐ sheen ☐ slick

Dry

Sediment odours
☐ normal/none ☐ sewage ☒ petroleum ☐ chemical
☐ anaerobic ☐ other

Water odours
☐ normal/none ☐ sewage ☐ petroleum ☐ chemical
☐ other

Turbidity (visual assessment)
☐ Clear ☐ Slight ☐ Turbid ☐ Opaque

Is water clarity reduced by:
☐ Suspended material (e.g mud, clay, organics) ☐ Dissolved material (e.g plant leachates)

Water level at the time of sampling
☒ Dry ☐ No flow ☐ Low ☐ Baseflow or near baseflow
☐ High ☐ Flood (don't sample)

Artificial features at the sampling site
Choose one or more categories

☐ Major ☐ Minor weir ☐ Ford ☐ Bridge ☒ Culvert ☐ Other

Description Bed level crossing Six Mile Ck Rd 2 RCP (round concrete pipe) culverts a lm diam

Large woody debris
Overall % cover of logs and branches greater than 10cm in diameter

10 % Notes on visibility

Extent of bedform features

Total % composition for all features must equal 100%

Height >1m Gradient >60°	**Waterfall** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Step Height <1m Gradient 5-60° Strong currents	**Cascade** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Height (m) _____ Est. Av. Gradient (°)
Gradient 3-5° Strong currents Rocks break surface	**Rapid** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Moderate currents Surface unbroken but unsmooth	**Riffle** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small currents Surface unbroken and smooth	**Glide** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Gradient 1-3° Small but distinct & uniform current Surface unbroken	**Run** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
Area where stream widens or deepens and current declines	**Pool** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)
A reasonable sized (>20% of channel width) cut-off section away from	**Backwater** 	_____ % of site _____ Est. Av. Length (m) _____ Est. Av. Depth (m) _____ Est. Av. Width (m)

Note: An additional response variable planform channel pattern is measured in the office

Macrophyte cover

Assess % cover of the sampling site by each category.

Overall % cover of macrophytes _____

_____ % cover of emergent macrophytes

_____ % cover of floating macrophytes

_____ % cover of submerged macrophytes

Total should equal overall % cover of macrophytes

Macrophyte composition

Use a macrophyte field guide (i.e. Sainty and Jacobs, 1994) to aid identification.
Listed macrophytes can be changed to reflect the common taxa present in each State or Territory.
N denotes a native taxa and I denotes an introduced taxa.

Emergent macrophytes

	Present	% cover
Brachiaria (Para Grass) I	☐	_____
Crassula (Crassula) N	☐	_____
Cyperus (Sedge) I/N	☐	_____
Eleocharis (Spikerush) N	☐	_____
Juncus (Rush) I/N	☐	_____
Paspalum (Water Couch) N	☐	_____
Phragmites (Common Reed) N	☐	_____
Ranunculus (Buttercup) I	☐	_____
Scirpus (Clubrush) N	☐	_____
Triglochin (Water Ribbon) N	☐	_____
Typha (Cumbungi) N	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Submerged macrophytes

	Present	% cover
Ceratophyllum (Hornwort) N	☐	_____
Chara (Stonewart) N	☐	_____
Elodea (Canadian Pondweed) I	☐	_____
Myriophyllum (Water Milfoil) I/N	☐	_____
Nitella (Stonewart) N	☐	_____
Potamogeton (Pondweed) N	☐	_____
Triglochin (Water Ribbon) N	☐	_____
Vallisneria (Ribbonweed) N	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Floating macrophytes

	Present	%
Azolla (Azolla) N	☐	_____
Callitriche (Starwart) I	☐	_____
Other _____	☐	_____
Other _____	☐	_____
Other _____	☐	_____

Overall % cover of native macrophyte taxa _____

Overall % cover of native macrophyte taxa _____

Total should equal overall % cover of macrophytes from above

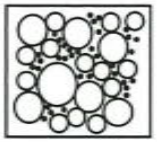
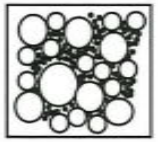
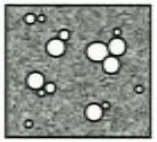
Bed compaction

Choose one category only

	Tightly packed, armoured Array of sediment sizes, overlapping, tightly packed and very hard to dislodge
	Packed, unarmoured Array of sediment sizes, overlapping, tightly packed but can be dislodged with moderate
	Moderate compaction Array of sediment sizes, little overlapping, some packing but can be dislodged with moderate
	Low compaction (1) Limited range of sediment sizes, little overlapping, some packing and structure but can be dislodged very easily
	Low compaction (2) Loose array of fine sediments, no overlapping, no packing and structure and can be dislodged very easily

Sediment matrix

Choose one category only

	Bedrock
	Open framework 0-5% fine sediment, high availability of interstitial spaces
	Matrix filled contact framework 5-32% fine sediment, moderate availability of interstitial spaces
	Framework dilated 32-60% fine sediment, low availability of interstitial spaces
	Matrix dominated >60% fine sediment, interstitial spaces virtually absent

Sediment angularity

Choose one category only

Assess cobble, pebble and gravel fractions only

	Very angular
	Angular
	Sub-angular
	Rounded
	Well rounded
	Cobble, pebble and gravel fractions not present

In the USEPA Habitat Assessment on the following pages, be sure to use the correct form for high or low gradient streams

Bed stability rating

Choose one category only

Unstable - eroding ← **Stable** → **Unstable - depositing**

Severe erosion	Moderate erosion	Bed stable	Moderate deposition	Severe deposition
Streambed scoured of fine sediments. Signs of channel deepening. Bare, severely eroded banks. Erosion heads. Steep streambed caused by erosion.	Little fine sediment present. Signs of channel deepening. Eroded banks. Streambed deep and narrow. Steep streambed comprised of unconsolidated (loosely arranged and unpacked) material	A range of sediment sizes present in the streambed. Channel is in a 'relatively natural' state (not deepened or infilled). Bed and bar sediments are roughly the same size. Banks stable. Streambed comprised of consolidated (tightly arranged and packed) material.	Moderate build-up of fine sediments at obstructions and bars. Streambed flat and uniform. Channel wide and shallow.	Extensive build up of fine sediments to form a flat bed. Channel blocked, but wide and shallow. Bars large and covering most of the bed or banks. Streambed comprised of unconsolidated (loosely arranged and unpacked) material.

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category			
	Excellent	Good	Fair	Poor
1. Epifaunal substrate / available cover	Greater than 70% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity / depth regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). Slow is <0.3m/s, deep is >0.5m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

HIGH GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
7. Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.					Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.					Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.					Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.					
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0				
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0				
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.					
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0				
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0				
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.					
SCORE	Left bank	10	9			8	7	6			5	4	3			2	1	0				
SCORE	Right bank	10	9			8	7	6			5	4	3			2	1	0				

TOTAL HIGH GRADIENT HABITAT SCORE [ ]

Site No. 7a Date 22-09-17

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																					
	Excellent					Good					Fair					Poor							
1. Epifaunal substrate / available cover	Greater than 50% of substrate favourable for epifaunal colonisation and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonisation potential (i.e. logs/snags that are not new fall and not transient).					30-50% mix of stable habitat; well-suited for full colonisation potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonisation (may rate at high end of scale).					10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.					Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	(5)	4	3	2	1	0	
2. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.					Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.					All mud or clay or sand bottom; little or no root mat; no submerged vegetation.					Hard-pan clay or bedrock; no root mat or vegetation.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	(3)	2	1	0	
3. Pool variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.					Majority of pools large-deep; very few shallow.					Shallow pools much more prevalent than deep pools.					Majority of pools small-shallow or pools absent.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	(0)	
4. Sediment deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.					Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.					Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition in pools prevalent.					Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.					
SCORE	(20)	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
5. Channel flow status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.					Water fills >75% of the available channel; or <25% of channel substrate is exposed.					Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.					Very little water in channel and mostly present as standing pools.					
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	(0)	
6. Channel alteration	Channelization or dredging absent or minimal; stream with normal pattern.					Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging (greater than 20 yr) may be present, but recent channelization is not present.					Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.					Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.					
SCORE	20	19	18	17	(16)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	

Dry

Note bed level
Road crossing

Continued over

Site No. _____ Date _____

USEPA Habitat Assessment
Circle a score for each parameter

LOW GRADIENT STREAMS

Habitat parameter	Condition category																	
	Excellent					Good					Fair					Poor		
7. Channel sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note – channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).					The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.					The bends in the stream increase the stream 1 to 2 times longer than if it was in a straight line.					Channel straight; waterway has been channelized for a long distance.		
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	(8)	7	6	5	4	3	2	1	0
8. Bank stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.					Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.					Unstable; many eroded areas; 'raw' areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
SCORE	Left bank	10	(9)			8		7		6	5		4		3	2		1		0	
SCORE	Right bank	10	(9)			8		7		6	5		4		3	2		1		0	
9. Vegetative protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understorey shrubs, or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.					70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one half of the potential plant stubble height remaining.					50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.					Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimetres or less in average stubble height.		
SCORE	Left bank	10	9			(8)		7		6	5		4		3	2		1		0	
SCORE	Right bank	10	9			(8)		7		6	5		4		3	2		1		0	
10. Riparian zone score (score each bank)	Width of riparian zone >18 metres; human activities (i.e. roads, lawns, crops etc.) have not impacted the riparian zone.					Width of riparian zone 12-18 metres; human activities have impacted the riparian zone only minimally.					Width of riparian zone 6-12 metres; human activities have impacted the riparian zone a great deal.					Width of riparian zone <6 metres; little or no riparian vegetation is present because of human activities.		
SCORE	Left bank	10	9			8		7		6	(5)		4		3	2		1		0	
SCORE	Right bank	10	9			8		7		6	(5)		4		3	2		1		0	

TOTAL LOW GRADIENT HABITAT SCORE [ ]

 Site No. 7a alt Date 22.09.17.

Channel cross-sections and variables to be measured in the area around a cross section

Detailed instructions on the measurement of channel cross-sections are provided in the protocol manual. Be familiar with these before proceeding.

Two cross-sections are required at homogeneous sampling sites (generally lowland streams) and three cross-sections at heterogeneous sampling sites (generally upland streams).

Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number 1 of 1

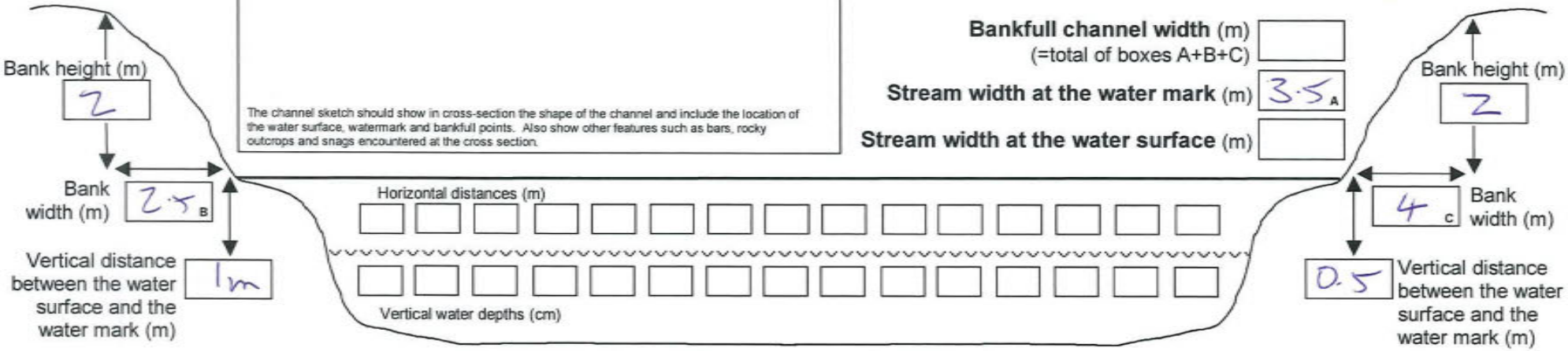
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☒ Other Dry

Bankfull channel width (m) (=total of boxes A+B+C)

Stream width at the water mark (m) 3.5 A

Stream width at the water surface (m)



Notes on cross-section measurement

Riparian zone width

Left bank 8 (m) Right bank 10 (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)	5	5
Gravel (2-16mm)	5	5
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)	90	90

Total 100% each

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	10
Pebble (16-64mm)	50
Gravel (2-16mm)	5
Sand (0.06-2mm)	15
Fines (silt and clay <0.06mm)	20

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☒ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☒ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☒ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☒ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Where the water level at the time of sampling is at or near the water mark level, stream width at the water surface will be equal to stream width at the water mark. In this case, vertical distance between the water surface and the water mark should be entered as 0.

Cross-section sketch

The channel sketch should show in cross-section the shape of the channel and include the location of the water surface, watermark and bankfull points. Also show other features such as bars, rocky outcrops and snags encountered at the cross section.

Cross-section number _____ of _____

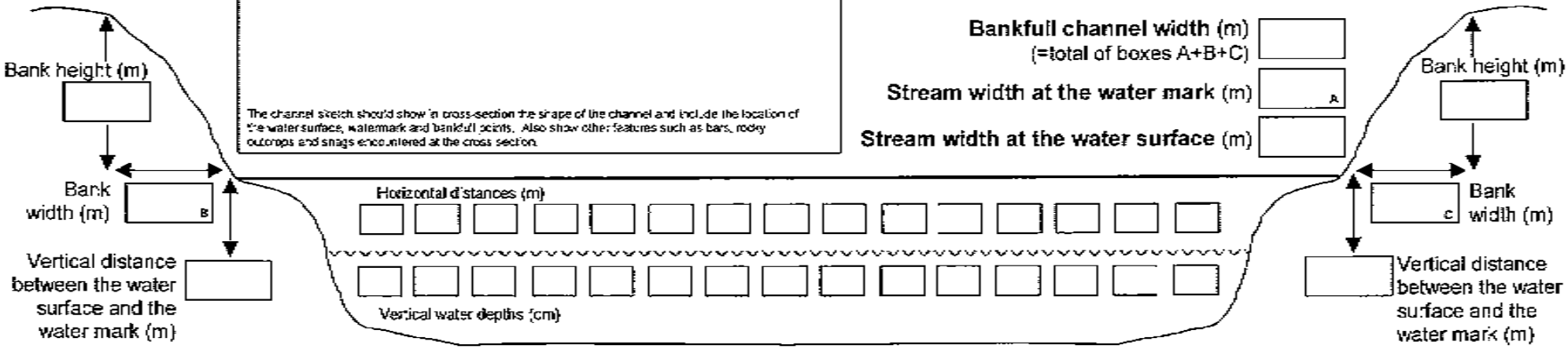
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Detritus cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

 Site No. _____ Date _____

Channel cross-sections and variables to be measured in the area around a cross section

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Cross-section sketch

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Cross-section number _____ of _____

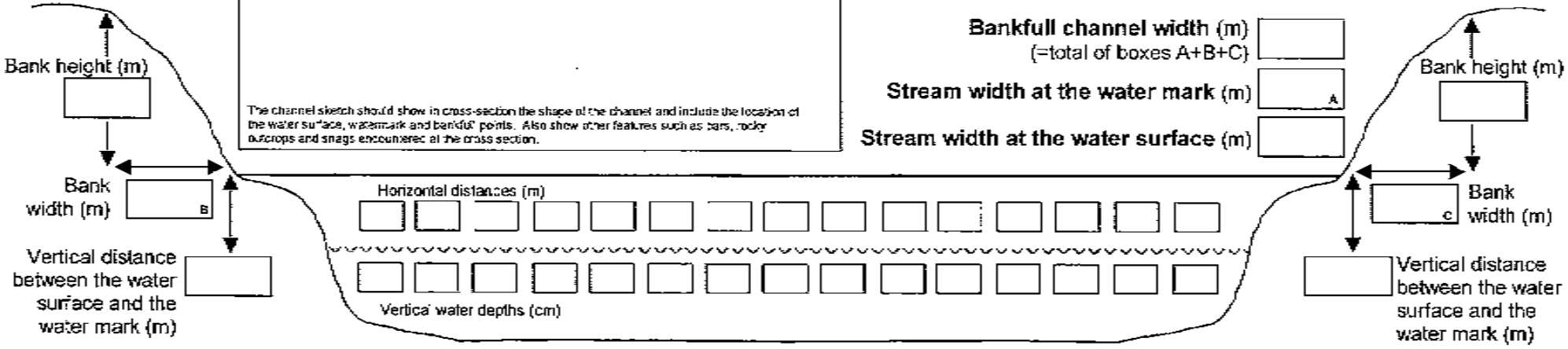
Type of bedform at the cross-section

☐ Riffle ☐ Run ☐ Pool ☐ Cascade ☐ Other _____

Bankfull channel width (m) (=total of boxes A+B+C) ☐

Stream width at the water mark (m) ☐ A

Stream width at the water surface (m) ☐



Notes on cross-section measurement

_____

_____

Riparian zone width

Left bank _____ (m) Right bank _____ (m)

Bank material

Assess % composition for each bank

	Left bank	Right bank
Bedrock		
Boulder (>256mm)		
Cobble (64-256mm)		
Pebble (16-64mm)		
Gravel (2-16mm)		
Sand (0.06-2mm)		
Fines (silt and clay, <0.06mm)		
	Total 100% each	

Substrate composition

Assess % composition in the area of bed 5m either side of the cross-section.

Bedrock	
Boulder (>256mm)	
Cobble (64-256mm)	
Pebble (16-64mm)	
Gravel (2-16mm)	
Sand (0.06-2mm)	
Fines (silt and clay <0.06mm)	

Total 100%

Assess in the area 5m either side of the cross section

Filamentous algae cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Periphyton cover

☐ <10% ☐ 10–35% ☐ 35-65% ☐ 65-90% ☐ >90%

Moss cover

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Detritus cover

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