WATTA WELLA RENEWABLE ENERGY PROJECT- HYDROLOGY AND FLOOD REPORT

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Climate Change Statement

A wide range of sources, including but not limited to the IPCC, CSIRO and BoM, unanimously agree that the global climate is changing. Unless otherwise stated, the information provided in this report does not take into consideration the varying nature of climate change and its consequences on our current engineering practices. The results presented may be significantly underestimated; flood characteristics shown (e.g. flood depths, extents and hazards) are may be different once climate change is taken into account.

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1. Executive Summary

Afflux Consulting were engaged to provide an assessment of hydrology and flood impacts arising from the Watta Wella Renewable Energy Project (the Project) a proposed solar farm, wind farm and battery energy storage system facility located east of Stawell in Victoria.

This report has been prepared to support discussions with relevant agencies and support an approvals pathway and an Environment Effects Statement (EES) referral.

The Project includes assets that are broadly defined as energy generating (i.e. solar and wind component), storage (battery storage) and support infrastructure (such as reticulation and access tracks).

The assessment undertaken has involved flood modelling for three recurrence intervals that are applicable to the various assessment phases and design requirements as indicated in Table 1. As such they will be of interest for different audiences at various stages throughout the project life. While there is a primary focus on understanding catchment implications for the rarer events (i.e.1% AEP) the Planning scheme requires a risk assessment which should also consider impacts at a range of frequencies and have been included for completeness.

Table 1. Planning and Design Requirements

Assessment Standard	Rationale	Audience
1% AEP	A 1 in 100 year flood event (1% AEP) is used to identify land likely to be affected by floodwater under the Northern Grampians Planning Scheme (the Planning Scheme) to determine the requirements for planning permits for new development within flood prone areas. Land Subject to Inundation Overlay (LSIO) within the Planning Scheme concerns areas that in a 1% AEP storm event are likely to be impacted by waters rising from a defined watercourse (typically to a depth <500mm). This can pose an unacceptable risk to development within the flood affected area. A Floodway Overlay (FO) concerns areas with that are regularly flooded and typically to a depth of >500mm. This concerns the actual channel or streambed of a watercourse. The Project area lies within both an LSIO and FO. Any new development within an LSIO or FO is subject to planning permit requirements under the Planning Scheme.	Northern Grampians Shire Council, Department of Environment, Land, Water and Planning (DELWP), Wimmera Catchment Management Authority.
39.35% AEP	This design requirement was requested by the proponent to inform the design location of infrastructure to determine operational impacts of flooding. This level of assessment is also used in risk assessment to determine if there are impacts at higher frequencies. It is an important indicator of stream shear stress and waterway functions.	Proponent, design team, facility operators
10% AEP	Commonly adopted within industry for the design of functional assets such as roadways and culverts. This level of assessment is also used in risk assessment to determine if there are impacts at higher frequencies.	Proponent, design team, facility operators

The approach used for the study is a hybrid approach. Remote from the area of interest a hydrological model has been used to estimate larger flows from the Wimmera catchment. This model has been developed after a review of historic assessments for the area.

Contemporary Direct Rainfall methods have been used for the local catchment and informed by recent photogrammetry survey collected for the Project. The Direct Rainfall method has the advantage of characterising complex interactions with terrain, and as such is considered more appropriate to develop an understanding of the various infrastructure requirements.

The infrastructure layout that has been assessed in this report has already undergone an iteration with catchment modelling which was initially focussed on a critical storm duration at the bottom of the study area (and found to be a 24 hour event). Realignments of project infrastructure has occurred in response to initial catchment modelling with the result that:

- The majority of wind turbine foundations and hardstands have been re-located to avoid major impacts (all but three turbines (T12, T40 and T47) lie outside the 1% AEP) and it is expected that any adverse impacts from water impacting wind turbine bases can be addressed through design by raising sensitive components at least 300mm above the identified flood level.
- Assessment of floodplain impacts (i.e. afflux) has been undertaken for pre and post development conditions and confirm that these impacts are highly localised and reduce to negligible amounts at associated property boundaries and able to be managed by landholder agreement.
- Cable reticulation for the turbines solar farm and battery components to the onsite substations are proposed to be underground
- The solar array area has been reconfigured to avoid native vegetation removal but some areas are impacted by flooding, and the inclusion of support infrastructure (such as inverter stations) may need to be addressed in more detail through further modelling, although preliminary afflux analysis indicates any floodplain impacts are highly localised and do not impact beyond associated property boundaries.
- The battery storage is located along an area identified in the LSIO and will require treatment to ensure that floodwaters are able to pass freely and to ensure that electrical installations and connections achieve at least 300mm freeboard above identified flood levels.
- The onsite substation locations are clear of major floodways and are not subject to any specific recommendations in relation to flooding and water management.

Following this initial phase further modelling has been undertaken to appreciate more localised impacts. Modelling was re-run for shorter duration events, more commensurate with design and operational requirements. Within the study area, the critical duration was found to be 1.0- 1.5 hours and a higher resolution model used to examine the flood issues in more detail. This further modelling has been used to assess likely impacts, and extract specific information that can be used for subsequent design.

In the preparation of this report, we have consulted with the Wimmera Catchment Management Authority (Wimmera CMA) to understand their requirements which are summarised as follows:

- Application of DELWP 2019 Floodplain Development guidelines to assess flood impacts
- Typical freeboard of 300mm above determined flood level for infrastructure deemed to be 'at risk' for the 1% AEP event such as floor levels and electrical requirements.
- Agreement with landholders can be used to satisfy concerns around impacts (such as afflux) if these are limited to within specific land parcels
- Works on waterways permits will be required in specific areas where infrastructure interacts with declared waterways and can be negotiated 'en masse' where issues are generic.
- Erosion and degradation of waterways have been identified in strategic documents as issues of concern for the Wimmera CMA. For the majority of cases the Works on Waterway permit process will place requirements on design phases in the vicinity of waterways.

- Application of standard conditions and a standardised approach to Works on Waterways permissions is favoured to avoid regulatory burden.
- Additional information is provided to assist in quantifying the erosion potential in and around infrastructure elements with the intent of reducing impacts.

With this background we have assessed the Project and the various infrastructure segments as summarised in Table 2.

Table 2. Project Flood Response and Afflux Summary

Infrastructure Item	1% AEP	10% AEP	39.35% AEP	Outcome
Wind Turbines and associated hardstands	All but 3 turbines foundations are located outside 1%AEP flood extent (T12, T40 and T47). 6 hardstand areas have interactions with the 1%AEP flood extent which exceed 10% of hardstand area (T12, T18, T19, T29, T40 and T47). Flood impact (afflux) has been assessed for 1% AEP scenario and all impacts are highly localised and do not pass beyond property boundary of land on which the turbine is situated.	All turbines located outside of flood extent. 5 hardstand areas have interactions with flood extent which exceed 10% of hardstand area.	All turbines except T47 located outside of flood extent.	Afflux is highly localised and is unlikely to be an issue. Recommend to address through agreement with affected landholder. Appropriate drainage design will be required around turbine bases to slow the velocity of runoff and direct runoff to the nearby watercourse, and to ensure that shear stresses are maintained within erosive limits for underlying soil and vegetation. Appropriate turbine foundation design for turbines within the 1% AEP flood extent will be required to ensure inundation or flowing water does not compromise foundation integrity
Solar Array	Flooding covering 44 hectares 2 associated with panel array mainly along Lansdowne Road frontage. Unlikely to be any displacement of floodplain associated with solar arrays as these are located above flood and on poles	Flood covering 13 hectares associated with solar array for short duration storms	Flood covering 4.6 hectares associated with solar array for short duration storms	Solar farm area is partially inundated. Freeboard and design levels for each 'panel' to be above flood levels including any rotation of panels associated with solar tracking. Solar panels are mounted on tracking arrays and movement of panels will ensure vegetation growth beneath to reduce erosion risk.
Solar Array-buildings and	8 structures and inverter pad	4 building and inverter pad locations fall	4 building and inverter pad locations fall	Afflux is highly localised and is unlikely to be an issue. Recommend to address

inverter stations	locations fall within flood extent. Afflux has been assessed for 1% AEP scenario and all impacts are highly localised and do not pass beyond property boundary of land on which the solar array is situated.	within flood extent	within flood extent	through agreement with affected landholder. Levels for buildings and inverter pads to be calculated from flood levels plus a minimum 300mm freeboard.
Battery Storage	1% AEP flows through battery storage area Afflux has been assessed for 1% AEP scenario and all impacts are highly localised and do not pass beyond property boundary of land on which the battery storage is located	Flood flows identified through battery storage area	Flood flows identified through battery storage area	Afflux is highly localised and is unlikely to be an issue. Recommend to address through agreement with affected landholder. Provide drainage as necessary to divert water past battery storages Provide 300mm freeboard above nominated flood level for all electrical connections
Access tracks	Crossings at 21 locations within flood extent or assessment buffers			Wimmera CMA Works on Waterway Permit includes standard requirements to address safe passage of flow under roads culvert and bridge structures and should be used in design phase where necessary. High risk road crossings may require further design or management controls to limit use at critical times.
Electrical Reticulation	All underground			Located underground, and further information will need to be provided for planning submission on the complexity of waterway crossings (and therefore construction depth and issues associated with methodology). For example, a deep crossing of a major waterway may not be suitable for open trenching.

Additional assessments have been undertaken for other floodplain interactions that are generally addressed in the Planning scheme requirements and include impact on receiving waterways, and assessment against strategic documents setting out Authority requirements. In all cases the impacts have been assessed as low after mitigation options have been recommended.

Caveats

- No assessment of works methodologies (e.g. trenching versus direction drilling) provided at this time, other than blanket statements
- No assessment of specific design for access tracks (e.g. changed levels for access roads)
- No assessment of water extraction or requirements (such as dams) to access these

2. Introduction

Afflux Consulting were engaged by Umwelt (Australia) Pty Ltd on behalf of RES Australia Pty Ltd (RES) to undertake a hydrology and flood assessment to support the planning approvals under the *Planning and Environment Act 1987* and an Environment Effects Statement (EES) referral to the Minister of Planning.

The engagement relates specifically to the Watta Wella Renewable Energy Project (the Project), a proposed solar farm, wind farm and battery energy storage system (BESS) facility located in the Joel Joel region in western Victoria (approximately 16 kilometres north-east of Stawell).

Project infrastructure includes wind turbines, solar panels, transmission cabling, onsite sub stations and a BESS facility which will be located over approximately 5,200 hectares and is summarised in Table 3.

The general location of the site and general project layout extent is provided in Figure 1 and Figure 2. Note figure 2 does not include access roads and ancillary items to assist in clarity in interpreting extent.

Table 3. Project components

Item	Quantity
Solar Array	Up to 170 ha of solar photovoltaic (PV) panels with a generation capacity of up to 85 megawatts (MW) direct current of electricity (MWdc) mounted on single axis tracker tables.
Wind Turbines	Up to 47 Wind Turbines Generators (WTG) with a maximum overall height (tip height) of up to 255 metres and generation capacity of approximately 376MW
BESS	Storage capacity of up to 400MW / 1,200MWh
Transmission lines and electrical	Overhead 220 kilovolt (kV) transmission line from both the wind and solar farm substation, and BESS to the existing Bulgana substation approximately 600 metres in length) Underground cabling for wind turbine reticulation within the project area connecting to the wind farm substation Underground DC and AC cabling for the solar farm and BESS connecting into inverters and transformers Onsite substation for both the wind farm and solar farm, and BESS (220kV / 33kV)
Road and access tracks	Internal access tracks up to 60km in length (running track of up to 7.5 metre wide including required erosion and sediment controls either side) within the wind farm and solar farm.
Support facilities (buildings and sheds)	An operational and maintenance facility (up to 6,720 square metres) for each project component Construction compound areas Other temporary infrastructure including car parking, site buildings and amenities Onsite borrow pits Hardstand and laydown areas for construction Temporary meteorological mast and solar irradiance monitoring equipment

Services provided by Afflux Consulting relate to the hydrological assessment of major creek and rivers systems in the region and hydraulic modelling to characterise flood conditions in the Project area.

As such our advice concerns the impacts of the proposed facility on surface water flows (limited to hydraulic impacts) and recommendations based on siting for design for key items of infrastructure to avoid damage from flood waters.

This report documents works undertaken by Afflux Consulting which include:

- The development of a catchment scale hydrologic model to account for regional flows passing through the area;
- Developing a number of local hydraulic models for a local catchment encompassing the Project region. These models target critical events for recurrence intervals associated with Planning and operational considerations.
- Providing assessments for different infrastructure classes included in the Project specification against the expected regulatory and approval requirements
- Developing recommendations for infrastructure classes based on relevant guidelines and approval requirements
- Providing specific design level information that can be used for further technical work

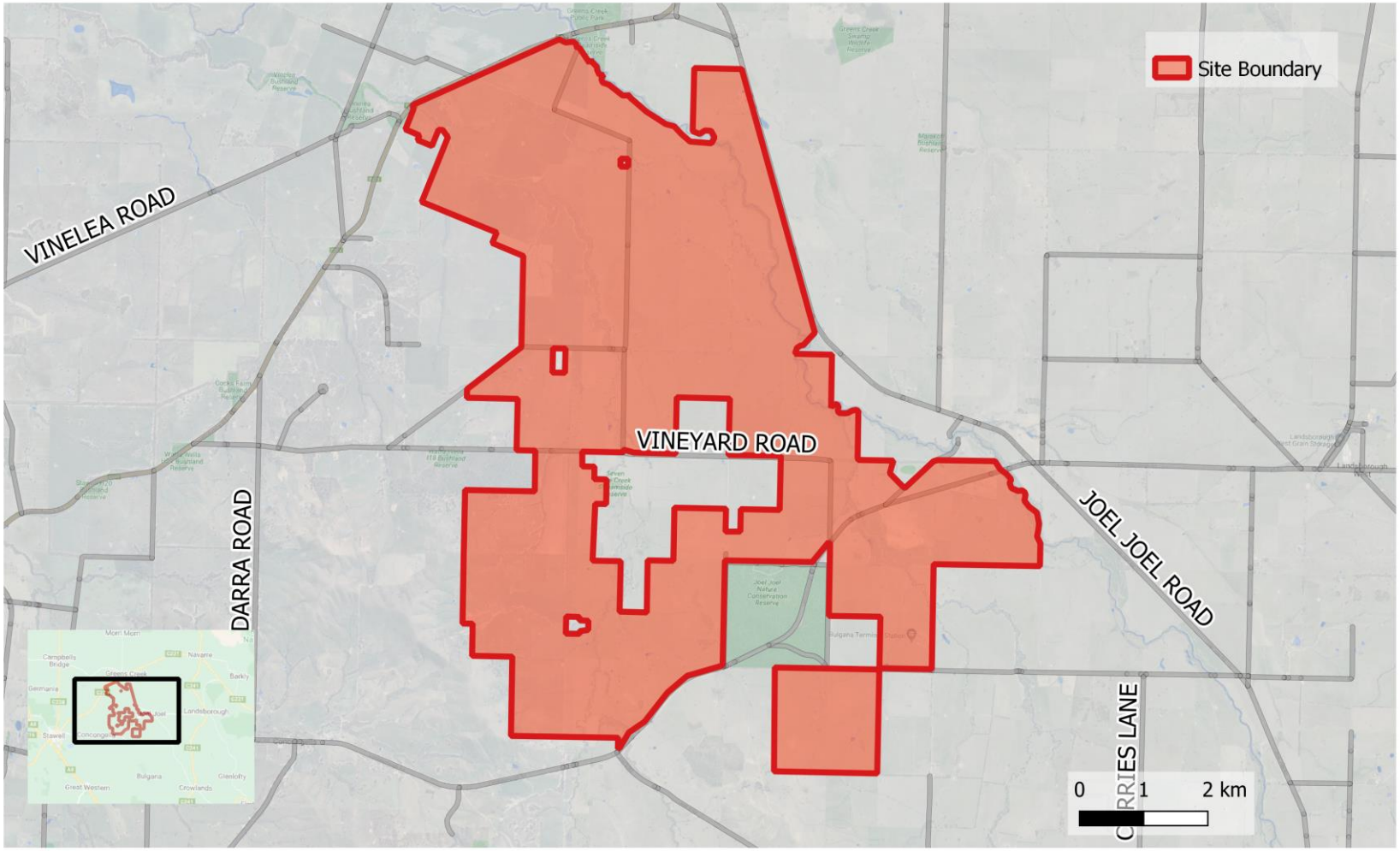

Figure 1. Site location (general)

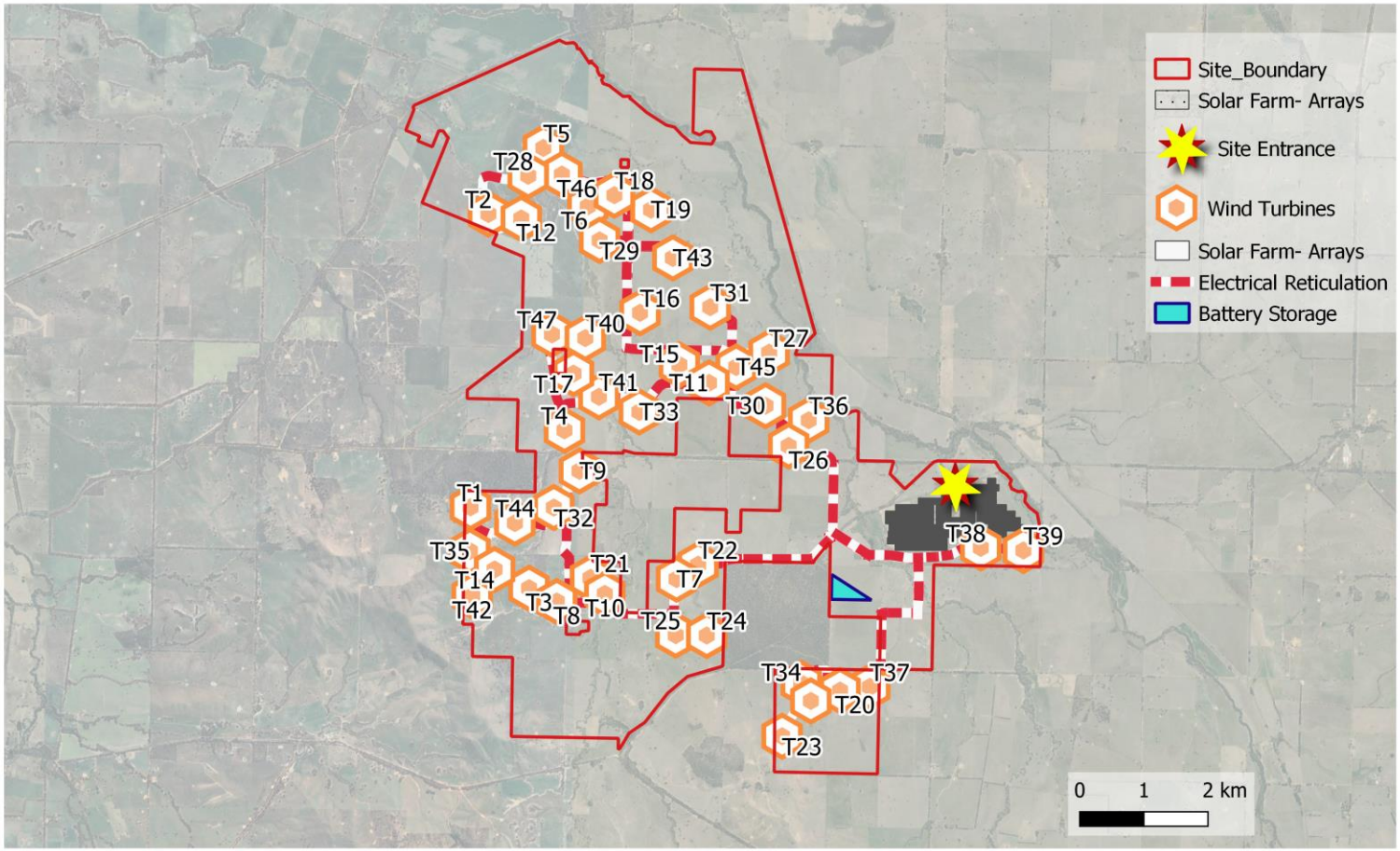

Figure 2. General site layout (as supplied)

2.1. Site Location

2.1.1 Existing Catchment conditions

The Project area sits within a catchment that is bounded to the west by Concongella Creek (approximately 10 kilometres to the west) and the Wimmera River (adjacent to the site's eastern boundary). The terrain is generally flat to moderately undulating with a number of defined hillocks rising to between 20 to 50 metres above the underlying terrain. Both the Six and Seven Mile creeks and a number of smaller tributaries run through the Project site.

The area is characterised by land historically cleared for farming and where livestock farming and cropping constitutes the majority of current activities in the area.

Figure 3 shows the Project area and associated flood related overlays associated with the region. It should be noted that while the majority of the Project site is zoned as Farming Zone with small areas (mainly associated with watercourses) that are zoned as Public Conservation and Resource Zone. Given the nature of this report the primary focus is on the Flood Overlay (FO) and Land Subject to Inundation Overlay (LSIO) affect some sections of the Project area and have some interaction with Project infrastructure components at various locations.

Figure 4 provides an indication of the topography of the area and slope.

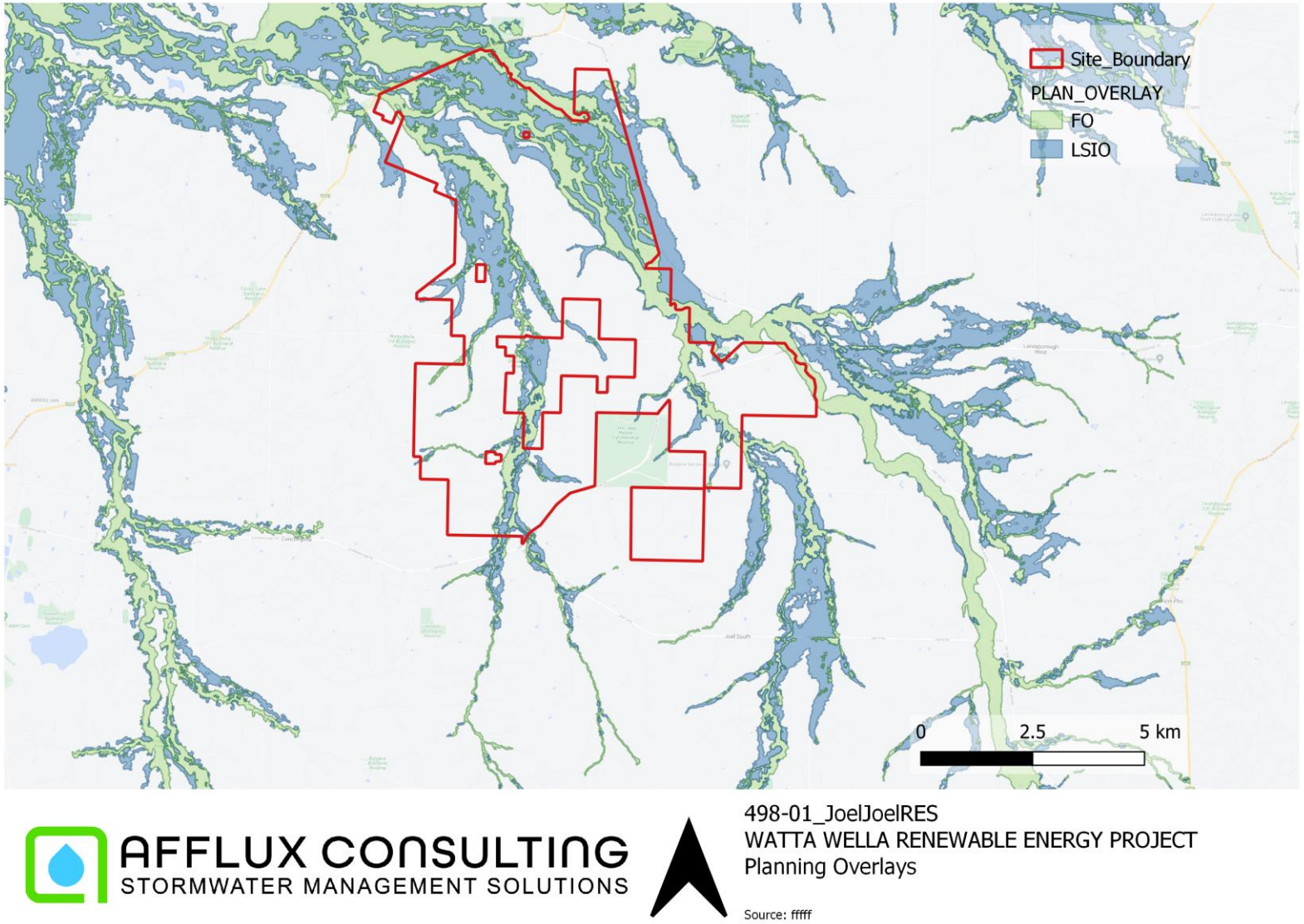

Figure 3. Planning overlays (flood-related)

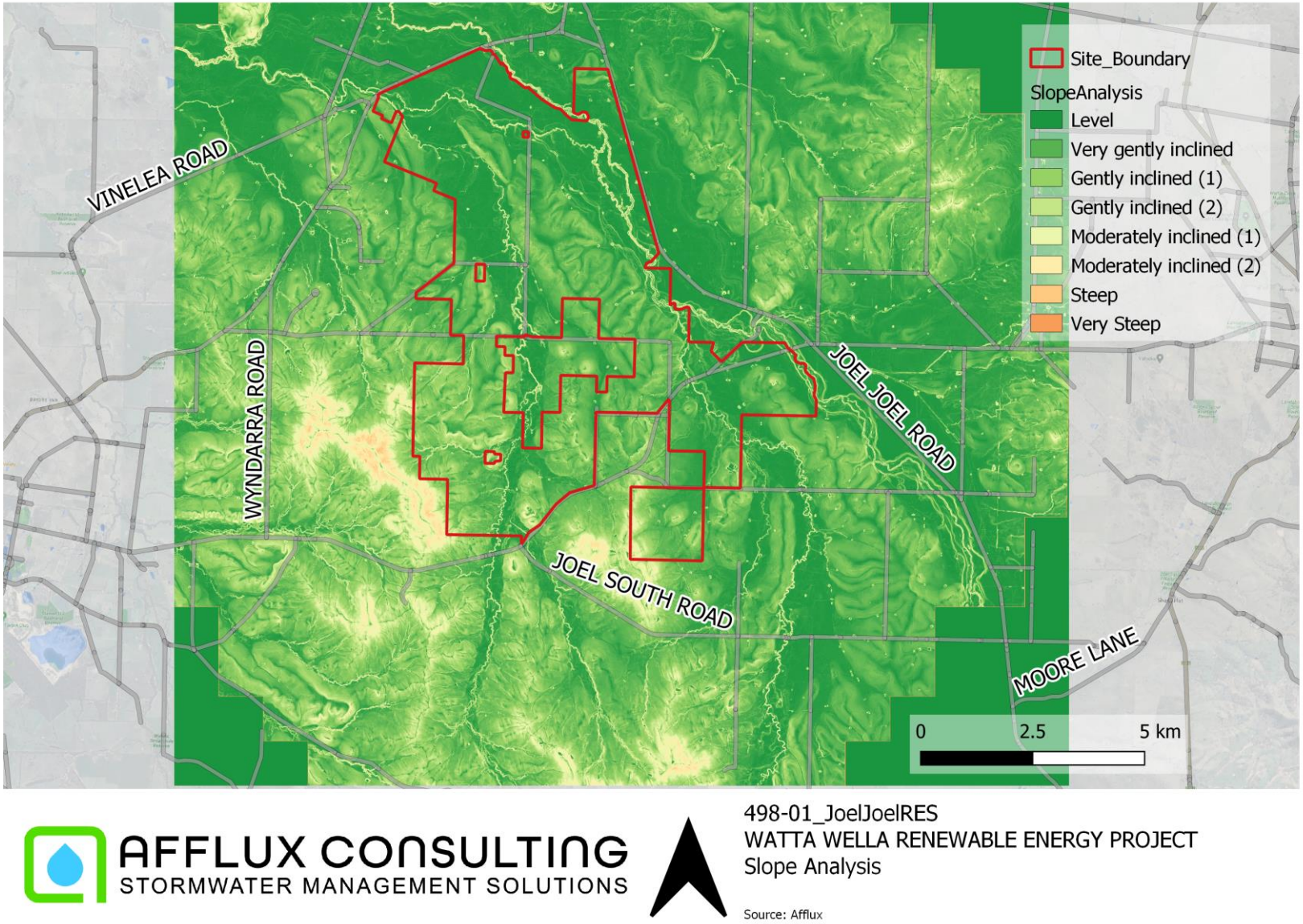

Figure 4. Site topography

2.2. Information Sources

A number of information sources have been used in the formation of this report; and include:

- Site inspection
- Aerial imagery
- DELWP's VicPlan cadastral information as accessed online
- Aerial survey (supplied by RES)
- Australian Rainfall and Runoff 2019
- Flood reports prepared for the Wimmera CMA
- Northern Grampians Planning Scheme
- Discussions with RES and Wimmera CMA

3. Policy and Approvals

The Project will require environmental and planning approval under the relevant Commonwealth and State legislation in order for it to proceed, and may be subject to assessment under the *Environment Effects Act 1978*.

It is expected that, at a minimum, approval will be required at various stages from the following agencies:

- Minister for Planning or delegate at DELWP
- Northern Grampians Shire Council
- Wimmera CMA

3.1. Relevant Guidelines

Issues addressed in this report will cover flood related requirements covered in legislation, policy and relevant guidelines including:

- *Water Act (1989)*
- Northern Grampians Planning Scheme
- Guidelines for Development in Flood Affected Land (2019)
- Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria (DELWP, 2021)
- Solar Energy Facilities Design and Development Guideline (DELWP, 2019).

These are summarised in Table 4 with further information provided in subsequent sections.

Table 4. Legislative and policy considerations

Instrument	Issues addressed	Relevance
Water Act (1989)	Amongst other things addresses the requirements for unhindered passage of flows across a site to avoid detriment to downstream areas. Two main areas are addressed: issues relating to consumptive or environmental use of water and impacts/ damage to property as a result of altered flow regime.	The *Water Act 1989* allows for declaration of flood levels by relevant authorities.
Northern Grampians Planning Scheme (the Planning Scheme)	Requires responsible/decision making Authority to consider certain issues prior to granting any approval. Allows responsible/decision making Authority to require conditions to be met through post-approval permit conditions. The Victorian Planning Provisions include specific clauses which contemplate renewable energy	Analysis will establish flood extent and decision criteria will draw on requirements of FO and LSIO as listed in the Planning Scheme. Both the LSIO and FO within the Planning Scheme concerns areas that in a 1% ARI are likely to be covered by floodwaters which may pose an unacceptable risk or hazard to flood plain users, and the planning scheme

	facilities to address climate change and the need to transition economy. Specifically in relation to flooding conditions should be reflected in overlays contained in the Planning Scheme which then set out objectives, decision criteria and guidelines.	introduces mechanisms to quantify and mitigate risks. The Project area lies within both an LSIO and FO.
Guidelines for Development in Flood Affected Land	Relate specifically to flooding and address the legislative and policy framework. Impacts of development on safety (life and property), flood storage and operational aspects (such as flood warning) should be addressed prior to any approval being issued.	Consider impacts of development against the criteria contained in the guidelines.
Regional Waterways Strategies	Regional Waterway Strategies are referenced under the Planning Scheme. They provide further context around local issues and priorities for consideration.	The Wimmera CMA Regional Catchment Strategy 2021-27 is the most relevant and has been prepared in consultation with local stakeholders and has been approved by the Minister for Water.
Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria	Address issues for consideration for siting and operation of wind energy facilities. Flooding is addressed as a subset of guidelines	Flood considerations generally reiterate requirements that would be typically found in planning scheme and as such will be addressed through reference to other technical guidelines. Analysis will include frequent storm scenarios which may impact on the economic operation of the facility and is a separate consideration to Planning requirements.
Solar Energy Facilities Design and Development Guideline	Address issues for consideration when siting and operation of solar energy facilities. Flooding is addressed as a subset of guidelines	

3.1.1. Flood Overlay

In accordance with **Clause 44.03** (Flood Overlay) of the Planning Scheme, some sections of the Project area are affected by Schedule 1 to the FO. The purpose of the FO is:

- *'To identify waterways, major floodpaths, drainage depressions and high hazard areas which have the greatest risk and frequency of being affected by flooding.*
- *To ensure that any development maintains the free passage and temporary storage of floodwater, minimises flood damage and is compatible with flood hazard, local drainage conditions and the minimisation of soil erosion, sedimentation and silting.*
- *To reflect any declarations under Division 4 of Part 10 of the Water Act, 1989 if a declaration has been made.*
- *To protect water quality and waterways as natural resources by managing urban stormwater, protecting water supply catchment areas, and managing saline discharges to minimise the risks to the environmental quality of water and groundwater.*

- *To ensure that development maintains or improves river and wetland health, waterway protection and flood plain health.'*

Schedule 1 of the FO (FO1) under the Planning Scheme relates to Glenorchy, Upper Wimmera, Mt William Creek, Concongella Floodway and Halls Gap. FO1 is primarily concerned with land extent proximate to major tributaries running through the area. The majority of proposed Project infrastructure is located outside the FO1 extent, however there are some areas where access tracks and electrical reticulation intersect with the FO1 and will require consideration to address impacts.

In accordance with **Clause 44.03-4** and **Clause 44.03-7,** there are a range of application requirements and decision guidelines which are summarised in Table 5 along with the response that will be demonstrated through analysis in this report.

Table 5. Flood Overlay Requirements

Application Requirements	Decision Guidelines	Response
Must be consistent with any relevant Floodplain Development Plan (FDP) If a local FDP has been developed for the area and has been incorporated into this scheme, an application must be consistent with the plan. Must include a Flood Risk Report which considers (in the absence of a FDP): Requirements of the Planning Scheme Consider Land use implications Consider if alternate siting appropriate Assess susceptibility to flood damage Assess Flood risk having regard to • exposure (to flooding), flood warning • management actions, and risk to emergency management • Impact of development on other users (e.g. afflux) Consider the effect of development on river and environmental health Specific information relating to the particulars of the proposed development to allow it to be assessed in context, including location, constructed levels and dimensions.	The responsible authority must consider, as appropriate: • The Municipal Planning Strategy and the Planning Policy Framework. • Flood Risk • Any comments of the relevant floodplain management authority. • The Victorian River Health Strategy (2002) and any relevant regional river health strategy and associated wetland plan. • Any other matters specified in a schedule to this overlay.	The Responsible Authority is anticipated to be the Local Council or Minister. Analysis supports both pathways. There is no identified FDP in place for the proposed Project area. The land use is contemplated under the Planning Zoning and will be addressed as part of the broader approvals. The Project does not introduce high-sensitivity flood land uses such as new dwellings to the Project area. This report deals solely with water and flooding issues raised under relevant Overlays. A Flood Risk Report is required. The report will address the various issues under a typical risk management framework. Refer to Section 5.2 of this report. In undertaking analysis there have been discussions with the Wimmera CMA and the report addresses their requirements and expectations around information and analysis to be undertaken. This includes site specific investigations and reference to historic reports and studies as necessary. See Catchment Design Requirements in Section 4 and Investigation outcomes in Section 5. For the purposes of this report the Victorian River Health Strategy (2002) is considered an outdated reference. Commentary will be provided identifying how the Project satisfies the intent of the Wimmera CMA Regional Catchment Strategy (2022-27) as a contemporary reference.

		There are no other matters identified under decision guidelines as a Schedule to the Overlay. Information on location of key items etc have been provided on the basis of initial modelling and assessment and may be subject to further refinement during detailed design. At this stage in the process, it is considered appropriate to address the majority of issues required under the overlay and potentially impose conditions to govern subsequent design refinements.

**For the purposes of this assessment there is no specific flood levels specified by the floodplain manager. It is considered that the overlay extents contained in the Planning scheme have been developed in consultation with the relevant authorities, and given the extensive nature of the application it is not viable to refer to location specific levels.*

3.1.2. Land Subject to Inundation Overlay

In accordance with **Clause 44.04** (Land Subject to Inundation Overlay) of the Planning Scheme, some sections of the Project area are affected by Schedule 1 to the LSIO. The purpose of the LSIO is:

- *'To identify flood prone land in a riverine or coastal area affected by the 1 in 100 (1 per cent Annual Exceedance Probability) year flood or any other area determined by the floodplain management authority.*
- *To ensure that development maintains the free passage and temporary storage of floodwaters, minimises flood damage, responds to the flood hazard and local drainage conditions and will not cause any significant rise in flood level or flow velocity.*
- *To minimise the potential flood risk to life, health and safety associated with development.*
- *To reflect a declaration under Division 4 of Part 10 of the* Water Act, 1989*.*
- *To protect water quality and waterways as natural resources by managing urban stormwater, protecting water supply catchment areas, and managing saline discharges to minimise the risks to the environmental quality of water and groundwater.*
- *To ensure that development maintains or improves river, marine, coastal and wetland health, waterway protection and floodplain health.'*

As demonstrated above, the purpose of the LSIO is similar to the FO but concerns areas with reduced flood depths in a 1% AEP and a lower flood risk.

Schedule 1 of the LSIO (LSIO1) under the Planning Scheme relates to Glenorchy, Upper Wimmera, Mt William Creek, Concongella Overland Flow Areas and Halls Gap. The LSIO1 extends beyond the FO1 to cover parts of the floodplain outside primary watercourses and channels. Similar to the FO1, the majority of proposed Project infrastructure is located outside the LSIO1, however in addition to access tracks and electrical reticulation, there is additional Project infrastructure that intersects with the LSIO1. This includes 3 wind turbines and sections of the solar farm that impact at the fringe (refer **Appendix E**).

In accordance with **Clause 44.04-4** and **Clause 44.04-8**, there are a range of application requirements and decision guidelines which are summarised in Table 6 along with the response that will be demonstrated through analysis in this report. It should be noted that responses that align with FO have not been duplicated.

Table 6. LSIO Requirements

Application Requirements	Decision Guidelines	Response
An application must be accompanied by certain information, including scaled site plans, ground elevations, floor levels, surrounding land uses and significant areas of environmental value. Construction details should also be provided for assessment: Additional flood level information should be provided if not available from the relevant responsible authority.	The responsible authority must consider, as appropriate: • The Municipal Planning Strategy and the Planning Policy Framework. • Any local FDP, and comments from the relevant floodplain management authority. • The compatibility of the proposed development with existing land uses, and the viability of locating elsewhere. • Various flood proofing and design responses. • Flood risk factors associated with the development including hazards to safety, emergency response, flood response planning and egress. • Impacts from the development altering floodwater flow on surrounding land uses. • Threats to environmental outcomes, including environmental flows, water quality and sites of scientific significance. • Any other matters specified in a schedule to this overlay.	The site has been selected based on an assessment of broader considerations including access to solar and wind resources and proximity to transmission infrastructure and the electricity grid. The majority of infrastructure sits outside the Overlay boundary. Based on assessment of flood impacts it is expected there will be minimal improvements from relocating the Project. Analysis will be used to confirm areas where impact occurs and provide information to determine if these are of concern or can be addressed through landholder agreement. Refer to Section 5 Investigations and Section 6 Discussion. Analysis will be used to update the flood extent beyond the overlay and provide assessments of how project components could be managed. Consideration will be given to how site management strategies could be implemented to reduce environmental impacts such as water quality.

3.1.3. Guidelines for Development in Flood Affected Land

The *Guidelines for Development in Flood Affected Land* (the Guidelines) were developed in 2019 in consultation with Catchment Management Authorities and have state-wide application. They follow closely the requirements of the Planning Scheme and provide additional guidance on how specific aspects should be addressed and provide a robust framework to ensure that issues are adequately identified and addressed.

The Guidelines set out four objectives with principles and assessment criteria as outlined in Tables 7 through to Table 10 below.

Table 7. Objective One. Protect human life and health, and provide safety from flood hazard

Guiding Principle	Assessment criteria	Project Response
Site and access safety must not be compromised	**Depth and flow** Development should not be allowed on properties where the depth and flow of floodwaters would be hazardous to people or vehicles entering and leaving the properties.	The Project is limited in how it interfaces with access to external areas, and analysis will confirm the viability of access. The majority of access tracks throughout the site have no interaction with flooded area, and where this does occur have been generally assessed to be low risk (low depth x velocity product as per hazard classification adopted in Risk Assessment- Appendix D) for the expected vehicular traffic. Where roads become inundated, they can be raised in accordance with conditions prescribed by the Wimmera CMA, or access can be rescheduled as part of operational planning.
Development must be located on sites of lowest overall hazard.	**Siting** Development and access should be located on land with the lowest overall hazard.	Response enshrined in broader referral around need for project and site selection.
Greenfield development sites must be designed to be safe from flood impacts.	**Greenfield development** Greenfield development sites should either be flood free or contain building envelopes filled to the Nominal Flood Protection Level (NFPL - the 1% AEP flood level plus freeboard).	
Hazardous materials must not contaminate floodwater.	**Hazardous material**s Developments and uses which involve the storage or disposal of hazardous materials must not be located on floodplains unless the materials are totally isolated from floodwaters.	A construction environmental management plan will be developed for the Project to submit with the planning application, to ensure best practice storage of hazardous materials is applied including the necessary bunding requirements and need to separate fuelling or workshop areas > 50 metre from watercourses.
Vulnerable people must not be exposed to floods and facilities providing vital community or emergency services must be operational during floods.	**Vulnerability** Buildings housing vulnerable people, community services facilities and emergency services should be sited outside the 1% AEP flood extent and, where	The site and operations are not expected to expose vulnerable populations and will not increase afflux to nearby sensitive receptors i.e. dwellings or community facilities.

	possible, at levels above the height of the probable maximum flood.	For the most part, infrastructure is located outside the 1% AEP flood however where access tracks for emergency services may be required further design mitigation may be developed if necessary to maintain operations.

Table 8. Objective Two: Minimise flood damage to property and associated infrastructure

Guiding Principle	Assessment criteria	Project Response
Buildings must not interfere with existing or proposed water, sewer or drainage services.	**Water services** Buildings and building envelopes should be located sufficiently away from a water, sewer or drainage asset to enable that asset to be serviced.	No significant water related infrastructure exists within the Project area.
Buildings must be designed to avoid significant financial impacts of flood damage.	**Floor levels** The floor levels of buildings should be set in accordance with Tables contained in guidelines	Impacted buildings and works will have prescribed floor levels in line with freeboard recommendations from Wimmera CMA at 300mm.
The basements of any new buildings must not flood.	**Basements** Basements should be designed to be protected from flooding.	No buildings with basements proposed. Not applicable.
Those parts of buildings affected by flooding must be able to withstand the effects of inundation	**Materials** Any building or portion of a building below the 1% AEP flood level should be constructed from flood-resistant materials.	Include in recommendations based on assessment of flooding depth and impact on building and fittings in line with freeboard requirements and risk assessment. 300mm freeboard proposed on electrical infrastructure.
Services to a building must be capable of functioning during and after a flood.	**Building services** Essential services to a building should be flood proofed or raised above the NFPL.	

Table 9. Objective Three: Maintain free passage and temporary storage of floodwaters

Guiding Principle	Assessment criteria	Project Response
The natural function of floodplains and overland flow paths to convey and store floodwater must not be compromised.	**Flow diversion** Development (including earthworks) should not divert floodwaters to the detriment of any adjoining property.	To be demonstrated through technical modelling. Any identified impacts to be presented to obtain landholder agreement where these are contained within landholdings.
	Velocity impact Development (including earthworks) should not increase	Able to demonstrate through modelling of before and after

	the flood velocity on any adjoining property	conditions. See Section 4 Investigations and Appendix F.
	Flood level impact Development (including earthworks) should not increase flood levels on any adjoining properties	
	Flood storage Earthworks and buildings should not result in a detrimental loss of flood storage.	

Table 10. Objective Four: Protect and enhance the environmental features of waterways and floodplains

Guiding Principle	Assessment criteria	Project Response
Development impacting on waterways and floodplains must consider their environmental qualities.	**Waterway and floodplain condition** Development should maintain or improve waterway and floodplain conditions.	Able to demonstrate no worsening of existing flood conditions and no impact on adjoining properties. Refer Section 4 Investigations.
	Access to riparian corridors Development should allow access to maintain riparian corridors.	No development is proposed within 100m of waterways therefore riparian buffers will remain intact with access maintained.
	Water quality Development should maintain or improve water quality	Assessment will consider impact of Project on receiving waters from both a quality and natural function perspective. A construction environmental management plan will need to be developed to protect water quality of runoff from the Project during construction. Drainage will be provided within the site around key infrastructure and access tracks to manage water flow and quality and may be subject to conditions required by Works on Waterways Permit.
	Natural function Development should maintain (by avoidance or offset) the natural function of floodplains and waterways in storing and conveying floodwater.	
	Amenity Development should retain or improve significant vistas or landscapes within the riparian corridor.	The Project will have visual impacts which should be assessed by qualified professional (e.g. Landscape and Visual Impact consultant).

3.1.4. Wimmera CMA Regional Catchment Strategy 2022-27

The Wimmera CMA Regional Catchment Strategy 2022-27 (the Strategy) provides an analysis of the area and the importance of waterways to the local community, and outlines a range of issues for consideration. As with most contemporary catchment strategies, the level of acknowledgement and inclusion of traditional owner values is prominently elevated.

Regionally, the catchment supports significant tourism activity, as well as livestock grazing (sheep) and cropping activities such as wheat and canola. The catchment's rivers and streams are influenced by a temperate to semi-arid climate. As such severe droughts and large floods make for variable hydrology and the adaption of unique and important riparian and aquatic ecosystems.

The Project is located in the Upper Catchment area. Key threats identified to water quality include climate change (incidence of drought but also increased rainfall intensity), soil erosion and the need for cropping and land management practices to retain ground cover, include perennial pasture and limiting stock movement during dry periods.

Desired outcomes for the short to medium term (6 to 20+ years) includes improvement to soils throughout the area, increased native vegetation along streams, protection of remnant vegetation and to limit the expansion of pest animals and plants.

The Project is not expected to impact adversely on the key values. Agreements with land holders, and the implementation of management regimes that support broader catchment outcomes are accepted as a sensible approach.

The erosive impacts of runoff is of concern, and analysis will include information and metrics to address this during subsequent design phases.

3.1.5. Policy and Planning Guideline for Development of Wind Energy Facilities in Victoria

The *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* (the Guidelines) was published in 2021 by DELWP. The Guidelines are intended to provide guidance for navigating the planning application process for wind energy facilities and are intended to provide consistency in decision making across the State.

The Guidelines outline a variety of approval pathways that may need to be addressed dependent on the significance of the proposal and impacts.

There are no specific water management issues identified in the guidelines which relate directly to hydraulic and hydrological impacts (such as flooding).

The Guidelines contemplate staging of development plans and approvals, including micro siting of turbines to avoid impacts to areas that should be avoided.

In the context of this report, it is considered that the level of detail provided is commensurate with the stage of project development. As such, the analysis will address major issues that will need to be addressed through the planning response and provide information to assist in subsequent design.

3.1.6. Solar Energy Facilities Design and Development Guideline

The *Solar Energy Facilities Design and Development Guidelines* (the Guidelines) were published in 2019 by DELWP. The Guidelines have a similar intent as the Guidelines associated with wind energy facilities (as discussed in Section 3.1.5 above), and include additional information on best practice advice relating to matters such as site selection, design and construction.

Site selection information suggests that in addition to solar and general access considerations, the site should be selected to avoid floodplains of a major watercourse.

Sensitivity to existing agricultural production is cited, and site selection should consider impacts on viable land having regard to protection of valuable soils (e.g. from erosion) and access to water resources required to support these uses into the future.

Flood management is explicitly identified and the potential for the facility to be impacted by flooding or the potential for earthworks to alter drainage patterns is required to be addressed through consultation with the relevant Catchment Management Authority. In accordance with the Victorian Planning Provisions, Clause 13.03 (Floodplains) is applicable to the Project and these floodplain management requirements are largely addressed through the planning overlays identified in Sections 3.1.1 and 3.1.2 above.

As such, analysis in this report will provide responses to the applicable planning overlays, including identification of potential flood impacts that are identified through analysis and not capture in currently published overlay extents.

3.1.7. Works on Waterway Permit

The Wimmera CMA has confirmed that any works in, on or over designated waterways (such as landscaping, access crossings, stormwater outlets, etc) will require a Works on Waterway Permit under their By-Laws (No 2014/01 Waterways Protection from Wimmera CMA prior to any works commencing).

A permit should be applied for and granted prior to commencing any work and remains in force for a period of 12 months although this can be extended if there are no changes to proposed works. As with other projects of similar scale and complexity it would be expected that the specific works permits would be applied for after relevant Planning approval has been granted and a construction contractor has been identified. The construction contractor will provide a range of equipment and practical experience that is expected to guide final detailed design to match capacity and ensure a cost effective outcome.

Various standards have been highlighted for particular categories of work and standard conditions are summarized below which should be adhered to through the detailed design. Where pipeline is mentioned, this is expected to be equally applicable to reticulation.

Access Crossing (Culvert)

- The width of the box culverts across the bed must be equal to [50% / 75%] of the typical stream bed width OR the total pipe diameter must be equal to the base stream bed width.
- A minimum culvert height of [900 millimetre / 1,200 millimetre] is required for low-level culvert crossings.
- All pipes and box culverts must be laid with their inverts placed at the existing bed of the waterway, with at least one pipe or box culvert being placed at least a minimum of 150 millimetre below the lowest portion of the bed to provide unrestricted passage of low flows and to maintain fish passage.

Access Crossing (Bridge)

- Where a bridge is below flood level any railings must be designed to minimise the trapping of flood debris as this can reduce the hydraulic capacity, cause upstream flooding and ultimately threaten the stability of the structure.
- The bridge decking must be constructed of concrete, timber or other non-erodible material.

Where the pipeline crossing is installed under a waterway via directional boring:

- Standard construction drawings for directional drilling must be submitted with the completed application.
- The pipeline is to be installed a minimum of two metres below the bed
- The entry and exit points of the directional drilling/bore must be no closer than 10 metres from the top of the bank on either side of the waterway.
- Measures must be undertaken to ensure the void between the pipe and the borehole is sufficiently backfilled and compacted.

Where the pipeline crossing is installed under a waterway via open trench:

- Standard construction drawings for plough and trench excavations must be submitted with the completed application.
- A minimum cover of 300 millimetre must be provided over the pipe/cable installed in the bank.

- A minimum cover of one metre must be provided over the pipe/cable installed in the bed. Where there is evidence of erosion along the bed in the vicinity of the crossing, an increased depth of cover would be necessary.
- Where water is flowing in the waterway, the material for backfilling the trench across the bed must consist of granular material.
- The material for backfilling of the trench across the bed (when there is no flow of water in the waterway) and banks of the waterway must consist of selected clay or sandy clay loam.

3.2. Topographic Data

Topographical data was provided by RES in October 2020 and covered approximately 360 square kilometres in one-kilometre tiles. It is understood that aerial photogrammetry techniques were used to generate a terrain model with elevations reported on a one by one metre grid. No specific details were provided as part of the data supply to verify the accuracy of data, however a cursory comparison with contour information obtained from the Victorian Data Warehouse suggests that there is sufficient detail to characterise the area.

Review of flooding reports prepared for the Wimmera CMA indicates that LiDAR coverage for the area is generally available to a vertical accuracy of between 0.15 and 0.5 metres. It is expected that the accuracy of the data provided for this study should at least equal, if not exceed these regional datasets.

For the purposes of modelling, the topographical data was aggregated and resampled at a 5 metre grid resolution and was necessary to limit impacts on model run times. At a regional scale, the loss of finer detailed terrain information is not expected to significantly alter the findings.

Figure 5 shows the Photogrammetry data supplied by the client, and Figure 6 shows the general extent of the catchment area that was subsequently delineated for the study along with upstream catchment areas (see later in report).

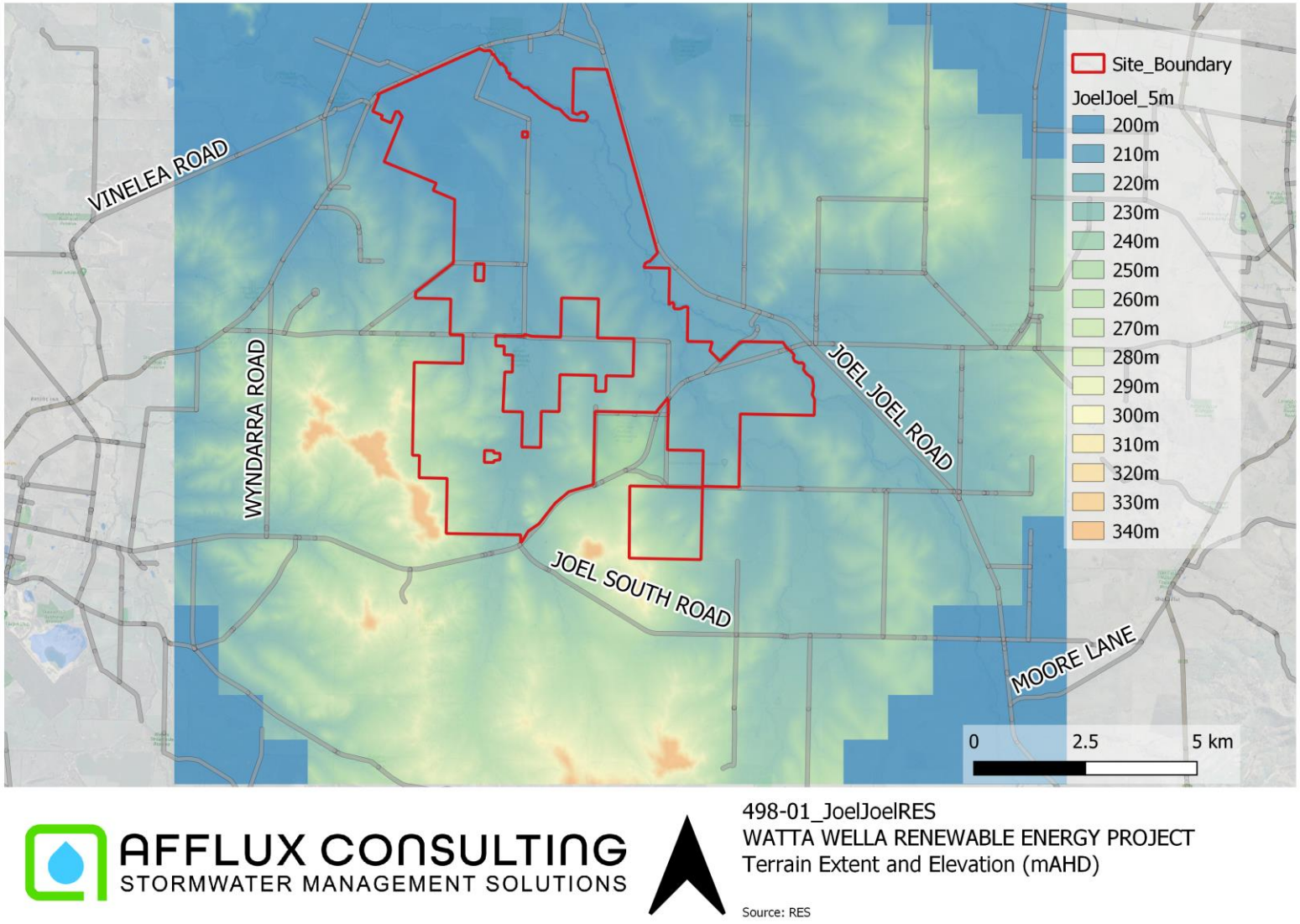

Figure 5. Terrain information- extent of photogrammetry supplied

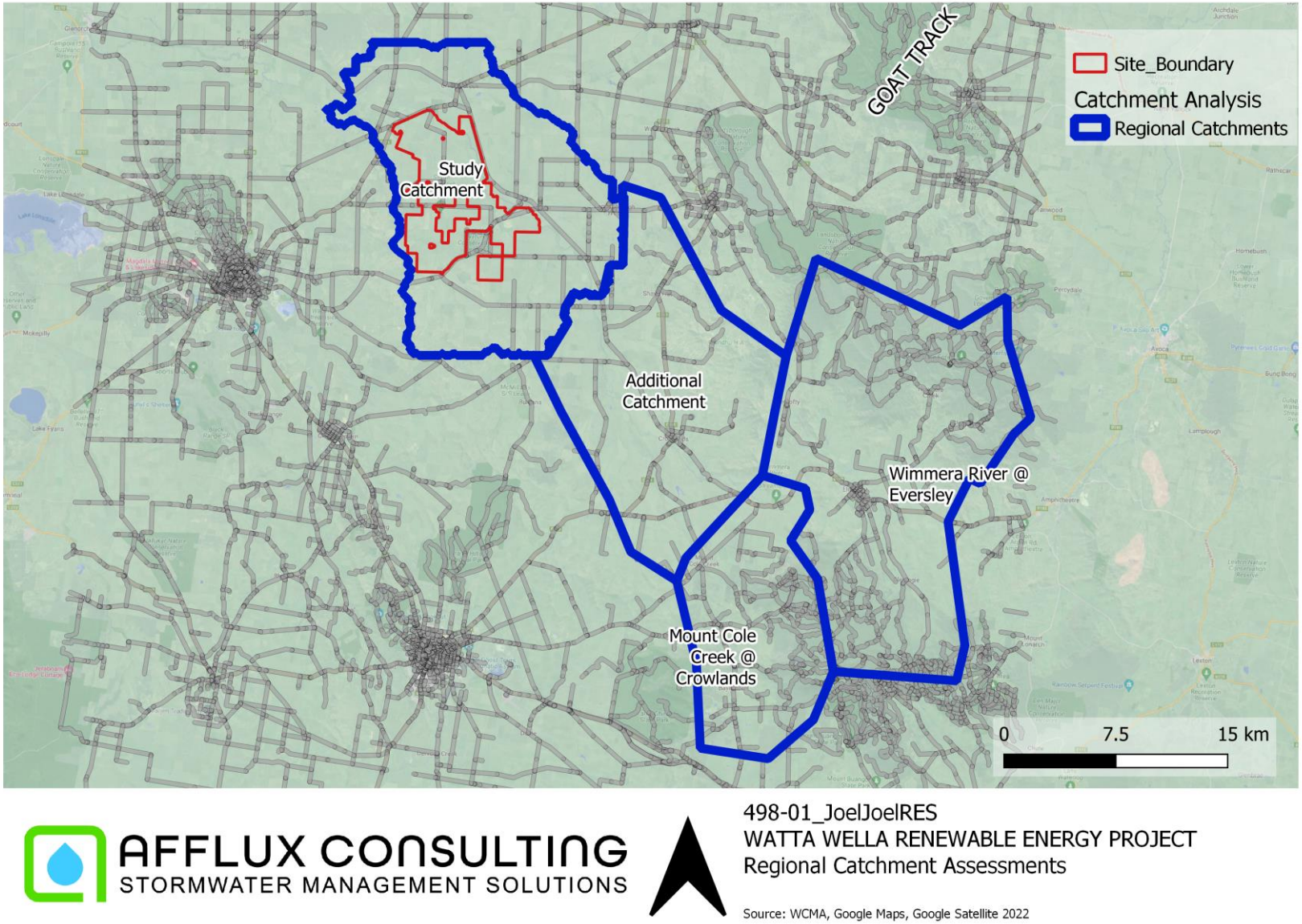

Figure 6. Catchment delineation and model area

4. Catchment Design Objectives

In accordance with the specified scope of works, the main focus of this study is to identify the extent of catchment flooding and any potential impacts arising from infrastructure provided for the Project, particularly in relation to floodplain impacts.

Design objectives are focussed on making recommendations for siting of infrastructure (including specifying construction levels above designated flood heights), and any areas where erosion and/ or scour may be of concern.

Secondary considerations include typical inundation duration and any impacts on critical infrastructures (i.e. in case maintenance access is required).

To address both the requirements for design of wind facilities and floodplain assessment, three storm recurrences were selected for analysis in accordance with definitions in Australian Rainfall and Runoff 2019 as shown in Table 11.

Table 11. Assessment Standard

Assessment Standard*	Rationale	Audience
1% AEP	Applicable under the Northern Grampian Shire Planning Scheme and utilised in EES Ministerial Guidelines from DELWP to guide impact assessment.	Approval and referral agencies
39.35% AEP	This is an industry standard used the design of renewable energy infrastructure. Flood impacts at higher frequency can inform risk assessment and have been included for completeness. It is an important indicator of stream shear stress and waterway functions.	Project team
10% AEP	Commonly adopted within industry for the design of functional assets such as roadways and culverts. Flood impacts at higher frequency can inform risk assessment and have been included for completeness.	Project team

**An impact of more than 10% of the hardstand area has been used to assess wind turbines and foundations due to the nature of any localised impact across all AEP's.*

In line with expected decision criteria, the following design objectives have been set for the various infrastructure components as listed in Table 12:

Table 12. Site design requirements (various infrastructure elements)

Infrastructure Segment	Construction and siting	Erosion and scour	Access
Solar farm	Ensure geotechnical reports and footing design considers flood extent to ensure adequate footing design is selected and integrity will not be affected by inundation.	Ensure geotechnical reports and footing design considers flood velocity and shear stress to ensure adequate footing design is selected and integrity will not be affected by floodwaters.	Access routes can be assessed against potential for assets to become isolated. during flood event
Wind turbines	Ensure that turbine bases are located above flood level and away from areas of significant inundation wherever possible. If not possible, ensure appropriate steps are taken to account for flood impacts in design and construction. Where flood interactions are identified, raise sensitive components above flood levels.		
Battery storage	Ensure located outside flood zone or raised above flood levels plus 300 millimetre freeboard		
Transformers/ substations	Ensure located outside flood zone or raised above flood levels		
Reticulation (underground)	Identify potentially submerged areas to ensure water protection to required standards. Consider Works on Waterway conditions.	N/A	
Road and access tracks	Roads are located to access facilities. Identify flow velocity and depth for consideration in design of road and crossing points to consider safety requirements and Works on Waterway conditions.	Consider impacts on road stability. Consider drainage design alongside access tracks. Subject to Works on Waterway conditions.	-
Associated buildings and facilities	Identify flood depth and safety issues that may require flood response (e.g. evacuation/ make safe procedures). Ensure hazardous materials are not stored in flood areas.	Identify flow velocity for consideration in foundation design of substation.	-

5. Investigations

A range of investigations have been undertaken in this study and are summarised as follows with further details provided in Appendices as indicated:

Investigation	Description	Outcome	Further Information
Site Visit	Site visits were conducted by Afflux staff on two occasions to gain an appreciation of the site context and proposed location of infrastructure	Allows an improved understanding and interpretation of results	See below
Regional Hydrology	To develop hydrological inputs for use as regional inputs into a local hydraulic model. Inputs have been developed from information contained in historical reports which included: • Concongella Creek (Stage 1A) • Upper Wimmera Flood Investigation Flow inputs were extracted from these reports and estimates were checked for 'sensibility'. Some proportioning and scaling of flows was required to address gaps in information, and to provide flow estimates for the recurrence intervals selected for analysis.	Hydrographs to apply to major external catchment flows (i.e. Wimmera River)	Appendix A.
Hydraulic Assessment	Hydraulic models were developed for the local catchment using a 'Direct Rainfall' approach. Consistent with recommended approaches in ARR 2019 a coarse model (20 metre grid) was originally developed to identify likely critical storm durations for return intervals, and a higher resolution model (five metre grid) used to better understand impacts requirements. In addition, before and after flood extents have been used to determine afflux impacts.	A comprehensive understanding of water flow across the Project area for a variety of storm events. Information can be used to inform risk assessment and design parameters/ recommendations.	Appendix B and Appendix F
Flood Risk Assessment	The Flood Overlay requires a Flood Risk Report as a formal response in the absence of a Floodplain Development Pan. Following a standard process of hazard identification, probability and severity	A risk category rating matrix and mitigation options for various infrastructure items, and assessment of risk for infrastructure items based	Appendix C

	flooding risks to and from the proposed facilities are assessed against guidelines.	on its application and the use of flood buffer	

5.1. Site Visit

A site investigation was undertaken in December 2020 to understand key site conditions, catchment characteristics and hydraulic controls of contributing catchment. Photos of the site and area can be seen in Figure 7 through to Figure 10 along with explanation in the labelling.

As a result of the site visit it was identified that the modelling would need to focus on a number of areas including:

- The solar farm and implications of back watering caused by culverts and roads
- Flow velocity in and around footings of wind turbine towers and general erosion risk
- Potential areas where cabling will pass through areas susceptible to inundation
- The need to respect riparian corridors
- Safe access into and around the Project area

Source: Afflux 2020

Figure 7. Wimmera River- View from bridge

Source: Afflux 2020

Figure 8. Solar farm- view looking north

Source: Afflux 2022

Figure 9. Site northern boundary (Stawell- Avoca Road)

Source: Afflux 2020

Figure 10. Solar farm site

5.2. Flood Results

Filtered flood modelling results with infrastructure overlain are presented for the range of recurrence intervals and parameters including:

- Depth
- Water Surface Elevation
- Flow velocity
- Hazard Classification
- Bed Shear Stress.

Based on discussions with the Wimmera CMA, previous experience and evolving industry practice there is a preference for results to be presented in an electronic format that allows for interaction and inspection of certain areas.

With this in mind, we have prepared a series of overview maps that focus on specific areas where clashes occur, and risk management and mitigation measures are proposed (see next section), as provided in Appendix D.

5.3. Flood Risk Assessment

The outcomes of the Flood Risk Assessment are summarised in Table 13 along with mitigation actions to ensure residual risk is maintained as Low.

Table 13. Flood Risk Assessment- Outcomes

Infrastructure Segment	Risk Assessment	Recommendations
Wind turbines	The majority of wind turbines are located outside flood impacted areas. Turbines T12, T18, T19, T29, T40 and T47 are located close to regions of increased flood impact and will require attention in design. These are highlighted in Appendix D. Where there are conflicts, elevated water levels may impact on electrical components, accessibility or foundation integrity. Afflux risk is assessed as low based on floodplain characterisation and pre and post development assessment.Erosion potential is low based on an assessment of Bed Shear Stress and Velocity.	A minimum 300 millimetre freeboard should be applied above predicted flood levels to all wind turbines falling within flood impacted areas for the protection of functional floor levels, critical storage and electrical connections. While erosion potential is assessed as low, subsequent design of foundations and footings should consider geotechnical conditions in more detail and avoid concentrating flows into any susceptible areas. Given the extremely low impact on floodplain storage, and high understanding of floodplain hydraulics (afflux maps) no volumetric offset is recommended.
Solar farm	Portions of the solar farm are inundated in events of differing magnitude. Construction of panel arrays unlikely to affect floodplain function (i.e. afflux). Depending on how panels affect vegetation underneath risk of erosion may be increased. Panel electrical connections may be impacted by floodwaters in 1% AEP	Ensure that axis of panel rotation and default horizontal (stow) position (typically 1 to 2 metres above ground level) to have at least 300 millimetre freeboard. Flood sensors must be installed to ensure the solar array returns to its default horizontal position in the event of inundation. All other associated switchboards and electrical infrastructure installed with a minimum of 300 millimetre freeboard above 1% AEP levels. Sunlight access to ground under solar panels should be assessed for viability of ground cover vegetation.
Solar farm (Inverter stations and associated buildings)	A number of structures (about half) are located in areas that are flood prone in events of different magnitudes. The size and orientation of buildings may interfere with free passage of water across the site.	A minimum 300 millimetre freeboard should be applied above predicted flood levels to all buildings falling within flood impacted areas for the protection of functional floor levels, critical storage and electrical connections.

Battery storage	The battery storage area has a minor overland flow path running through the centre.	Freeboard allowances above flood levels should be applied to all electrical items and connections. Allowance will need to be made for flow conveyance through site and addressed in detailed design to allow for a flow path or conveyance method to avoid this impact.
Reticulation	Reticulation is located underground with the majority crossing terrain with no flood impacts. In some sections reticulation crosses under water courses that may be deemed as significant	Reticulation is largely immune from flood impacts, however electrical requirements for conduits and insulation will need to meet appropriate standards. Careful selection of construction methodology will be required for crossings under identified waterways and meet the requirements of Works on Waterway permits. Connections and fitments of electrical items will need to occur above flood level with minimum 300mm freeboard applied.
Access track	Access tracks have generally been assessed as low risk and should be suitable for larger maintenance vehicles in the majority of instances. There are isolated instances of elevated hazard in some locations. Areas where there are interactions with flood extents are identified in Appendix D.	Access tracks should be designed based on operational requirements. Controls should be in place to limit access to suitable vehicles based on risk characterisation. Some areas will require special consideration; and may include limits on access or use or crossings designed to avoid hazard exposure. Where roads are proposed to be raised to improve access, additional design will be required for culverts and crossings and to confirm that afflux impacts are acceptable at the property boundary. Afflux conditions within property should be negotiated by agreement with landowner.
Ancillary areas	Around half of the ancillary areas have some interaction with floodplain, however this may be in the form of buffer or isolated ponding, but generally present low risk.	Areas should be designed and operated to avoid unwanted discharge to water courses. Sediment and erosion control measures should be employed
Site access	The access point as proposed into the solar farm is impacted in a smaller storm event.	Consider relocating access further to the west to avoid areas of inundation and include warning signage as necessary.
Site operation-flood recovery	Some areas become inundated in catchment scale events and may	Consider access requirements for recovery post flood. If required ensure

	impede access to infrastructure items for prolonged periods.	that design standards are consistent with other access requirements.
Riparian encroachment	The majority of infrastructure is located outside of riparian zone or deemed as unlikely to impair major riparian functions (i.e. flow, habitat)	Reach agreement with relevant agencies (e.g. Wimmera CMA) that encroachment is acceptable.

6. Discussion

To satisfy approval requirements under the Planning Scheme, a risk assessment approach is the preferred method. An assessment has been undertaken based on flood extents associated with different recurrence intervals and duration commensurate with a range of design and approval requirements.

Analysis has used a regional approach to develop hydrological inputs to apply to the major watercourse through the area (the Wimmera River) and direct rainfall methods for local runoff which includes watercourses which 'rise' in the study area.

Loss parameters have been included for regional modelling, which was focussed on a 24 hour critical storm duration for the 1% AEP event at the solar farm location, as the main infrastructure element that is impacted by riverine runoff.

For the remainder of storm events, it was decided to not include losses when calculating the runoff generated by the catchment, and in a practical sense this would correspond to a storm event falling on a catchment that was already saturated. Nevertheless, the assessment gives a conservative estimate of flows and when coupled with a generous flood extent buffer, ensures that infrastructure items are either located in areas which pose low risk, or are identified for specific treatments in subsequent iterations of design.

The analysis uses a robust risk assessment framework that has been applied to all proposed infrastructure elements based on the latest (May 2022) layout provided. It concludes that for the majority of infrastructure items there is low risk from flooding, either directly on the infrastructure component, or to other floodplain uses.

For the small number of areas where there are interactions with flooding, design or management responses have been provided to reduce risk to acceptable levels and articulated using a risk assessment matrix.

Thus, the analysis supports the requirements of the Planning Scheme which provide the formalised mechanism for assessment of the Project for planning purposes.

Additionally, this report has considered a range of relevant guideline documents and the requirements of the Wimmera CMA and incorporated these into the response accordingly.

It has been agreed with Wimmera CMA that for areas where there are interactions with flood levels in a 1% AEP, a 300 millimetre freeboard buffer is required. This has been applied across the Project area and maps are prepared which show finished levels required for flood protection at critical locations across the Project area. In addition, the Works on Waterways permit process has been identified as required at later stages in the Project life, and design information has been extracted from the flood model results at various locations and is commensurate with risk.

Based on an assessment of the Project stage it is expected that there will be further design refinements required, but the approach taken will allow the process to progress with confidence, albeit with conditions placed in any permit or authority to proceed. The use of buffer distances around flood extents will allow for minor realignments in response to site constraints that may become evident through further investigations, as too the approach to provide design information that may assist in the design of roads and crossings that may be required under the Works on Waterways permit process.

7. Recommendations

Based on the investigation above it has been found that parts of the Project area are flood prone, and as such there will need to be accommodation for various infrastructure items as indicated below for the Project infrastructure layout (provided May 2022).

7.1. Wind Turbines

Wind turbines can be located as indicated.

Where wind turbines are found to be impacted by floodwaters, electrical connections/ junction boxes should be raised a minimum 300mm above the expected flood level or inside a suitably rated enclosure (e.g. IP57 or higher).

Six wind turbines along with foundations fall within the flood buffer areas used in analysis and which would require special consideration have been identified. Of these, 3 actual wind turbines will have specific electrical fitout requirements. These are shown in Table 14.

Table 14. Wind turbine impacts

Impact	Item
Wind turbine	T12, T40 and T47
Wind turbine and associated foundations	T12, T18, T19, T29, T40 and T47

Wind turbines that encroach within 30m of potential riparian areas should have footings designed to minimise potential for erosion and scour.

7.2. Conduits, cables and other electrical infrastructure

All conduits and cables under areas identified as being flood prone should be suitably waterproofed across the zone of inundation as shown in the included mapping, and extending beyond the identified buffer area in each direction either side of the flooded zone.

7.3. Solar Farm

Solar panels arrays will be mounted above ground on variable axis of rotation to track sun. At the lowest point of rotation panels should be at least 300mm above any identified flood level. Flood sensors can be incorporated into the array design to assist with further reducing flood impacts by returning the panels to an acceptable level above flood waters.

Access into the solar farm area is currently proposed for a length of Landsborough Road that is impacted by flood waters in a moderate return storm (10% AEP) and it is recommended to be located further west (approximately 60 metres) to avoid this situation.

Flood impacts (afflux) associated with inverter stations and other supporting infrastructure (such as sheds) has been assessed to be within acceptable limits and does not extend beyond the relevant property boundary. As such these can be addressed through agreement with the relevant landholder.

7.4. Substations and battery storage containers

Substations and battery storages should be set 300mm above the applicable flood level where indicated.

Provision may be needed to allow water to drain through the centre of the site.

7.5. Road and access track crossings

At this stage the operational requirements for roads have not been articulated however the following recommendations are made:

- For roads that are not required for all weather access but are otherwise located in areas that are inundated in more frequent flood event, consideration given to limiting access along these roads in wet weather conditions, or to include provision for maintenance (e.g. grading) in the event they become difficult to traverse.
- The Wimmera CMA Works on Waterways permit conditions should be consulted to better describe specific requirements, and an application will be required for each identified road crossing.
- Sections of roadways and access tracks that are constructed to provide all weather access to infrastructure items should be provided with culverts to relieve flows or constructed in such a manner to minimise the potential for washout in the event of inundation.
- Where roads are constructed to be raised above potential flood levels further assessment may be required to ensure ponding and backwatering do not detrimentally raise flood waters to levels where infrastructure may be compromised. This may require further assessment and landholder agreement as necessary.

7.6. Riparian buffers

The Wimmera CMA may have requirements for riparian buffers extending outwards from a nominated line denoting waterways and may be a consideration for the various the solar farm elements. Based on current layouts the infrastructure offset appears to provide close to a 100 metre buffer to identified waterways and is much greater than the minimum 30 metre riparian buffer that would be typically provided.

8. Conclusions

The Project has been analysed for flooding from the local catchment and surrounding watercourses (i.e. Wimmera River and Seven Mile Creek).

The flood analysis has used a combination of flows determined by previous regional flood studies and a more detailed study of the local catchment using direct rainfall methods and a high resolution two dimensional flood model. As per latest guidance, ensemble approaches have been used to determine critical storms for inclusion in the local catchment model.

Flooding analysis has included scenarios for the 39.35%, 10% and 1% AEP events, and interactions with proposed infrastructure have been identified within a buffer distance for each event where they occur.

A risk assessment methodology is the preferred approach to identifying requirements under the Planning Scheme (which underpins the approvals process) and a methodology has been used to consider the impact of each infrastructure item proposed.

While the majority of proposed elements represent low flood plain risks, there are a number of areas where further mitigation is required and has been addressed in the recommendations.

Further information is provided to assist with subsequent design development for the proponent, however any resultant changes are unlikely to alter flood plain risk from that reported here.

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