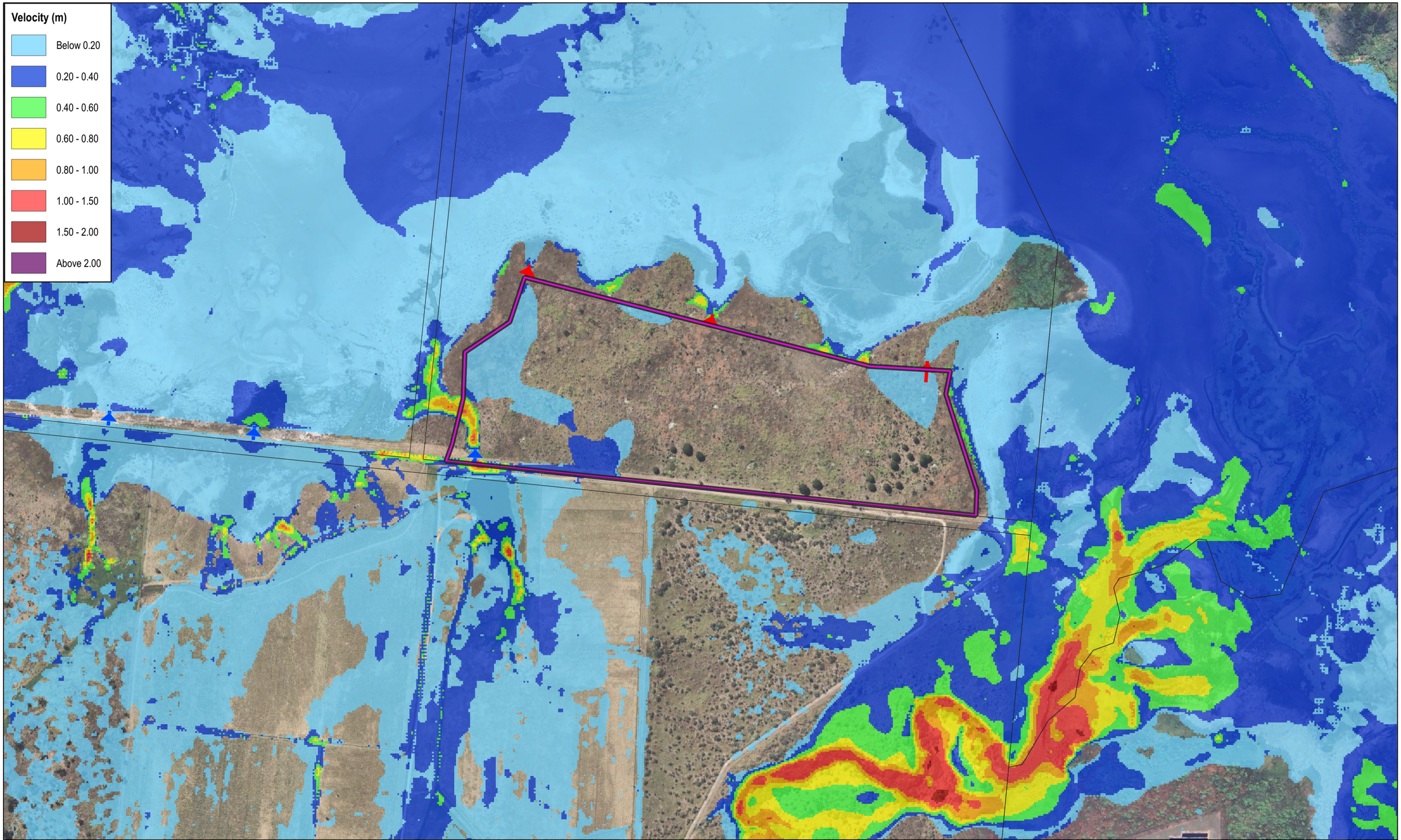


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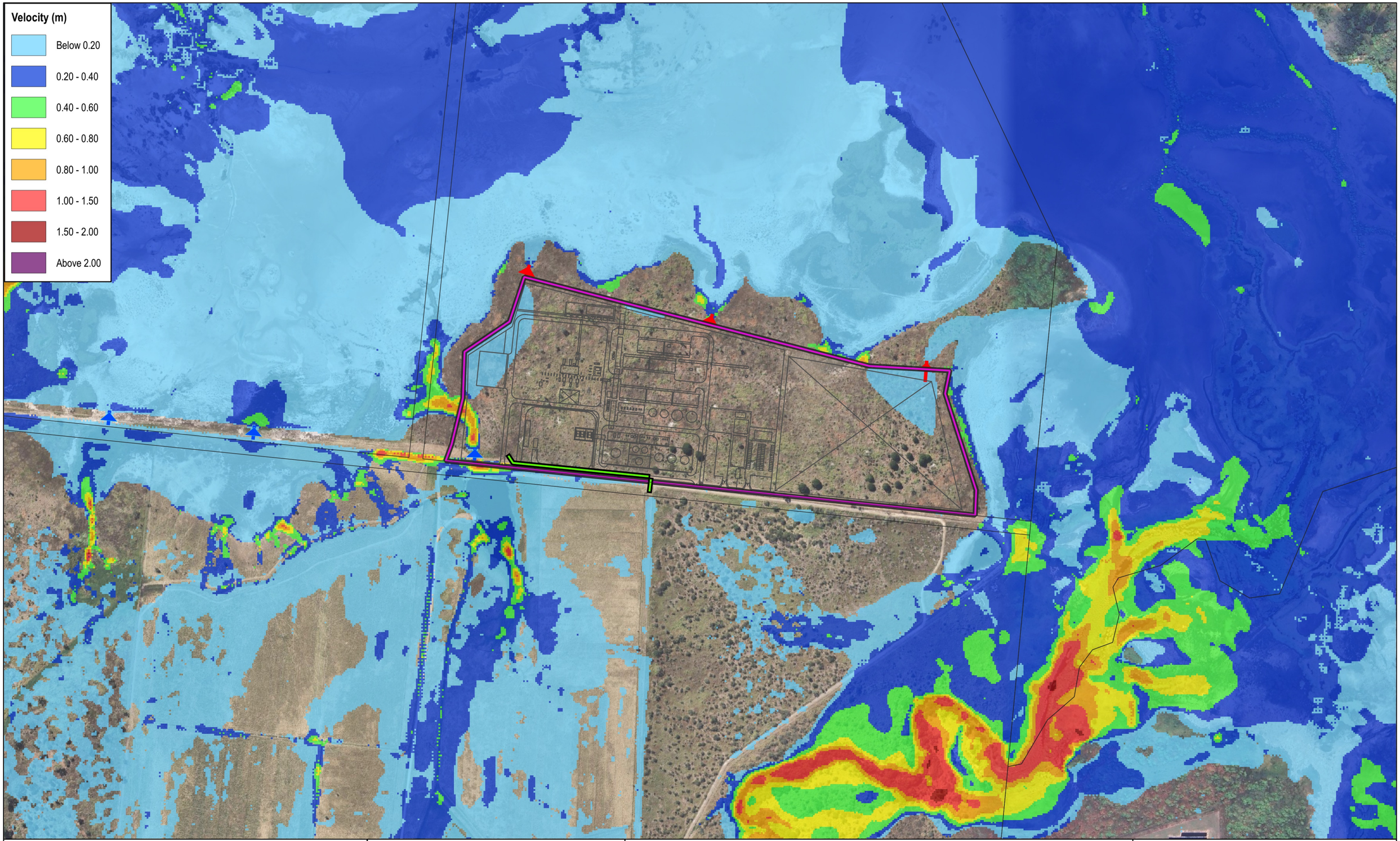
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- Land Parcels
- Development Extent
- Baseline Culverts (Rectangular)
- Baseline Culverts (Circular)

JET ZERO - PROJECT ULYSSES
STUART, TOWNSVILLE

1% AEP Maximum Baseline Flow Velocity

Prepared By: IG Reviewed by: AW	Date: 20/03/2025 Revision: A NCE Ref: MJ2601	Size A3	Map E01



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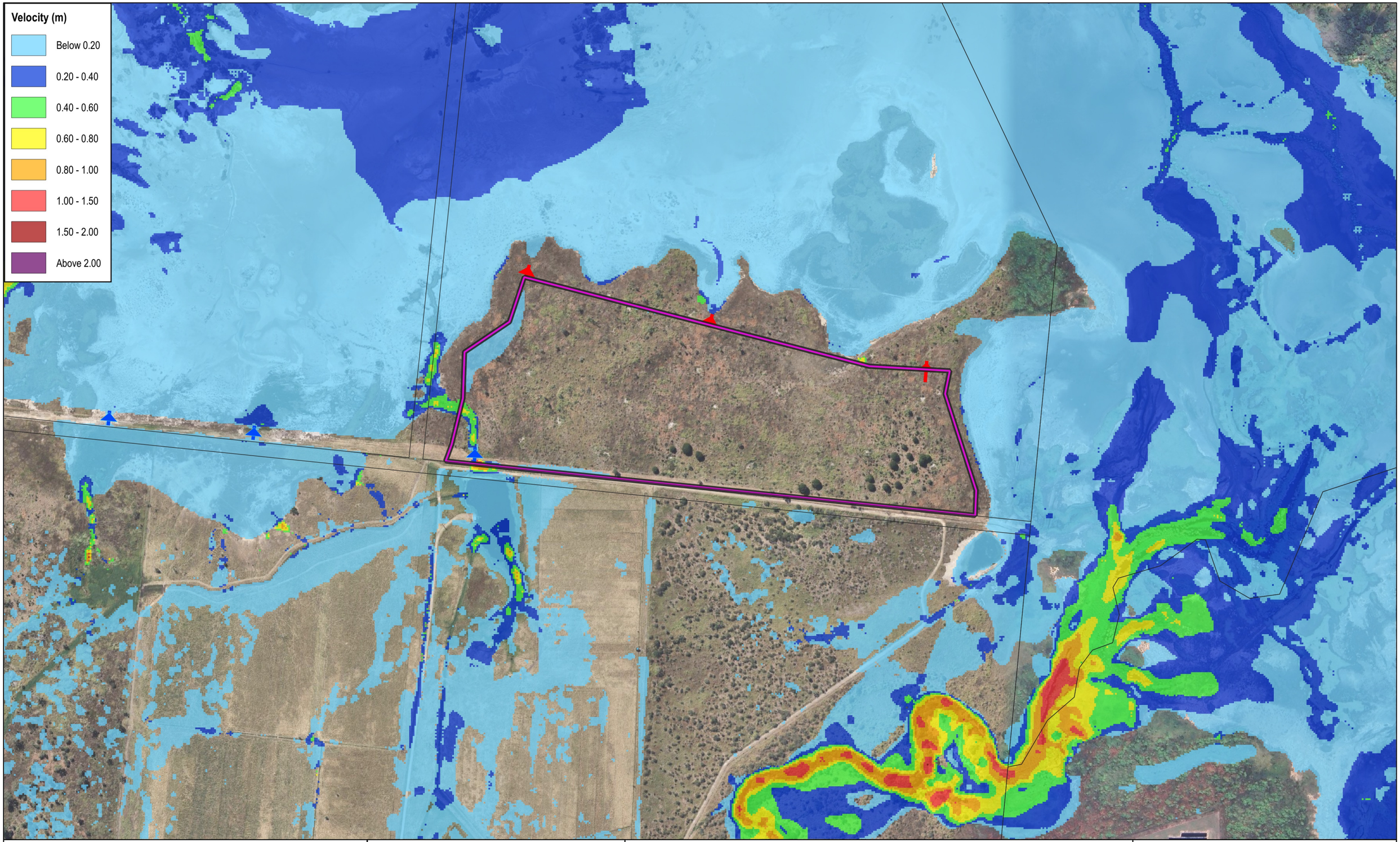
Legend

- Land Parcels
- Development Extent
- Proposed Site Layout
- Baseline Culverts (Rectangular)
- Baseline Culverts (Circular)
- Proposed Minor Levee

JET ZERO - PROJECT ULYSSES
STUART, TOWNSVILLE

1% AEP Maximum Developed Flow Velocity

Prepared By: IG Reviewed by: AW	Date: **20/03/2025** Revision: **A** NCE Ref: **MJ2601**	Size **A3**	Map **E02**



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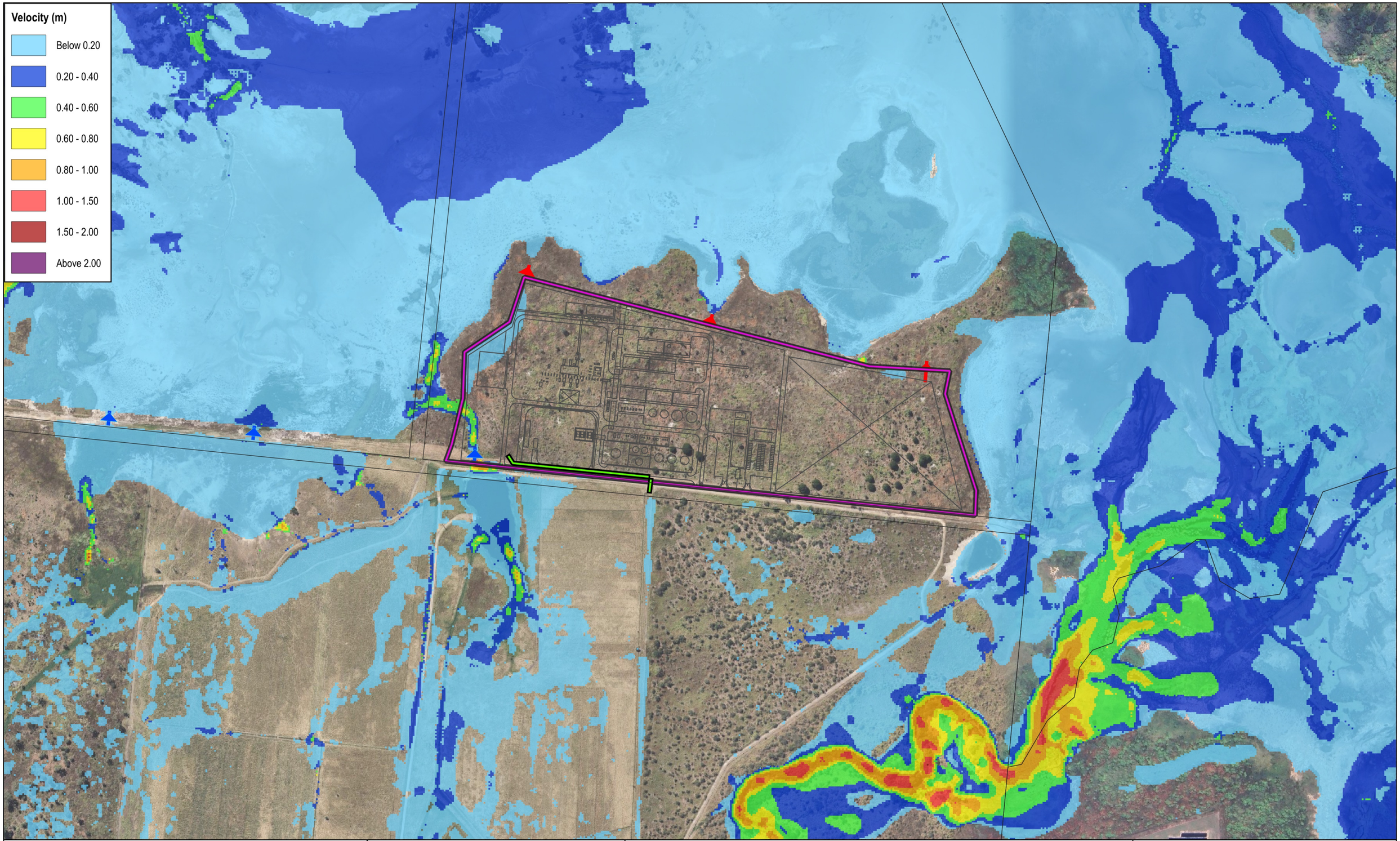
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- Baseline Culverts (Circular)

JET ZERO - PROJECT ULYSSES
STUART, TOWNSVILLE

20% AEP Maximum Baseline Flow Velocity

Prepared By: IG Reviewed by: AW	Date: 20/03/2025 Revision: A NCE Ref: MJ2601	Size A3	Map E03



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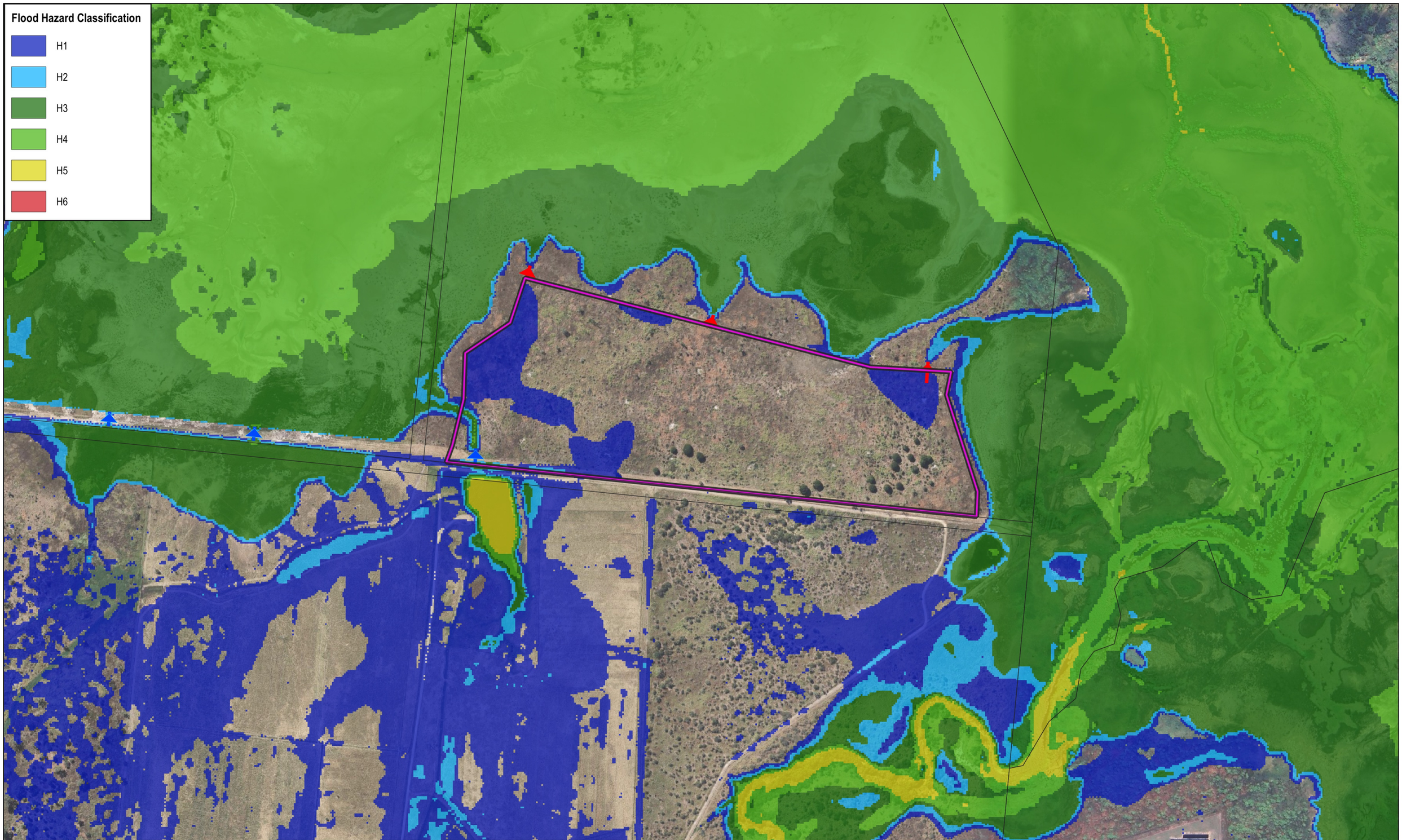
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STUART, TOWNSVILLE

20% AEP Maximum Developed Flow Velocity

Prepared By: IG Reviewed by: AW	Date: **20/03/2025** Revision: **A** NCE Ref: **MJ2601**	Size **A3**	Map **E04**

APPENDIX F

Flood Hazard Results



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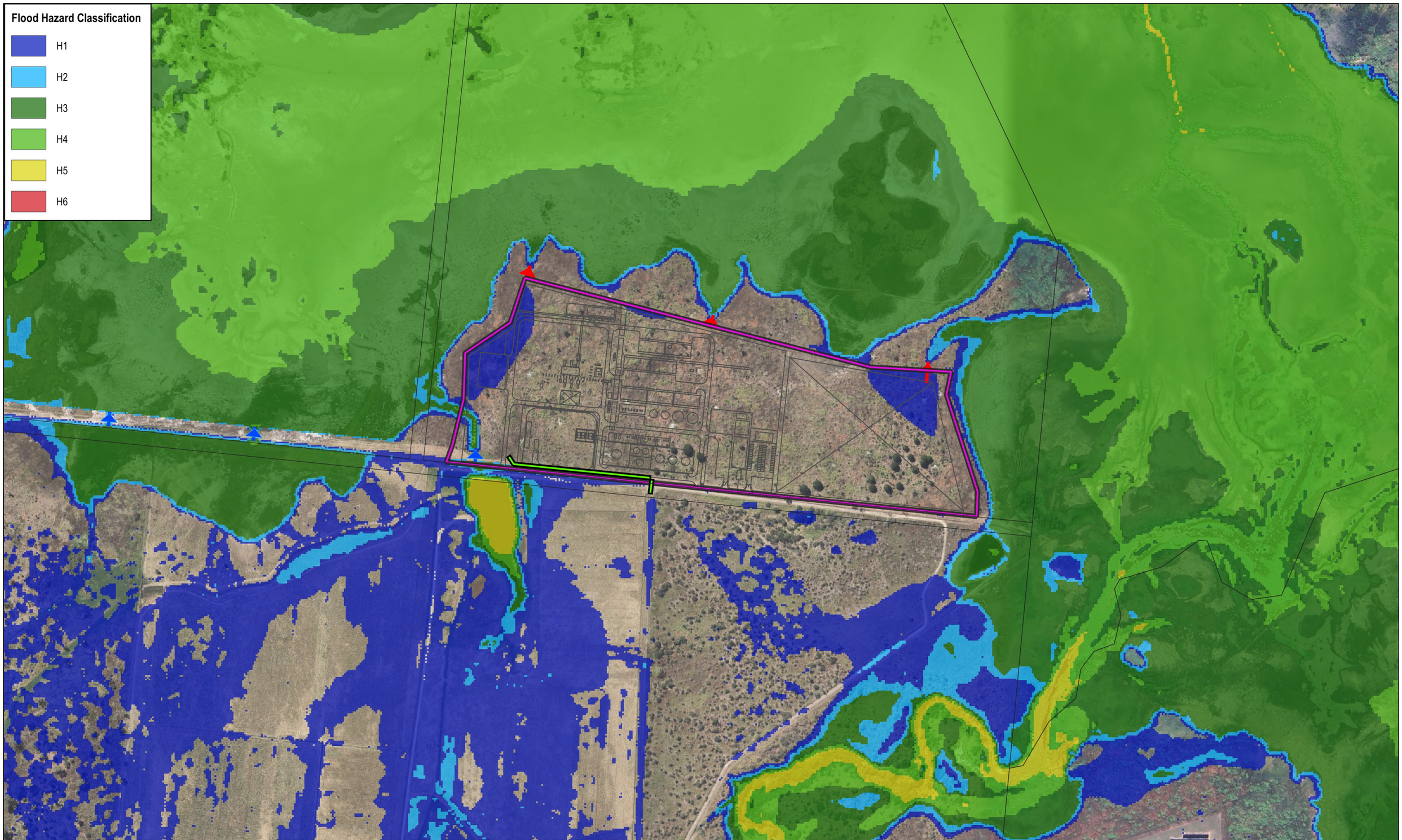
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1% AEP Maximum Baseline Flood Hazard

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- Baseline Culverts (Circular)
- Proposed Minor Levee

JET ZERO - PROJECT ULYSSES STUART, TOWNSVILLE

1% AEP Maximum Developed Flood Hazard

Prepared By: IG Reviewed by: AW	Date: 20/03/2025 Revision: A NCE Ref: MJ2601	Size A3	Map F02

Flood Hazard Classification

- H1
- H2
- H3
- H4
- H5
- H6

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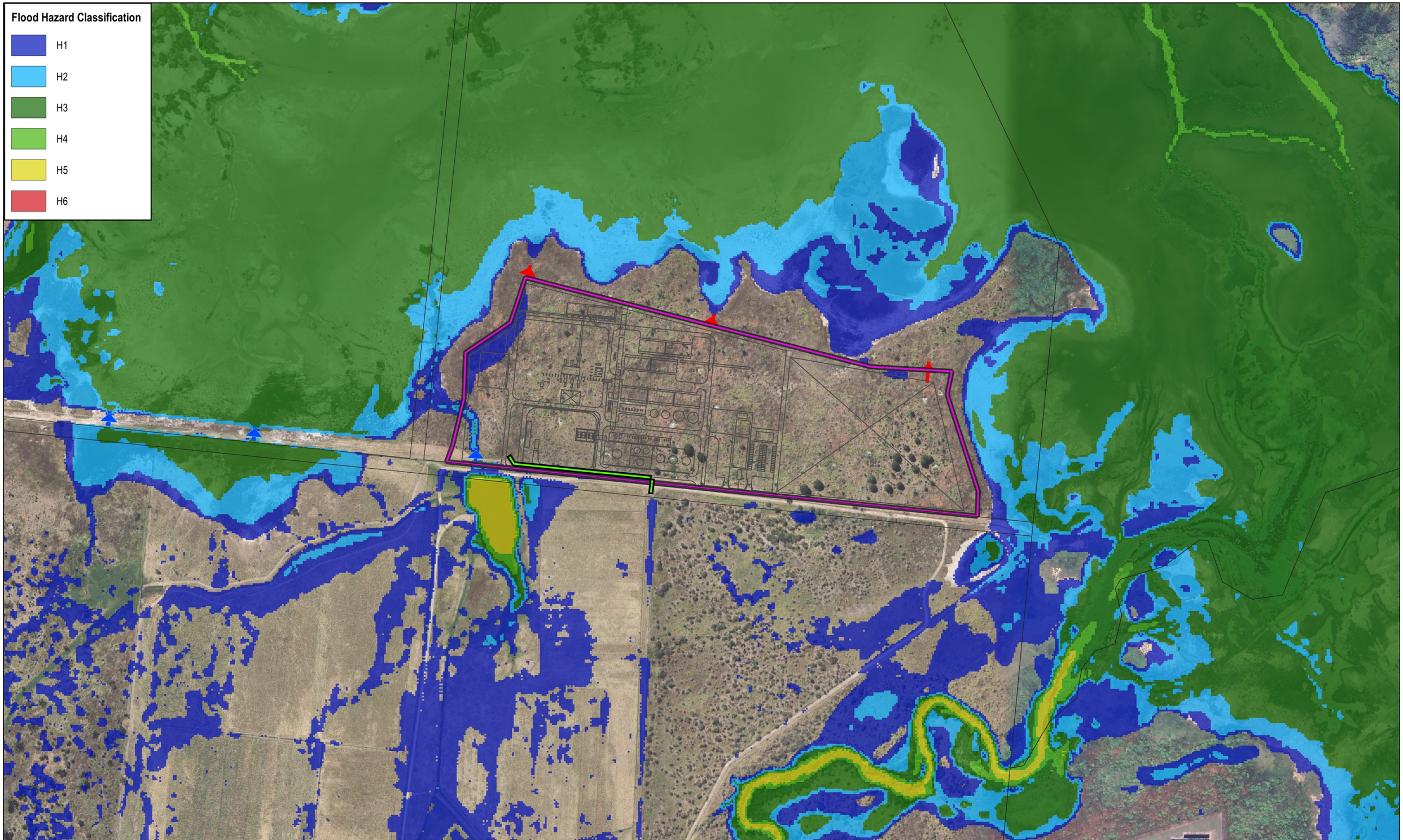
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- Land Parcels
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- Baseline Culverts (Circular)

JET ZERO - PROJECT ULYSSES STUART, TOWNSVILLE

20% AEP Maximum Baseline Flood Hazard

Prepared By: IG Reviewed by: AW	Date: 20/03/2025 Revision: A NCE Ref: MJ2601	Size A3	Map F03



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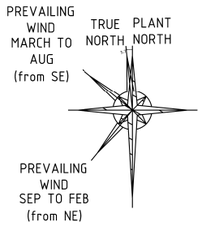
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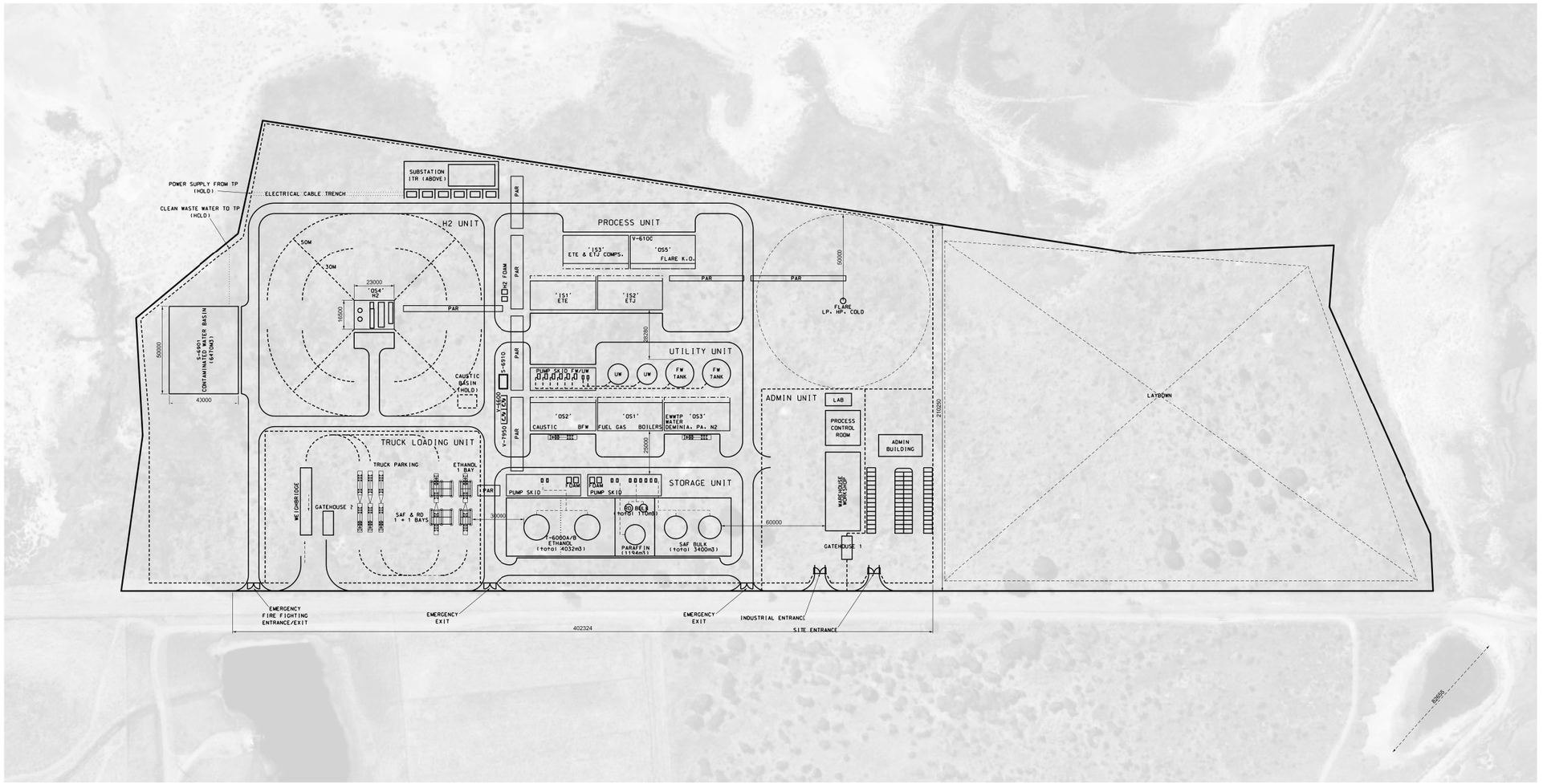
20% AEP Maximum Developed Flood Hazard

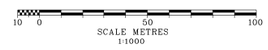
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APPENDIX G

Site Layout Plan







NOTES

1. GOOGLE EARTH SITE IMAGE IS APPROXIMATELY SCALED.
2. ALL COORDINATES IN METERS, ALL DIMENSIONS IN MILLIMETERS.
3. THIS LAYOUT IS BASED ON REV A3 PROCESS DATA.

HOLDS

1. SITE CO-ORDINATES AND BOUNDARY LINE.
2. EQUIPMENT SIZE AND LOCATION.
3. MODULE SIZE AND LOCATION.
4. TRUCK LOADING/UNLOADING.
5. THIRD PARTY TIE-IN LOCATIONS.
6. ADMIN AND SUBSTATION BUILDINGS SIZE AND LOCATION.
7. REQUIREMENT FOR COOLING WATER (NOT SHOWN IN LAYOUT).
8. REQUIREMENT FOR SULPHURIC ACID STORAGE TANK.
9. REQUIREMENT FOR H2 STORAGE BULLETS.
10. FLARE STERLIE RADIUS.
11. ANALYSER HOUSE REQUIREMENT, QUANTITY AND LOCATION.
12. HYDROGEN COMPRESSOR LOCATION ASSUMED TO BE WITHIN H2 MODULE (OS4).
13. REQUIREMENT FOR CAUSTIC BASIN AND SIZE.

KEY

- UNDERGROUND
- FENCE
- LAYDOWN/ACCESS
- EQUIPMENT
- MODULE/PIPERACK/STRUCTURE
- ROADS/CIVIL
- PIPING STUDY
- PROPOSED SAF PLOT LIMIT

PAR	PRE-ASSEMBLED RACK
PAU	PRE-ASSEMBLED UNIT
TP	THIRD PARTY

REFERENCE DRAWINGS

Rev	Date	Revision Object	Written	Checked	Approved Technical	Approved Project
X	X	INTERNAL	NM	GM	GM	NP

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PROJECT ULYSSES PRE-FEED
QUEENSLAND, AUSTRALIA

CONCEPTUAL OVERALL PLOT PLAN

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1 William St, Perth WA 6000
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PLANS AND DOCUMENTS referred to in the SDA APPROVAL

Queensland Government

SDA approval: AP2025/005

Jet Zero Australia

Project Ulysses

216651C

Document Title

Fire and Explosion Analysis

Document Number

216651C-000-RT-1950-0002

Jet Zero Document Number

28011007-HSE-REP-00006

Rev.	Date	Reason for Issue	Prepared by	Discipline Check	Technical Integrity	Project Approval
0	11-01-25	Issued for Design	WPL	PB	PT	RH
A	21-11-24	Issued for Review	AS/WPL	PB	PT	RH
A1	18-11-24	Issued for Inter-Discipline Check	AS/WPL	PB	PT	

JET ZERO RETURN CODE

Jet Zero AUSTRALIA

X 1 Reviewed & Accepted (Final & Certified)	Work May Proceed
☐ 2 Reviewed & Accepted (As Noted)	Work May Proceed Revise and Resubmit numerical rev
☐ 3 Reviewed & Returned (Correct & Resubmit)	Work Should Not Proceed Revise and Resubmit alpha rev for review
☐ 4 Information Only (Not Reviewed)	Work May Proceed Information Only
☐ 5 Reviewed & Accepted (Comments to be included in next stage)	

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Hold Status Sheet	
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EXECUTIVE SUMMARY

Fire and Explosion Analysis (FEA was carried out for the Alcohol to Jet Fuel (ATJ) plant converting ethanol feedstock to Sustainable Aviation Fuel (SAF). The plant will be constructed in Townsville, Queensland and will produce 100 ML of SAF and 10 ML of renewable diesel per annum. The plant consists of 2 main elements: Inside Battery Limits (ISBL) and Outside Battery Limits (OSBL). The study covered both the ISBL and OSBL of the facility, which is a combination of Alcohol To Jet (ATJ) - (Ethanol-to-Ethylene (ETE) and Ethylene-to-Jet (ETJ) units) and OSBL consisting of tank farm with loading/ unloading gantry, hydrogen generation, utilities, tanker loading and services.

The objective of the Fire and Explosion Analysis (FEA) is to identify Loss of Containment (LOC) scenarios from the ATJ facility and estimate the maximum credible events for all release types as input to the layout development and regulatory consent requirement. The consequence results will also be used as a high-level assessment of potential escalation events in the facility.

Major hazards of this facility were found to be from the ETE (IS1) and ETJ (IS2) modules. These modules are 4-5 storeys high and contain large amount of process equipment within a small space and a high level of congestion. Thermal radiation resulting from jet and pool fire, toxic (Acetaldehyde) and flammable dispersion from these modules were found to be largely confined within the site for small to medium releases due to the separation distance to the site boundary. For explosion events the 0.07 bar overpressure contour from both modules and small section of 0.14 bar contour from ETJ module and was found to encroach to offsite areas. At these overpressure, fatality of personnel outdoors is expected to be minimum.

Loss of containment events from the IS3 module could lead to offsite thermal radiation from jet fire and pool fire events due to location of the module close to the site boundary. Although the IS3 module is much smaller compared to the ETE and ETJ module, the credible VCE event was found to lead to offsite impact from the 0.07 bar explosion contour. The Liquid Hydrocarbon Storage Vessel in OS5 could give rise to pool fire and also toxic dispersion (97m for 23mm release) due to presence of Acetaldehyde which could impact offsite areas.

Fire and toxic events from small and medium process loss of containment events were not found to impact the manned buildings towards the east of the facility. Credible explosion overpressure to the manned buildings was evaluated to be less than 0.14 bar (from IS2 module). The manned buildings (i.e. control room and admin building is impacted by approximately 0.10 bar explosion overpressure, which could cause windows breakage and damage to the building but not to a level that leads to its failure, causing fatality of operators within. Design of the buildings will need to consider the credible explosion load (i.e. windows facing away from process area/ no windows and strengthening of the structure may be required).

Pool fire thermal radiation arising from the storage tanks and tanker loading area could result in a larger pool fire with thermal radiation that could extend offsite towards the plant access road at the South Boundary.

Several escalation events were also considered in this assessment. Events such as BLEVE of the LPG tank and catastrophic rupture of the hydrogen storage tanks could lead to explosion overpressure that could have a larger impact compared to the primary event. Escalation events can be minimised with separation distance, provision of active fire protection and inventory reduction.

The major hazard arising from the hydrogen module is explosion overpressure as hydrogen has the propensity for detonation. Worst case explosion overpressure from the H2 generation area is expected to be from the electrolyser building due to the congestion and confinement of the building. The 0.21 bar explosion contour from the electrolyser building could impact the

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H2 storage tanks and the H2 separation and purification skids located within the module. Due to the large separation distance provided in the OS4 module, thermal radiation from jet fire and flammable dispersion was found to be confined within the module.

As the basis for isolation is 10 minutes, most of the thermal radiation resulting from loss of containment event arising from modules IS1, IS2 and IS3 could lead to impairment and subsequently escalation to neighbouring equipment and structures within the module and to adjacent modules due to the close proximity of equipment in ISBL. Hence rapid detection and isolation is key to minimise escalation events, particularly for the modules whereby separation distance is difficult to achieve, as the release for medium, large and full-bore ruptures would typically deplete quickly after isolation.

The 0.35 bar and 0.21 bar explosion overpressure arising from explosion within IS1, IS2 and IS3 modules could impact neighbouring modules and extend to the utilities area. 0.21 bar explosion overpressure arising from the ETJ module could impact critical emergency equipment (i.e. flare KOD, firewater tanks and Firewater Pumps leading to escalation. However, the manned buildings, storage tanks and the hydrogen generation module are outside of the 0.14 bar overpressure contour.

The following recommendations are raised to reduce the escalation risk within the facility and to the public:

- The basis of this study is manual isolation (assumed to take 10 minutes), meaning that if ignited, most releases could have the potential to cause escalation due to the modular design of the plant. Modularisation of plants tend to have a greater safety cost due to greater congestion which increases the risk of escalation and explosions. Rapid detection and isolation (i.e. with automatic isolation and blowdown upon confirmed detection) would reduce the duration of release, such that escalation is less likely to happen. Provision of automatic shutdown would be most beneficial for the IS1, IS2 and IS3 modules whereby there are large number of process equipment with limited separation distances.
- It should be noted that even small releases can impair adjacent modules due to limited separation between modules. Acceptability of escalations due to jet/pool fires and explosions between modules should be considered and recommended for separation distances to be reviewed based on COMPANY escalation acceptance criteria.
- Most large and full-bore releases are anticipated to exceed offsite and lead to escalation, it is recommended to evaluate frequencies of these releases in future QRA studies to ensure the risk to offsite is acceptable.
- Explosion with the IS1, IS2 and IS3 modules could give rise to large explosion overpressure. Equipment containing significant ethylene and hydrogen inventory that can give rise to large explosive cloud (e.g. Hydrogenation HP Separator, hydrogenation reactor, ethylene separation and refinement columns) should be located whereby the ventilation is maximised to disperse any released flammable vapour (i.e. edge of module, at the top elevation) or be sited outside of the module in a more open location to reduce the resulting explosion overpressure.
- Computational Fluid Dynamics (CFD) explosion analysis is recommended during FEED design phase for more accurate explosion overpressure prediction due to the high confinement and congestion within the IS1, IS2, IS3 modules and electrolyser building.
- Suitable containment and drainage should be provided for process vessels containing large amounts of liquid inventory and at the tanker loading area to limit the spread of any liquid release and the resulting pool fire.

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- Required fire and explosion design accidental loads should be evaluated during FEED design phase to evaluate passive fire/blast protection for critical process/ emergency equipment and structure to avoid catastrophic escalation events.
- Provision of active fire protection for the storage tanks and other critical process vessel containing significant quantities of flammable liquid inventory could provide cooling, reducing likelihood of escalation.
- Critical utilities required during emergency such as the firewater system, flare KOD, nitrogen unit should be located in a safe area, preferably upwind from process releases and protected from fire and explosion hazards. In addition, critical process equipment that could lead to catastrophic escalation events (i.e. Hydrogen Storage Tank, LPG tank) should be located away/ protected from process hazards.
- Although the manned buildings were found to be outside the 0.14 bar explosion overpressure threshold, the buildings could still be subjected to explosion overpressure of around 0.1 bar. Design of the buildings will need to consider the credible explosion load (i.e windows facing away from process area/ no windows and strengthening of the structure may be required). Risk to operators working within the facility and offsite personnel should be evaluated to ensure the risk is acceptable.

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