JAMES COOK UNIVERSITY
AUSTRALIA

Natural Assets Management Plan, 2021

James Cook University – Bebegu Yumba Campus, Townsville

Cairns
Singapore
Townsville

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IERC	Indigenous Education and Research Center
DEHP	Department of the Environment and Heritage Protection
GIS	Geographic Information System
TCC	Townsville City Council
TWRC	Tropical Weed Research Center
WQ	Water Quality

Background to Bebegu Yumba Campus Natural Assets Management Plan (NAMP)

Vision

'A University campus that values the balance between our unique dry-tropical natural environment and sustainable development. The JCU Bebegu Yumba campus is a living laboratory, where teaching, learning and research play a key role in management of our natural assets. Our skills in developing innovative technology for natural asset management and demonstrating best practice attract students, staff and industry, both locally and globally.'

Overview of the Bebegu Yumba Campus and the NAMP

James Cook University's Bebegu Yumba campus is a 380-hectare site that contains a variety of remnant and regrowth dry tropical savannah woodlands backing onto the Mt Stuart range, including two major ephemeral creek systems and several tributaries within the Ross River catchment. The maintained area of campus is approximately 100 hectares and contains developed areas with well-established native and introduced plantings, artificially landscaped areas around buildings, and an artificial rainforest area along Wadda Mooli Creek in the centre of the campus. The ephemeral creeks that flow through campus feed into the Ross River and are important assets to the campus, providing green corridor and important ecosystem services to the surrounding environment. The upstream reaches of these creeks are an excellent example of the natural condition of the area and should be maintained free from development and invasive pest impacts in perpetuity.

The abundance and diversity of flora and fauna that the campus supports are a drawcard to students and staff, particularly international students. This has the potential to be utilised as a tool for learning, teaching, research as well as marketing the University. JCU also has a responsibility to protect and enhance the natural assets of the campus and is bound by specific local, state and federal legislation in relation to this.

The Bebegu Yumba Campus Natural Assets Management Plan (NAMP) aims to protect and enhance the natural assets on campus, while helping to inform future sustainable development of the campus through the campus Master Plan and Discovery Rise projects. The 2021 NAMP should assist the campus master planning process ensuring JCU is an exemplar of best practice in campus planning and development. The NAMP will help to identify high value species, habitats, and green corridors, and aim to protect and enhance these areas where possible while encouraging master plan developments to prioritise degraded and previously cleared areas for development.

As a University with a specific focus and expertise in tropical biodiversity, JCU should utilise its campus and internal resources as a living laboratory to help protect and enhance the natural assets in a way that supports and enriches learning, teaching and research and presents real, field-based learning opportunities for students. Emerging technology will also play a key role in monitoring and managing natural assets into the future. JCU has a unique opportunity to draw on its expertise in eResearch and the new Internet of Things degree to demonstrate innovative practices in this area. The action plans recognise this potential and specific projects should be identified that could potentially link with the eResearch Centre.

Goals of the Natural Assets Management Plan, Bebegu Yumba Campus

The Bebegu Yumba Campus NAMP seeks to guide actions towards the achievement of six main goals which encompass the key areas of managing the natural assets on campus. These goals are:

1) Goal One: Identify, document, and protect campus' cultural heritage through an all-inclusive approach.
2) Goal Two: Identify, protect, and maintain at ecologically sustainable levels native fauna and their associated habitats on campus
3) Goal Three: Ensure efficient and effective management of native vegetation on Townsville campus to enhance contiguous connectivity with adjacent flora to improve ecosystem services and other vegetation functions.
4) Goal Four: Control and manage pest and weed on Townsville campus for environmental sustainability.
5) Goal Five: Protect and manage waterway and riparian areas on Townville campus to enhance ecological values and movement of terrestrial and aquatic fauna.
6) Goal 6: Maintain, manage, and enhance Townsville campus' landscape through ecologically sustainable design principles and actions.

List of actions have been tabulated under each goal for implementation to ensure the sustainable management of the Bebegu Yumba campus natural assets.

Benefits of the NAMP to JCU

Having a coordinated NAMP for the campus allows JCU to comprehensively plan and develop its unique natural assets in a coordinated and strategic way. There are numerous economic, social, environmental, and reputational benefits of developing and implementing the NAMP and showcasing the campus as an exemplar in natural asset management in balance with a sustainable built environment and related infrastructure. JCU has the knowledge and expertise to ensure our natural assets are managed effectively. This can link closely with teaching, learning and research, providing an on-site living laboratory for students and staff, and attracting external organisations and businesses with our ability to showcase best practice and innovation in natural asset management.

The NAMP allows JCU to build better linkages with external stakeholders through the development of collaborations and partnerships that have mutual benefits for both parties. The diversity of natural assets on the Bebegu Yumba campus provides opportunities for JCU to work with businesses and organisations to develop a range of technologies and best practice examples in environmental management. This will not only benefit industry but also expose students and staff to hands-on experience in innovative practices, preparing them for the workforce.

Economic benefits can be clearly defined, especially in the areas of sediment and erosion control, pest and weed management and riparian and waterway protection. Well managed natural assets provide a range of ecological and social services and benefits and minimise the risk of significant environmental damage and associated high costs to repair.

Funding and Resources

Current funding for natural asset management is inadequate to address the NAMP objectives. As a minimum, compliance with relevant legislation should be achieved, and this may require additional funding, particularly in relation to weed and pest management obligations. Significant additional resources and funding will be required to ensure the campus can reach its vision to be a world leader in natural asset management for the wet tropics. Current funding allocated to natural asset management comes from the Environmental Maintenance budget within the Estate Directorate for both the Townsville Bebegu Yumba and Cairns Nguma-bada campuses. The fund is currently used primarily at the Townsville campus to undertake some weed and pest management, erosion control and revegetation works on a very small scale. The amount of funding allocated to the NAMP will significantly affect the outcomes and condition of the campus' natural assets. JCU must weigh up both the benefits of implementing the NAMP with adequate funding and the risks of not investing in it.

It must be noted however that some of the action plans in the NAMP can be implemented at relatively low cost by utilising the resources of the university. Many of the actions identified have the potential to link with curriculum and research to undertake on-ground projects that benefit both the campus and the students. There are also opportunities to draw on the volunteer resources of JCU in areas such as revegetation works. Where funding becomes available to undertake specific programs that provide benefit to the university's natural assets, and aligns with the objectives of the NAMP, JCU may look to pursue it. Funding applications may be made in collaboration with external partners at the discretion of JCU. Where collaborations are established, there should be clear mutual benefits identified for both parties in undertaking the project. Potential funding avenues identified include:

- Federal or State funding for environmental activities
- Potential for companies to fund offsets for development (e.g. main roads)
- Opportunity to attract ecotourism students with holiday courses on campus
- Black throated finch - student PhD
- Corporate funding

Relevant Stakeholders

There are a wide range of stakeholders that are relevant to the development and on-going implementation of the NAMP. Relevant stakeholders have been listed against relevant actions in the action plan sections. However, it is worthwhile listing all relevant stakeholders here. All stakeholders identified as having relevance to the NAMP are listed below.

Internal Stakeholders

- JCU Academics
- JCU Researchers
- JCU Estate Directorate
- College of Science and Engineering
- College of Public Health, Medical and Veterinary Sciences
- Australian Aboriginal and Torres Strait Islander Centre
- eResearch Centre
- TropWater
- Centre for Tropical Environmental & Sustainability Science
- Staff
- Students
- JCU Sustainability Club

External stakeholders

- Department of Defence - Lavarack Barracks
- Townsville City Council
- Townsville Hospital
- Bindal People
- Wulgurukaba People
- Greening Australia
- Coastal Dry Tropics Landcare
- Conservation Volunteers
- NQ Dry Tropics
- Department of Environment and Heritage Protection (QLD)
- Department of Natural Resources and Mines (QLD)
- Department of Environment (Federal)
- BirdLife Townsville
- North Queensland Wildlife Care
- Rockwheelers Mountain Bike Club
- Tangaroa Blue
- Department of Employment (Federal)
- Biosecurity Queensland

Relevant Legislation and Information

There is federal, state and local government legislation and regulations that JCU is required to meet in its management of its natural assets. Relevant legislation and regulations are listed below.

- Aboriginal and Torres Strait Islander Act 2005
- Aboriginal Cultural Heritage Act 2003
- Biosecurity Act 2014
- Environmental Protection Act 1994
- Environment Protection and Biodiversity Conservation Act 1999
- Fisheries Act 1994
- Native Title Act 1993
- Nature Conservation Act 1992
- Sustainable Planning Act 2009
- Vegetation Management Act 1999
- Water Act 2000

Each section of the NAMP references other documentation, information or research that may be relevant to that section. Where practical this documentation will be collected and stored as a supplement to the NAMP.

Action Plans

An action plan has been developed for each goal of the NAMP. The action plans identify specific actions that need to be undertaken toward the achievement of each goal of the NAMP within the resources available. Ninety actions (listed in the Action Plan Tables) have been identified across the six goals encompassing eight action plan sections. These sections are:

1) Cultural heritage protection
2) Native fauna and habitat protection
3) Native vegetation management
4) Pest management
5) Weed management
6) Waterway and riparian management
7) Land management
8) Fire management

Due to the high number of actions identified in each section, a priority ranking system has been developed to ensure the NAMP is achievable and manageable. Actions rated as Very High and High priority will have a higher level of resourcing allocated compared to lower priority actions. Where the required resources are available these actions will be undertaken first. When actions are a lower priority but are easily achievable, they will be undertaken as resources permit.

Monitoring and Evaluation

The NAMP is designed to be a three-year plan with annual reviews to monitor progress. At the end of the three years a major review and update will be completed. In developing the action plans under each section of the NAMP it is important that monitoring and evaluation for each action is clearly defined and measurable so that progress can be identified. It is important that the NAMP is supported by senior management at JCU, in particular the Sustainability Advisory Committee and the Estate Directorate, and appropriate resources are allocated to ensure the campus can meet the objectives of the NAMP.

Goal One of Townsville Natural Assets Management Plan

"Identify, document, and protect campus' cultural heritage through an all-inclusive approach"

JCU Townsville campus hosts several culturally significant assets some of which are not yet known. Identifying and documenting Indigenous Australian and contemporary cultural heritage in relation to the campus' natural assets will provide understanding of the University's place in, and importance to, Traditional Owners perspectives of protecting the natural and cultural assets on campus. Protecting the campus' cultural heritage will require an all-inclusive approach of engaging Indigenous people, JCU students and staff, and the public through teaching, learning, research, and public education on the importance of culturally significant artefacts and sites. The sustainability of Bebegu Yumba campus cultural heritage is contingent upon documenting and preserving the cultural heritage to be passed on to future generation.

1.1 Objectives for Cultural Heritage Protection

The key objectives for Cultural Heritage under the NAMP are:

- Document the campus' Indigenous Australian and contemporary cultural heritage in relation to its natural assets/environment
- Ensure the plan involves and is guided by local Indigenous groups and all documented information and actions are fully endorsed by an agreed working group that represents all relevant stakeholders
- Provide an understanding of the Indigenous story/history of the campus grounds and the wider landscape at a high level
- Protect the cultural heritage of the campus in relation to the natural assets/environment
- Encourage inclusion of Indigenous cultural heritage and contemporary heritage in the development of the campus master plan where appropriate
- Enable local Indigenous knowledge and practices to be passed on, undertaken or re-established on campus

1.2 Scope

The campus' natural assets/environmental sites and how they relate to Australian Indigenous cultural and environmental heritage and contemporary cultural heritage.

Table 0.1 Relevant Information related to Cultural Heritage Protection

Document/information source	Author/Contact	Comments
QLD museum book on local cultural stories	Unknown	Additional information required
Carpet snake story for Mt Stuart range	Unknown	Permission required to document
Work on country - Bindal	Arthur Johnstone	Additional information required
Wadda Mooli Creek rerouting - historical maps and information	JCU library	Conduct search at library
Verbal histories of the campus	Indigenous elders	Permission required to document
Thesis on stone tool quarries	JCU library	Source document
4K1G interview - history of area	Unknown	Max Lenoy to source
Course connections run up at Wujal Wujal	Dermot Smyth	
Witchetty Grub tree - Western campus	Unknown	Permission required to document
Creek renaming important cultural and environmental milestone	N/A	Gather related articles
Eucalyptus platyphylla trees remaining from Cyclone Althea - unique growth characteristics	N/A	Collect photographic history

1.3 Management Practices and Procedures

Currently no management practices are in place for environmentally related management of cultural heritage. However, the NAMP action plan will aim to address this. JCU is required to comply with relevant legislation including:

- Aboriginal and Torres Strait Islander Act 2005
- Aboriginal Cultural Heritage Act 2003
- Native Title Act 1993

Table 0.2 Cultural Heritage Protection Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
1.1	Consultation with Traditional Owners	Continue talks with Traditional Owners on Cultural heritage protection to identify sites that are important to preserve and stories they are willing to share regarding history on the site	Instigation of talks with Traditional Owners. Finding best people to begin talk.	Nil	N/A	• Local Traditional Owners • Estate Directorate • Max Lenoy • Uncle Russell Butler • Michelle Bird	N/A	Very high	Jan 2022	Ongoing	• Best people identified and talks commenced • Sites to preserve identified • Stories about sites shared and documented
1.2	Conduct site wide archaeological survey	Undertake a site wide archaeological survey to ascertain the cultural history of the site and preserve any culturally significant artefacts or sites	Commitment of Discovery Rise to instigate survey	TBA	TBA	• Discovery Rise • Estate Directorate • Michelle Bird (archaeological consultant with ties to local Traditional Owners) • Traditional Owners	• Archaeology • Indigenous studies	High	Dependent of DR advice	Dependent of DR advice	• Completed report on site archaeology • Cultural history of site ascertained • Identified culturally significant artifacts preserved
1.3	Develop procedure for any artefacts found on site	Develop procedures to deal with the discovery and preservation of any item of cultural significance	Time and identification of key personnel to contact in such an instance	Nil	N/A	• Estate Directorate	N/A	Medium	Jan 2022	Jul 2022	• Completed procedure manual and adoption by staff and contractors
1.4	Collect information on specific culturally significant sites on campus and store the GIS and metadata	The collection of data/data points will make the preservation of any designated culturally significant areas easy to locate, expatiating development and avoiding any unnecessary destruction of significant sites	GIS data and the knowledge of the significance of the site	TBA	TBA	• Local Traditional Owners • Estate Directorate • James Maloney • David Roy	GIS	Medium	Jan 2022	Jul 2022	GIS data available to help guide any future development
1.5	Develop an interpretive track and signage for the campus (similar to Jezzine Barracks)	Tie in with Verandah Walk and/or bush walking tracks as part of campus master plan	Input from IRG on how to commence discussions and design	TBA	TBA	• Local Traditional Owners • Max Lenoy • Uncle Russell Butler • Estate Directorate • Discovery Rise	Indigenous studies	Medium	Jan 2022	Until complete	• Interpretive track and signage developed • Indigenous plantings on tracks completed
1.6	Traineeship for Indigenous Identified student with Environmental Manager	Offer traineeships to indigenous identified students allowing them hands on experience in environmental management. PVC IERC to develop program and attract funding.	• Understanding of what training is being provided • Liaise with relevant HR staff	TBA	TBA	• Estate Directorate • Human Resources • Indigenous Students	N/A	Low	Jan 2022	Ongoing	Trainee working with environmental manager
1.7	Continue establishing bush gardens with significance to particular areas (medicinal plants near medical, butterfly garden near childcare etc.)	Use gardens for learning, teaching and research and to enhance the environmental assets on campus	• Understanding of plants • Input into garden design.	TBA	TBA	• Local Traditional Owners • Max Lenoy • Uncle Russell Butler • Betsy Jackes • Greg Calvert • Estate Directorate • Discovery Rise • Landscape architect	Botany	Low	Jan 2022	Until complete	Gardens established on campus
1.8	Review other universities' approaches to cultural asset preservation	Allow JCU to work with other universities and utilise tried and tested methods of cultural heritage protection	Basic review - only resource needed is time/human resources	Nil	N/A	• Estate Directorate • Max Lenoy • Indigenous studies	N/A	Low	Jan 2022	Dec 2022	Completed review and identification of any areas that may be added to our cultural heritage preservation section of NAMP

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
1.9	Record traditional stories linked to the JCU campus (e.g. carpet python story)	Understating of the university's place in, and importance to, the Traditional Owners perspective	Recording device to preserve stories and a means of preservation for future use/ applications (if allowed)	TBA	TBA	• Traditional Owners • Max Lenoy	Indigenous studies	Low	Jan 2022	Until complete	• Recorded stories stored • Understanding of permissions of usage for each story.
1.10	Provide tours on cultural environmental sensitivity/ understanding	Utilise the natural and cultural assets around campus to educate students, staff, and the general public	Understanding of what courses already exist and how to expand on them to include the cultural environmental tour	TBA	TBA	• Rosita Henry • Shelley Greer • Max Lenoy • Uncle Russell Butler	• Archaeology • Anthropology	Low	As required	As required	• Tours provided to key staff and students at JCU • Number of participants undertaking tour
1.11	Investigate and monitor potential important sites on campus	Create research for students to conduct long term monitoring and investigation of potential significant sites	Defining areas for investigation and research	Nil	N/A	• Rosita Henry • Shelley Greer	• Archaeology • Anthropology • GIS	Low	Jan 2022	Ongoing	• Research being undertaken regularly as part of the curriculum

Goal Two of Townsville Natural Assets Management Plan

"Identify, protect, and maintain at ecologically sustainable levels native fauna and their associated habitats on campus"

Native fauna on Townsville campus are very important for their ecological services and the role they play in teaching, learning, and research as well as the attraction of tourists and students to the campus and its surrounding landscapes. Native fauna and their habitats on campus are however faced with threats including new developments, vehicle interactions, and interactions with students, staff, and visitors. Identifying key species and their status will help to set priorities for Townsville campus master plan refresh. This will also help to strategically protect and maintain the known species and their habitats for continued flow of environmental and educational benefits to the campus and its associated surroundings.

The sustainability of Townsville campus fauna requires undertaking ongoing mapping of priority zones and fauna studies to inform the campus master plan. The ongoing fauna studies will result in updated list of significant species on campus to inform habitat protection areas. This will also provide opportunity to undertake bio-condition assessment at priority areas on campus to identify significant protection areas and preferred areas for future development. The NAMP will provide guidelines that will aim to preserve significant habitats wherever possible, in areas earmarked for development. Data from ongoing fauna surveys and bio-condition assessment of fauna habitats will provide opportunities for habitat restoration and enhancement of significant species. This data will also assist in investigating and implementing passive ways to reduce excess population of native problem species on campus as well as reintroduction of significant species to campus.

2.1 Objectives for Native Fauna and Habitat Protection

The key objectives for Native Animal and Habitat Protection under the NAMP are:

- Identify key species (including endangered, vulnerable and near threatened species) and habitats to inform the campus master plan refresh
- Identify priority areas of fauna habitat on campus to protect and enhance
- Take a whole-of-catchment approach to fauna maintenance and management
- Improve understanding of native animal species and habitat on campus and how to manage fauna on a multi-functional landscape

2.2 Scope

All native animals on campus and their associated habitats.

Table 0.1 Relevant Information related to Native Fauna and Habitat Protection

Document/information source	Author	Comments
Strategies for Protection of Environmental Values - JCU Discovery Rise	Golder Associates	References EVNT species and is relevant for habitat protection
National recovery plan for the bare-rumped sheathtail bat Saccolaimus saccolaimus nudicluniatus (critically endangered)	Martin Schulz and Bruce Thomson	Potential for this species to be on campus. If found the recovery plan should be referenced closely.
Environmental Reports - Biodiversity and Conservation Values	Department of Environment and Heritage Protection	Lists threatened and priority species found within 4km of campus. Available online from DEHP website.
JCU Fauna List 2005	Greg Calvert	List of fauna species known on campus in 2005. Available from Manager, Environment.
Campus mammals list - 2007	Greg Calvert	List of mammal species found on campus in 2007. Available from Manager, Environment.
Discover Nature - Fauna section	JCU	Lists species found on the Townsville campus.
Atlas of Living Australia	Atlas of Living Australia website	Comprehensive database that lists species occurrence records for the campus including dates and locations.

2.3 Management Practices and Procedures

Currently, management of native wildlife and associated habitat on campus is done on an ad-hoc basis in compliance with relevant legislation. Management is coordinated by the Manager, Environment and Sustainability, within the Estate Directorate. The NAMP will help to create specific management practices and procedures for native animal management on campus. A set of procedures providing guidance on minimising impact of developments and ground maintenance on native wildlife and habitat on campus have been prepared. These are separate documents to the NAMP and will complement the NAMP.

Procedures include:

- General grounds maintenance procedures for protection of native animals and habitat.
- Construction environmental management plan - native animal protection included in design guideline requirements.
- Wildlife handling/relocation procedure for native animals commonly found in buildings, or where trees/habitat needs to be removed (such as reptiles, possums, birds, and bats).
- Species management plans for commonly impacted, rare, threatened or problematic species, including:
    - Great Bowerbird - Chlamydera nuchalis
    - Brush Turkey - Alectura lathami
    - Kookaburra species; Dacelo leachii and Dacelo novoguineae
    - Bare-rumped sheath tailed bat - *Saccolaimus saccolaimus* (if identified as present from surveys).
    - Any endangered, vulnerable or near threatened (EVNT) species identified on campus.
    - Any native species deemed by the working group as requiring additional management outside of standard legislation

Table 0.2 Native Fauna and Habitat Protection Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
2.1	Continue fauna surveys and studies on priority development zones identified on campus map to inform DR/campus master plan	It is important to inform the campus master plan and DR on significant species and habitat locations as early as possible to allow suitable planning and design. Ensure data is mapped on GIS	Information from DR/P&D about proposed development areas and approximate timeline for development. Researchers, students and/or consultants to undertake fauna surveys	Dependent on who does the survey and area covered - nominal amount $20,000	TBA	• Discovery Rise • Estate Directorate • Researchers • Students • Consultants	• Planning • GIS • Ecology	Very High	Jan 2022	Dec 2022	• Number of studies/surveys conducted and area covered • Data collected and priority zones mapped on GIS
2.2	Update list of significant species on campus to inform habitat protection areas.	State and Federal species classifications are constantly changing and politically motivated so JCU should prepare its own list of significant species based on local knowledge and importance. This could be an Honours student project.	Knowledge input from key stakeholders Ongoing review and updates from Estate/ working group	Nil	N/A	• Key academics and researchers • Students • Estate Directorate	• Ecology	Very High	Jan 2022	Dec 2022	List created and agreed upon by working group
2.3	Undertake Bio-condition assessment across campus and develop campus map with bio-condition ratings	Focus on areas marked for development first. Create a zoning map for campus on GIS to identify condition and preferred development and protection areas. Bio-condition map will inform the campus master plan/DR and will guide future planning under the NAMP	Researchers, students and/or consultants to undertake bio-condition assessment. May require training for students to be able to undertake assessments	Dependent on who does the survey and area covered - nominal amount $50,000	TBA	• Researchers • Students • Consultants • Estate Directorate • Discovery Rise	• Ecology • GIS	Very High	Jan 2022	Until completed	• Number of assessments conducted, and area covered • Data collected and mapped on GIS
2.4	Undertake 'train the trainer' session for bio-condition assessments for ecology students	Greg Calvert to provide training to JCU students and others on undertaking bio-condition assessments to assist the NAMP process	Funding to run the training	$5,000	TBA	• Greg Calvert • Conrad Hoskin • Students • Other interested people • Estate Directorate	Training could be provided as part of undergraduate or post graduate coursework	High	Jan 2022	Jul 2023	Number of people trained
2.5	Update list of all native fauna species on campus	Include migratory species. This could be an Honours project, updating from the last document had, and including the status of the species	Some lists provided. Require review from suitable persons	Nil	N/A	• Relevant academics • Estate Directorate	• Ecology	High	Jan 2022	Dec 2022	Completed peer reviewed list of species known on campus and their status
2.6	Map known habitat for species on campus on JCU GIS	Map current known habitat and continually update as information becomes available	Knowledge input from key stakeholders. Ongoing review and updates from Estate/ working group	Nil	N/A	• TropEco • Honours student • Estate Directorate	• GIS • Ecology	High	Jan 2022	As required	Completed map and regular updates as new information is received
2.7	Identify any significant habitat in areas to be developed (i.e. tree hollows, mature trees, mistletoe, etc) and map on GIS	Aim to preserve significant habitat wherever possible, even when an area is to be developed	Researchers, students and/or consultants to undertake fauna surveys. Information from DR/P&D about proposed development areas and approximate timeline for development.	Dependent on who does the survey and area covered - nominal amount $10,000	TBA	• Researchers • Students • Consultants • Estate Directorate • Discovery Rise	• Ecology • GIS	High	Jan 2022	As required	• Number of studies conducted and area covered • Data collected and mapped on GIS

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
2.8	Identify opportunities to improve monitoring and mapping of fauna in collaboration with eResearch	Regular interaction between interested parties to establish and develop digital systems and research opportunities, e.g., eResearch and monitoring systems	An understanding of technology and resources available.	$50,000	TBA	• eResearch staff • Roboclub • JCU GIS	• Roboclub • IoT	High	Jan 2023	Jan 2024	• Design sprint (monitoring systems with eResearch) • Quality and quantity of data collected through monitoring program
2.9	Update the list of projects for undergraduates and post graduates to undertake research on campus	e.g bare-rumped sheathtail bat or native rodent research	Understanding of projects needed to be completed	Nil	N/A	• Academic staff • Estate Directorate	• Directly linked	Medium	2022	Ongoing	Useful projects running with direct implications on natural assets
2.10	Conduct a study of aquatic species in JCU waterways	Species survey in waterways on JCU Property. Inclusive of wet and dry season.	Expertise in aquatic monitoring and relevant equipment.	TBA	TropEco may be able to fund a small project	• TropWater • Student research • Fresh water ecology	Fresh water ecology: species survey	Low	2022	Until completed	• List of species found in waterways. • Health and quantity of species • Identified areas for improvement
2.11	Conduct fauna surveys on non-developable areas	Ensure all data is mapped on GIS	Researchers, students and/or consultants to undertake fauna surveys	Dependent on who does the survey and area covered - nominal amount $20,000	TBA	• Researchers • Students • Consultants • Estate Directorate • Discovery Rise	• Ecology • GIS	Low	2023	2024	• Number of studies conducted and area covered • Data collected and mapped on GIS
2.12	Investigate opportunities for reintroduction of significant species to campus (e.g. black throated finch)	Working group to investigate species that could potentially be reintroduced on campus and what would be required to do so. Recovery plan has already been developed	Expert advice	Nil	N/A	• Researchers • Species experts • Students • Estate Directorate • Discovery Rise	• Research • Ecology	Low	2023	Until completed	Species reintroduction successful
2.13	Work with marketing to promote our unique fauna on campus as an attraction for prospective students and staff	Eg. Short videos of fauna on campus, students conducting research, trapping etc. Photographing and posting pictures to JCU facebook and webpages	Video/photography/editing equipment and skills	TBA	TBA	• Audio visual students • Research staff • Marketing	• Student project (Media/Audio visual) • Business/ Marketing students	Low	2023	Ongoing	• High quality video and photography receiving positive responses from staff and students • Market research should dictate this
2.14	Look at population diversity within groups of species as an indicator of ecological condition (e.g. small bird communities, native rodent species, small skinks)	Potential research projects for honours students or postgraduates	Researchers and students to undertake research	Dependant on projects developed	TBA	• Researchers • Students • Estate Directorate	• Research • Could be embedded in curriculum as field study opportunity • GIS	Low	2023	Yearly	• Number of studies completed • Extent of campus surveyed
2.15	Develop ecological principles for the Discovery Rise development	Use data gathered from NAMP to guide the development of ecological principles for DR. Should be primarily driven by DR with input from NAMP working group members	Stakeholder input into process	NA	NA	• Discovery Rise • Future JCU residents • Estate Directorate • Students • Staff	• Planning • Ecology	Low	2023	2023	Completed document

Goal Three of Townsville Natural Assets Management Plan

"Ensure efficient and effective management of native vegetation on Townsville campus to enhance contiguous connectivity with adjacent flora to improve ecosystem services and other vegetation functions"

Green corridors on Townsville campus host varieties of fauna with both the flora and fauna playing vital roles in teaching, learning, research, ecosystem services, ecological restorations, and tourism on campus. Management of campus native vegetation will ensure that existing fauna are sustained. Regular monitoring and mapping of campus vegetation will provide insight into the status of significant vegetation species and communities and bio-conditions of priority areas. This will help ensure that the campus master plan is developed at ecologically sustainable scale. Surveying and mapping of green corridors is essential for identifying potential habitats for maintenance, restoration, and protection and this will consequently enhance fauna movement.

Surveying and mapping native vegetation will also aid in the identification of indigenous vegetation species used for indigenous learning and cultural activities to promote indigenous engagement on campus. Sustainability and effective management of native vegetation on Townsville campus requires researcher-student-staff engagement approaches including:

- Students' engagement in GIS mapping of vegetation on campus.
- Linking research and curriculum opportunities for campus vegetation management through students' projects.
- Software development for automatic identification and monitoring of plant species health and campus vegetation cover change.

While internal management procedures are ensured, the NAMP will also assist in identifying opportunities for collaboration with not-for-profit organizations and local communities to undertake native vegetation management activities including revegetation works.

3.1 Objectives for Native Vegetation Management

The key objectives for Native Vegetation Management under the NAMP are:

- Maintain contiguous connectivity for native vegetation to provide green corridors for fauna
- Maintain and enhance native endemic vegetation communities on campus for teaching, learning, research, community engagement, and ecotourism activities
- Ensure relevant procedures are followed to manage native and rehabilitated vegetation on campus and sustain native vegetation by incorporating endemic native species into future planting lists
- Ensure development of the campus master plan will not significantly impact on significant flora and its associated fauna.
- Demonstrate best practice in native vegetation management and use this to inform the campus master plan

3.2 Scope

Vegetation on campus with a primary focus on natural areas. However, landscaped areas will be included in this section in conjunction with the landscaping plan.

Table 0.1 Relevant Information related to Native Vegetation Management

Document/information source	Author/Source	Comments
Strategies for Protection of Environmental Values - JCU Discovery Rise	Golder Associates	References EVNT species and is relevant for habitat protection
Environmental Reports - Biodiversity and Conservation Values	Department of Environment and Heritage Protection	Lists threatened and priority species found within 4km of campus. Available online from DEHP website or from Manager, Environment.
Discover Nature - Flora section	JCU	Lists flora species found on the Townsville campus.
Atlas of Living Australia	Atlas of Living Australia website	Comprehensive database that lists species occurrence records for the campus including dates and locations.
Matters of State Environmental Significance	Department of Environment and Heritage Protection	Lists significant vegetation areas found on campus. Available online from DEHP website or from Manager, Environment.
Regional Ecosystems report	Department of Environment and Heritage Protection	Lists broad regional ecosystems found on campus. Available online from DEHP website or from Manager, Environment.
BioCondition Benchmarks for Regional Ecosystem Condition Assessment - Brigalow Belt Bioregion	Department of Science, Information Technology and Innovation	Provides information on regional ecosystem benchmark bioconditions.
Revegetation Strategy for the City of Thuringowa	Con Lokkers, 2003	Information relevant for revegetation works on JCU campus
Revegetation Strategy for the Townsville City Council Region	Con Lokkers, 2000	Information relevant for revegetation works on JCU campus
Grow Me Instead brochure	Nursery and Garden Industry Queensland	A Guide for Gardeners in Queensland Dry Tropics on preferred species to grow.
Urban Nature Program - fact sheets	Townsville City Council	Series of fact sheets on native plantings for landscaped gardens in Townsville.
Campus species list - excel spreadsheet	Betsy Jackes	Lists known species (native and exotic) on the Townsville campus.
Grass Genera in Townsville	Nanette Hooker	
Dinah Hansman - thesis in library	Dinah Hansman	Needs investigation
Significant tree mapping - Townsville campus	JCU GIS and maps	Significant trees included on Townsville campus interactive map and JCU GIS

3.3 Management Practices and Procedures

The Estate Directorate is responsible for vegetation management in natural and landscaped areas at JCU. The campus contains nearly 300 hectares of natural areas, which mostly contains endemic flora. Current management of this area is minimal, with some ad-hoc weed management undertaken and a small amount of active revegetation occurring in riparian areas. Much of the natural areas are in relatively good condition with the major threats being weed infestation and development influences. Some areas toward the centre and front of campus have moved from natural, unmaintained areas to actively maintained areas in recent years and this has impacted vegetation communities. The main impact has been regular slashing of these areas. This change has been for various reasons including, reducing fire risk for university infrastructure, campus development, aesthetics and weed management.

Relevant procedures would be developed to assist in the management of native vegetation on the campus (see Action Plan) and a planting list would be developed to inform future revegetation programs and landscaping projects that want to incorporate native species.

A key component of this section of the NAMP will be the bio-condition assessment of the campus and mapping of regional ecosystems on a smaller scale (to the Department of Environment and Heritage Protection mapping). This will help to inform campus master planning and the Discovery Rise development by identifying significant vegetation species and communities and ensuring ecologically sustainable development of the campus going forward. Maintenance and improvement of green corridors on campus is essential for fauna movement and will also be a high priority for this section of the NAMP. The below Action Plan outlines the actions required to achieve these objectives.

Table 0.2 Native Vegetation Management Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
3.1	Continue mapping trees that present potential habitat for the bare-rumped sheath tailed bat and include on JCU GIS	Survey will help identify potential habitat and inform the master plan for priority habitat protection areas	Qualified person to undertake survey	TBA	TBA	• Estate Directorate • Discovery Rise • Ecology students • DEHP • GIS students	• Ecology • GIS	Very High	Jan 2022	Jun 2022	Potential habitat trees mapped and included on the JCU GIS
3.2	Map the rest of regional ecosystem to a higher scale than DEHP maps	DEHP mapping is insufficient to identify small regional ecosystems on campus, in particular in riparian areas. Ground surveys and mapping should be conducted to update these maps to a higher scale to allow better management of the campus.	Staff, students or contractor to undertake detailed survey	TBA	TBA	• Estate Directorate • Ecology students • GIS students • External contractor • DEHP	Ecology	Very High	Jan 2022	Dec 2022	More detailed regional ecosystem mapping completed for the campus
3.3	Identify significant trees/ species/ communities to retain and protect and feed this information into the campus master planning	Some species and communities/ecosystems on campus hold significant environmental values and should be identified for retention	Surveying of the campus and identification of significant species and distribution	TBA	TBA	• Estate Directorate • Discovery Rise • Academics • Researchers	Ecology	Very High	Jan 2022	June 2022	• Significant trees/ species/ communities mapped • Master plan informed by mapping
3.4	Locate and map Betsy's wattle on JCU GIS	Rare species occurring on campus. Locations should be mapped to inform planning and development.	Expert to identify and map species on campus	TBA	TBA	• Estate Directorate • Discovery Rise • GIS academics	• Ecology • GIS	High	Jun 2022	Dec 2022	• Species mapped and included on JCU GIS
3.5	Identify key areas for restoration and prioritise works (consider revegetation for erosion mitigation).	Undertake restoration works in key areas in line with priorities. Revegetation sites have been prioritised to complete green corridors in line with master plan.	Persons involved in revegetation works	Nil	N/A	• Estate Directorate • Greening Australia • Coastal Dry Tropics Landcare • Conservation Volunteers	Ecology	High	June 2022	Ongoing	• Priority areas identified • Extent of revegetation works completed and maintained
3.6	Ensure new developments are sensitive to flora protection and management	Work with Discovery Rise and Planning and Development to ensure processes are in place to minimise impacts on native vegetation	Persons involved in developing and ensuring impact minimisation processes are in place	Nil	N/A	• Estate Directorate • Discovery Rise	NA	High	Jan 2022	Ongoing	Guidelines developed to ensure structured process in place for vegetation management on new developments
3.7	Work with Indigenous groups to identify trees used for Indigenous learning and culturally significant trees on campus	Trees to be mapped on the JCU GIS with permission from local Indigenous groups	Indigenous elder to assist with mapping	TBA	TBA	• Local Indigenous groups/elders • Estate Directorate • Academics	• Indigenous studies • GIS • Ecology	Medium	2022	Until completed	Significant trees mapped and data collected
3.8	Link up GIS studies and botany/ecology studies to perform GIS mapping of trees on campus	Mapping conducted by students and staff and uploaded to JCU GIS and iNaturalist	Staff and students to conduct surveys	Nil	N/A	• Estate Directorate • Academics	• GIS • Botany • Ecology	Medium	2023	Until completed	Number of trees mapped by students
3.9	Link research and curriculum opportunities for vegetation management and mapping	Identify opportunities for academics/ researchers to incorporate research gaps into the curriculum and promote students projects to gather data on campus	Persons involved	Nil	N/A	• Estate Directorate • Academics	• Botany • Ecology • GIS	Medium	Jan 2022	Dec 2022	Number of projects/ subjects/ students involved
3.10	Identify all flora species on campus	Update Discover Nature website to include species found on campus that are not currently listed	Survey of campus and review of Discover Nature	Nil	N/A	• Botany researchers • Estate Directorate	• Botany	Medium	2022	2023	Flora species lists on Discover Nature updated
3.11	Look at development of software to identify plant species, vegetation cover and regional	Automatic plant identification could be a powerful tool for assessing ecosystem health and	Will be dependent on resources available within eResearch.	TBA	TBA	• eResearch • Estate Directorate	• eResearch	Medium	2022	2024	Software investigated and developed if feasible

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
	ecosystem mapping from aerial or drone photography	diversity and monitoring changes over time	Some external funding would be required.								
3.12	Look at opportunities to collaborate with local not-for-profits to undertake revegetation works on campus	NFP's can undertake large scale works at low cost and provide opportunities for students and staff to volunteer.	Persons and NFPs involved	TBA	TBA	• Estate Directorate • Greening Australia • Coastal Dry Tropics Landcare • Conservation Volunteers • NQ Dry Tropics	• Ecology	Medium	2022	Ongoing	Number of partnerships established
3.13	Map mistletoe on campus and aim to retain important habitat/host trees (some students have already started this)	Due to its importance in providing food for native bird and insect species, mistletoe increases the ecological value of the trees it is located in and should be mapped and retained where possible	Students to undertake mapping	TBA	TBA	• Estate Directorate • Ecology students • GIS students	• Ecology • GIS	Medium	2022	Until completed	Mapping of mistletoe on campus completed
3.14	Compare current and historical aerial maps for vegetation coverage	TCC Mosaic and JCU have historical aerial maps of the Townsville region. Looking at vegetation coverage will help to identify changes over time.	Mapping of aerial surveys on the JCU GIS	Nil	N/A	• Estate Directorate • TCC	• Ecology • Research	Low	2022	2023	Maps included on the JCU GIS as layers

Goal Four of Townsville Natural Assets Management Plan

"Control and manage pest and weed on Townsville campus for environmental sustainability"

Animal pests on Townsville campus have several negative impacts on the campus' natural assets as well as the people and the infrastructure. Ensuring the protection and longevity of campus' physical, natural, and human assets require effective control of pest animals through identification of the various pests and their locations to inform control mechanisms.

Another problematic feature on Townsville campus is invasive weeds. There are a significant number of weed species located on campus posing significant environmental and economic risk to JCU and a strategic approach is necessary to combat the issue and reduce the ongoing costs to JCU of managing invasive weeds. The succeeding sections present the objectives and action plans for both pest management and weed management.

4.1 Pest Management

Previous actions on pest management have involved using camera traps to identify and manage pest animals. However, more dynamic, and advanced techniques are required for the control and management of pest animals on campus.

4.1.1 Objectives for Pest Management

The key objectives for Pest Management under the NAMP are:

- Control and manage pest animals to minimise impacts on the campus' natural assets and to mitigate harm to all JCU personnel, research and infrastructure.
- Provide opportunities for research to be conducted on pest animals, including eResearch and the use of AI to identify and monitor the population and movement of pest animals on campus.

4.1.2 Scope

- Control of pests that have a negative environmental impact on campus
- Monitoring impacts of pest animals on threatened species
- Research opportunities on pest animals

Table 0.1 Relevant Information related to Pest Management

Document/information source	Author/Source	Comments
Wild Dog Management Strategy 2011-16	Department of Employment, Economic Development and Innovation	
Wild dog information page	Department of Agriculture and Fisheries	Includes links for fact sheets, guidelines and control methods
Feral Cat information page	Department of Agriculture and Fisheries	Includes links for fact sheets, guidelines and control methods
Indian Myna information page	Department of Agriculture and Fisheries	Includes links for fact sheets, guidelines and control methods
Cane Toad information page	Department of Agriculture and Fisheries	Includes links for fact sheets, guidelines and control methods
Tilapia information page	Department of Agriculture and Fisheries	Species information
Declared animals of Queensland	Department of Agriculture and Fisheries	General information on declared pests for Queensland
Townsville Local Government Area Wild Dog Management Plan	Townsville City Council	
Declared Pest Plants and Animals information page	Townsville City Council	Lists significant pests and management strategies for the local region
Regional Pest Management Strategy for the Burdekin Dry Tropics Region	NQ Dry Tropics	

4.1.3 Management Practices and Procedures

Regular pest management is currently conducted on the Townsville campus for wild dogs. Ad-hoc pest management is conducted for additional species as required and in line with relevant legislation and local management strategies.

- Wild dog management

Wild dogs are a declared Class 2 pest and thus JCU has a legislated obligation to undertake control programs to manage populations on campus. Wild dog management is usually conducted on an annual basis in conjunction with the Department of Defence. This allows JCU and Defence to coordinate management for the local area and gain a better outcome and reduce costs. In some instances, where an incident occurs that presents a risk to the JCU public or livestock at the Vet Sciences precinct, additional management may be required, and a local contractor will be engaged to provide these services at short notice.

JCU maintains records of wild dogs trapped or sighted, and records any incidents or risks arising using the enterprise Riskware software. Procedures will be reviewed on an annual basis, along with the data collected, to ensure management minimises risks to the University community.

- Other pest animal species

Other pest animal species that require active management will be identified and management plans developed in the first year of the NAMP. Links to procedures will be provided in this section of the NAMP and made available online.

Table 0.2 Pest Management Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
4.1	Continue using camera traps to passively identify pests on campus	Use camera traps to help identify and manage pests on campus	Camera traps, persons to install camera traps, persons to analyse data collected	$2000	$2000	• Estate Directorate • Vet Science	• Ecology • Vet Science	High	Jan 2022	Ongoing	Pest species identified on cameras
4.2	Continue to create GIS layer and database for pest animal recordings/ trappings	Record pest data in GIS	Persons involved with GIS database management	Nil	N/A	• GIS staff • Estate Directorate • Vet Science	• Ecology • Vet Science • GIS	High	Jan 2022	Ongoing	Records uploaded to GIS at frequent intervals
4.3	Liaise with researchers about collaborations on possible pest identification technology	Collaborate with JCU researchers or academics to develop possible AI for identification of pest and their behaviour on campus	Persons involved in collaborations, researchers, academics	Nil	N/A	• Estate Directorate • Ecology researchers • eResearch	• Ecology • eResearch	Medium	2022	Until completed	• Collaborations started • Number of researchers/ academics involved • AI technology developed and in use

4.2 Weed Management

JCU envisions that control and management of invasive weeds will take a collaborative approach for the benefit of JCU staff and students, local communities, and external agencies, where possible. This collaborative approach may include the engagement of students and researchers in developing a cost-benefit analysis for weed treatment, with results being beneficial to students' career development and effective environmental management on campus. Local communities may also benefit from the adoption of simple cost-benefit technique for weed management developed on Townsville campus. The NAMP will provide guidelines to assist collaborative research on weed ID and control through AI, GIS, and remote sensing technologies with possible opportunities for curriculum refresh. Opportunities for external collaborations for weed control will also be sought where possible to ensure that best practice on campus is extended to surrounding catchments. The long-term goal of weed control on Townsville campus is to create a campus that is free of invasive and problem weeds.

4.2.1 Objectives for Weed Management

The key objectives for Weed Management under the NAMP are:

- Identify and prioritise weed species to manage
- Map and zone weed species together with bio-condition assessments to ensure that on-grounds control is carried out based on prioritised objectives and effective monitoring is undertaken to assess the effectiveness of management activities
- Collaboratively develop biosecurity plans for problem weed species
- Use latest technology to identify, map and treat weeds, and showcase this to others
- Create a campus free of weed species in the long term

4.2.2 Scope

- All species recognised as environmental weeds or potential weeds on campus
- All areas of campus
- Maintain some introduced weed species for educational purposes but closely controlled and risk managed

Table 0.3 Relevant Information related to Weed Management

Document/information source	Author/Source	Comments
Strategies for Protection of Environmental Values - JCU Discovery Rise	Golder Associates	
Weed species information page	Department of Agriculture and Fisheries	List all relevant weed species in Queensland and provides fact sheets.
Regional Pest Management Strategy for the Burdekin Dry Tropics Region	NQ Dry Tropics	Lists environmentally significant weeds and management practices. Includes Class 1 - 3 weeds and Weeds of National Significance. Potential to use prioritisation tool for JCU weeds.
Department of Defence weed management plan	Department of Defence	Source document and use for reference
Discover Nature	JCU	Lists weeds for each campus
JCU Herbarium	JCU	Reference samples for weed species
Townsville Local Government Area Pest Management Plan 2010 - 2014	Townsville City Council	

4.2.3 Management Practices and Procedures

Weed management is undertaken by the Estate Directorate at JCU. Some species have been present for many years and have become well established on campus. JCU is required to actively manage Class 1 and 2 weed species found on campus. These are identified as part of Action Plans and management strategies developed to address these species. Previously, management of weeds in natural areas on campus has relied on a member of grounds to identify and undertake control. While this has been somewhat effective for some species of weeds, the size of the task and lack of resources, along with the retirement of the grounds staff member after many years of service at JCU, has meant there is a lack of knowledge and on-groundwork currently occurring with regard to weed management. This has been identified as a significant risk to JCU, both environmentally and economically, and the NAMP aims to address this issue by developing management plans and procedures and seeking resources to undertake weed control on priority species.

The Action Plan identifies the need to create a list of weed species to be managed on campus as well as prioritisation of weed species based on several important variables. This process will also draw on existing recognised control techniques where they exist or develop JCU specific procedures if no effective control procedure is available. Known weed populations will be mapped on the JCU GIS. This will be done as a high priority so that on-ground works can be strategised with the resources available. Any weed control works undertaken will be recorded on the GIS so that effectiveness of control measures over time can be assessed. The next version of the NAMP will contain reference to the species-specific control procedures and priority matrix for weed control.

The Estate Directorate currently has a casual staff member who is qualified to undertake weed control work. However, this position will not have the capacity to meet the requirements of the NAMP in their current position. Where additional work is required, JCU will look to outsource work to qualified contractors or train existing staff so they are qualified to carry out the work required. JCU has also invested in weed control equipment and appropriate PPE to ensure qualified staff have access to the required equipment necessary to undertake works.

Table 0.4 Weed Management Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
4.4	Identify and map the distribution of weed species to be managed on campus	Weed distribution on campus to be identified and mapped to enable monitoring the effectiveness of management strategies.	Persons to undertake grounds surveys	TBA	TBA	• Estate Directorate • GIS staff	• Ecology • GIS	Very High	Jan 2022	Jun 2022	Weed species distribution mapping completed
4.5	Complete the development of weed management procedures for identified weeds	Procedures for on campus management developed using existing resources.	Person to develop procedures	Funds will be required to undertake control programs	Environmental maintenance - $5,000	• Estate Directorate • Coastal Dry Tropics Landcare • Greening Australia • Defence • Townsville Hospital • TCC • Rockwheelers • DEHP • NQ Dry Tropics	Ecology	Very High	Jan 2022	Jun 2022	Procedure created and implemented
4.6	Distinguish zones and objectives for each weed species and manage each species based on objectives and zoning	To be done in collaboration with Bio-condition assessments and priority zoning for DR	Staff member to undertake mapping/zoning work	Nil	N/A	• Estate Directorate • GIS staff	Ecology	High	Jun 2022	Dec 2022	Zoning and objectives created for each weed species and included in campus weed management plan
4.7	Eradicate Class 1 -3 weeds on campus, where practical	Weed distribution and species to be established and eradicated in a prioritised manner as resources permit. Reassess the work that has been done and continue from there	Staff or contractors to undertake weed control. Weed control equipment. Funding to undertake works	$100,000 per year for 5 years, then reassess	$10,000	• Estate Directorate • Coastal Dry Tropics Landcare • Greening Australia • Defence • Townsville Hospital • TCC • Rockwheelers • DEHP • NQ Dry Tropics	Ecology	High	Jan 2021	Dec 2024	• Number of Class 1-3 weeds remaining on campus compared to baseline figures • Number of Class 1-3 weeds eradicated on campus • Area of Class 1-3 managed effectively
4.8	Ensure weed management complements fire management and vice versa	Link fire and weed management actions to complement each other.	Persons involved in ensuring linkages	Nil	N/A	• Estate Directorate	Ecology	High	As required	As required	Links are established and functional between fire and weed management
4.9	Establish cost of weed treatment for significant weeds on campus and look at cost of inaction	Weeds have significant economic costs to landholders, and this can escalate significantly if not controlled early. A business case should be developed to convey managing the risks of not acting on funding weed control.	Person to develop business case on weed species management	Nil	N/A	Estate Directorate	Ecology	High	Jun 2022	Jun 2023	Business case developed to highlight cost of weed control and cost of inaction
4.10	Continue to liaise with JCU researchers and academics about any collaborations possible	Opportunities for students to undertake weed ID and control, and GIS mapping projects on campus. Possible research projects to be sent to College Deans for input.	Researchers, students, academics involved	Nil	N/A	• Estate Directorate • Academics • Students	Ecology	Medium	Jan 2022	Ongoing	Number of subjects/ students/ research projects involved with weed management

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
4.11	Continue to look at potential for weed ID from campus multi-spectral aerial imagery	Potential to develop programs to identify weeds from aerial photography. Work with eResearch on potential for a project to be established.	Persons involved and equipment to be used	TBA	TBA	• eResearch • Estate Directorate • Ecology academics	• Ecology • eResearch	Medium	2022	Until completed	Program developed for weed identification
4.12	Develop a culture of weed identification and reporting amongst staff and students	Encourage staff and students to report any weed sightings and provide information and training to improve knowledge and skills	Training and information	$2,000	$2,000	• Estate Directorate • JCU staff • JCU students	Ecology	Medium	2022	2023	• Number of people undertaking training/ accessing information • Number of reports on weed sightings received
4.13	Investigate collaboration between JCU and Tropical Weed Research Centre	Potential for JCU to work with TWRC on weed management programs and link to JCU curriculum and research	Persons working on collaborations	Nil	N/A	• Estate Directorate • Tropical Weed Research Centre • Academics	Ecology	Low	2022	Until completed	Discussion had with TWRC about potential collaborations
4.14	Look at potential for use of drones for weed mapping and control	Potential to develop programs to identify weeds from drone footage and drone/robot mounted sprayers for control of some weeds	Persons involved, drones	TBA	TBA	• eResearch • Estate Directorate • Ecology academics	• Ecology • eResearch	Low	2023	Until completed	Drones used for weed mapping and/or control

Goal Five of Townsville Natural Assets Management Plan

"Protect and manage waterway and riparian areas on Townville campus to enhance ecological values and movement of terrestrial and aquatic fauna"

Waterways and riparian areas on the Townsville campus are a critical habitat for both flora and fauna species and require special management and protection to ensure campus' natural assets are maintained. Riparian areas provide an important buffer between the developed campus and waterways, helping to filter sediment and nutrients, supporting significant vegetation, and housing important fauna communities. The campus' two major creeks, Wadda Mooli and Goondaloo Creeks, have significant cultural values to the local Bindal and Wulgurukaba Peoples. Ongoing investment is required to ensure that the cultural and ecological values of the creeks are maintained and enhanced. The NAMP will provide guidelines towards the maintenance and enhancement of the campus' waterways and their riparian zones through researcher-student-staff collaboration as well as the engagement of external experts.

The collaborative actions will include regularly monitoring the conditions of campus waterways and riparian buffer zones to identify and prioritise issues that require management actions. Evaluation of riparian buffer zones for its effectiveness in enhancing the quality of the aquatic habitat and the protection of key environmental assets in relation to ongoing developmental activities will inform the campus master plan of future development strategies. JCU Townsville envisions to employ innovative ways to demonstrate best practice management of waterways and riparian zones through eResearch, AI technologies, and engagement of experts. This will create opportunities that will enhance teaching, research, and learning utilizing the campus as a living laboratory for water quality monitoring, aquatic habitat maintenance, and riparian assets management.

5.1 Objectives for Waterway and Riparian Management

The key objectives for Waterway and Riparian Management under the NAMP are:

- Identify significant values of campus waterways and riparian areas and raise awareness of the importance of waterways and riparian areas.
- Ensure waterways and riparian areas provide ecological connectivity and refuge for native plants and animals.
- Ensure waterway and riparian management strategies align with campus master plan and catchment plans and maintain or enhance the quality of the ecosystem within the campus' catchment.
- Create accepted definitions for waterways and associated buffer zones on campus to ensure appropriate and ongoing protection of aquatic habitat and riparian zones.
- Ensure waterway and riparian management plan informs and aligns with the campus master plan.

5.2 Scope

- All open waterways and associated flora and fauna within riparian buffer zones on campus
- Fish passage through extent of waterways on campus
- Erosion control in waterways

Table 0.1 Relevant Information related to Waterway and Riparian Management

Document/information source	Author/Source	Comments
Strategies for Protection of Environmental Values - JCU Discovery Rise	Golder Associates	References EVNT species and is relevant for habitat protection
Environmental Reports - Biodiversity and Conservation Values	Department of Environment and Heritage Protection	Lists threatened and priority species found within 4km of campus. Available online from DEHP website or from Manager, Environment.
Matters of State Environmental Significance	Department of Environment and Heritage Protection	Lists significant vegetation areas found on campus. Available online from DEHP website or from Manager, Environment.
Regional Ecosystems report	Department of Environment and Heritage Protection	Lists broad regional ecosystems found on campus. Available online from DEHP website or from Manager, Environment.
BioCondition Benchmarks for Regional Ecosystem Condition Assessment - Brigalow Belt Bioregion	Department of Science, Information Technology and Innovation	Provides information on regional ecosystem benchmark bioconditions.
Revegetation Strategy for the City of Thuringowa	Con Lokkers, 2003	Information relevant for revegetation works on JCU campus
Revegetation Strategy for the Townsville City Council Region	Con Lokkers, 2000	Information relevant for revegetation works on JCU campus
Regulated Vegetation Management Map for the campus	Department of Natural Resources and Mines	Contains all waterways and stream level information
A Revegetation Guide for Tropical Riparian Forests	Greening Australia	
Fishways and Goondaloo Creek historical information	Ross Kapitzke	A range of documents, photos and information on the history of the fishway and Goondaloo Creek
Black Ross (Townsville) Water Quality Improvement Plan - 2010	Townsville City Council	

5.3 Management Practices and Procedures

JCU currently complies with the relevant legislation regarding preserving buffer zones and undertaking works in waterways. JCU has invested considerable resources in managing erosion, re-establishing riparian vegetation, removing weed species, and reinstating fish passage in the campus creeks. No formal management plan has existed previously to incorporate this work and it is intended that the NAMP will provide coordination and strategic direction on management of waterways and riparian areas. This will inform the campus master plan and Discovery Rise development to minimise any impacts on these critical areas and ensure they are preserved and enhanced in coming years.

The Action Plan outlines a number of actions that need to be taken to improve knowledge and baseline data so that effective management of the waterways and riparian areas can take place in coming years. As formal management practices and procedures are developed for this section, they will be added to the NAMP.

Table 0.2 Waterway and Riparian Management Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
5.1	Define buffer zones of campus waterways and include on JCU GIS	Defining riparian areas for campus waterways will help set boundaries for effective management	Spatial equipment, mapping equipment, persons involved	Nil	N/A	• Estate Directorate • GIS staff	NA	Very High	Jan 2022	Jun 2022	Riparian areas defined and on GIS
5.2	Use time-lapse photography of creeks and spatial data to look at changes over time	Time-lapse photography will help identify issues or improvements to key areas on campus waterways. This can be a minor project of a student	Aerial images, camera, and someone to take photos annually	Nil	N/A	• Estate Directorate • GIS staff	GIS	High	Jan 2022	Ongoing	Annual photos taken at selected locations on campus
5.3	Identify waterway and riparian condition and erosion issues and assign ratings	Waterway condition assessment will help with planning of priority actions	Persons involved in development of assessment tool for rating condition	TBA	TBA	• Estate Directorate • GIS staff	• GIS • Ecology	High	Jan 2022	Jun 2022	Ratings assessment conducted on major waterways
5.4	Prioritise and rehabilitate areas within waterways and riparian buffer zones based on condition ratings and priority areas	Undertake strategic program for waterway and riparian rehabilitation on campus, in conjunction with campus master planning	Persons involved in development of priority plan	Nil	N/A	• Estate Directorate • TropWater • Greening Australia • Coastal Dry Tropics Landcare • Conservation Volunteers • NQ Dry Tropics • DEHP	• TropWater • Ecology	High	Jan 2022	Ongoing	Area of waterways and riparian areas rehabilitated
5.5	Evaluate riparian buffer zones for effectiveness and decide whether to increase or decrease in certain areas	Some areas may require larger buffer zones to protect key environmental assets (must still meet legislative requirements)	Persons involved in surveys and review of buffer zones	Nil	N/A	• Estate Directorate • Discovery Rise • Ecology students and researchers	Ecology	Medium	Dec 2022	Jun 2023	Buffer zones reviewed and updated where necessary
5.6	Investigate the use of drones to help with mapping of the creek on a regular basis	Mapping could be conducted annually for wet and dry seasons	Drone use	TBA	TBA	• eResearch • GIS staff	• EResearch • GIS	Medium	Jun 2022	Ongoing	Annual wet and dry season surveys conducted
5.7	Develop whole of catchment WQ monitoring program in collaboration with TropWater and eResearch (and Creekwatch)	Campus can be used as a living laboratory for water quality monitoring and can create a cross-discipline collaboration. Encourage use latest automatic sampling/sensor technology	Funding and expertise to carry out project	$20,000+	TBA	• eResearch • TropWater • Conservation Volunteers • Estate Directorate	• eResearch • TropWater	Medium	Aug 2022	Aug 2023	Water quality program developed and functional
5.8	Collaborate with academics to encourage inclusion of Townsville campus riparian assets in teaching, learning and research	Townsville campus has unique riparian assets that could be used for teaching, learning and research	Time to undertake collaborative activities	Nil	N/A	• Estate Directorate • Academics • TropWater	• Ecology • TropWater	Medium	2023	Yearly update of projects	Number of projects undertaken on campus
5.9	Ensure fire access tracks through waterways are compliant	Investigate compliancy requirements of fire trails	Persons involved in investigations	TBA	TBA	Estate Directorate	N/A	Medium	2022	2022	Compliance investigated and any breaches rectified
5.10	Utilise JCU's internal expertise to create examples of best/innovative practice in waterway and riparian management	Develop specific projects to demonstrate best practice in waterway management	Expertise and project ideas	TBA	TBA	• TropWater • eResearch • Ecology academics • Estate Directorate	• TropWater • eResearch • Ecology	Low	2023	Ongoing	Number of projects undertaken on campus

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
5.11	Expand research on fishway design and effectiveness	Additional research on the fishway design could be useful to inform future designs	Researchers and students involved	TBA	TBA	• Estate Directorate • Ross Kapitzke • TropWater	• TropWater	Low	2023	Until completed	Research undertaken on fishway design
5.12	Research fish migration and species diversity in campus creeks	Determine the migration rate and pattern of fish in the creeks	Research expertise	TBA	TBA	• Estate Directorate • TropWater • Ecology researchers	• TropWater • Ecology	Low	2023	2024	Fish species sampling conducted and list of species present collated
5.13	Design natural stormwater treatment areas to improve water quality of run-off	Identify areas where natural stormwater treatment can be installed and work with JCU researchers and external experts to install	Expertise and funding to install	TBA	TBA	• Estate Directorate • TropWater • Researchers • External experts	• TropWater	Low	2023	2024	Number of treatment areas installed
5.14	Undertake aquatic weed removal where required	Remove aquatic weeds in any semi-permanent water bodies	Labour to undertake removals	TBA	TBA	• Estate Directorate	NA	Low	As required	As required	Aquatic weeds removed where required
5.15	Create projects with not-for-profit groups to provide on ground experience to students (and staff)	Collaborations to enhance the waterways and riparian areas and provide mutual benefits to both organisations	Experts, students, staff	TBA	TBA	• Estate Directorate • Ecology students • Staff • Greening Australia • Coastal Dry Tropics Landcare • Conservation Volunteers • NQ Dry Tropics	Ecology	Low	2023	2024	• Number of collaborations • Number of participants • Area covered by relevant projects
5.16	Contact Defence to obtain water quality monitoring results for Wadda Mooli Creek	Defence has been recording water quality in Wadda Mooli Creek for many years	Persons to analyse reports	Nil	N/A	• Estate Directorate	N/A	Low	Jan 2022	Ongoing	Water quality results obtained

Goal Six of Townsville Natural Assets Management Plan

"Maintain, manage, and enhance Townsville campus' landscape through ecologically sustainable design principles and actions"

The aesthetic features of the Townsville campus and its surrounding landscapes are pull factors that bring people from different parts of the world to Townsville. Maintaining and managing the internal landscape, both artificial and natural, will ensure that negative environmental impacts from activities occurring within the landscape is at least minimized if not eliminated. This will also ensure that the multi-functional landscape of JCU Townsville and its wider catchment will not have any significant negative spillover effect on the surrounding landscapes. This section outlines objectives and strategies for JCU's land management and fire management to enhance the landscape of the Townsville campus.

6.1 Land Management

JCU Townsville land management activities may be carried out in collaboration with external environmental experts to ensure that best practice is maintained. JCU also aims to explore opportunities for teaching and research related to land management. These opportunities could include erosion control methods, sustainable practices for track maintenance, grazing management, and fire management.

6.1.1 Objectives for Land Management

The key objectives for Land Management under the NAMP are:

- Maintain and enhance the land condition in natural areas on campus and ensure land is zoned appropriately for its ecological values.
- Ensure campus development and operational activities do not negatively impact natural areas.
- Ensure groundwater resources are utilised sustainably.
- Promote the natural assets of the campus and encourage opportunities to access the campus' natural assets through leisure, teaching, learning and research in ways that minimise impact on the land.
- Restore degraded land areas, particularly in areas that are ecologically important or unlikely to be developed.

6.1.2 Scope

- Artificial waterways and drains
- Sediment and erosion control
- Ground water/bores
- Vet Science grazing land
- Soil and mulch stockpiles
- Trails including fire, walking and mountain biking
- Contaminated land and historical dumping sites
- Vehicle management related to fire trail access and biosecurity
- Infrastructure management in natural areas

- Restoration of degraded sites
- Fences and borders
- The interface between developed areas and natural areas

Table 0.1 Relevant Information related to Land Management

Document/information source	Author/Source	Comments
Townsville City Council Sediment and Erosion Control guidelines	Townsville City Council	
Sediment and Erosion information booklet	Townsville City Council	
Stormwater management plans for development	Townsville City Council	
Mountain bike tracks schedule and maps	Townsville Rockwheelers	
JCU GIS	JCU Estate Directorate	Information on infrastructure and environmental assets
Clean down procedures for vehicles	Department of Agriculture and Fisheries	Checklist for vehicle clean down and inspection procedures and weed hygiene
Generic land management plan template	NQ Dry Tropics	Provided as guidance for developing a land management plan - reference document
Grazing management best practice	Regen-Ag	
Erosion control best management	Watershed Artisans	
Erosion Control Field Guide	Watershed Artisans	
JCU Design Guidelines - Environmental Management	JCU Estate Directorate	Specifications for JCU contractors to follow in sediment and erosion control

6.1.3 Management Practices and Procedures

The Estate Directorate is responsible for management of natural areas around the campus. The campus contains nearly 300 hectares of land that is not actively maintained. This area however requires ongoing environmental maintenance. The Land Management section of the NAMP covers all areas related to general land management that aren't covered in the other sections. This includes all the areas included in the scope above. Current management practices are listed below.

- Sediment and erosion control

The Townsville Campus is required to comply with Townsville City Council's sediment and erosion specifications for all earthworks being undertaken on campus. This includes soil and mulch stockpiles on campus. JCU has included sediment and erosion control requirements in its Design Guidelines - Environmental Management section.

- Trail maintenance (including fire access tracks)

Trails on campus are primarily managed by the Grounds section within the Estate Directorate.

- Fire access tracks

Fire access track maintenance occurs annually, with the tracks graded and repaired following the wet season. This is managed by the Grounds Supervisor. Specifications for maintenance are outlined in the Fire Management Plan.

- Walking tracks

There are limited maintained walking tracks on campus, with one official walking track being built through Discovery Rise from the old water tank at the end of Monkhouse Rd, leading up the hillslope. There are some unofficial tracks in natural areas to the South of the campus, however these are not recognised by JCU currently and are not maintained. Most walkers will use the fire access tracks when walking around the natural areas on campus. Responsibility for walking track maintenance is the responsibility of the Estate Directorate.

- Mountain Bike tracks

Townsville Rockwheelers has a Licence to Occupy agreement with JCU for construction, use and maintenance of mountain bike tracks on JCU land. These tracks form part of the Douglas Mountain Bike Reserve. Townsville Rockwheelers uses best practice in trail maintenance and JCU works closely with the club to ensure trails do not have an adverse impact on the surrounding environment.

- Groundwater management

JCU currently pumps water for irrigation from two bores on campus. These are located adjacent to Nursing Sciences and Engineering. Meters have been installed on each bore to monitor usage and a bore height and water quality monitoring program has been developed to ensure groundwater use is sustainable. Additional bore locations will be investigated in coming years to identify alternative water sources for irrigation, particularly for high use areas such as the sporting fields. Where

additional bores are installed, they will be added to the bore monitoring program.

- Contaminated land and historical dumping sites

The JCU Townsville campus does not have any land recognised as contaminated. However, there are known and unidentified sites that have historically been used for dumping of waste materials. Much of these dumping sites have been cleaned up in recent years. There are still areas that need further attention.

- Vehicle management

Effective vehicle management in the campus' natural areas is important to reduce the risk of environmental damage through unrestricted vehicle access, illegal dumping, and biosecurity threats posed by introduced weeds and pest animals. JCU has a wide network of fire trails and restricted access is important to ensure any environmental threats are minimised. Vehicles requiring access to these areas should comply with the Department of Agriculture and Fisheries Clean down procedures for vehicles.

Access to the fire access tracks must only be granted by the Estate Directorate. JCU Security can provide access where required and should consult closely with the Grounds Supervisor and Manager, Environment to ensure need for access is demonstrated. Gates to the access tracks should be locked immediately after use.

- Infrastructure management in natural areas

JCU is required to maintain effective buffers between natural areas and its infrastructure to reduce risks posed by natural disasters such as bushfires, floods, and cyclones. JCU will comply with maintaining legislated buffer zones and will endeavour to minimise any impact on vegetation and wildlife especially in riparian areas and waterways. Where new infrastructure is required in green field sites, the JCU Estate Directorate will work closely with contractors to ensure a comprehensive management plan is established to minimise any environmental impacts and comply with relevant legislation.

Table 0.2 Land Management Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
6.1	Map key landscape features on the JCU GIS	Features to be mapped include creeks, boundaries, tracks, trails, fence lines, riparian areas	Input from Environment Manager and GIS staff	Nil	N/A	• Estate Directorate • JCU GIS staff	GIS	High	Jan 2022	Dec 2022	Mapping of all key features on the campus GIS
6.2	Use GIS and photography to map erosion points and update annually to monitor progression	Use GIS in combination with aerial and ground photography to monitor erosion in key areas on campus	GPS camera, input from GIS staff	Nil	N/A	• Estate Directorate • JCU GIS staff	GIS	High	May 2022 (or wet season)	Ongoing	GIS mapping and photography updated annually
6.3	Discuss land and environmental management with Vet Science in relation to grazing areas. Protection of watercourses should be a priority.	Better land management is required to protect soil and waterways. A land/ environmental management plan should be developed to better manage the grazing areas of campus. Some discussions have started.	Vet staff input, possible consultant to develop plan	TBA	TBA	• Estate Directorate • Vet Science • Consultant	N/A	High	Jan 2022	Jan 2023	Land/environmental management plan developed for Vet grazing yards
6.4	Map contaminated areas and historical dumping grounds on GIS	Mapping of known contaminated areas on campus is important to determine how to manage those areas	Historical knowledge from JCU staff	Nil	N/A	• Estate Directorate	N/A	Medium	2023	2024	All historical dumping sites and any contaminated sites mapped
6.5	Use GIS and photography to map fence condition and update annually	Use GIS in combination with ground photography to monitor fence condition on campus	GPS camera, input from GIS staff	Nil	N/A	• Estate Directorate • JCU GIS staff	GIS	Low	To be done in conjunction with erosion mapping if time and resources permit	Annual updates	GIS mapping and photography updated annually
6.6	Gather information on relevant contacts to advise on best practice land management	Include areas such as: erosion control, weed, pest and fire management, groundwater management, track maintenance, grazing, etc.	Estate staff to develop links to consultants	Nil	N/A	• Estate Directorate	Knowledge of best practice from relevant disciplines	Low	2022/ 2023	As required	Contact list developed and discussions held regarding best practice on campus
6.7	Identify wash down bays on campus and specifications	Compliant wash down bays required for environmental protection, including weed and pest management	Staff review	Nil	N/A	• Estate Directorate	N/A	Low	2022	Until completed	Report completed on wash down bays and any recommendations provided
6.8	Identify and promote opportunities for research or teaching to be conducted on campus sites regarding land management	Possible projects could include erosion control methods, track maintenance, grazing management, fire management, GIS mapping	Support from Estate Directorate for projects	Nil	N/A	• Researchers • Academics • Estate Directorate	• GIS • Planning	Low	2022/2023	Ongoing	Number of projects undertaking research or teaching and learning on campus

6.2 Fire Management

Fire management is a component of land and infrastructure management in areas prone to fire. JCU Townsville aims to manage fire on campus and the surrounding environment to ensure that the natural and artificial assets of the campus are protected from fire. Fire regimes on the Townsville campus will be managed in a way that promotes the health of the local regional ecosystems and protects vulnerable areas such as the vine thickets of Goondaloo Creek. The fire management strategies will involve but not limited to the following:

- Breaking campus into zones to allow for mosaic burning on a rotating basis and for better management of ecosystems and protection of built assets.
- Mapping zones and fire breaks/trails on GIS and updating annually with burn areas.
- Identifying maximum fuel loads in individual zones to ascertain when a burn should occur to mitigate unwanted fire.
- Identifying areas that are susceptible to environmental damage from fire and developing strategies to protect them.

JCU aims to ensure that any burn that takes place on campus has a defined reason, aim and objectives, and means of measurement. This will help ensure that unnecessary fires do not occur. JCU also aims to investigate opportunities for external contractors to manage fire on campus.

6.2.1 Objectives for Fire Management

The key objectives for Fire Management under the NAMP are:

- Manage the natural assets as effectively and as close as possible to the natural fire regime, while working in conjunction with the Fire Management Plan (Infrastructure protection).
- Maintain burning for ecological purposes in natural areas on campus.
- Create burning regimes that protect fire sensitive communities.
- Protect vine thickets by keeping fire away from vine thickets.

6.2.2 Scope

Natural/non-maintained areas of campus.

6.2.3 Management Practices and Procedures

The Estate Directorate is responsible for fire management at JCU. The Estate Directorate is currently developing a Fire Management Plan (FMP) for management of fire in relation to campus infrastructure protection. It is envisaged the NAMPs Fire Management section will work alongside the FMP and the plans will aim to complement each other where possible. As part of the NAMP action planning, an ecological fire management procedure will be developed and referenced in this section of the NAMP once completed. This will aim to manage the fire regime in a way that promotes the health of the local regional ecosystems and protects vulnerable areas such as the vine thickets of Goondaloo Creek.

JCU already works closely with its neighbours including Department of Defence, Townsville Hospital, Townsville City Council and Rockwheelers Mountain Bike Club and Queensland Fire and Emergency Services (QFES) in relation to fire management. A local fire management group is

already in place to manage fire in the Mount Stuart region and the group meets at least once per year to discuss fire planning for the area

Table 0.3 Relevant Information related to Fire Management

Document/information source	Author/Source	Comments
Historical campus burns regime maps	JCU grounds supervisor	Collate and store for future reference
Fire Management Guidelines - Brigalow Belt (North)	Reef Catchments	Guidelines for ecological fire management for relevant regional ecosystems
Fire hazard management overlays	Townsville City Council	
Natural disaster risk management study - Bushfire hazard study	C&R Consulting (for Townsville City Council)	
Bushfire Assessment and Preliminary Bushfire Management Plan For The Proposed Discovery Rise Development	RPS	Mostly related to risk to developments. Available upon request.
Fire management and the vegetation communities of the Townsville and Thuringowa shires: Some ecological considerations	JCU, ACTFR Adams and Skull	
Lavarack Barracks fire management plan	Department of Defence	Source document
NAFI aerial photography	NAFI	Historical fires aerial photography
The influence of fire on the Australian tropical savanna landscape	Greg Calvert	Literature review
Castle Hill Bushfire Mitigation Works	Townsville City Council	Document provided for NAMP reference. Relates to track maintenance for fire management.
Fire Management Guidelines for regional ecosystems - excel spreadsheet	Queensland Government	Summary of fire management practices for all Queensland regional ecosystem types
Fire ecology subject		
Fire management for weed control		
Fire scape - Burning for ecological purposes	Fire ecologists	

Table 0.4 Fire Management Action Plan

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
6.9	Break campus into zones for fire management	• Zoning will allow for mosaic burning on a rotating basis and allow for better management of ecosystems and protection of built assets • Zoning to take into consideration regional ecosystems (link with vegetation RE Mapping)	• Mapping equipment • Persons involved	Nil	N/A	• JCU GIS staff • Greg Calvert • Estate Directorate	• GIS • Ecology	High	Jan 2022	July 2022	Fire zoning complete and available for use
6.10	Map zones and fire breaks/trails on GIS and update annually with burn areas	Links with above action: annual monitoring of fire trails, firebreaks, and the burn area of that particular year	• Zone Map (above) and Fire Infrastructure mapping • Annual inspection	Nil	N/A	• JCU GIS staff • Estate Directorate	• GIS	High	Jan 2022	July 2022	• Baseline data collected and stored • Annual inspections occurring
6.11	Map identified areas to protect from fire (e.g. Goondaloo Creek vine thickets) and develop a methodology for protection	Map identified areas that are susceptible to environmental damage from fire and develop policy to protect them	Map of habitats and waterways showing areas for protection	Nil	N/A	• Greg Calvert • Conrad Hosking • Estate Directorate • Betsy Jackes • Lin Schwartzkopf	• Ecology • GIS • Zoology	High	Jan 2022	Dec 2022	• All areas for protection from fire defined • Methodology to protect them established
6.12	Investigate opportunities for external contractor to manage fire on campus	Have contractors manage the burn regime of the university. The potential also exists to link in Defence	• Contact Defence to see who they work with • Get quotes from contracts to ascertain viability	TBA	TBA	• Defence • Mick Blackman (Fire contractor) • Paul Williams (Firescape) • Estate Directorate	N/A	High	Jan 2022	Annual assessment	Quotes received for cost of contracted fire management
6.13	Before each burn is started, define the objectives and aims	A definitive reason for the burn, defined objectives and aims, and allowing for a means of measurement	Understanding of desired outcomes	Nil	N/A	• Fire management staff	N/A	High	June 2022	Ongoing	• Objectives and aims are stated • Objectives and aims are achieved
6.14	Ensure weed management is considered in creating burning regime	• Ensure grader grass does not get burnt • Manage Leucaena with fire - needs to be hot to stimulate seed bank • Link with weed management procedures to ensure burning complements fire management	An understanding of what weeds will be encouraged / discouraged by fire	Nil	N/A	• Landcare • CDTLC • Greg Calvert • Estate Directorate	N/A	High	As required	As required	Fire is being used to effectively manage weeds
6.15	Develop plan and procedure to avoid burning in riparian areas	Preservation of riparian areas by avoiding fires	Persons to develop plan and procedure	Nil	N/A	• Estate Directorate	N/A	High	June 2022	Dec 2022	• Plan developed to avoid riparian burns • No burns occur in riparian areas
6.16	Develop fire management procedure for natural areas to enhance ecological function and to complement burning for infrastructure protection	A procedure of best practise for natural and built asset protection / improvement	Relevant experts to advise strategy in collaboration with Estate staff	Nil	N/A	• Estate Directorate • Conrad Hosking • Greg Calvert • Discovery Rise	N/A	Medium	June 2022	June 2023	• Best practice for fire management defined • Procedure for best practise has been developed

Item number	Action	Details	Resources required	Funding required	Funding available	Key stakeholders	Links to curriculum or research	Priority	Commencement date	Completion date	Measurement and evaluation
6.17	Map Bushfire hazard	Identify the potential for bushfire and develop a hazard map	Qualified person to undertake mapping	TBA	TBA	• Estate Directorate • Discovery Rise • JCU GIS staff	• GIS • Ecology	Medium	2023	2023	• Potential for bushfire in given areas identified • Map developed with coding system to identify potential for fires
6.18	Identify maximum carrying capacity for fuel loads in each zone	Identify maximum fuel loads in individual zones to ascertain when a burn should occur to mitigate unwanted fire. This can be linked with bio condition assessment of the various areas.	• Qualified person to undertake assessment • The means to monitor it	TBA	TBA	• Greg Calvert • Estate Directorate	• Ecology • Botany	Low	2023	As required	Maximum carrying capacity established for particular environs
6.19	Erosion control of fire trails or other fire management infrastructure, post fire	Develop a methodology to deal with erosion mitigation caused by fires or fire management infrastructure (trails, breaks etc.)	• Qualified person to assess erosion impacts • Contractor to undertake remediation works where required	TBA	TBA	• Estate Directorate	• Ecology • Environmental management	Low	As required	Ongoing	• Trail maintenance procedure manual developed • Erosion prevention measures being used • Erosion problems being mitigated
6.20	Annual review of plan and actions	Annual review of fire plan to see that objectives and aims for the year are being achieved. Reassess plan and see where improvements can be made.	Stakeholders to review plan	Nil	N/A	• Estate Directorate	N/A	Low	2022	Ongoing	• Annual reviews are occurring • Plan is being reassessed and improved.