

Noosa River Estuary

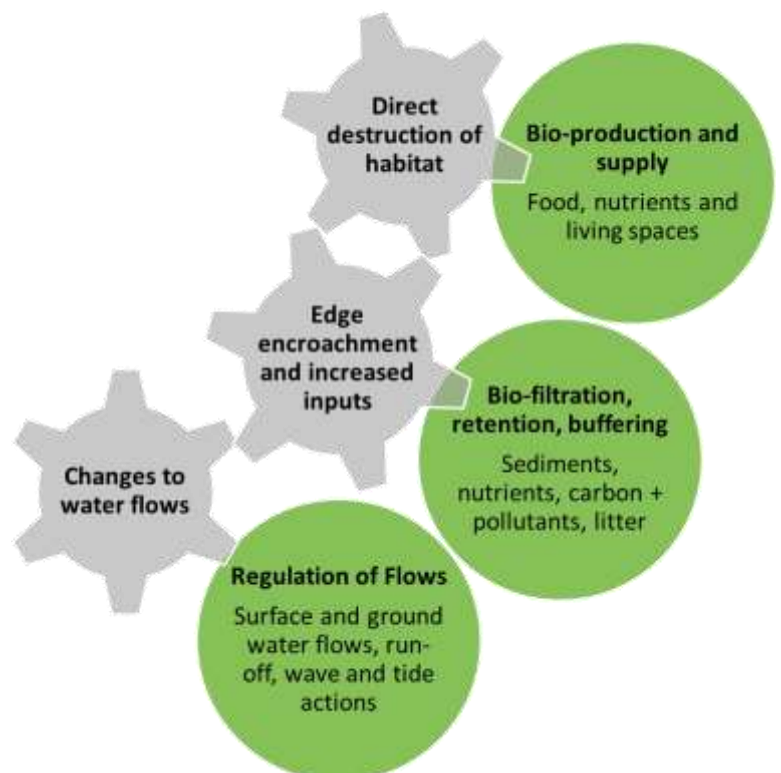
Assessment of Urban Land-Use Pressures

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Get your Wetlands Noosa

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Urban land-uses disrupt ecological functions of Wetlands

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Noosa River Estuary

Assessment of Urban Land-Use Pressures

Introduction

The lower Noosa River and its catchment form a complex estuarine system consisting of broad shallow lakes and tidal channels receiving run-off draining the surrounding catchment as well as downstream flows from the upper River. A diversity of salt and freshwater wetland habitats and their rich plant and animal communities grow throughout the Estuary's extensive littoral and riparian margins.

The Estuary is also the most urbanised part of the Noosa River system and the most intensively-used section of waterways and riverside land. The residential, commercial and tourism centres of Tewantin, Noosaville and Noosa Heads have been developed closely around the southern and western shores of the Estuary, crossed by grids of urban roads, utilities and other infrastructure, and serving over 50,000 residents and two million visitors a year.

This report presents the results of a preliminary survey of this relatively small and complex socio-ecological system, focused on the main types of intensive land-uses associated with urban development, exerting pressures on the ecology and amenity of the Noosa Estuary precinct.

Get your Wetlands Noosa

The survey was organised as initial fact-finding for a **Get your Wetlands** project, with the goal of strengthening conservation activities in the lower Noosa River by raising awareness of the Estuary as a valuable and vital ecosystem; highlighting the pressures on the Estuary's ecology from intensive land-use development; and identifying opportunities to improve ecological conservation, restoration and management.

The project was organised under the auspices of Noosa community groups, NICA and OzFish, with a grant from Queensland Department of Environment and Science as part of their Community Sustainability Action grant program.

The survey involved **broad-scale desktop mapping** of the whole central Estuary and its catchment using existing spatial datasets. This enabled identification of the main geographic and ecological features of the lower River and the main types of intensive land-use exerting pressure on the ecosystem throughout the Estuary and catchment. Additional data were collected by NICA on **waterway use** – vessels and associated infrastructure – jetties, ramps, moorings, in the waterway and on the shore.

From the broad-scale mapping, areas requiring priority attention were identified, where several forms of urban land- and waterway-use have been developed together at particular sites and exert combined pressure on the ecology and amenity.

The project then made **initial ground surveys** of some of these multiple-impact sites, to look in more detail at their ecological condition and specific site management issues, as the basis for preparing preliminary concept plans for improved site management, restoration and enhancement.

The next stages of the Get your Wetlands project will use the assessment findings to promote and help develop short- and long-term restoration actions for the Estuary foreshore and riparian wetlands.

Short-term actions will include **targeted Clean-ups** to initiate restoration of foreshore sites where damage has been allowed to accumulate. The long-term objective is for local community groups to work with Noosa Council as the principal authority to develop an effective **restoration program** for the Estuary foreshore and riparian wetlands. This could include wetland rehabilitation and enhancement combined with actions to convert and adapt the main forms of urban land-uses and infrastructure to low-impact eco-positive designs.

Summary of Findings and Recommendations

Main Findings

Noosa Estuary and Wetlands

- The central Estuary between Lake Cooroibah, Lake Weyba and Noosa River mouth has a local catchment of nearly 4,000 hectares, draining into 900 hectares of tidal waterways and a remarkable 66 kilometres of shoreline and foreshore lands.
- A range of salt and freshwater wetlands - mangroves, seagrasses, reed beds, marshes, swamps and woodlands - form the dominant natural habitats along the estuary foreshore and creek margins and across the riparian basins. They provide ecological services vital to the Estuary's health, productivity and resilience: wetlands produce all the Estuary's food, nutrients and living spaces; and buffer, filter, stabilise and regulate all materials flowing through the ecosystem.

Urban land-use pressures on Noosa's wetlands

- Urban Noosa has been developed extensively and closely around the Estuary foreshore and across the catchment. Overall, 48% of the foreshore and 38% of the catchment basin have been converted to intensive land-uses.
- The main forms of urban land-use in Noosa Estuary – buildings, roadways, drains, sewer lines, recreational parks and waterway infrastructure – have been built with little apparent regard for the underlying ecosystem and not designed to be low-impact or ecologically compatible.
- When poorly-designed and developed too close to wetland areas, urban land-use disrupts their vital ecological processes and degrades the Estuary's health, resilience and amenity, in several ways:
- **Direct destruction of habitat** – in Noosa Estuary urban roads, paths, parks, sewer lines and more than 1,000 shoreline structures (jetties, boat ramps, stormwater outfalls, etc) have been developed directly on nearly half of the length of foreshore and across extensive parts of the catchment.
- **Edge encroachment and intrusions** – overall around 60% of Estuary foreshore land (41 km out of 66km) is degraded by urban land-use built in close proximity and with inadequate buffering, resulting in extensive encroachment and increased inputs of 'foreign' materials – weeds, pollutants, litter and waste, domestic plants, pets and pest animals.
- **Changes to water flows** – the run-off from every building, road and other hard surface in urban Noosa (over 1,400 ha) is channelled through the stormwater drainage (SWD) system into the estuary, causing significant disruption to the ecological functions of foreshore and riparian wetlands and the estuary as a whole. Noosa's urban run-off is likely to be the most significant source of contaminant materials (solid waste and litter, sediments, dissolved chemicals, plant and weed debris) entering the Estuary.

Existing management and conservation measures

- There is no effective policy or system for conserving or sustaining the natural values of Noosa Estuary. There are few controls over the range of land-and waterway-uses in the Estuary precinct and very few examples of eco-friendly urban or waterway infrastructure design. The few formal reserves are themselves compromised by urban land-use pressures. Overall, only 38% of foreshore land were assessed as adequately buffered (more than 100 metres) from urban land-use.

Opportunities for Improved Management

- Although widespread, the main urban land-uses occur in combination at particular sites, for example stormwater drains and other shoreline structures are built where roadways, parks and other hard surfacing cross the public foreshore. These multi-impact sites present useful opportunities for cost-effective management by introducing integrated solutions to address land-use pressures directly and restore healthy foreshore and littoral habitats.
- An initial 12 sections of foreshore and several riparian areas were found to be suitable to pilot such an approach. Preliminary ground surveys were made at 6 of the multi-impact sites identified, to make a closer assessment of the sites' ecological conditions and management issues presented.
- These details were used to prepare initial concept plans for site restoration, presented in the final part of the report.

Preliminary Recommendations

The survey and assessment findings are intended to be of use particularly to Noosa Council and local community organisations¹ interested in improving the health and amenity of the Noosa River and Estuary. There is renewed interest in addressing some of the long-standing issues such as sedimentation, run-off, foreshore degradation and loss of estuarine habitats and wildlife; the progressive loss of amenity associated with increased use and poorly designed development of the urbanised waterway and Estuary precinct; and the lack of resilience-building and adaptation measures in current river and catchment management.

It is evident from the survey that intensive urban land- and waterway-use have contributed to significant loss of ecological health and amenity along most stretches of the central Estuary and foreshore; and that there are opportunities available to develop a relevant effective management program to address the main issues.

Resilient River Strategy

The main recommendation is for Noosa Council to develop and lead a substantial long-term Resilient River strategy with a major component directed at ecological restoration and enhancement of the urban Estuary and catchment.

The strategy could be developed and delivered efficiently and effectively as a collaborative partnership between 'whole of Council' and local community organisations using a combination of new and existing resources.

An integrated ecosystem-based management approach is recommended based on the findings of the current survey and other recent river and catchment research.

The recommendation is to develop three pilot programs centred on the clusters of priority sites identified in the survey.

- A** Lake Doonella and Tewantin centre, foreshore and catchment – proposed sites 2, 3, 4, 5, 6, 7
- B** Weyba Creek, foreshore and catchment plus parts of Noosaville – proposed sites 8, 9, 10
- C** Noosa North Shore and Ferry crossing – proposed sites 1, 11, 12

Strategic objectives for each pilot program – under a Council-Community partnership of 5-7 years – would include:

- Reduction of ecological pressures and impacts from intensive urban land- and waterway-uses
- Restoration of foreshore, littoral and riparian habitats and enhancement of biodiversity
- Strengthen ecological resilience and climate adaptation measures
- Enhancement of public access, amenity and enjoyment

Resilient River Pilot Programs – Clusters of Priority Foreshore Sites

A	site 2. Tewantin Esplanade - Lakeside Park site 3. RSL & Tewantin Parks site 4. Lake Doonella North Foreshore and Wetland Refuge site 5. Lakes Resort Foreshore - Goodchap St - Doonella Bushland Reserve site 6. Cranks Creek Riparian/ Esplanade site 7. Hilton Esplanade Foreshore
B	site 8. Chaplin Park Foreshore site 9. Lion's Park (part) Foreshore site 10. Weyba Creek Park – Lake Weyba Drive Riparian Tract
C	site 1. Ferry Park - Moorindil Street Foreshore - Wooroi Ck site 11. Maximilian Drive Ferry Foreshore site 12. Noosa North Shore Esplanade – Frying Pan Foreshore

¹ including NICA, OzFish, Noosa & District LandCare, Noosa Parks Association, Healthy Land & Water, Noosa Community Biosphere Association, North Tewantin BushCare Group and others

Part 1 Noosa River Estuary – Broad-scale Assessment

The survey and assessment were based on desktop mapping of the whole Noosa Estuary and its catchment using a range of existing spatial datasets with supplementary ground observations.

The main study area was the central Estuary lying between Lake Cooroibah and Lake Weyba and the River mouth at Laguna Bay, including the areas of Tewantin, Noosa North Shore, Noosaville, Noosa Heads and Weyba Creek.

For the assessment, the following features were mapped and measured in each of the six sections:

- The extent and nature of the Estuary's main geographic and ecological features.
- The main forms of pressure exerted on the Estuary ecosystem by intensive urban land-use – buildings, roads, stormwater points, sewer infrastructure and foreshore/waterway infrastructure – in the local catchment basins and around the margins of the main tidal channels and tributary creeks.
- Formal environmental protection provisions including fish habitat areas (FHAs), local Bushland Reserve areas and Queensland Parks.

Further details of the methodology, data sources and selected references are described in **Appendices**.

Geography and Ecology

The catchment of the lower Noosa River extends over 9,000 hectares (90 km²) across three sub-basins: Lake Cooroibah sub-basin to the north is 1,240 ha and Lake Weyba sub-basin at the southern end of the system is nearly 3,950 ha. Between the two major lakes, the central Estuary has a catchment basin of nearly 4,000 ha, in six separate catchment sections – Noosa North Shore, Tewantin, Doonella, Noosaville, Noosa Heads and Weyba Creek.

The main features of the area are shown in **Map 1** and summary statistics are listed in **Table 1**.

Summary descriptions and maps of the survey results for each of the six sections of the central Estuary are provided in **ATTACHMENT I** of this report.

Tidal Waterways and Shores

The most significant feature of the central Estuary is the mosaic of river and creek tidal channels, shallow banks and islands, and their littoral and riparian margins. These include Noosa River, Weyba Creek, Lake Doonella and the tidal reaches of Wooroi and Cranks Creeks, covering a total area of 920 hectares and extending along 66 kilometres of shoreline and foreshore land.

Catchment Tributary Creeks

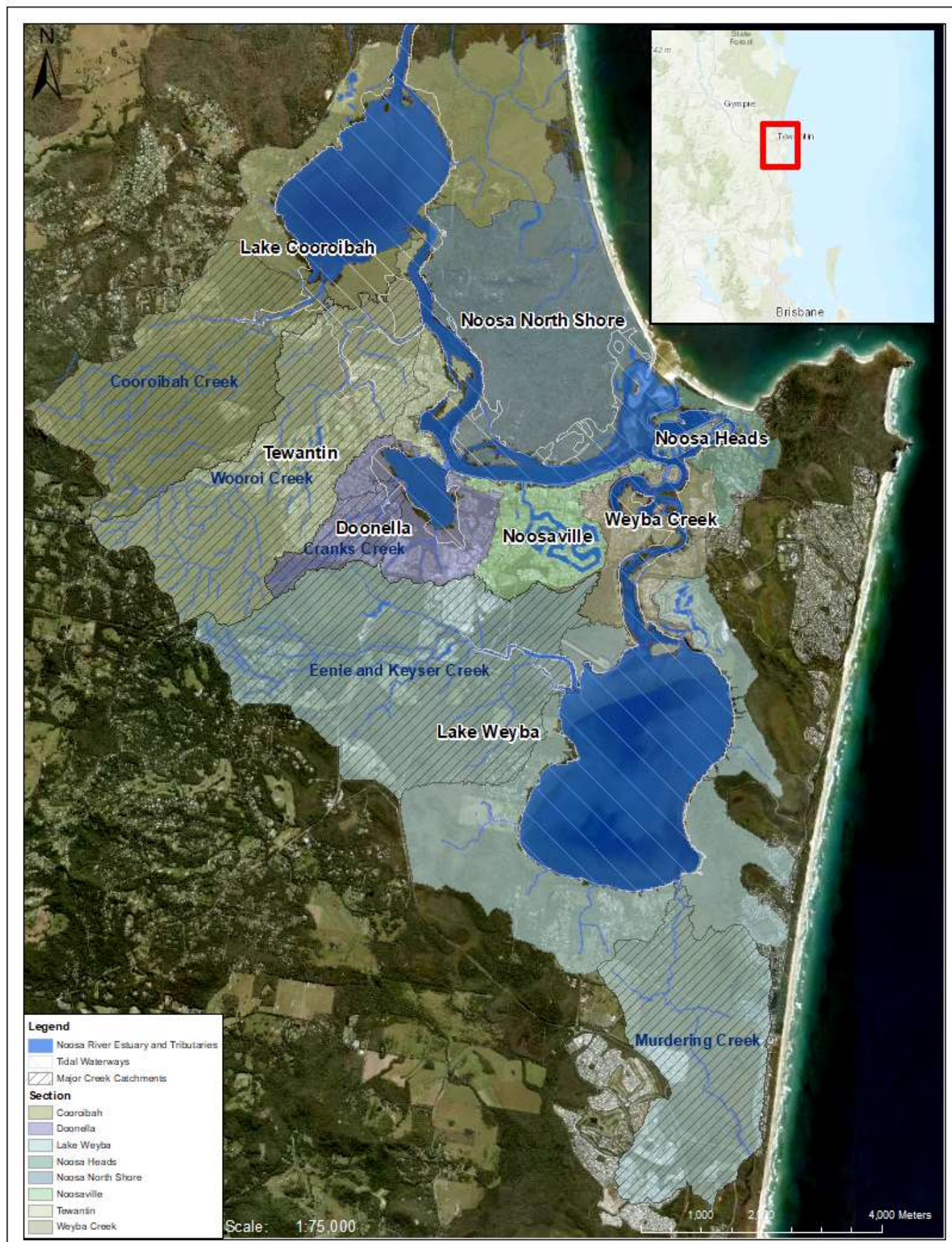
Another important feature is that most of the lower River catchment drains into the main river and lakes via just 6 large tributary creeks. Their combined freshwater catchment area is over 5,000 ha, 57% of the total 9,000 ha basin.

Four of these creeks drain extensive basins into the two major lakes rather than the central Estuary – Cooroibah Creek into Lake Cooroibah; Eenie, Keyser and Murdering Creeks into Lake Weyba.

Just two of the large tributary creeks drain the central Estuary sub-basin – Wooroi Creek drains a basin of 1,250 ha, over 90% of the Tewantin section catchment; and Cranks Creek drains nearly 200 ha – and run into relatively large tidal channels to join the main river at Tewantin and Lake Doonella respectively.

Outside these two creeks, the remaining 63% of the central Estuary catchment drains via many small basins along the foreshores of Tewantin, North Shore, Noosaville, Noosa Heads and Weyba Creek.

MAP 1 **Noosa River Estuary - Tidal Waterways, Catchment Basins and major Tributary Creeks**



Wetlands in Noosa River Estuary

The term “wetlands” is used here and commonly to refer to the variety of ecosystems that grow at the interface of land and water areas, where the land margins are inundated by water – salt or fresh – for periods of time (Department of Environment and Science Queensland 2013).

The plants and animals that grow in these watery land areas are specialists, each species finely attuned to the particular local conditions of salt and fresh surface waters, ground waters and sediments that flow through the ecological system, and to their neighbours in the wetland community.

In the Noosa River Estuary, wetlands form the major physical habitats across the aquatic, littoral and riparian zones. They occur in two main categories – along all the tidal shoreline shallows and foreshore land (littoral zone), and in all the periodically wet riparian land areas across the freshwater catchment basins.

Noosa’s tidal foreshore wetlands are salt-, brackish- and fresh-water wetland habitats, including seagrasses, mangroves, tidal marshes, reed beds, brackish and freshwater swamps and woodlands. They grow along 66 kilometres of tidal foreshore land throughout the estuary, varying in width from a few metres to several hundred metres, depending on the topography and hydrology of the land; and covering an estimated total area of over 300 ha.

Riparian catchment wetlands are freshwater swamps, woodland and marshes growing in the land drainage catchments across the 4,000 ha basin of the central estuary – through Tewantin, Noosa North Shore, Noosaville, Noosa Heads and Weyba Creek.

Both categories of wetland habitats are integral parts of the Noosa River Estuary, vital to its long-term ecological health, resilience, biodiversity and productivity. They are also a major contributor to the natural amenity and scenic attraction of the Estuary’s waterways, foreshores and riparian lands.

Ecologically the significance of wetlands, when healthy and intact, is that they provide a range of essential ecosystem services.

Ecosystem services provided by wetlands in Noosa River Estuary

- ✓ Wetlands **produce and provide** much of the food, nutrients and habitat for the Estuary’s diverse plant and animal communities.
- ✓ Wetlands are natural **buffers and filters, capturing, stabilising and processing** a high proportion of sediments, dissolved substances and pollutants washed off the riparian catchment and in from the waterways.
- ✓ Wetlands **regulate** all surface- and ground-water run-off from the land and govern the influence of tidal flows and ebbs throughout the Estuary.
- ✓ Because of their natural buffering properties, maintaining and strengthening the health and resilience of wetlands are also important **adaptation** measures in the face of increasing impacts from climate change.

TABLE 1. Noosa River Estuary and Catchment – Summary Statistics

MAJOR SECTIONS		Sub-Basin	Urban area	Major Creek	Tidal Waters	Tidal Foreshore	ULU ² encr. Foreshore
- Features		ha	ha (%)	ha	ha	km	km (%)
LAKE COOROIBAH SECTION							
- Lake Cooroibah, foreshore and catchment		1,240	202 (16%)	1,100	690	15	ns
- Cooroibah Creek and catchment							
NOOSA NORTH SHORE SECTION							
- Noosa North Shore foreshore and catchment		1,220	123 (10%)		*3	12	3 (22%)
- Goat Island							
TEWANTIN SECTION							
- Tewantin main river channel and foreshore		1,360	504 (37%)	1,250	280	10	5 (45%)
- Makepeace and Sheep Islands							
- Wooroi Creek and catchment							
DOONELLA SECTION							
- Lake Doonella and foreshore		460	280 (60%)	190	120	5	2 (18%)
- Cranks Creek and catchment							
NOOSAVILLE SECTION							
- Noosaville main river channel and foreshore		330	254 (77%)		350	17	17 (100%)
- Noosa Waters and catchment							
NOOSA HEADS SECTION							
- Noosa Sound, Noosa Spit and Woods foreshore		180	115 (63%)		*2	10	7 (74%)
- Hayes Island foreshore							
WEYBA CREEK SECTION							
- Weyba Creek main channel and foreshores (west bank, east bank)		320	180 (55%)		160	12	7 (59%)
- Keyser and other islands							
LAKE WEYBA SECTION							
- Lake Weyba and foreshore							
- Eenie & Keyser Creeks and catchment		3,950	949 (24%)	2,630	1,030	17	ns
- Murdering Creek and catchment							
TOTALS – Central Estuary Sections only		3,880	1,456 (38%)	1,440 (37%)	920	66	41
TOTALS – incl. Lakes Cooroibah and Weyba		9,100	2,607 (29%)	5,160	2,640	96	

² ULU, Urban Land-Use

³ Areas of tidal waters are included in the figures for adjacent Sections

Urban Land Use in Noosa Estuary

A major source of damaging pressures on estuaries and wetlands throughout Queensland and elsewhere comes from intensive urban development, where land clearing and construction of buildings, roadways and other hard surfaces are carried out on or close to the natural ecosystem, without adequate separation or buffering (Department of Science Information Technology Innovation and the Arts 2015).

The main forms of urban land-use identified in Noosa Estuary were as follows:

- Buildings – residential, commercial
- Roads, paths and other hard surfacing
- Recreation parks
- Stormwater drainage (SWD)
- Sewer pipelines
- Waterway infrastructure – boat ramps, jetties, etc.

These land-uses and structures were mapped and measured across the whole central Estuary and in each of six sections – Tewantin, Lake Doonella, Noosaville, Weyba Creek, Noosa Heads and Noosa North Shore. Additional data on waterway infrastructure was obtained from a NICA vessels survey (2022).

The survey results for the whole central Estuary are summarised in **Table 3**.

TABLE 3. Survey Results for whole Noosa central Estuary

Summary Data on Noosa central Estuary and catchment	ha	%
• Total central Estuary catchment area	3,880 ha	
• Total urban land-use (ULU) in central Estuary precinct	1,456 ha	38%
• Major creek catchment areas (Wooroi and Cranks Creeks)	1,440 ha	37%
• Total extent of tidal waters	920 ha	
Summary Data on Noosa Estuary Foreshores	km	%
• Total length of tidal foreshore	66 km	
• Total extent of foreshore encroachment by ULU (ULU <100 m from water's edge)	41 km	62%
• Total extent of foreshore habitat direct destruction by ULU (ULU <10 m from water's edge)	32 km	48%
• Total extent of riverside recreation areas	7 km	5%
• Total extent of sewer pipelines on foreshore (<50m from water's edge)	32 km	49%
Summary Data on Foreshore and Waterway Structures	Number	
• Total numbers of stormwater drains	248	
• Numbers of jetties/ pontoons (outside Noosa Waters)	384	
• Numbers of jetties/ pontoons in Noosa Waters	454	
• Vessel moorings ⁴	90	
• Boat ramps ⁴	13	
• Vessels (>5m) anchored in Estuary channel ⁴	150	

⁴ Supplementary data from NICA survey, September 2022

Nature and Extent of Land-Use Pressures in Noosa Estuary

Each of the main forms of urban land-use and infrastructure can affect the estuarine ecosystem by a combination of direct and indirect pressures: **Direct habitat destruction, Edge encroachment and increased intrusions** and **Changes to water flows**. The severity and spread of the pressure depend on the specific design and management of the land-use and its proximity to natural habitat (Newton et al 2020). In this study each of these mechanisms was assessed as a significant concern for the ecology of the Estuary and its wetlands.

Direct Habitat Destruction from Urban Land-Use

Where a building, roadway, recreation area or other urban structure or hard surface is built immediately on the foreshore or in a riparian area, the natural wetland habitat is destroyed or significantly degraded, including the physical land-form, hydrology and specialised plant and animal community.

Direct Habitat Destruction	Extent in Noosa Estuary
<ul style="list-style-type: none">Buildings, roadways, parking, other hard surfaces built directly on foreshore land (<10m from shoreline and water's edge)	Along 32 km of foreshore (48% of 66 km total)
<ul style="list-style-type: none">Riverside parks (recreation areas) and associated structures	Along 7 km of foreshore (5% of total)
<ul style="list-style-type: none">Waterway infrastructure - jetties, ramps, pontoons	Over 800 structures built on foreshore and across littoral zone
<ul style="list-style-type: none">Buried sewer pipelines (<50m from water's edge)	Along 32 km of foreshore (48% of total)

The ecological services provided, the natural amenity of the site, and the ecological integrity and resilience of the foreshore or riparian area are also extinguished, which increases the area's vulnerability to further damage, from erosion for example.

Edge effects - Encroachment and Increased Inputs from Urban Land-Use

Where any of the forms of urban land-use are built adjacent or close to the Estuary foreshore or riparian area the natural habitat is impacted by encroachment and increased inputs of 'foreign' materials, spread or carried accidentally or deliberately into the area.

Edge Encroachment and increased intrusions	Extent in Noosa Estuary
<ul style="list-style-type: none">Private and public properties, buildings, roadways, parks, golf courses etc. built close to foreshore or riparian wetlands (<100m from water's edge/ wetland)	Along 41 km of the estuary shoreline (62% of the total 66 km) Across 1,456 ha of riparian catchment land (38% of the total 3,880 ha)

A number of factors make Noosa Estuary and wetlands highly vulnerable to these effects:

- Urban land-use pressures are not easily contained on the land-use site and will intrude and spread readily into nearby wetlands and waterways.
- Wetland areas tend to be linear habitats with lengthy exposed edges, naturally porous to and not readily protected from external inputs.
- A broad range of types of encroachment and intrusions are observed along the extensive edges of the Estuary's foreshore and riparian wetland habitats, including increased weeds, plant debris, pest animals; domestic cats; sewage leakage; litter and waste materials and pollutants – from nearby residential and commercial properties, gardens, golf courses, construction sites and roadways.

Each of these intrusions has the potential to significantly disrupt and degrade the ecological functioning of the wetland habitat, especially by overloading its capacity to filter, capture and process contaminant materials spreading in from adjacent land or water areas.

Edge effects, encroachment and increased intrusions are widespread and well-recognised risks to urban wetland areas (Department of Environment and Heritage Protection 2011). Guidelines for developers and managers are to maintain an adequate buffer between intensive land-use and wetlands. A native vegetation buffer extending at least 100 metres from HAT (highest astronomical tide) is recommended in tidal areas, although it should be noted that this would serve to buffer the water body but not necessarily the foreshore or riparian wetland.

This survey found that only small portions of Noosa Estuary foreshore can be considered adequately buffered from urban land-use encroachment. Overall only 25 km (38%) of the 66 km foreshore had a reasonable vegetated buffer, measured as more than 100m between urban land-use and the water's edge. Refer also to the following section on Foreshore Habitat Protection in Noosa Estuary.

Changes to Water Flows

A related mechanism by which urban land-use damages the estuary ecosystem is by disrupting a fundamental ecological function of wetlands to regulate the hydrology, retention and filtration of water flowing through the system.

Changes to Water Flows	Extent in Noosa Estuary
<ul style="list-style-type: none"> Hard surfaces and structures 	All hard structures and surfaces (>1,000 foreshore structures recorded) alter the hydrology of the littoral and riparian zones
<ul style="list-style-type: none"> Urban run-off and contaminants from 1,456 ha of urban land, buildings, roadways, hard surfaces 	All run-off and contaminants are channelled directly onto the shore or into wetlands via 248 SWD outfalls

All forms of urban land-use built in or close to wetland habitats will alter the natural patterns of water flows (surface and ground water; salt and fresh; rainfall and tidal water): the impermeable surfaces and objects channel or block the volume and speed of water and water-borne materials into or out from the wetland to or from adjacent land and water areas.

The most significant form of this pressure and damage in Noosa estuary is the **stormwater drainage (SWD) system**. By design, the SWD system collects and channels the entire volume of water running off Noosa's urban areas⁵ into the estuary's wetland areas and waterways. The run-off water carries significant quantities of dissolved and particulate contaminant materials – **solid waste and litter, sediments, dissolved chemicals, plant and weed debris and seeds** – from the surfaces of every property, building, road and other hard structure and land area.

The SW drains concentrate and channel the urban run-off either into a wetland area, or, bypassing the wetland, directly onto the shore and into the waterway. Both practices drastically change the hydrology and ecology of the riparian and littoral zones. The former floods the wetlands with concentrated pulses of run-off water and contaminants; the latter, where the SW drain bypasses the wetland, pulses the contaminated freshwater run-off directly into the tidal (saltwater) waterway, and in the process starves the wetland of essential freshwater inflows from the land.

Distribution of Urban Land-Use in Noosa Estuary

The survey mapped the widespread distribution of the main forms of urban land-use in each part of Noosa central Estuary. The detailed results for each section of the Estuary foreshore are shown in **Table 4** below.

Summary descriptions and maps of the features and land-use pressures recorded in each of the six sections are provided in **ATTACHMENT I** of this report.

⁵ **Urban stormwater run-off into Noosa River estuary:** total area of urban land-use in the central estuary catchment was mapped as 1,456 ha. Based on average annual rainfall of 1,700mm at Tewantin (BOM), the average annual volume of urban Noosa's run-off is estimated at 25,000 megalitres (10,000 Olympic swimming pools) all channelled into SWD system. Total volume of Noosa's tidal waters is estimated at 46,000 megalitres (assuming average depth of 5m over 915 ha area).

TABLE 4. *Extent of Land-Use Pressures on Foreshore Habitats across Noosa Estuary*

Noosa Estuary Sections		Direct destruction of foreshore habitat							Encroachment, increased inputs				Changes to flows
		ULU ⁶ <10m		Parks <10m		Sewers<50m		Jetties etc.	ULU <100m		Roadway <100m		SW Drains
Lengths of Foreshore	km	km	%	km	%	km	%	number	km	%	km	%	number
Noosa North Shore foreshore	10	2	22	0	0	0		64	3	27	3	34	0
Goat Island foreshore	2	0			0	0	0	0	0	0	0	0	0
NOOSA Nth SHORE SECTION	12	2	18	0	0	0	0	64	3	22	3	27	0
Wooroi Creek - tidal reach	3	0.6	18	0	0	1	19	0	1	26	1	25	36
Tewantin foreshore	3	2	48	0.3	9	2	70	38	3	98	1	33	15
Pig (Makepeace) Island	2	0.2	14	0	0	0	0	2	0.5	28	0	0	0
Sheep Island	2	0	0	0	0	0	0	0	0	0	0	0	0
TEWANTIN SECTION	10	2	24	0.3	3	3	29	40	5	45	2	19	51
Lake Doonella foreshore	4	0.8	20	0	0.8	4	89	2	2	51	2	44	17
Cranks Creek - tidal reach	1	0.1	13	0.4	38	0.4	40	0	0.3	4	0	2	3
DOONELLA SECTION	5	0.9	19	0.4	8	4	81	2	2	18	2	15	20
Noosaville foreshore	4	4	94	3	78	1	22	47	4	100	3	79	42
Noosa Waters	13	13	100	1	11	12	94	454	13	100	12	97	23
NOOSAVILLE SECTION	17	16	99	4	27	13	77	501	17	100	15	92	65
Hayes Island foreshore	6	6	100	0.6	10	5	83	197	6	100	6	100	18
Noosa Spit and Woods	4	1	22	0.7	18	1	20	1	2	40	1	28	8
NOOSA HEADS SECTION	10	7	67	1	13	5	56	198	7	74	7	69	26
Weyba Creek - East shore	6	0	1	0	0	1	22	4	2	34	1	10	11
Weyba Creek - West shore	6	3	56	0.4	6	6	94	29	5	83	5	80	75
WEYBA CREEK SECTION	12	4	29	0.4	3	7	59	33	7	59	6	46	86
TOTALS	66	32	48	7	5	32	49	838	41	62	35	53	248

Forms of intensive Urban Land-Use (buildings, roadways, other hard surfaces)

Foreshore Habitat Protection in Noosa Estuary

The mapping survey measured the extent of foreshore and littoral wetland areas where there is a formal environmental protection mechanism in place, and/ or where there is a native vegetation (i.e. wetland) buffer of at least 100 metres between waterway and urban land-use.

The results are summarised in the Table below for each of the main sections of the central Estuary.

Along the total 66 km of tidal foreshores in Noosa Estuary, just 25 km (38%) were mapped as reasonably buffered from urban land-use, i.e. by a fringe of natural vegetation 100 metres or more wide, between the nearest urban land-use (roadway, building, etc.) and the shoreline or water's edge.

The following formal protected areas were recorded⁷:

Qld. or Local **environmental reserves** designated along 35 km (54%) of tidal foreshore land.

Noosa River **Fish Habitat Area** designated along 36 km (55%) of tidal channels and littoral zone.

Both these types of area-based reserve are compromised in some parts of the Estuary by the close development of urban land-use: in total, along 6.2 km (18%) of foreshore designated as environmental reserve, urban land-use is developed to within 50m of the water's edge; as well as along 6.4 km (18%) of the foreshore land directly adjacent to the FHA.

TABLE 2. Foreshore and Littoral Habitat Protection

Noosa Central Estuary – Main Sections		Extent of Foreshore Buffering (>100 m) and Designated Reserves					
Total Foreshore, km		Wetland Buffer	%	Env. Reserve	%	FHA	%
Noosa North Shore section	12	9	78	10	87	12	98
Tewantin section	10	6	55	8	77	8	82
Doonella section	5	3	52	4	80	4	89
Noosaville section	17	0	0	0	0	0	0
Noosa Heads section	10	3	26	4	38	0	0
Weyba Creek section	12	5	41	9	76	11	93
TOTALS	66	25	38	35	54	36	55

⁷ There is no area-based marine/ estuarine conservation mechanism in place other than the Noosa River FHA.

Part 2 Priority Sites for Improved Management & Restoration

Combined Pressures at Sites

An important feature of urban development around Noosa Estuary is that the main land-uses and waterway uses tend to coincide and operate in combination at particular sites: for example, road reserves, drains, sewer lines, recreational areas, river access points and associated hard structures and surfaces have been built together at many public foreshore sites in the Estuary.

At these sites the multiple land-use structures and activities exert combined pressures which exacerbates the impacts on ecological health and on the amenity of the intensively used site.

This pattern of concentrated land-use at particular sites presents useful opportunities for improving Estuary management: a targeted approach at these relatively few key locations would address the combined pressures from multiple sources systematically and cost-effectively.

The mapping survey identified an initial 12 sections of foreshore as sites in priority need of management attention. Refer to **Table 5**.

Criteria for inclusion in the list were that the site has:

- i. Multiple types of intensive land-use exerting pressure on the ecosystem and amenity.
- ii. Site problems not being addressed in any concerted fashion; general neglect and lack of management attention to ecological and amenity values.
- iii. Significant strategic value as potential pilot & demonstration site for foreshore restoration and enhancement.

TABLE 5. Priority Foreshore Sites for Improved Management & Restoration

Priority Foreshore Sites	Central Estuary mapped sections
1. Ferry Park - Moorindil Street Foreshore - Wooroi Ck	Tewantin section
2. Tewantin Esplanade - Lakeside Park	
3. RSL & Tewantin Parks	
4. Lake Doonella North Foreshore and Wetland Refuge	Doonella section
5. Lakes Resort Foreshore - Goodchap St - Lake Doonella Bushland Reserve	
6. Cranks Creek Riparian/ Esplanade	
7. Hilton Esplanade Foreshore	Noosaville section
8. Chaplin Park Foreshore	
9. Lion's Park (part) Foreshore	
10. Weyba Creek Park – Lake Weyba Drive Riparian Tract	Weyba Creek section
11. Maximilian Road – Ferry Foreshore	Noosa North Shore section
12. Noosa North Shore Esplanade – Frying Pan Foreshore	

The survey also identified 3 catchment areas in the central estuary for priority attention:

- Wooroi Creek and catchment
- Cranks Creek and catchment
- Noosa Springs catchment area.

Site Restoration & Enhancement Concepts

Preliminary ideas were developed for restoration of the 12 priority foreshore sites, based on consideration of generic types of restoration and enhancement actions. Refer to **Table 6**.

TABLE 6. Preliminary Restoration Ideas for selected Foreshore sites

Priority Foreshore Sites for Restoration	Generic Restoration & Enhancement Needs							
	A	B	C	D	E	F	G	H
1. * Ferry Park – Moorindil St.		B	C	D	E	F	G	H
2. * Tewanin Esplanade Lakeside Park	A	B		D	E	F	G	H
3. * Tewanin & RSL Parks	A	B		D	E	F	G	H
4. * Lake Doonella North Foreshore	A	B	C	D	E	F	G	H
5. * Lakes Resort – Goodchap Street Foreshore	A	B	C			F	G	H
7. Cranks Creek Riparian/ Esplanade		B				F	G	
8. * Hilton Esplanade Foreshore		B	C	D	E	F	G	
9. Chaplin Park Foreshore		B		D	E	F	G	H
10. Lion's Park (part) Foreshore		B		D	E	F		
11. Weyba Creek Park – L.Weyba Drive Foreshore	A	B	C	D	E	F	G	H
12. Maximilian Drive Ferry Foreshore	A	B	C	D	E	F	G	
13. Frying Pan Foreshore, Noosa Nth Shore Esplanade			C			F	G	H

* Preliminary ground surveys made at these sites

Generic Site Restoration & Enhancement Actions

- A** Targeted Clean-up of accumulated weeds, debris, litter
- B** Management of run-off, including conversion of SWD
- C** Removal of hard debris, rock fill, obsolete structures and surfaces
- D** Landscape rehabilitation /erosion repair
- E** Management of road reserve land, vehicle access, parking, boat access;
conversion to 'Green' infrastructure and surfaces
- F** Vegetation restoration and enhancement
for ecological health, resilience, biodiversity, amenity
- G** Improved public amenity, enjoyment and engagement
for access (pedestrian, kayak, cycle), information, signage, 'trails', viewpoints, hides, small boat launch
- H** Engagement of adjacent property owners in site 'co-management'

Ground Surveys

As an additional part of the *Get your Wetlands* project, preliminary ground surveys were made at 6 of the priority foreshore sites identified. The aim was to look in more detail at the Ecological Condition and Management Issues apparent on the ground at these sites, and use these as the basis for preparing outline site restoration concepts that could be discussed further between Noosa Council, NICA and interested BushCare groups.

Project resources were insufficient to complete ground surveys at each of the 12 priority sites identified. Further ground surveys and planning work will be required in order to develop an extended restoration program.

At each of the 6 ground survey sites, electronic tablets were used to note and rate standardised aspects and measures of Ecological Condition, Management Issues and the presence of significant specimens of Habitat trees and Cultural features such as midden heaps directly onto site maps.

In addition, the ground surveys identified 4 sites as priorities for Targeted Clean-up as a preparatory step for restoration. Parts of these sites have long-term accumulation of weeds, debris and litter.

The results of the ground surveys are summarised in **Table 7** below. Sites targeted for Clean-ups are highlit.

TABLE 7. Summary Ecological Condition and Management Issues at 6 Priority Sites

1° Foreshore Sites – Ground Surveys		No. Issues Noted										
		ECo	E	HR	BS	L	SW	VD	WI	O	HT	CF
1	Ferry Park – Moorindil St.	VG – VP	2	5	17		2		5	3	6	
2	Tewantin Esplanade Lakeside Park	VG – VP	1	1	7		6	3	13	-	-	
3	Tewantin & RSL Parks	G – VP	1	1	3	1	2	1	10		3	1
4	Lake Doonella North Foreshore	VG – VP	1	4	7	1	8	12	4		2	
5	Hilton Esplanade Foreshore	M – VP	5	1	25		4		3	2	3	1
6	Lakes Resort- Goodchap St Foreshore	VG – P	1	6	4	3	5	3	23	1	4	

Ecological Condition Rating

1. Very Good (VG)
2. Good (G)
3. Moderate (M)
4. Poor (P)
5. Very Poor (VP)

Targeted Clean-up

Habitat trees present (HT)

Cultural features present (CF)

Issue/ Pressure Noting

- Erosion (E)
- Hard Rubbish (HR)
- Built Structures (BS)
- Litter (L)
- StormWater Drain (SW)
- Vegetation Damage (VD)
- Weed Infestation (WI)
- Other (O)

Preliminary Site Restoration Concepts

ATTACHMENT II presents Preliminary Site Restoration Concepts for each of the 6 ground survey sites. These are based on the results obtained from the survey and assessment work.

Each site concept includes a site map summarising the ground survey results with accompanying notes on site tenure, significance and management issues recorded in the survey, as background for a set of proposed restoration and enhancement actions.

Proposed Follow-up Actions

Targeted Site Clean-ups

To fulfil the final part of the *Get your Wetlands* project grant, NICA propose to organise intensive Clean-ups of the selected sites in the first part of 2023 in collaboration with Noosa Council and local BushCare groups.

The aim will be to use these on-site actions to promote and kick-start the proposed Noosa Estuary Restoration Program as a collaboration between Noosa Council and community groups.

Noosa Resilient River Strategy – Estuary Restoration Program

As follow-up to the *Get your Wetlands* project, NICA recommends that Noosa Council use the findings of the Estuary-Pressures survey to develop and lead a Resilient River strategy, with a major component directed at ecological restoration and enhancement of the Estuary.

The strategy could be developed as a collaborative partnership between the ‘whole of Council’ and local community organisations, using a combination of new and existing resources.

The outline proposal is to develop three pilot programs centred on the clusters of priority sites identified in the survey.

Resilient River Pilot Programs

- A** Lake Doonella and Tewantin centre, foreshore and catchment – proposed sites 2, 3, 4, 5, 6, 7
- B** Weyba Creek, foreshore and catchment plus parts of Noosaville – proposed sites 8, 9, 10
- C** Noosa North Shore and Ferry crossing – proposed sites 1, 11, 12

An integrated ecosystem-based management approach is recommended based on the findings of the current survey and other recent river and catchment research.

Strategic objectives for each pilot program of 5-7 years would include:

- Reduction of ecological pressures and impacts from intensive urban land- and water-uses
- Restoration of foreshore, littoral and riparian habitats and enhancement of biodiversity
- Strengthen ecological resilience and climate adaptation measures
- Enhancement of public access, amenity and enjoyment
- Council-Community partnership.

ATTACHMENT I Main Features and Pressures in each Section

Noosa North Shore
Tewantin
Doonella
Noosaville
Noosa Heads
Weyba Creek

ATTACHMENT II Preliminary Site Restoration Concepts

Site 1.	Ferry Park – Moorindil Street
Site 2.	Tewantin Riverside – Lakeside Park
Site 3.	Tewantin & RSL Parks
Site 4.	North Lake Doonella Foreshore
Site 5.	Hilton Esplanade & Parade
Site 6.	Lakes Resort – Goodchap Street Foreshore