Appendix A. Navigation Impact Assessment

Roads and Maritime Services

Western Harbour Tunnel and Warringah Freeway Upgrade

Technical working paper: Navigation impact assessment

January 2020

Prepared for

Roads and Maritime

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Executive Summary

The Western Harbour Tunnel and Warringah Freeway Upgrade project is proposed to include driven tunnels and an immersed tube tunnel for the crossing of Sydney Harbour between Birchgrove and Waverton. A detailed description of the construction works is provided in Section 6 (Construction work) of the environmental impact statement and **Section 5** of this report. Marine construction activities would primarily occur in the Inner Harbour with transits of construction vessels through the Outer Harbour.

The proposed marine activities in the Outer Harbour that would impact on marine safety and navigation include:

- Transportation of immersed tube tunnel units constructed outside of Port Jackson
- Transits of split hopper barges over a duration of about six to seven weeks between the Western Harbour Crossing and the designated offshore disposal site (for dredge material considered suitable for offshore disposal).

The proposed marine activities in the Inner Harbour that would impact on marine safety and navigation include:

- Marine activities associated with the temporary construction support sites at White Bay (WHT3), Berrys Bay (WHT7) and Yurulbin Point (WHT4) for the immersed tube tunnel and driven tunnels. There is expected to be a significant increase in boating traffic as a result of the construction vessels, including:
    - Barges for delivering material, removing tunnel spoil, or for other construction activities
    - Tugboats for manoeuvring barges
    - Transport vessels for workers
- Construction of the Western Harbour Tunnel component, including Sydney Harbour south (WHT5) and north (WHT6) cofferdams, and placement of the immersed tube tunnel. Specific activities that would restrict navigation include:
    - Boating traffic as a result of construction vessels including barges, tugboats and transport vessels
    - Reduced navigation width due to construction of the cofferdams. A marine exclusion zone would be established around the cofferdams. The navigable width between the exclusion zones would be reduced to about 460 metres from 620 metres
    - Dredging prior to placement of the immersed tube tunnel units
    - Placement of the immersed tube tunnel units, including placement of foundation material, locking fill, backing fill and rock protection. This would require seven 48 hour navigation restrictions
    - Temporary closure and/or relocation of the Birchgrove Ferry wharf
    - Temporary occupation of the waterway in the vicinity of Snails Bay dolphins, which are an existing mooring location for larger vessels.

The impact on navigation in the Outer Harbour would be considered negligible. This is due to the relatively wide waterway widths and infrequent movement of marine construction vessels.

The impact on navigation at the construction support sites at White Bay (WHT3), Berrys Bay (WHT7) and Yurulbin Point (WHT4), and on the approaches thereto, would be considered acceptable. A high number of construction vessel movements are expected. However, this part of the Harbour has been retained as a ‘working harbour’. In addition, vessels significantly larger than the marine construction vessels currently

transit the Inner Harbour. Waterway users would be required to maintain a proper lookout and abide by the navigation rules (refer **Section 4.3**).

The impact on navigation in the vicinity of the Western Harbour Crossing would be considered tolerable. The impact on navigation in this area would be more severe than other parts of the Harbour. The transit time for vessels past the location of the Western Harbour Crossing would increase. With the exception of the Harbour City Ferries and Captain Cook Cruises, which would experience timetabling delays due to the increased transit time, the works would have minimal impact on other commercial business eg charter companies and commercial fishing fleets. Oil tanker movements to and from the Gore Bay Terminal would be accommodated. Provided waterway users maintain a proper lookout and abide to the navigation rules (refer **Section 4.3**) the impact on navigation would be manageable.

The implementation of safeguards and management measures would assist in avoiding or mitigating potential impacts on safety and navigation during construction.

Operational impacts on marine safety and navigation associated with the Western Harbour Crossing would be negligible. Rock protection would be placed over the immersed tube tunnel segments and the depth of the Harbour at the crossing would be retained.

Safeguards and management measures relevant to navigation impacts of the project are identified in **Section 6** of this report.

1 Introduction

This section provides an overview of the Western Harbour Tunnel and Warringah Freeway Upgrade (the project), including its key features and location. It also outlines the Secretary's environmental assessment requirements addressed in this technical working paper.

1.1 Overview

The Greater Sydney Commission's *Greater Sydney Region Plan – A Metropolis of Three Cities* (Greater Sydney Commission, 2018) proposes a vision of three cities where most residents have convenient and easy access to jobs, education and health facilities and services. In addition to this plan, and to accommodate for Sydney's future growth the NSW Government is implementing the *Future Transport Strategy 2056* (Transport for NSW, 2018), a plan that sets the 40 year vision, directions and outcomes framework for customer mobility in NSW. The Western Harbour Tunnel and Beaches Link program of works is proposed to provide additional road network capacity across Sydney Harbour and to improve transport connectivity with Sydney's northern beaches. The Western Harbour Tunnel and Beaches Link program of works include:

- The Western Harbour Tunnel and Warringah Freeway Upgrade project which comprises a new tolled motorway tunnel connection across Sydney Harbour, and an upgrade of the Warringah Freeway to integrate the new motorway infrastructure with the existing road network and to connect to the Beaches Link and Gore Hill Freeway Connection project
- The Beaches Link and Gore Hill Freeway Connection project which comprises a new tolled motorway tunnel connection across Middle Harbour from the Warringah Freeway and Gore Hill Freeway to Balgowlah and Killarney Heights and including the surface upgrade of Wakehurst Parkway from Seaforth to Frenchs Forest and upgrade and integration works to connect to the Gore Hill Freeway at Artarmon.

A combined delivery of the Western Harbour Tunnel and Beaches Link program of works would unlock a range of benefits for freight, public transport and private vehicle users. It would support faster travel times for journeys between the Northern Beaches and south, west and north-west of Sydney Harbour. Delivering the program of works would also improve the resilience of the motorway network, given that each project provides an alternative to heavily congested harbour crossings.

1.2 The Project

Roads and Maritime Services (Roads and Maritime) is seeking approval under Division 5.2, Part 5 of the *Environmental Planning and Assessment Act 1979* to construct and operate the Western Harbour Tunnel and Warringah Freeway Upgrade (the project), which would comprise two main components:

- A new crossing of Sydney Harbour involving twin tolled motorway tunnels connecting the M4-M5 Link at Rozelle and the existing Warringah Freeway at North Sydney (the Western Harbour Tunnel)
- Upgrade and integration works along the existing Warringah Freeway, including infrastructure required for connections to the Beaches Link and Gore Hill Freeway Connection project (the Warringah Freeway Upgrade).

Key features of the Western Harbour Tunnel component of the project are shown in **Figure 1-1** and would include:

- Twin mainline tunnels about 6.5 kilometres long and each accommodating three lanes of traffic in each direction, connecting the stub tunnels from the M4-M5 Link at Rozelle to the Warringah Freeway and to the Beaches Link mainline tunnels at Cammeray. The crossing of Sydney Harbour between Birchgrove and Waverton would involve a dual, three lane immersed tube tunnel
- Connections to the stub tunnels at the M4-M5 Link project in Rozelle and the mainline tunnels at Cammeray (for a future connection to the Beaches Link and Gore Hill Freeway Connection project)
- Surface connections at Rozelle, North Sydney and Cammeray, including direct connections to and from the Warringah Freeway (including integration with the Warringah Freeway Upgrade), an off ramp to Falcon Street and an on ramp from Berry Street at North Sydney
- A ventilation outlet and motorway facilities (fitout and commissioning only) at the Rozelle Interchange
- A ventilation outlet and motorway facilities at the Warringah Freeway in Cammeray
- Operational facilities including a motorway control centre at Waltham Street, within the Artarmon industrial area and tunnel support facilities at the Warringah Freeway in Cammeray
- Other operational infrastructure including groundwater and tunnel drainage management and treatment systems, signage, tolling infrastructure, fire and life safety systems, lighting, emergency evacuation and emergency smoke extraction infrastructure, CCTV and other traffic management systems.

Key features of the Warringah Freeway Upgrade component of the project are shown in **Figure 1-2** and would include:

- Upgrade and reconfiguration of the Warringah Freeway from immediately north of the Sydney Harbour Bridge through to Willoughby Road at Naremburn
- Upgrades to interchanges at Falcon Street in Cammeray and High Street in North Sydney
- New and upgraded pedestrian and cyclist infrastructure
- New, modified and relocated road and shared user bridges across the Warringah Freeway
- Connection of the Warringah Freeway to the portals for the Western Harbour Tunnel mainline tunnels and the Beaches Link tunnels via on and off ramps, which would consist of a combination of trough and cut and cover structures
- Upgrades to existing roads around the Warringah Freeway to integrate the project with the surrounding road network
- Upgrades and modifications to bus infrastructure, including relocation of the existing bus layover along the Warringah Freeway
- Other operational infrastructure, including surface drainage and utility infrastructure, signage, tolling, lighting, CCTV and other traffic management systems.

A detailed description of the project is provided in Chapter 5 (Project description) and construction of the project is described in Chapter 6 (Construction work) of the environmental impact statement. The project alignment at the Rozelle Interchange shown in **Figure 1-1** and **Figure 1-3** reflects the arrangement presented in the environmental impact statement for the M4-M5 Link, and as amended by the proposed modifications. The project would be constructed in accordance with the finalised M4-M5 Link detailed design (refer to Section 2.1.1 of Chapter 2 (Assessment process) of the environmental impact statement for further details).

The project does not include ongoing motorway maintenance activities during operation or future use of residual land occupied or affected by project construction activities, but not required for operational infrastructure. These would be subject to separate planning and approval processes at the relevant times.

Subject to the project obtaining planning approval, construction is anticipated to commence in 2020 and is expected to take around six years to complete.

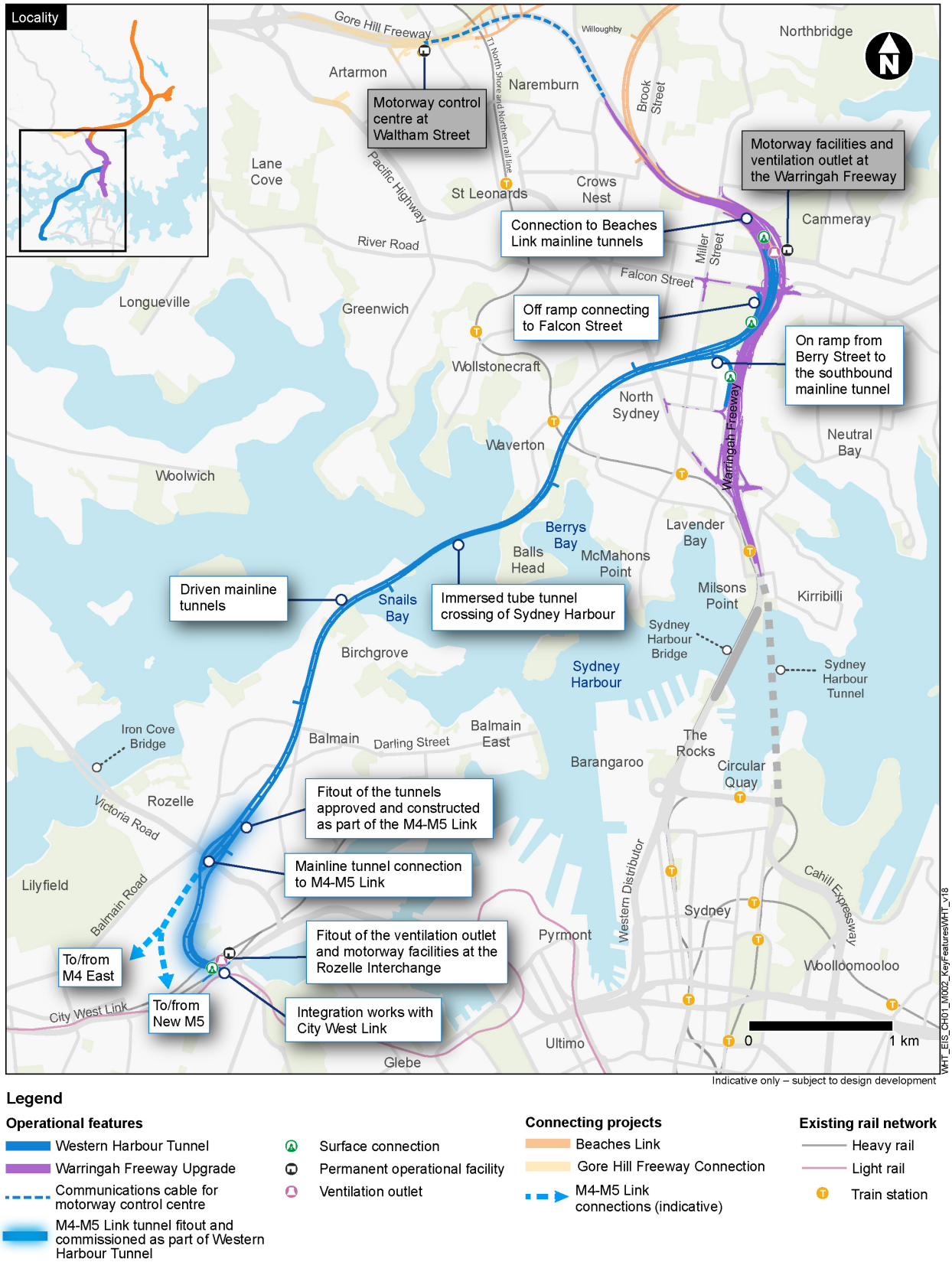

Figure 1-1: Key features of the Western Harbour Tunnel component of the project

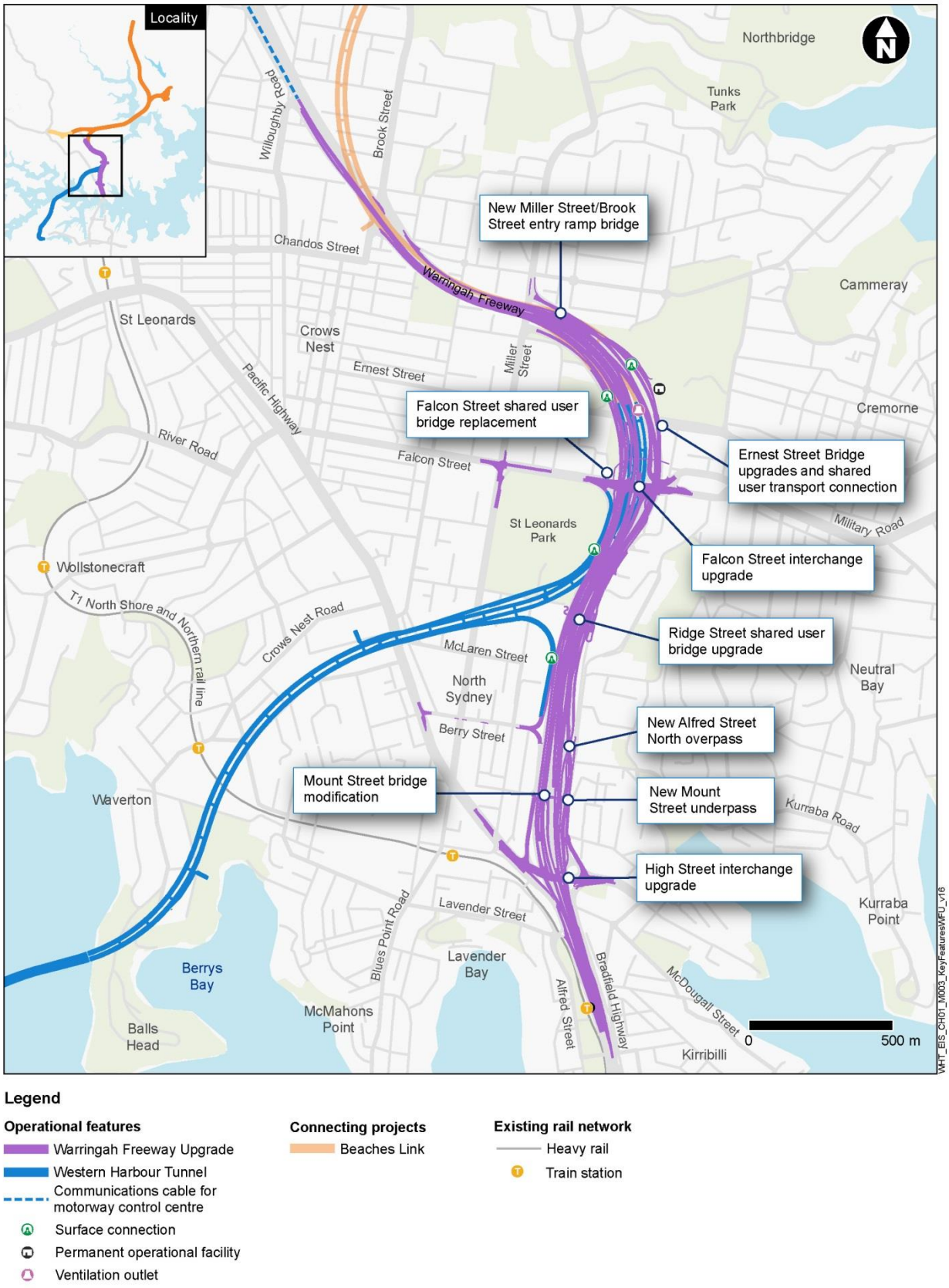

Figure 1-2: Key features of the Warringah Freeway Upgrade component of the project

1.3 Key Construction Activities

The area required to construct the project is referred to as the construction footprint. The majority of the construction footprint would be located underground within the mainline tunnels. However, surface areas would be required to support tunnelling activities and to construct the tunnel connections, tunnel portals and operational ancillary facilities.

Key construction activities would include:

- Early works and site establishment, with typical activities being property acquisition and condition surveys, utilities installation, protection, adjustments and relocations, installation of site fencing, environmental controls (including noise attenuation and erosion and sediment control) and traffic management controls, vegetation clearing, earthworks and demolition of structures, establishment of construction support sites including acoustic sheds and associated access decline acoustic enclosures (where required), construction of minor access roads and the provision of property access, temporary relocation of pedestrian and cycle paths and bus stops, temporary relocation of swing moorings within Berrys Bay and relocation of historic vessels
- Construction of Western Harbour Tunnel, with typical activities being excavation of tunnel construction accesses, construction of driven tunnels, cut and cover and trough structures and construction of cofferdams, dredging activities in preparation for the installation of immersed tube tunnels, casting and installation of immersed tube tunnels and civil finishing and tunnel fitout
- Construction of operational facilities comprising of a motorway control centre at Waltham Street in Artarmon, motorway and tunnel support facilities and ventilation outlets at the Warringah Freeway in Cammeray, construction and fitout of the project operational facilities that form part of the M4-M5 Link Rozelle East Motorway Operations Complex, a wastewater treatment plant at Rozelle and the installation of motorway tolling infrastructure
- Construction of the Warringah Freeway Upgrade, with typical activities being earthworks, bridgeworks, construction of retaining walls, stormwater drainage, pavement works and linemarking and the installation of road furniture, lighting, signage and noise barriers
- Testing of plant and equipment, and commissioning of the project, backfill of access declines, removal of construction support sites, landscaping and rehabilitation of disturbed areas and removal of environmental and traffic controls.

Temporary construction support sites would be required as part of the project (refer to **Figure 1-3**), and would include tunnelling and tunnel support sites, civil surface sites, cofferdams, mooring sites, wharf and berthing facilities, laydown areas, parking and workforce amenities. Construction support sites for Western Harbour Tunnel would include:

- Rozelle Rail Yards (WHT1)
- Victoria Road (WHT2)
- White Bay (WHT3)
- Yurulbin Point (WHT4)
- Sydney Harbour south cofferdam (WHT5)
- Sydney Harbour north cofferdam (WHT6)
- Berrys Bay (WHT7)
- Berry Street north (WHT8)
- Ridge Street north (WHT9)
- Cammeray Golf Course (WHT10)
- Waltham Street (WHT11).

During the construction of the Warringah Freeway Upgrade, smaller construction support sites would be required to support the construction works (as shown on **Figure 1-3**). These include:

- Blue Street (WFU1)
- High Street south (WFU2)
- High Street north (WFU3)
- Arthur Street east (WFU4)
- Berry Street east (WFU5)
- Ridge Street east (WFU6)
- Merlin Street (WFU7)
- Cammeray Golf Course (WFU8)
- Rosalind Street east (WFU9).

A detailed description of construction works for the project is provided in Chapter 6 (Construction work) of the environmental impact statement.

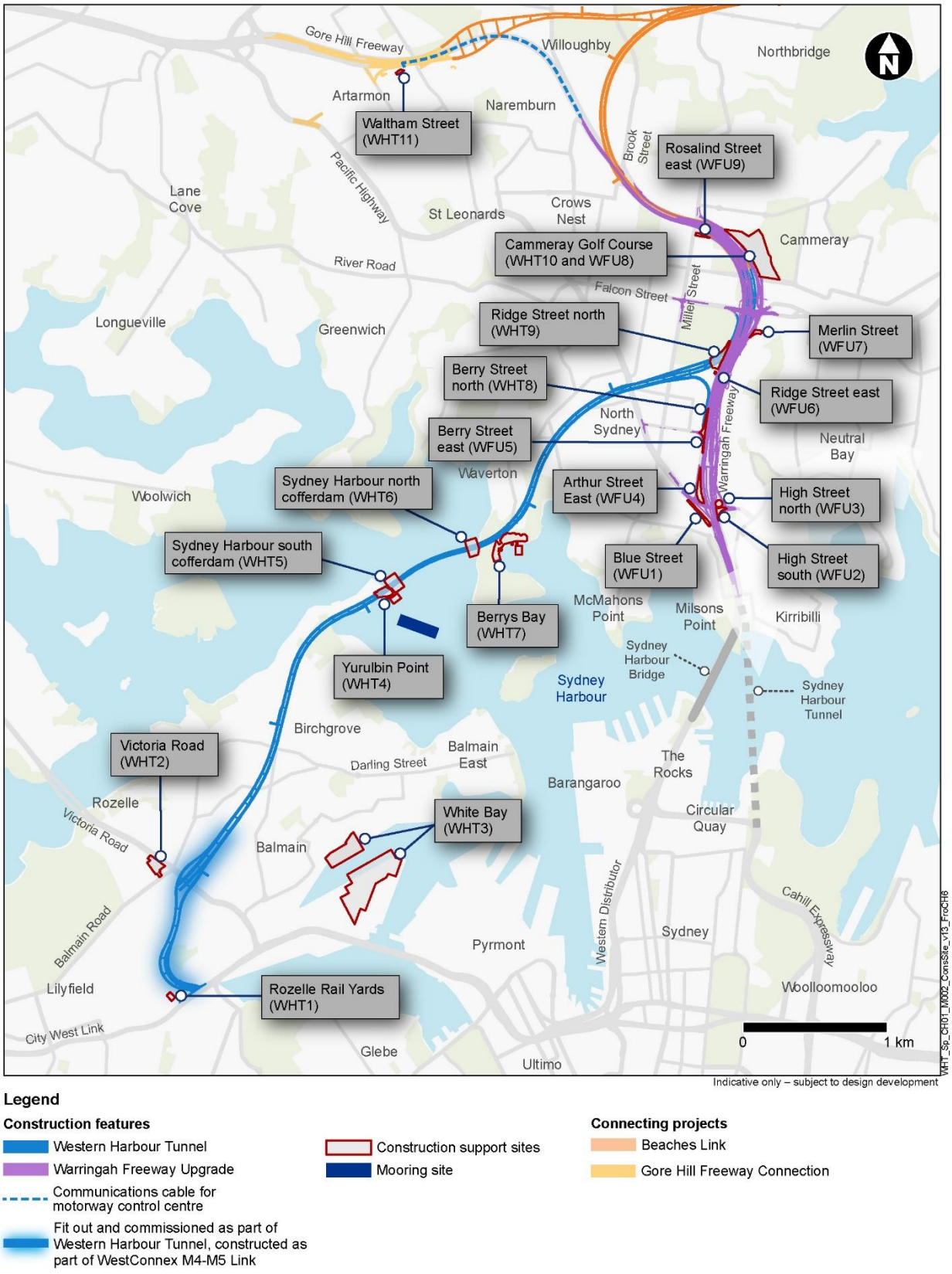

Figure 1-3: Overview of construction support sites

1.4 Project Location

The project would be located within the Inner West, North Sydney and Willoughby local government areas, connecting Rozelle in the south with Naremburn in the north.

Commencing at the Rozelle Interchange, the mainline tunnels would pass under Balmain and Birchgrove, then cross Sydney Harbour between Birchgrove and Balls Head. The tunnels would then continue under Waverton and North Sydney, linking directly to the Warringah Freeway to the north of the existing Ernest Street bridge.

The motorway control centre would be located at Waltham Street, Artarmon, with a trenched communications cable connecting the motorway control centre to the Western Harbour tunnel along the Gore Hill Freeway and Warringah Freeway road reserves.

The Warringah Freeway Upgrade would be carried out on the Warringah Freeway from around Fitzroy Street at Milsons Point to around Willoughby Road at Naremburn. Upgrade works would include improvements to bridges across the Warringah Freeway, and upgrades to surrounding roads.

1.5 Purpose of this Report

Roads and Maritime have commissioned Haskoning Australia Pty Ltd, a company of Royal HaskoningDHV (RHDHV), to prepare a Navigation Impact Assessment to support the environmental impact statement for the project and to address the environmental assessment requirements of the Secretary of the Department of Planning, Industry and Environment (Planning and Assessment) (formerly Department of Planning and Environment) 'the Secretary's environmental assessment requirements'.

The scope of this study involves:

- Review of background information including site conditions
- Establish existing waterway navigation and commercial and recreational usage
- Determine likely occupation of the waterway during construction including number, type, frequency and duration of marine construction traffic
- Assessment of potential navigation impacts and proposed mitigation measures
- Preparation of Navigational Impact Assessment report.

1.6 Secretary's Environmental Assessment Requirements

Key Issue 1 and 8 of the Secretary's environmental assessment requirements identified potential impacts that relate to marine safety and navigation. The key issues and the desired performance of the project was stated as:

- Key Issue 1 - Transport and Traffic
    - Desired performance outcome:
        - Network connectivity, safety and efficiency of the transport system in the vicinity of the project are managed to minimise impacts
        - The safety of transport system customers is maintained
        - Impacts on network capacity and the level of service are effectively managed
        - Works are compatible with existing infrastructure and future transport corridors

- Key Issue 8 - Socio-economic, land use and property
    - Desired performance outcome:
        - The project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities
        - The project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure.

In this regard, The Secretary's environmental assessment requirements relating to the Navigation Impact Assessment, and where these requirements are addressed in this report are outlined in **Table 1-1**.

Table 1-1: Secretary's environmental assessment requirements - Navigation Impact Assessment

Secretary's environmental assessment requirements	Where addressed
Key Issue 1, Requirement 1 *The Proponent must assess construction transport and traffic (vehicle, marine, pedestrian and cyclists) impacts, including, but not necessarily limited to:* *a) a considered approach to route identification and scheduling of marine and land transport movements, particularly outside standard construction hours;* *b) the number, frequency and size of construction related vehicles (passenger, marine, commercial and heavy vehicles, including spoil management movements);* *c) construction worker parking;* *d) the nature of existing traffic (types and number of movements) on construction access routes (including consideration of peak traffic times and sensitive road users and parking arrangements including internal Port roads and land if utilised during construction);* *e) access constraints and impacts on public transport, pedestrians and cyclists;* *f) how construction of the project affects the capacity of, and the need to close, divert or otherwise reconfigure elements of, the road, cycle and pedestrian network;* *g) details of how construction and scheduling of works are to be coordinated in regard to public events and cumulative traffic impacts resulting from concurrent work on the project and other major projects, under or preparing for or commencing construction in the vicinity of the proposal;* *h) alternatives to road transport of construction spoil including marine and rail options as well as potential re-use in existing land reclamation areas or in association with Resource Recovery Exceptions (if obtained from the EPA) to minimise traffic impacts on the road network;* *i) the likely risks of the project to public safety, paying particular attention to pedestrian safety and users of Sydney Harbour; and* *j) impacts to water based traffic and shipping channels on Sydney Harbour.*	Section 6
Key Issue 8, Requirement 2 *The Proponent must assess impacts from construction and operation on potentially affected properties, businesses, recreational users and land and water users (including potential cumulative impacts associated with use of Glebe Island and White Bay in consideration of other major developments in the precinct), including amenity impacts (including from cumulative and extended construction time frames and construction fatigue), property acquisitions/adjustments, future land uses, access, relevant statutory rights, and community severance and barrier impacts resulting from the project.*	Section 6
Key Issue 8, Requirement 3 *Where an immersed tube (immersed tube tunnel) method of construction is proposed for use in Sydney Harbour, the Proponent must:*	Section 6

Secretary's environmental assessment requirements	Where addressed
a) *Provide details of how reductions to current Harbour depths will be avoided;* b) *Provide details confirming the level of protection for the immersed tube tunnel's will be similar to or better than that of the existing Sydney Harbour Tunnel;* c) *Identify impacts to ship scheduling in consultation and agreement with the Harbour Master;* d) *Assess the impact to the Viva supply chain for fuel oils at Gore Cove; and* e) *Provide details of full mission simulation which takes in account, but is not necessarily limited to:* i. *movement and placement of the immersed tube tunnel's; and* ii. *identification of weather restrictions and towage requirements for the safe movement of seagoing ships to and from berths in Glebe Island, White Bay, Gore Cove and past proposed Project work areas in Glebe Island and White Bay, and Birchgrove to Waverton.*	

The report herein provides an assessment of the impact on marine navigation resulting from construction of the immersed tube tunnel. In doing so, the report partially or completely addresses the following key issues and requirements of the Secretary's environmental assessment requirements:

- Key Issue 1, Requirement 1a, 1h, 1i and 1j
- Key Issue 8, Requirement 2
- Key Issue 8, Requirement 3c and 3d.

A mission simulation as per Requirement 3e has been carried out to assess the impact of the works on seagoing ships accessing Gore Cove and Glebe Island, and the impact of transporting the tunnel units on existing harbour operations. The simulation demonstrated that the construction method proposed in Chapter 6 (Construction work) of the environmental impact statement can be constructed with limited impact to existing harbour operations or infrastructure.

2 Description of Port Jackson

Port Jackson (Sydney Harbour) is a drowned river valley that was formed during a period of natural sea level rise about 10,000 years ago. It is typically a well-mixed estuary due to low fresh water discharges from the catchment and significant tidal turbulence.

The Transport for NSW (TfNSW) Regional Boating Plan for the Sydney Harbour Region (TfNSW, 2015) divides Port Jackson into five main areas, with each area characterised by different physical attributes and usage patterns. The five main areas are:

a) Outer (Sydney) Harbour, a wide waterway between Sydney Heads, the Opera House at Bennelong Point and Admiralty House at Kirribilli Point
b) Inner (Sydney) Harbour, a high traffic area between the Outer Harbour extending upstream to Yurulbin Point and Manns Point. The Inner Harbour encompasses Circular Quay, Darling Harbour and the Bays Precinct comprising Blackwattle Bay, White Bay, Johnstons Bay and Rozelle Bay
c) Parramatta and Lane Cove Rivers, which extend upstream of Yurulbin Point. The rivers merge at Greenwich Point
d) North Harbour, bordering the northern side of Outer Harbour and extending north of Cannae Point and Dobroyd Head
e) Middle Harbour, bordering the western side of the Outer Harbour and extending west of Middle Head and Grotto Head.

The Western Harbour Tunnel borders the Inner Harbour and the Parramatta and Lane Cove Rivers, stretching from Yurulbin (Longnose) Point in the south to Balls Head in the north, a distance of some 630 metres. Construction activities for the project also require occupation and work boat transits throughout other parts of the Outer Harbour and Inner Harbour including Berrys Bay, White Bay and Snails Bay.

Relevant maps for the site and relating to various aspects of the Navigation Impact Assessment are attached in the Appendices. These are listed below.

Appendix A contains maps displaying relevant spatial data and comprises:

- Map 1 – Port Jackson Overview and Mooring Areas
- Map 2 – Maritime and Navigation Features of Port Jackson
- Map 3 – Proposed Construction Plan and Navigation Restrictions
- Map 4 – Community Groups and Clubs
- Map 5 – Commercial Operators
- Map 6 – Government Organisations
- Map 7 – Boat Launching, Dry Storage and Marina Facilities
- Map 8 – Proposed Marine Construction Traffic Route for Civil Works.

Appendix B contains the Roads and Maritime Services Boating Maps covering the works area including:

- Map 1 – Port Jackson – East of Sydney Harbour Bridge
- Map 2 – Port Jackson – Western Area Lower Parramatta and Lane Cove River.

3 Existing Site Conditions

3.1 Bathymetry

The seabed of Port Jackson comprises numerous deep holes, shoals, basins, rocky islands and reefs. The bathymetry of the Outer Harbour and Inner Harbour is illustrated in Navigation Charts AUS201 (Port Jackson Eastern Sheet) and AUS202 (Port Jackson Central Sheet) (refer **Map 2** in **Appendix A**).

The Outer Harbour is relatively deep and wide with water depths generally exceeding 15 metres below Chart Datum (CD) (-15 metres CD)[1]. A shallow reef, known as Sow and Pigs, is located between Middle Head and South Head at the entrance to Sydney Harbour. Dredge channels are maintained on either side of the reef. The Western Channel is the deeper channel. The minimum depth of the channel is reported as -13.7 metres CD on AUS201 and the flood and ebb tide currents are one knot (about 0.5 m/s).

The Inner Harbour is considerably narrower with variable water depths. Water depths are typically -12 to -14 metres CD. However, deep holes are located near McMahons Point (-44 metres CD), Balls Head (-31 metres CD) and Yurulbin Point (-18 metres CD). These locations coincide with higher currents reported to be up to two knots on AUS202.

A detailed bathymetric map in the vicinity of the immersed tube tunnel has been produced. The map is based on the latest available bathymetric soundings, provided by Roads and Maritime. This available bathymetry data is presented in **Figure 3-1**.

The bathymetry at the proposed crossing location is best described as a defined channel with relatively steep banks. The depth of the channel in the vicinity of the crossing averages about -15 metres CD, with a notable hole of about -17 metres CD in depth near Yurulbin Point.

Other notable features within the vicinity of the site include a deep hole that is about -32 metres CD deep and is located just off the shore of Balls Head to the south west.

In addition, a number of bays are located in close proximity to the location of the proposed Western Harbour Crossing. These bays include Balls Head Bay directly to the north, Gore Bay (Cove) to the north west, Snails Bay to the south and Berrys Bay on the eastern side of Balls Head. With the exception of Gore Bay, the bays are generally around -5 to -10 metres CD in depth decreasing towards the head of the bays. Gore Bay provides deepwater access close to the shoreline with water depths about -10 to -15 metres CD.

[1] *Chart Datum is the zero reference point from which tidal heights and chart soundings are calculated and is an approximation of the Lowest Astronomical Tide (LAT). Chart Datum is about 0.925 metres below Australian Height Datum (AHD).*

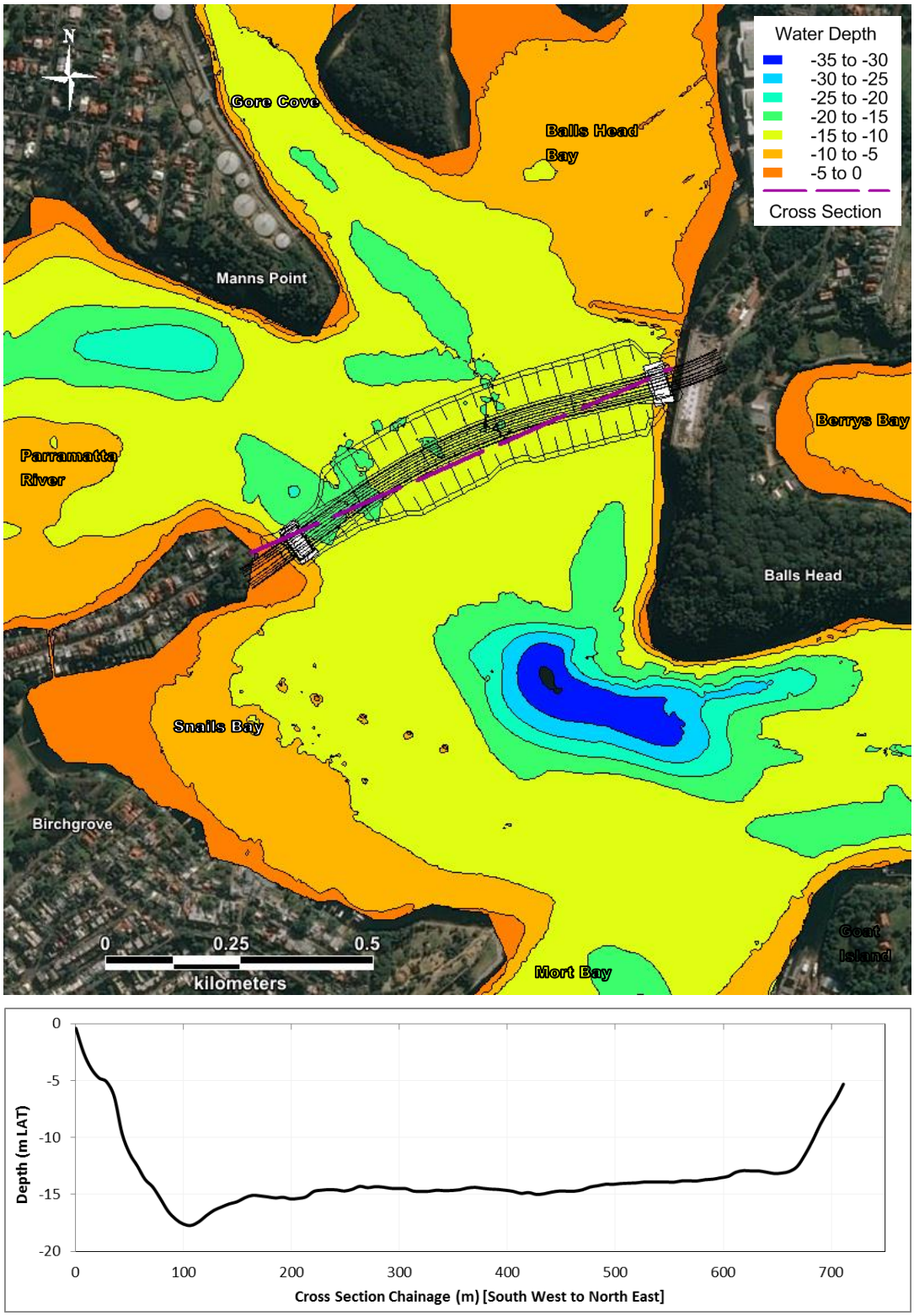

Figure 3-1: Local bathymetry at the study site. Based on the latest available bathymetric soundings, provided by Roads and Maritime

3.2 Tides

Port Jackson is a semi-diurnal, micro-tidal (one metre on neaps and two metres on spring tides) estuary. Tides propagate through deeper regions of the Harbour and the direction is governed by the complex geometry of the shoreline. Very little change in tidal amplitude and phase is observed throughout the Inner and Outer Harbour.

Tidal water levels in Port Jackson are represented by tidal planes at the Fort Denison tide gauge. Tidal planes are summarised in **Table 3-1**.

Table 3-1: Port Jackson Tidal Planes (MHL, 2012)

Tidal Plane	Chart Datum (metres)	Australian Height Datum (metres)
Highest Astronomical Tide, HAT	2.1	1.18
Mean High Water Springs, MHWS	1.57	0.65
Mean High Water, MHW	1.45	0.53
Mean High Water Neaps, MHWN	1.33	0.41
Mean Sea Level, MSL	0.95	0.03
Mean Low Water Neaps, MLWN	0.56	-0.37
Mean Low Water, MLW	0.44	-0.49
Mean Low Water Springs, MLWS	0.32	-0.61
Lowest Astronomical Tide, LAT	0	-0.93

3.3 Waves

The wave climate in the Inner Harbour and further upstream is contributed to primarily by wind waves and boat-generated waves. Ocean swells that enter the Outer Harbour are diffracted by the complex bathymetry and shoreline configuration such that most of the waterway upstream of Bradleys Head is beyond the extent of ocean swell penetration. Wind waves and boat-generated waves combine to generate the incident wave conditions.

3.3.1 Wind waves

Wind waves are generated when the wind blows across a body of water. The size and period of these waves depends on the wind speed, the distance over which the wind blows (fetch) and the water depth. Design wind velocities for the site were obtained from *Australian Standard Structural Design Action Part 2: Wind Actions (AS/NZS1170.2:2011)*. Wind wave hindcast procedures set out in the Coastal Engineering Manual (USACE, 2008) were used to predict the incident wind wave climate in Port Jackson.

Wind waves are typically defined at primary directions separated by 45 degrees. The fetch is defined as the average length of eight radials separated by three degrees, centred on the primary direction (SPM, 1984).

Westerly winds result in the highest design wind velocity and corresponding wave height and, as such, this wind direction has been adopted for assessment of wave heights in Port Jackson. The wave heights for varying fetches and Average Recurrence Intervals (ARIs) are summarised in **Table 3-2**. This Table can be used to predict maximum wave heights at other locations.

Table 3-2: Incident wave height for a westerly wind direction

Fetch	0.5 km		1 km		2 km		5 km	
Average Recurrence Interval (ARI)	H_s (m)	T (s)	H_s (m)	T (s)	H_s (m)	T (s)	H_s (m)	T (s)
1 year	0.3	1.3	0.4	1.6	0.5	2.0	0.8	2.6
50 year	0.4	1.4	0.5	1.7	0.7	2.2	1.1	2.9
100 year	0.4	1.4	0.5	1.8	0.7	2.2	1.1	3.0

Notes: significant wave height H_s is the average of the highest 1/3 of waves in a wave train. H_{max} ~ 1.86H_s
T= period (seconds)

The maximum fetch at the location of the Western Harbour Crossing is about two kilometres to the west and at Snails Bay it is about 1.2 kilometres to the east. The significant wave height at these locations for a one year ARI event is about 0.5 metres with a period of two seconds and 0.3 metres with a period of 1.5 seconds respectively. Construction sites and work areas in other locations, including Berrys Bay (WHT7) and White Bay (WHT3) construction support sites, are generally more protected with a lower fetch compared to the location of the Western Harbour Crossing and Snails Bay.

3.3.2 Boat waves

Boat generated waves are governed by the submerged shape of the boat hull, the boat speed and the water depth. Typically boat waves exhibit a diverging component which emanates at the bow, and a transverse component that follows behind the stern.

The boat speed relative to the water depth and boat length can affect the form of the waves. This is conveniently considered in relation to the:

1. Depth Based Froude number F_d, where:

   $F_d = \frac{V}{\sqrt{gd}}$, where:
   V = vessel speed (m/s)
   g = acceleration due to gravity (9.81 m/s^2)
   d = water depth (m)

2. Length Based Froude number F_{nl} (applicable to deepwater) where:

   $F_{nl} = \frac{V}{\sqrt{gL}}$, where:
   V = vessel speed (m/s)
   g = acceleration due to gravity (9.81 m/s^2)
   L = water line length of vessel (m)

When F_d is less than one, the vessel speed is defined as sub-critical, and when it is greater than one it is defined as supercritical. The “critical speed”, ie when F_d=1, is associated with maximum wash generation. Similarly, F_{nl}=0.5 corresponds to maximum resistance of a moving vessel and corresponding maximum wave height.

F_d=1 and F_{nl}=0.5 should, therefore, be avoided as far as possible. Also acceleration and deceleration phases by vessels should be considered to minimise effects caused by passage through the critical threshold speeds.

The depth limited vessel speed corresponding the maximum wash generation (F_d=1) in the vicinity of the Western Harbour Crossing (water depth of 15 metres) is 12 to 13 m/s (23 to 25 knots). The deepwater vessel speed corresponding the maximum wash generation (F_{nl}=0.5) in the vicinity of the Western Harbour Crossing is tabulated in **Table 3-3** for vessels of varying length.

Table 3-3: Critical vessel speed in deep water

Vessel length (m)	Critical Speed (m/s)	Critical Speed (knots)
4	3	6
8	4	9
12	5	11
16	6	12
20	7	14
25	8	15
30	9	17
40	10	19
50	11	22
100	16	30
200	22	43

Typical maximum boat wave heights and periods about 50 metres to 100 metres from the vessels sailing line are set out in **Table 3-4**.

Table 3-4: Maximum boat wave height and period 50 to 100 metres from the sailing line

Vessel Type	Average H_{max} [1]	T (sec) [1]	Power (W/m) [2]
Power Boat	0.5	2 to 3	736
High Speed Catamaran Ferries	0.3	5 to 7	618
15 metre Motor Cruiser	0.7	3 to 4	1923

Note:
1. Based on RHDHV Database
2. Power is measure in watts per metre

Boat waves attenuate with distance from the sailing line. It is noted that there is no reduction in wave period from the sailing line. NSW Maritime (2005) note that the wash height from a high speed catamaran ferry in deep water and at a distance from the sailing line of 400 to 450 metres is about 0.15 metres representing a decrease of about 50 per cent. It is assumed the attenuation of power boat and motor cruiser wash would be similar.

3.3.3 Combining boat waves and wind waves

Boat waves and wind waves travel across a body of water at varying velocities, which depends on a range of factors. As a result of the varying wave velocities, there is a possibility that the wind waves and boat waves would be superimposed. It is overly conservative to simply sum the design wind wave heights in

Table 3-2 with the design boat wave heights in **Table 3-4** to describe a design combined wave climate (DECC, 2009). One reason why it is conservative is that it is highly improbable that either commercial or recreational boating vessels would be operating in conditions coincident with the defined ARI event. Also, the different wave periods must be accounted for.

There are very few guidelines available for combining separate wave climates. A simplified approach adopted in DECC (2009) to account for the reduced likelihood of joint occurrence of the waves becoming superimposed is to sum half the incident wind wave energy and the total boat wave energy and then solve for the combined wave height.

Table 3-5 presents the equivalent combined design wave conditions. The period adopted for the combined conditions has been assumed based on the period of the wind wave climate and boat wave conditions. This is considered to be the upper bound and lower bound of expected design wave periods and as such, the resolved design wave heights are considered sufficiently conservative.

Table 3-5: Equivalent combined design wave conditions

Location	Average Recurrence Interval	Wind Wave Maximum Power (W/m)	Boat Wave Maximum Power (W/m)	Total Power (W/m)	Condition 1		Condition 2	
					Period (sec)	Height (m)	Period (sec)	Height (m)
Western Harbour Crossing	1 year	491	1923	2168	2.0	1.05	4.0	0.74
	50 year	1058	1923	2452	2.2	1.07	4.0	0.79
Snails Bay	1 year	132	1923	1989	1.5	1.16	4.0	0.71
	50 year	267	1923	2057	1.7	1.11	4.0	0.72

It follows from the above that the largest combined boat and wind wave height with a one year ARI at the site of the Western Harbour Crossing and Snails Bay would be 1.05 metres and 1.16 metres respectively.

A similar assessment could be carried out for other return periods and locations in Port Jackson.

3.4 Wind

Wind has an influence on wave formation and the manoeuvrability of a vessel. The annual wind roses for Sydney at 9am and 3pm are displayed in **Figure 3-2**.

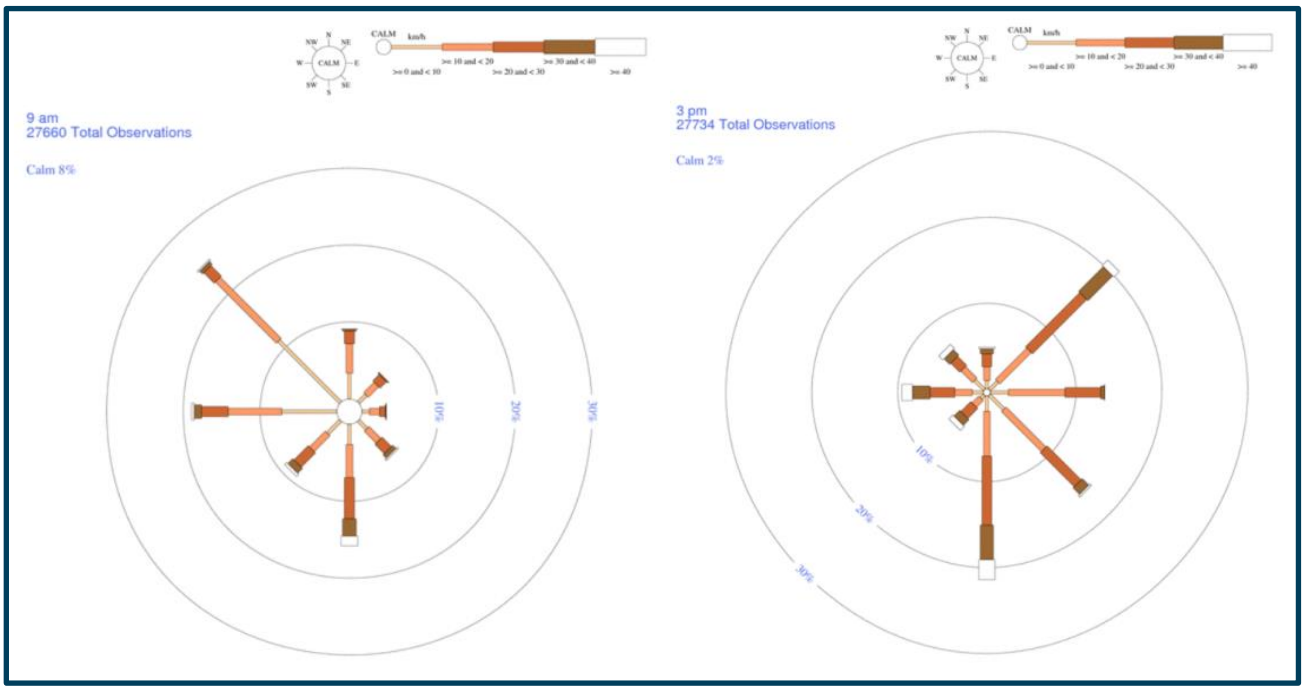

Figure 3-2: Annual wind roses for Sydney at 9am and 3pm

3.5 Daylight hours

The summer solstice is the day that receives the most daylight hours of any day in a year. It occurs between the 21st and 23rd December. The day length between sunrise and sunset is about 14 hours and 25 minutes with sunrise at 5:41am and sunset at 8:06pm.

The winter solstice is the day that receives the least daylight hours of any day in a year. It occurs between the 21st and 23rd June. The day length between sunrise and sunset is around 9 hours and 54 minutes with sunrise at 7:00am and sunset at 4:54pm.

4 Existing Navigation

4.1 Acts and Regulations

The legislation to be observed when navigating in NSW waterways includes:

- Commonwealth Government legislation
  - *Navigation Act 2012*
  - *Shipping Registration Act 1981*
  - *Maritime Safety (Domestic Commercial Vessel) National Law Act 2012*
  - Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013
  - *Maritime Transport & Offshore Facilities Security Act 2003*
  - Maritime Transport & Offshore Facilities Security Regulations

- NSW Government legislation
  - *Marine Safety Act 1998*
  - Marine Safety Regulation 2016
  - *Ports and Maritime Administration Act 1995*
  - Port and Maritime Regulation 2012
  - *Work Health and Safety Act 2011*
  - Work Health and Safety Regulation 2011.

The *Navigation Act 2012* is legislation that covers international ship and seafarer safety. The act applies to 'regulated Australian vessels', which includes vessels registered under the *Shipping Registration Act 1981* and vessel proceeding on an overseas voyage or for use on an overseas voyage. The *Navigation Act 2012* provides the legislative power for Australia to implement the following treaties developed by the International Maritime Organisation, the International Labour Organisation and United Nations Conferences:

- International Convention for Standards of Training, Certification and Watchkeeping for Seafarers (STCW)
- Maritime Labour Convention (MLC)
- International Convention on Load Lines (Load Lines)
- International Convention for the Safety of Life at Sea (SOLAS)
- Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)
- International Convention for Safe Containers (CSC)
- International Convention on Tonnage Measurement of Ships
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- Convention of Limitation of Liability for Maritime Claims
- International Convention on Salvage
- United Nations Convention on the Law of the Sea (UNCLOS) - in certain parts.

The *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* is the regulatory framework for certification, construction, equipment, design and operation of domestic commercial vessels in Australia. The Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013 is made under authority of the Act and dictates how the provisions of the Act are to be applied. A domestic commercial vessel is defined as any vessel that is for use in connection with commercial, governmental or research activities, including construction activities. However, a vessel is not a domestic commercial vessel if the vessel is a 'regulated Australian vessel' whereby safety requirements are outlined in the *Navigation Act 2012*.

The *Marine Safety Act 1998* (the Act) sets out the broad legal policy relating to marine safety and other matters in NSW. The Marine Safety Regulation 2016 (the Regulation) is made under authority of the Act and dictates how the provisions of the Act are to be applied.

The Regulation makes provisions with respect to:

- safety of navigation
- marine safety licences, including the following:
    - vessel registration
    - aquatic licences (including for commercial aquatic activities), and
    - boat driving licences
- safety equipment that must be carried on vessels including requirements for the wearing of lifejackets.

With regards to safety of navigation in NSW, the Regulation adopts the Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) with modifications. The COLREGS applies to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels. It is an international document that defines the navigation rules to be followed to prevent collisions between two or more vessels.

4.2 Regulatory authority

The Australian Maritime Safety Authority (AMSA) is the Australian Government authority with responsibility for operational activities of the *Navigation Act 2012* and administers the *Marine Safety (Domestic Commercial Vessel) National Law Act 2012*, Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013 and marine orders.

Roads and Maritime is the NSW Government authority with responsibility for marine safety and regulation of commercial and recreational boating, including enforcement of the *Marine Safety Act 1998* and Marine Safety Regulation 2016. Roads and Maritime produced the NSW Boating Handbook (Roads and Maritime, 2016), which is an interpretation of the law and legislation to assist the general public in understanding the navigation rules and requirements.

The NSW Police Marine Area Command also has the authority to enforce the Marine Safety Regulation 2016 in addition to additional duties they perform, particularly drug and alcohol testing of skippers.

In addition to the authority granted to Roads and Maritime, within the Sydney Harbour Port Limits, the Harbour Master, who is an employee of the PANSW, has the authority to issue directions to vessel operators under Part 7 of the *Marine Safety Act 1998* and the Master of any vessel shall comply with direction given by the Harbour Master. Sydney Harbour Port Limits incorporates the Western Harbour Tunnel crossing and is defined as:

> *the waters of Sydney Harbour and of all tidal bays, rivers and their tributaries connected or leading to Sydney Harbour bounded by mean high water mark together with that part of the Tasman Sea below mean high water mark enclosed by the arc of a circle of radius four nautical miles having as its centre the navigation light at Hornby Lighthouse (South Head) (PANSW, 2016).*

4.3 Safety of Navigation – Key Rules

The key navigation rules applying to the assessment of navigation in relation to the Western Harbour Tunnel component of the project are outlined below.

4.3.1 Look Out and Safe Speed

Two key rules in the COLREGS are:

- Rule 5 – Look-Out
  Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

- Rule 6 – Safe Speed
  Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

  In determining a safe speed, the following factors shall be among those considered:

  a) the state of visibility
  b) the traffic density including concentrations of fishing vessels or any other vessels
  c) the manoeuvrability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions
  d) at night, the presence of background light such as from shore lights or from back scatter of her own lights
  e) the state of wind, sea (waves) and current, and the proximity of navigational hazards
  f) the draught in relation to the available depth of water.

The Marine Safety Regulation 2016 provides additional requirements for a minimum distance to be maintained between vessels and other objects. The minimum distance is specified as:

- 30 metres from a vessel, towing equipment or person being towed to any vessel, land, structure and other things when travelling at a speed of 6 knots or more
- 60 metres from a vessel, towing equipment or person being towed to a person in the water or a dive flag.

If these distances are not practical then a safe distance and speed must be maintained, which is defined as a distance and speed that will ensure the vessel will not cause danger or injury to the person, or damage to the thing, having regard to all relevant safety factors, including:

- weather conditions at the time
- visibility
- speed of the vessel
- obstructions to navigation that are present.

4.3.2 Collision Avoidance

The conduct of vessels in sight of one another is established in the COLREGS, which sets out international ‘rules of the road’ to avoid a collision. These rules are summarised in the NSW Boating

Handbook (Roads and Maritime, 2016). The general rules of navigation are that a power vessel must give way to:

- sailing vessels
- vessels restricted in their ability to manoeuvre
- vessels approaching head on, by altering course to starboard
- vessels approaching from the right (starboard) hand side (ie crossing)
- any vessel being overtaken.

Additional rules apply to a sailing vessel underway, including a requirement for sailing vessels to keep out of the way of a vessel restricted in their ability to manoeuvre.

Vessels restricted in their ability to manoeuvre include:

- a vessel engaged in dredging, surveying or underwater operations
- a vessel engaged in a towing operation (ie tug assisted) where the towing vessel and her tow are severely restricted in their ability to deviate from their course.

Vessels restricted in their ability to manoeuvre must display special lights and signals. In addition, in narrow waterways such as Sydney Harbour, power vessels less than 20 metres in length and sailing vessels must give way to a vessel which can safely navigate only within a narrow channel or fairway (ie large ships). These vessels are not required to display special lights and signals.

The Marine Safety Regulation 2016 modifies Rule 18 of the COLREGS to include a clause that vessels displaying an orange diamond shape have priority over all other vessels (sail and power). It is understood that a number of ferries on Sydney Harbour display the orange diamond shape, including the First Fleet and Freshwater Fleet ferries.

4.3.3 Wash

The Marine Safety Regulation 2016 includes a provision to minimise wash and notes that the operator of a vessel must not cause wash that damages or impacts unreasonably on:

a) any dredge or floating plant
b) any construction or other works in progress
c) any bank, shore or waterside structure, or
d) any other vessel, including a vessel that is moored.

This provision impacts the way in which a vessel is operated.

4.4 Site specific navigation requirements

4.4.1 Harbour Master Directions

Supplementary to the navigation rules identified above, the Harbour Master, under Part 7 of the *Marine Safety Act 1998*, directs that:

- All vessels of length overall (LOA) 30 metres or over are required to participate in the Vessel Traffic Service (VTS). The Sydney Harbour Vessel Traffic Service area is defined as: *From Port limits to Longnose Point* (commonly referred to as Yurulbin Point) (PANSW, 2016).

- Pilotage is compulsory for vessels of length overall (LOA) 30 metres or over unless the vessel is exempt under the *Marine Safety Act 1998*
- General navigation is prohibited from following areas:
    - Waters within 50 metres from a tanker secured at Gore Bay, White Bay or Glebe Island
    - 60 metre clearance from any security regulated passenger ship, berthed at the Overseas Passenger Terminal, Circular Quay or White Bay Cruise Terminal, White Bay 5
    - 100 metres from the wharf face of the terminal in Gore Bay at any time
- Vessels must not exceed four knots within 100 metres of:
    - any dredger or floating plant
    - any construction or any works in progress
- The minimum under keel clearance (UKC) for all seagoing vessels must be of 10 per cent of the vessels deepest draught while in transit to the seaward limit of the berth box and 0.5 metres in the berth box and at all times whilst alongside. Passage planning tankers are required to maintain (UKC) of 10 per cent of deepest draught + 0.2 metres
- The maximum draught for Sydney Harbour is 13.7 metres
- Tug assistance from one or more tugs is required for all vessels greater than 30 metres in length (increased to 75 metres if a bow thruster is fitted)
- Seagoing ships greater than 100 metres in length must be escorted by an Authority vessel displaying red and blue flashing lights. Vessels must not pass between the escort vessel and seagoing vessel or within 30 metres of the seagoing vessel
- Anchoring is prohibited within 200 metres of Snails Bay dolphin berths.

4.5 Navigation restrictions

Navigation restrictions in the vicinity of the Western Harbour Crossing include:

- Gore Bay/Cove fuel terminal operated by Viva Energy Australia. The restriction is specified by PANSW as 100 metres from the wharf face or 50 metres from a tanker berthed at the terminal
- HMAS Waterhen, an Australian Defence Force facility. The restriction is noted on the Port Jackson – Western Area Lower Parramatta and Lane Cove Rivers boating map (Roads and Maritime, 2016). Vessels are required to keep clear of the facility by staying outside of the yellow buoys
- All land and structures including moorings and dolphin berths in Snails Bay. Vessels traveling at more than six knots are required to maintain a distance of 30 metres from vessels, land or structures.

The Gore Bay and HMAS Waterhen Exclusion zones are marked on the Roads and Maritime Boating Maps in **Appendix B**.

4.5.1 Sydney Harbour Bridge Transit Zone

A transit zone has been implemented in the vicinity of the Sydney Harbour Bridge. This transit zone is between Millers Point and Blues Point in the west and extends to between Kirribilli Point and Bennelong Point in the east. Vessels must not exceed 15 knots in the transit zone and they are not permitted to stop, anchor or drift.

4.5.2 Darling Harbour Speed Limit Area

A speed limit is imposed in Darling Harbour, upstream of a line between Barangaroo Point and Balmain East Ferry Wharf. The speed limit is eight knots (about 15 km/h). The speed limit reduces to four knots

(about seven km/h) upstream of Anzac Bridge and upstream of King Street Wharf. The speed limits zones are marked on the Roads and Maritime Boating Maps in **Appendix B.**

4.5.3 NSW Marine Safety Regulation 2016

The NSW Marine Safety Regulation 2016 specifies speed limits for certain areas. These include:

- Waters between a line from Inner South Head to Inner North Head and a line from the stone pillar at Bradley's Head to Hermit Point and including Middle Harbour and North Harbour, the speed limit for vessels exceeding 30 metres is 12 knots
- Waters between a line from the stone pillar at Bradley's Head to Hermit Point and a line from Balls Head to Ballast Point, the speed limit for vessels exceeding 30 metres is 10 knots
- Upstream of a line between Balls Head and Ballast Point, the speed limit for vessels exceeding 30 metres is six knots.

4.5.4 Aquatic Events and licencing

Additional restrictions may be imposed by an Aquatic Event such as a race, competition or exhibition. An aquatic licence issued by Roads and Maritime under the *Marine Safety Act 1998* may be required for organised activities on navigable waters that restricts the availability of those waters for normal use by the public. Roads and Maritime may elect to establish an exclusion zone around the activity. This would typically only occur for major events such as New Year's Eve fireworks display or the start of the Sydney to Hobart Yacht race.

The typical exclusion zone in the vicinity of the Western Harbour Crossing for the New Year's Eve fireworks display is shown in **Figure 4-1**.

Figure 4-1: New Years Eve fireworks exclusion zone

4.6 Navigation widths

The entrance to Sydney Harbour is relatively narrow and constrained by the Sow and Pigs Reef, a shallow rock structure at the entrance to the Harbour. Dredge channels are maintained on either side of the reef. The navigation width between the lateral marks (port and starboard) on the outer edge of the Western Channel is about 290 metres. The Western Channel is wider than the Eastern Channel.

The Outer Harbour, inside the Sow and Pigs Reef, is generally relatively wide and narrows upstream. In the vicinity of Bennelong Point and Kirribilli Point, the navigable width of the waterway is about 450 metres. This is similar to the navigable width between Dawes Point and Milsons Point (Sydney Harbour Bridge).

The navigation width in the Inner Harbour continues to decrease with a navigable width of 360 metres between Goat Island and Balls Head and 310 metres between Snails Bay outer dolphin and Balls Head. Further upstream and in the vicinity of the immersed tube tunnel, the navigable width between Yurulbin Point and Manns Point is about 310 metres.

The Western Harbour Crossing of the Inner Harbour, from Yurulbin Point to Balls Head, is about 630 metres. The navigable width is about 620 metres.

The navigation widths in Darling Harbour and Johnstons Bay, on the approach to White Bay and Glebe Island, are relatively narrow. The minimum navigable width is about 240 metres between Baileys Marine Fuels (eastern end of White Bay) and Darling Island. Defined turning basins are located in Darling Harbour and Johnstons Bay for vessels accessing White Bay and Glebe Island. The largest berth at White

Bay and Glebe Island is White Bay 5 (Cruise Terminal) at 333 metres by 35 metres. Vessels up to this size can adequately manoeuvre in Darling Harbour and Johnstons Bay with the assistance of one or more tugs, despite the relatively narrow navigation widths.

4.7 Waterway users

The TfNSW Regional Boating Plan for the Sydney Harbour Region (TfNSW, 2015) noted that areas within part of Port Jackson attract varying waterway users. The users for Parramatta and Lane Cove Rivers, Inner Harbour and Outer Harbour are summarised in **Table 4-1**.

Table 4-1: Waterway users of Port Jackson defined in the NSW Regional Boating Plan for the Sydney Harbour Region (TfNSW, 2015)

Parramatta and Lane Cove Rivers	Inner Harbour	Outer Harbour
Rowing in the relatively shallow bays such as Iron Cove	Navy operations including the HMAS Waterhen facility at Waverton	Sailing and yachting
Other non-powered craft use including sailing, dragon boating and kayaking	Pleasure craft and cruising around iconic landmarks of Sydney (Opera House and the Harbour Bridge) and during major events such as the New Year's Eve fireworks display and the annual Australia Day celebrations	Leisure boating
General cruising by small and large vessels	Commercial activities including: • Commercial and private marinas • Major ferry hub at Circular Quay and King Street Wharf, Darling Harbour • Private ferries, water taxis, commercial adventure vessel operations in the Bays Precinct and Darling Harbour • Commercial fishing fleet operating out of Blackwattle Bay • International cruise ships berthing at White Bay Cruise Terminal and Overseas Passenger Terminal, Circular Quay • Commercial tankers and bulk carriers operating out of Gore Bay, White Bay and Glebe Island.	Non-powered craft use such as kayaking in the sheltered bays
On water storage in large mooring fields, such as Five Dock Bay and Woodford Bay shown in **Map 1** and **Map 2** in **Appendix B**		Recreational fishing typically in the sheltered bays
		On water storage in large mooring fields
		Swimming and diving in the Camp Cove area and in Chowder Bay
Commercial activities, including commercial and private marinas		Major events such as the New Year's Eve fireworks display, Australia Day celebrations and the start of the annual Sydney to Hobart yacht race
Regular ferry services		Commercial activities including: • Commercial and private marinas • Ferries, water taxis, commercial adventure vessel operations • Navigation access for international cruise ships, commercial tankers and bulk carriers accessing the Inner Harbour • Naval activities at Garden Island • Seaplane operations at Rose Bay.

In addition to the users defined in **Table 4-1**, it is noted that the Inner Harbour is also used for:

- Rowing and dragon boating, particularly in the protected waters of Blackwattle Bay and Rozelle Bay
- On water storage in mooring fields such as Berrys Bay and Lavender Bay
- Off water boat storage in dry stack facilities and hard stands at White Bay and Rozelle Bay.

The users in **Table 4-1** can be grouped in three main sectors comprising community groups and clubs, commercial operators, and government organisations. These three sectors are discussed in the following sections and the various user groups are shown in **Map 4** to **Map 7** in **Appendix A.**

4.7.1 Community Groups and Clubs

4.7.1.1 Paddle craft groups and clubs

Recreational paddle craft users frequent the protected bays of Port Jackson and its tributaries. Paddle craft include rowing skulls, kayaks, dragon boats, surf skis and stand up paddle boards.

A number of rowing and kayaking clubs are scattered around the Parramatta and Lane Cove Rivers. The closest club to the Western Harbour Crossing is the Balmain Rowing Club at the end of White Street, Balmain. Rowing Clubs are generally located where they have access to flat water and minimal conflicting boating traffic.

At least five dragon boat clubs and two rowing clubs are located in Blackwattle Bay in the Inner Harbour. These clubs frequently use Blackwattle and Rozelle Bays for training and racing. There are no other paddle craft clubs located around the Inner Harbour.

The wave climate in the Outer Harbour is generally higher than in the Inner Harbour and Parramatta and Lane Cove Rivers. Paddle craft that frequent the Outer Harbour are generally suited to 'rougher water' and include surf skis and outrigger canoes. The primary club in the Outer Harbour is Bondi Outrigger Club located in Rose Bay. The Mosman Rowers club was established at Mosman Bay in 1911. However, the club progressively relocated to Pearl Bay in Middle Harbour and club rowing activities are no longer conducted from the Mosman Rowers club in Mosman Bay. In addition, a number of commercial companies offer kayak tours or hire paddle craft. These include:

- OzPaddle, Rose Bay and Woolloomooloo Bay
- Point Piper Kayak Centre, Rose Bay
- Kayaking Tours Sydney, Rose Bay.

In general, paddle craft do not cross the shipping channels in the Outer Harbour and do not frequent the Inner Harbour with the exception of Blackwattle and Rozelle Bays.

4.7.1.2 Fishing Clubs

The NSW Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources) recommends that fish or crustaceans caught west of the Sydney Harbour Bridge should not be consumed by humans and for fish caught east of the Sydney Harbour Bridge, no more than 150 grams of fish should be consumed per month. The recommendation is a precautionary measure due to elevated levels of dioxins in fish and crustaceans across the harbour.

As such, congregations of fisherman or club activities are not known to occur in the Inner Harbour. However, land based fishing is a popular activity from public wharves and seawalls.

Fishing is popular in the Outer Harbour and offshore of Sydney, particularly around the Sow and Pigs Reef as the complex nature of the seafloor attracts numerous fish species. However, there are no known clubs located on the foreshore of the Harbour that frequently fish in the area.

4.7.1.3 Sailing Clubs

A number of sailing clubs are located on the lower reaches of the Parramatta and Lane Cove Rivers. These clubs include:

- Balmain Sailing Club
- Drummoyne Sailing Club
- Hunters Hill Sailing Club
- Lane Cove 12 Foot Skiff Sailing Club
- Greenwich Flying Squadron
- Greenwich Sailing Club.

The race courses of these clubs are laid out to achieve a good competitive outcome given prevailing wind conditions at race time. The day of the week that the various clubs regularly sail is documented in **Table 4-2**. One or more of the race courses for all of these clubs traverse Western Harbour Crossing. Course maps for these clubs are included in **Appendix C**.

In addition to weekly club racing, some of the clubs would hold interclub regattas including State and National Championships. Such regattas would typically be conducted over a weekend, or during a week long period in late December or January.

A number of the clubs run training camps or training days throughout the year, particularly for juniors and learn to sail groups in 'off the beach' dinghies. In addition, some teams would train mid-week, particularly leading up to interclub regattas and championships. Training sessions would be more common for 'off the beach dinghies' than yachts.

Table 4-2: Sailing calendar for clubs on the lower Parramatta and Lane Cove Rivers

Club	Yachts	Off the beach sailing dinghies
Balmain Sailing Club	Fridays year round Sundays year round	Fridays during summer Sundays during summer
Drummoyne Sailing Club	Tuesdays during summer Sundays year round	Sundays during summer
Hunters Hill Sailing Club		Sundays during summer Training conducted on Tuesday, Thursday, Friday and Saturday during summer
Lane Cove 12 Foot Skiff Sailing Club		Saturdays during summer
Greenwich Flying Squadron	Saturdays during summer Wednesdays during summer Sundays during winter	Sundays during summer
Greenwich Sailing Club		Sundays during summer

Note: Summer sailing is generally between September and April and winter sailing is generally May to August. The start and finish date of the season for each club varies. Not all clubs sail every weekend during the defined period

There are no sailing clubs located in the Inner Harbour. However, a number of sailing clubs are located around the Outer Harbour including:

- Royal Sydney Yacht Squadron
- Sydney Flying Squadron
- Sydney Amateur Sailing Club
- Vaucluse Yacht Club
- Vaucluse Amateur 12 ft Sailing Club

- Woollahra Sailing Club
- Royal Motor Yacht Club of NSW
- Royal Prince Edward Yacht Club
- 18 Footers Sailing Club, Double Bay
- Double Bay Sailing Club
- RAN Sailing Association
- Cruising Yacht Club of Australia (CYCA).

The race courses for these clubs are scattered across the Outer Harbour and offshore with courses laid out to achieve a good competitive outcome given prevailing wind conditions at race time.

4.7.1.4 Scout and Guide Clubs

A number of Sea Scout and Girl Guide groups are located on Port Jackson. Activities carried out by Sea Scouts and Girl Guides may include kayaking, paddling and sailing. There are no groups located on the foreshore of the Inner Harbour and only two Sea Scout groups on the foreshore of the Outer Harbour at Mosman Bay and Clifton Gardens. Groups on the Parramatta and Lane Cove Rivers are located a sufficient distance upstream that they would not be impacted by the construction activities.

4.7.1.5 Marine Rescue NSW

Marine Rescue NSW is a not-for-profit, community-based organisation supported by the NSW Government. Marine Rescue was established in 2009 and is an amalgamation of the Australian Volunteer Coast Guard Association, Royal Volunteer Coastal Patrol and Volunteer Rescue Association. The Marine Rescue base for the Port Jackson (Sydney Harbour) region is located at Birkenhead Point. In conjunction with Marine Rescue Middle Harbour, they service the closed and open waters around Sydney.

4.7.1.6 Annual events

A number of major paddling, sailing and swimming events are conducted annually on Port Jackson. Details of these events are summarised in **Table 4-3**. It is noted that the events are all conducted on the Outer Harbour.

Table 4-3: Major paddling, sailing and swimming events, Port Jackson

Paddling and Rowing Events	Sailing Events	Swimming Events
Manly Wharf Bridge to Beach Ocean paddle race for surf skis, ocean kayaks and stand up paddle boards organised annually by Ocean Paddler in February. The race commences at Milson Park, Kirribilli with the finish at Manly. The course generally follows the edge of the shipping channel. In 2019, the event attracted about 300 entrants.	Rolex Sydney to Hobart Yacht Race The race, organised by CYCA, is conducted annually with the start on Boxing Day (26th December). The starting line is in the vicinity of Nielsen Park/Steele Point with the course proceeding offshore. An aquatic license is issued by Roads and Maritime for the start of the race and navigation exclusion zones apply. The race attracted 85 entrants in 2018.	Sydney Harbour Splash Swimming race organised annually by Bondi Lifeguards in January. The event is held in Rose Bay, Outer Harbour and comprises three courses varying in distance from one kilometre to five kilometres. The event attracted over 600 entrants in 2019.
Sydney Harbour Challenge Outrigger race organised annually by Australian Outrigger Canoe Racing Association (AOCRA) in February. The race course starts and finishes at Manly with a turning buoy at Blues Point. The course generally follows the edge of the shipping channel. In 2019, the event attracted over 100 entrants (600 participants).	Sail Sydney Regatta for off the beach dinghies organised annually by Woollahra Sailing Club in December. The regatta holds international status and includes Olympic sailing classes and invited classes. Multiple race areas are established in the Outer Harbour. In 2019, the racing attracted about 300 entrants.	
	Sydney Harbour Regatta Regatta for yachts organised annually by Middle Harbour Yacht Club in March The event typically attracts over 150 yachts with racing in the Outer Harbour and Offshore.	

4.7.2 Commercial operators

The vast majority of the commercial operations in Port Jackson are located in the Bays Precinct, which has been retained as a working harbour, or nearby at Darling Harbour and Balmain. The commercial operations in this area include marine contractors, commercial fishing fleet, charter vessels, passenger cruise terminals, bulk terminals and storage facilities, and ferry services.

4.7.2.1 Cruise, container and bulk shipping terminals

Overseas Passenger Terminal

The Overseas Passenger Terminal (OPT) located at Circular Quay is the only commercial berth for international cruise liners on the seaward side (east) of the Harbour Bridge. The OPT berth pocket is able to support the large international cruise ships now operating around Australia. The maximum headway under the Sydney Harbour Bridge is 53.4 metres at zero tide and at the centre of the bridge. The Harbour Masters direction requires two metre clearance under the Bridge. Therefore, the maximum vessel air draught is 51.4 metres. Vessels that berth at the OPT are generally not able to pass under the Sydney Harbour Bridge due to air draught restrictions.

White Bay and Glebe Island Precinct

The White Bay and Glebe Island precinct is an essential port facility close to the centre of Sydney and located in the Inner Harbour. In the past, the precinct served as a container terminal, coal loader, grain loader and RORO (Roll On Roll Off) terminal. The precinct is currently an important facility for dry bulk imports, the cruise industry and bunkering (refuelling).

The dry bulk facility is able to handle commodities such as bulk cement, gypsum, sugar, salt, oils, lubricants and tallow. In addition, the terminal includes storage facilities and batching plants to cater for dry bulk imports. Clients included Sugar Australia, Cement Australia and Gypsum Resources Australia. There are currently plans to upgrade the Glebe Island Multi-User Facility with a Review of Environmental Factors (REF) prepared early 2018 (AECOM, 2018).

The White Bay Cruise Terminal was completed in 2013. About 230,000 passengers pass through the White Bay Cruise Terminal per year. The number of passengers is forecasted to increase to 530,000 per annum by 2045 (PANSW, 2016).

Baileys Marine Fuels in White Bay operate a bunkering facility at the eastern end of the quay. A large range of vessels from small recreational craft to ferries and charter vessels are bunkered at the site. Vessels are expected, where possible, to approach the facility from the east and berth starboard side alongside. On leaving, vessels are to cross to the southern side of the channel before proceeding east. This navigation procedure conforms to the navigation rules outlined in **Section 4.3** of this report and Section 2.67 of the Harbour Masters Directions.

Navigation into Johnstons Bay and White Bay for the larger cruise liners, cargo ships and bulk carriers requires manoeuvring in the Darling Harbour and Johnstons Bay turning basins with the assistance of one or more tugs. Based on “Sydney Port Passage Planning 2012”, these designated turning basins are 360 metres diameter and 320 metres diameter respectively.

Gore Bay Terminal (Viva Energy)

Gore Bay has been operating as a fuel import and storage facility since 1901. In addition to importing fuel, the facility fuels bunkering vessels that service White Bay (including the cruise terminal), Glebe Island and the OPT.

Previous data has shown that about 80 movements of tankers have been registered over a period of one year. However, numerous additional movements of bunkering vessels are registered.

4.7.2.2 Harbour City Ferries (Sydney Ferries)

Harbour City Ferries (HCF) is the operator of Sydney Ferries on behalf of the NSW Government. The ferry fleet along with the maintenance facility at Balmain is leased by HCF on a seven year term. Two ferry routes traverse the Western Harbour Crossing. Route F3 operates between Circular Quay and Parramatta, while route F8 operates between Circular Quay and Cockatoo Island. The number of ferry transits past the Western Harbour Crossing, in each direction, is displayed in **Table 4-4**. The ferries operate between about 6am and midnight.

The closest ferry wharf to the proposed Western Harbour Tunnel is Birchgrove Wharf, at the end of Louisa Road, Birchgrove. The F8 Service typically stops at Birchgrove Wharf.

Table 4-4: Ferry transits past the Western Harbour crossing

Ferry Service	Weekday	Saturday	Sunday	Public Holiday
F3 Circular Quay to Parramatta [1]	50	30 [3]	36 [4]	28
F3 Parramatta to Circular [1]	49	29 [3]	34 [4]	26
F8 Circular Quay to Cockatoo Island [2]	23	18	13	13
F8 Cockatoo Island to Circular Quay [2]	23	17	12	12

Note:

1. *Some services terminate and commence at intermediate locations along the route between Circular Quay and Darling Harbour and do not connect to Circular Quay or Parramatta River*
2. *With the exception of the first service from Cockatoo Island to Circular Quay and the last service from Circular Quay to Cockatoo Island each day, all services commence and terminate at Circular Quay and Cockatoo Island respectively*
3. *Includes Easter Saturday*
4. *Includes Easter Sunday.*

The routes are serviced by the Rivercat and Harbourcat vessels.

Six other ferry services operate throughout the Inner and Outer Harbour. These include:

- F1 – Circular Quay to Manly
- F2 – Circular Quay to Taronga Zoo
- F4 – Cross Harbour (Pyrmont Bay to Watsons Bay)
- F5 – Circular Quay to Neutral Bay
- F6 – Circular Quay to Mosman Bay
- F7 – Circular Quay to Double Bay.

4.7.2.3 Captain Cook Cruises

Captain Cook Cruises operates a Lane Cove to City ferry service, which stops at Birchgrove Wharf. The Super Rocket fleet of ferries services the route that operates from Monday to Friday (excluding public holidays). The service includes:

- Two ferries operating in the morning with four City bound services and two Lane Cove bound services between 7am and 9:10pm
- One ferry operating in the evening with two City bound services and four Lane Cove bound services between 3.25pm and 7:52pm. Note that the first City bound and first Lane Love bound service does not operate during school holidays.

The Lane Cove to City ferry service stops at Birchgrove Wharf during the private school term only at:

- 7:42am
- 8:07am
- 4:18pm
- 6:07pm.

Captain Cook Cruises operates a number of other ferry services in the Inner and Outer Harbour.

Captain Cook Cruises also offers a number of sight-seeing and cocktail dinning cruises in larger vessels. However, it is understood the route for these vessels is generally between Darling Harbour and Manly with various stops and attractions along the way, ie not in the direction of the Western Harbour Crossing.

4.7.2.4 Commercial Fishing

Commercial fishing is banned in Sydney Harbour, including the Parramatta River and connected tidal waterways. The ban was introduced as a precautionary measure in 2006 due to elevated levels of dioxins in fish and crustaceans across the harbour. The commercial fishing fleet in Sydney are primarily located in Blackwattle Bay and would mostly fish offshore.

4.7.2.5 Water Taxis

A number of water taxi companies operate on Port Jackson and its estuaries. To increase business, a number of the water taxis offer more than a taxi service, including providing private tours of the harbour and exclusive New Year's Eve fireworks cruises or Vivid light display cruises. Some of the vessels are also available for private charter.

4.7.2.6 Charter Companies

Numerous yacht charter, deep sea fishing charter and boat hire companies are located in Port Jackson and its estuaries. Due to the fishing restrictions in Port Jackson, the fishing charter companies would generally operate offshore.

Charter companies in the Inner Harbour include:

- Liquid Edge Yacht Charters in Mort Bay, Balmain
- Deep Blue Charters, Balmain
- SailCorp Yacht Charters, McMahons Point
- Sydney Harbour Yacht Charter in Berrys Bay, Waverton
- Sydney Motor Yacht Charters, Darling Harbour
- Australian Superyachts, Pyrmont.

In addition, Blackwattle Bay in the Inner Harbour is a designated berthing area for charter vessels. However, the headquarters for the charter companies may be based elsewhere.

4.7.3 Government Organisations

4.7.3.1 Royal Australian Navy

HMAS Waterhen is located on the western side of Balls Head in the Inner Harbour. The facility is the Royal Australian Navy's lead establishment for Mine Warfare including Australia's Mine Countermeasures (MCM) Force and Clearance Diving Team. The facility was upgraded in the mid-1990s and the maritime facilities include two wharves, a small boat jetty and boat ramp. Numerous vessels are berthed at Waterhen. The largest of these are thought to be six 'Huon Class' Mine Hunter Coastal vessels.

Garden Island is located on the shoreline of the Outer Harbour and is referred to as Fleet Base East or HMAS Kuttabul. The base was established in 1913. Today, Garden Island is connected to the mainland following reclamation of the spit.

In addition, to the HMAS facilities in Port Jackson, there are a number of areas that are designated naval waters, in which anchoring restrictions apply. These include:

- Spectacle Island on the Parramatta River
- Chowder Bay
- Rose Bay in the vicinity of Steele Point
- Rose Bay in the vicinity of Shark Island
- Man of War Anchorage in the vicinity of Garden Island and Clark Island.

4.7.3.2 NSW Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources)

The NSW Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources) office for the Sydney North Region is located at 12 Shirley Road, Wollstonecraft, on the eastern side of Gore Bay. The facility comprises a hardstand area and two small finger jetties. It is unclear what vessels operate from this facility. However, they would be responsible for overseeing fishing activities and enforcing relevant legislation including the *Fisheries Management Act 1994*.

4.7.3.3 Water Police

The NSW Police Marine Area Command is located in Camerons Cove, immediately east (downstream) of White Bay in the Inner Harbour. The Marine Area Command is the primary facility in Port Jackson and as such, services Port Jackson and NSW waters up to 200 nautical miles from the coast.

In case of an emergency, the Water Police would need access to the waterway at all times of the day.

4.7.3.4 Roads and Maritime

The Roads and Maritime Services maritime division is based at Rozelle Bay. Roads and Maritime Boating Safety Officers are employed to patrol discrete regions throughout NSW in order to ensure compliance of waterway users with the relevant legislation.

In addition to their responsibility as a regulatory authority, Roads and Maritime is the owner of the bed of Sydney Harbour and its tributaries. The property boundary between the land and water is typically defined as the Mean High Water mark. As such, Roads and Maritime is the owner of a number of seawall assets in Sydney Harbour and is responsible for managing seabed leases, which may be held by private residents or commercial organisations such as marinas.

4.8 Vessel use

4.8.1 Recreational Vessels

The TfNSW Regional Boating Plan for the Sydney Harbour Region (TfNSW, 2015) noted that there were about 20,000 registered recreational vessels in the Sydney Harbour region. However, it was noted that Roads and Maritime's licence and registration data does not capture vessels that do not require registration including non-powered craft such as kayaks, canoes and 'off the beach' sail craft and power craft less than a specified engine power (currently 4.0 kW [about five horsepower (hp)]).

About 60 per cent (12,000) of the registered vessels were between two and six metres in length, which are defined as trailerable. The average registered vessel length was 6.6 metres and 14 per cent (2800) of all registered vessels were greater than 10 metres.

The report noted that in recent years, the boating and commercial sectors estimated that over one million people annually use boats as a form of recreation on the Harbour. Additionally, about 15 million passengers used ferry service across Sydney Harbour and the Rivers in 2011-12.

Kitesurfers and personal watercraft (PWCs) are prohibited on Sydney Harbour.

4.8.2 Boat Storage Facilities

A number of boat storage and boat launching facilities are located around Port Jackson and its estuaries that provide storage for recreational seagoing vessels. These include:

- Moorings
- Dry dock storage facilities
- Marina facilities
- Boat ramps.

Commercial marina facilities generally offer the wide range of premium services for the boating community. As such, they generally attract larger vessels and represent a high density of boat storage for the area of occupation. Boat ramps and dry storage facilities attract smaller trailerable craft and often attract users from a large geographical area.

The larger marinas and boat ramps located on Port Jackson are outlined in **Table 4-5**.

In addition to marinas, boat ramps and dry dock facilities, numerous mooring fields are located throughout Port Jackson. These include Berrys Bay, Snails Bay and numerous other bays in the Outer Harbour, Inner Harbour and Parramatta and Lane Cove Rivers. The moorings are either privately leased from Roads and Maritime or commercially leased from Roads and Maritime with a lease arrangement for occupants. Some of the marinas also offer a tender service to commercial and/or private moorings within a defined area for vessels registered with the club or marina.

Table 4-5: Marinas, boat ramps and dry storage facilities in Port Jackson

Location	Marinas	Boat Ramps and Dry Storage Facilities
Parramatta and Lane Cove Rivers	• Private marina at 2-8 Water Street, Birchgrove • Balmain Marina and Camerons Marina, Balmain • Private marina at 1A Wulumay Close, Rozelle • Birkenhead Point Marina, Birkenhead • Gladesville Bridge Marina, Drummoyne • D'Albora Marinas Cabarita Point, Cabarita • Pulpit Point Marina, Hunters Hill • Woolwich Marina, Woolwich • Private marina at King Street, Wollstonecraft. The larger vessels berthed at these marinas are up to 30 metres in length (measured from SIX Maps).	• *Hawthorne Canal, Lilyfield* • Taplin Park Boat Ramp, Drummoyne • Bayview Park Boat Ramp, Concord • *Kendall Bay, Cabarita Park* • Blaxland Road Boar Ramp, Rhodes • Silverwater Park, Silverwater • Wharf Road Boat Ramp, Ermington • Kissing Point Boat Ramp, Putney • Woolwich Boat Ramp, Margaret Street, Woolwich • Burns Bay Reserve Boat Ramp, Riverview • *Manns Point Boat Ramp, Greenwich.* **italics denote small boat ramps with limited water depth and/or parking.*
Inner Harbour	• Sydney Superyacht Marina, Rozelle The larger vessels berthed at these marinas are in excess of 50 metres in length (measured from SIX Maps).	• Sydney Boathouse dry boat storage, Rozelle • Sydney Harbour Boat Storage, White Bay.
Outer Harbour	• Mosman Bay Marina, Mosman • Rose Bay Marina, Rose Bay • Point Piper Marina, Point Piper • Royal Motor Yacht Club Marina, Point Piper • Double Bay Marina, Double Bay • D'Albora Marina, Darling Point • CYCA Marina, Darling Point. The larger vessels berthed at these marinas are up to 35 metres in length (measured from SIX Maps).	• Lyne Park Boat Ramp, Rose Bay.

The largest recreational sail yacht that would semi regularly traverse the Western Harbour Crossing would be Wild Oats XI, which docks at Woolwich Dock. The vessel dimensions are:

- Length: 30 metres
- Beam: 5.1 metres
- Draught: 5.91 metres.

Cruisers of a similar length would generally have a larger beam, shallower draught and higher engine power.

4.8.3 Commercial vessels

The TfNSW Regional Boating Plan for the Sydney Harbour Region (TfNSW, 2015) noted that Sydney Harbour has a large commercial vessel fleet, with 20 per cent of the State's commercial vessels based in the Harbour. Commercial activities include charter vessels, work boats and barges, adventure vessels, water taxis, passenger ferries, and sea-going commercial ships.

4.8.3.1 White Bay and Glebe Island Precinct

Individual berth dimensions at White Bay and Glebe Island are outlined in **Table 4-6**. Vessels accessing the facility would be less than the size of the berths.

Table 4-6: Berths at Glebe Island and White Bay

Berth	Depth of Berth (m CD)	Size of Berth (m, length x width)
Glebe Island 1	11.9	232 x 35
Glebe Island 2	11.8	234 x 35
Glebe Island 7	10.7	229 x 35
Glebe Island 8	8.1	115 x 35
White Bay 2	10.6	141 x 35
White Bay 3	10.7	260 x 35
White Bay 4	11.1	254 x 35
White Bay 5 (Cruise Terminal)	11.0	333 x 35

4.8.3.2 Overseas Passenger Terminal

The berth dimensions for the OPT allows vessels such as Ovations of the Seas and Queen Mary 2 to berth there. The dimensions of these cruise ships are outlined in **Table 4-7**.

4.8.3.3 Gore Bay Terminal (Viva Energy)

The berth dimensions for Gore Cove 1 and Gore Cove 2 could not be obtained. However, the Port Authority of NSW vessel movement indicates Eagle Le Havre was docked at Gore Cove 1 in January 2018. Smaller vessels such as the ICS Allegiance and ICS Integrity dock at Gore Cove and offer bunkering services to the remaining harbour side docks including OPT and White Bay. The dimension of Eagle Le Havre and ICS Allegiance are included in **Table 4-7**.

4.8.3.4 Harbour City Ferries (Sydney Ferries)

The Rivercats and Harbourcats owned by Sydney Ferries and operated by HCF are non-planing catamaran ferries. There are seven Rivercats and two Harbourcats in service. The key dimensions of the Rivercat and Harbourcat vessels are outlined in **Table 4-7**.

4.8.3.5 Captain Cook Cruises

The Captain Cook Super Rocket fleet operates on the City to Lane Cove ferry route. The fleet comprises four identical vessels. The vessel dimensions are outlined in **Table 4-7**.

4.8.3.6 Water taxis

Water taxis operating on Port Jackson are typically less than 10 metres in length.

4.8.3.7 Charter companies

Charter vessels would be similar in size and construction to recreational vessels. The majority of the charter vessels would be around 10 to 20 metres in length. However, the largest charter vessels in Blackwattle Bay are up to 42 metres (SMEC, 2016).

Table 4-7: Dimension of commercial vessels operating in Port Jackson

	Ovation of the Seas	Queen Mary 2	Eagle Le Havre	ICS Integrity	HCF (Sydney Ferries) Rivercat	HCF (Sydney Ferries) Harbourcat	Captain Cook Cruises Super Rocket
Vessel Type	Cruise Ship	Cruise Ship	Oil Tanker	Bunkering Vessel	Passenger Ferry	Passenger Ferry	Passenger Ferry
Displacement (t)	168,666	79,287	67,742	5424	60	35	-
Length (m)	348	345	250	112.7	37	27.1	23.9
Beam (m)	41.2	41	44	17.6	10	7	7.2
Draught (m)	8.5	10.3	13.7 (summer)	7.2 (summer)	1.5	1.0	2.2
Maximum Speed (knots)	22	30+	15.8	-	23	24	28

4.8.4 Government vessels

4.8.4.1 Royal Australian Navy

The largest vessels berthed at HMAS Waterhen are thought to be six 'Huon Class' Mine Hunter Coastal vessels. The dimensions and displacement of the vessels are outlined in **Table 4-8**.

Fleet Base East (Garden Island) is the home port for eleven vessels in the Royal Australian Navy (RAN) between 118 and 230 metres in length. The largest of these is HMAS Adelaide (III) and HMAS Canberra (III), which are both ‘Canberra Class’ Amphibious Assault Ships. The dimensions of these vessels are outlined in **Table 4-8**.

Larger vessels may be moored at the Man of War Anchorage or other naval waters. However, this would generally only occur during periods of war.

Table 4-8: Dimension of government vessels operating in Port Jackson

	RAN 'Huon Class'	RAN ‘Canberra Class’	OPV Nemesis
Vessel Type	RAN Mine Hunter Coastal vessels	RAN Amphibious Assault Ships	NSW Police Offshore Patrol Vessel
Displacement (t)	732	27,831	104
Length (m)	52.5	231	32
Beam (m)	9.9	32	-
Draught (m)	3	7.18	-
Maximum Speed (knots)	14	19	-

4.8.4.1 Water Police

The NSW Police Marine Area Command operates a number of vessels, the largest of which is the Offshore Patrol Vessel (OPV) Nemesis. It is reported to be the largest purpose built police boat in the southern hemisphere. The dimensions of the vessel are recorded in **Table 4-8**.

4.8.4.2 Roads and Maritime

The majority of Roads and Maritime vessels are trailerable craft and jet skis. However, Roads and Maritime does maintain a fleet of vessels at Rozelle for a range of activities. The vessels are generally less than 10 metres in length.

4.9 Summary of vessel use

On the basis of the above, the largest vessels to navigate through the Outer Harbour would be commercial cruise ships accessing the OPT. These vessels have historically been up to 348 metres in length.

Vessels up to 333 metres in length could access White Bay in the Inner Harbour provided the air draught is less than the clearance under the Sydney Harbour Bridge. These vessels would not navigate upstream of Darling Harbour or in the vicinity of the Western Harbour Crossing.

Vessels that frequently traverse past the Western Harbour Crossing would include:

- Recreational and commercial sail and power craft between 4.5 metres and about 35 metres in length
- RAN vessels up to 52.5 metres in length
- Oil tanker about 250 metres in length
- Bunker vessels up to 113 metres in length
- HCF/Sydney Ferries up to 37 metres in length.

Of these, the RAN vessels, oil tankers and bunker vessels would not continue into the Parramatta and Lane Cove Rivers.

4.10 Foreshore recreation

The Outer Harbour comprises numerous foreshore reserves and sandy beaches that offer public recreation for swimming and bathing. These include Camp Cove, Watsons Bay, Parsley Bay, Nielsen Park/Shark Beach, Blackburn Cove (Murray Rose Pool) and Clifton Gardens Reserve/Beach. Baths (swimming enclosures) and/or shark nets have been installed at most of these locations.

The Inner Harbour is generally congested, and the foreshore is either steep and rocky or developed. There are very few foreshore areas that offer public recreation for swimming and bathing.

Parramatta and Lane Cove Rivers are generally steep and rocky. The head of the bays are generally shallow and comprise estuarine sands and silts. A number of the mud flats at the head of the bays have been reclaimed to provide sporting fields. As such, foreshore recreation is limited. Greenwich Baths, Greenwich and Dawn Fraser Baths, Balmain both offer swimming enclosures for the public.

4.11 Foreshore structures

The foreshore in the vicinity of Yurulbin Park is lined by a sandstone block seawall. A number of jetties, pontoons and mooring pens adjoin private residence on both sides of Yurulbin Point. It is assumed the seabed occupied by the private foreshore structures is leased from Roads and Maritime.

The foreshore of Balls Head, on the northern side of the Inner Harbour, is undeveloped. The former Coal Loader Wharf and HMAS Waterhen are located on the western side of Balls Head. The eastern side of Balls Head, in Berrys Bay, is the site of the former British Petroleum (BP) fuel terminal. In addition, a

couple of disused marinas and jetties are located on the foreshore of Berrys Bay including Woodleys Marina.

5 The Project

The Western Harbour Crossing of Port Jackson would comprise an immersed tube tunnel about 630 metres in length. The tunnel would be about 35 metres wide and nine metres high to accommodate three lanes of traffic in each direction.

The immersed tube tunnel would join excavated tunnels at either end that would be excavated with roadheaders. Temporary cofferdams would be constructed to allow construction of permanent interface structures at the interface between the bored tunnels and immersed tube tunnel.

5.1 Summary of methodology and program

A brief summary of the construction methodology is provided below. The construction plan is attached in **Map 3** in **Appendix A**. A detailed construction method is provided in Chapter 6 (Construction work) of the environmental impact statement. The construction method would be refined during the detailed design phase of the project.

1. White Bay temporary construction support site (WHT3)
    a) Establish facility for casting and fit out of immersed tube tunnel units, supply of all other materials including cofferdam piles and interface structure concrete and handling of dredge material unsuitable for offshore disposal.
2. Immersed tube tunnel transportation and immersion
    a) Casting and fit out of immersed tube tunnel units at White Bay
    b) Transport to Snails Bay temporary mooring location for storage of completed units
    c) Transport to Western Harbour Crossing and immersion.
3. Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6)
    a) Construction of two temporary cofferdams about 50 metres by 25 metres. Top of the cofferdam would be about +3 metres AHD
    b) Excavation inside cofferdam with excavators loading material into barges and transported to an approved area for offshore disposal
    c) Formation of concrete interface structures linking the immersed tube tunnel and driven land based tunnels.
4. Dredging
    a) Dredging of soft sediments not suitable for offshore disposal with a backhoe dredger with a closed environmental clamshell. Material that is not suitable for offshore disposal would be barged to White Bay transfer site for treatment and disposed of at a land-based licenced facility
    b) Dredging of soft ground materials suitable for offshore disposal with a trailer suction hopper dredger (TSHD), and barged to the designated offshore disposal site for disposal
    c) Dredging of stiff ground materials suitable for offshore disposal with a backhoe dredger with a clamshell or open bucket, and barged to the designated offshore disposal site for disposal
    d) Dredging of soft rock material with a backhoe dredger with an open bucket, and barged to the designated offshore disposal site for disposal
    e) Dredging of a rock layer suitable for offshore disposal with a cutter suction dredger (CSD) with broken down rock removed with a backhoe dredger and barged to the designated offshore disposal site for disposal.
5. Foundation, locking fill, back fill and rock protection
    a) Placement of gravel foundation prior to immersion of the immersed tube tunnel units
    b) Placement of locking fill and backfill in tunnel trench after immersion of immersed tube tunnel units

c) Placement of rock protection layer to protect the immersed tube tunnel.

6. Construction support sites at Berrys Bay (WHT7) and Yurulbin Point (WHT4)
    a) Establishment of construction support sites including construction of floating structures and/or fixed wharves and jetties
    b) Barge roadheaders from White Bay to the construction support sites for excavation of the driven tunnels
    c) Retrieval of tunnel spoil from the roadheaders and transport by barge to the land based transfer station at White Bay
    d) Decommissioning of construction support site with equipment demobilised to White Bay.

An approximate program for the construction activities mentioned above is outlined in Chapter 6 (Construction work) of the environmental impact statement.

The location of work items and vessel movements associated with the activities at the Western Harbour Crossing (including Sydney Harbour south (WHT5) and north (WHT6) cofferdams), Berrys Bay construction support site (WHT7) and Yurulbin Point construction support site (WHT4) are displayed in **Figure 5-1** and **Figure 5-2**.

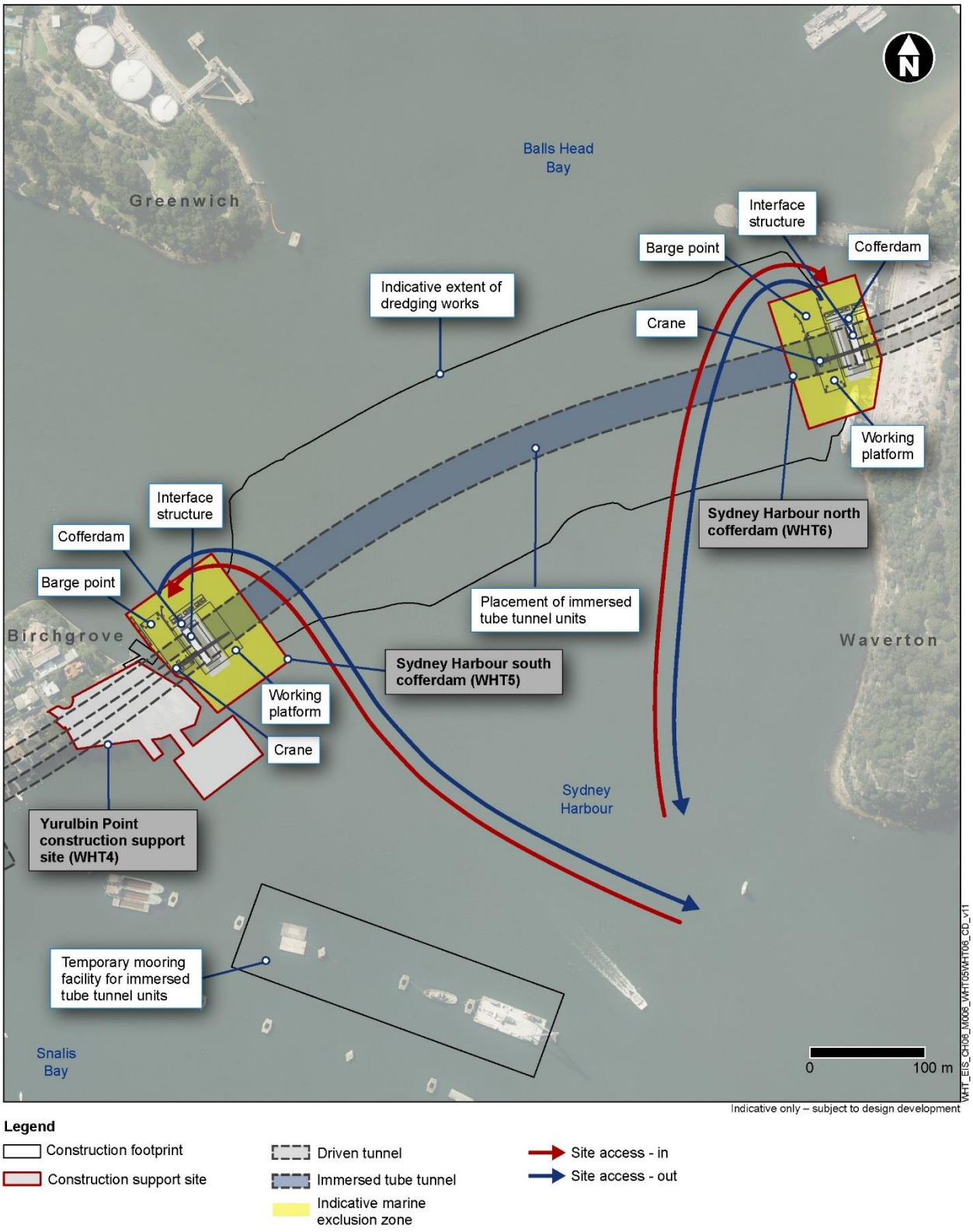

Figure 5-1: Construction activities associated with Yurulbin Point construction support site (WHT4) and Western Harbour Crossing including Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6)

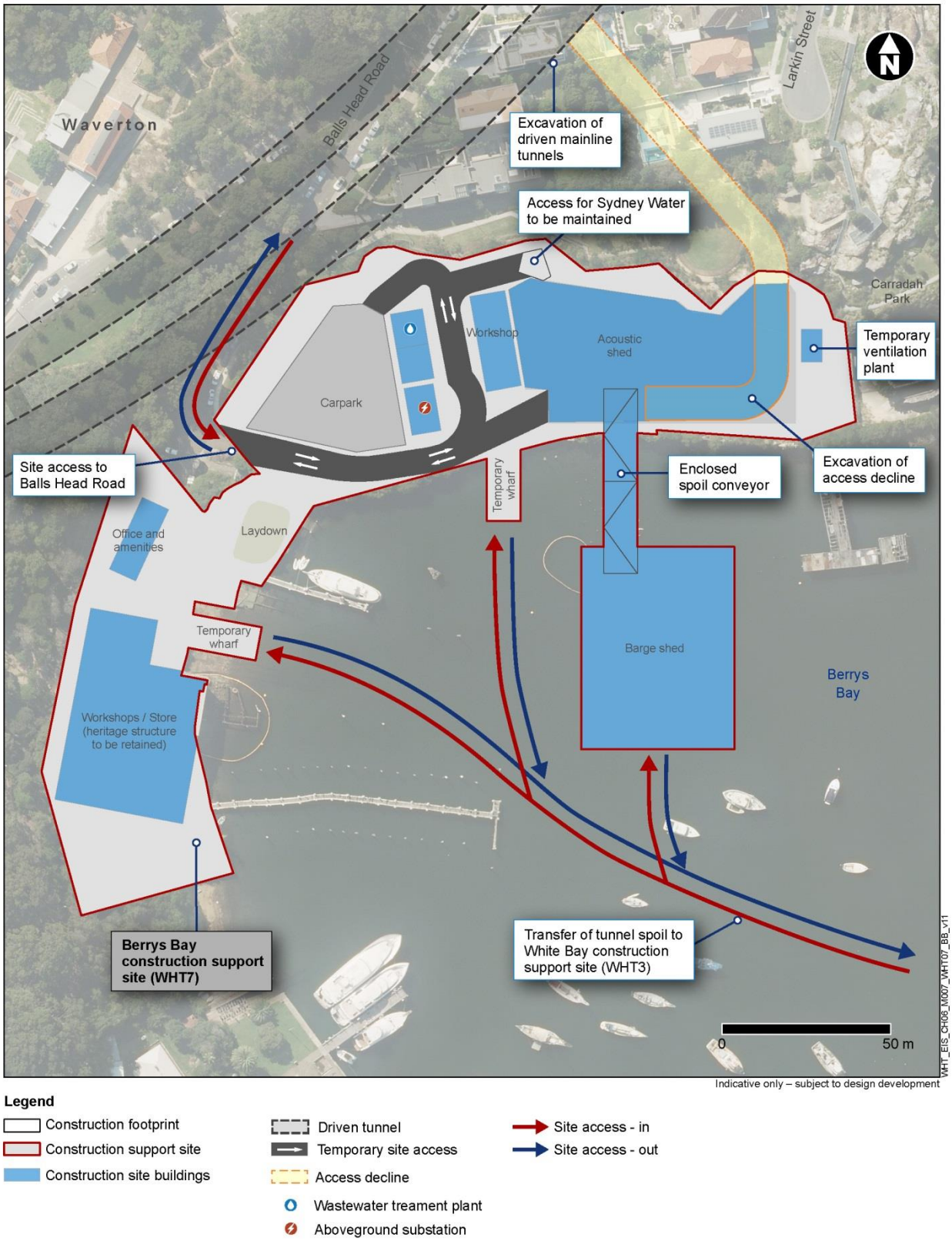

Figure 5-2: Construction activities associated with Berrys Bay construction support site (WHT7)

5.2 Summary of marine traffic

The peak period for marine traffic would be during construction of the interface structures where there may be up to 100 barge movements between White Bay and the cofferdams per day. However, duration of these works would be relatively short.

Prolonged periods of high marine construction activity would occur over 12 months of the construction program. During this period, the following construction activities would be underway:

1. Construction of cofferdams - vessel movements may include about:
    a. Two stationary barges about 50 metres x 20 metres
    b. Eight small boat movements for transfer of labour to White Bay per day
    c. 16 barge movement to White Bay per day.

2. Dredging - vessel movements may include about:
    a. 1 CSD operating during standard construction hours or TSHD operating 24 hours a day in the dredged footprint
    b. Small boat movements included in construction of the cofferdam
    c. Six barge movements to offshore disposal location. Movements may occur 24 hours per day.

3. Transport of tunnel spoil from construction support sites at Berrys Bay (WHT7) and Yurulbin Point (WHT4) to White Bay (WHT3) - vessel movements may include about:
    a. Six small boat movements from Berrys Bay to White Bay and eight from Yurulbin Point to White Bay per day
    b. Six barge movements from Berrys Bay to White Bay and 12 from Yurulbin Point to White Bay during the day for delivery of material and removal of spoil
    c. Four barge movements from Yurulbin Point to White Bay between sunset and sunrise (night).

4. Potential transport of immersed tube tunnel units - vessel movements may include:
    a. Six tug boat movements from the Outer Harbour to White Bay and/or White Bay to Snails Bay dolphins (each tunnel unit requires a minimum of three tugs for each movement)
    b. Two work boat movements from the Outer Harbour to White Bay and/or White Bay to Snails Bay dolphins
    c. One immersed tube tunnel unit movement from the Outer Harbour to White Bay and/or White Bay to Snails Bay dolphins.

The route of the vessel movements is shown in **Map 8** in **Appendix A**. Note that vessel movements are each way (ie arriving at a site and leaving a site counts as two movements).

Daily vessel movements during this period may therefore be about:

- 50 barge movements
- 32 small boat movements for transporting employees
- Tug boat movements
- Two stationary barges at the cofferdams that may move periodically
- One dredger
- One immersed tube tunnel unit.

5.3 Waterway Occupation

Marine activities would occupy certain parts of the waterway for the majority of the construction period. The affected areas including:

a) White Bay construction support site(WHT3)
b) Snails Bay, about 35 metres either side of the outer row of dolphins
c) Berrys Bay construction support site (WHT7)
d) Yurulbin Point construction support site (WHT4)
e) Location of the two cofferdams, Sydney Harbour south (WHT4) and Sydney Harbour north (WHT6).

6 Assessment of impacts and mitigation measures

This final section of the assessment assesses the likely impacts of the intended construction works on navigation in the study area. Where impacts are noted, measures to mitigate their severity or avoid them altogether are proposed. These measures can be investigated further within the environmental impact statement process and within the relevant licences and permits, subject to final incorporation within the eventual management plans which will be used during construction.

The program for construction activities is outlined in Chapter 6 (Construction work) of the environmental impact statement. The size and number of registered vessels in NSW is progressively increasing overtime (Transport for NSW, 2014). However, at the end of the construction period, the increase in vessel size, distribution of the size of vessels or the frequency of navigation traffic on Port Jackson is likely to be similar to the existing demand analysis in **Section 4**. As such, the assessment of user groups and vessel use in **Section 4.7** and **Section 4.8** is expected to remain similar until the end of the construction period.

6.1 Marine construction equipment requirements

Vessel movements would be conducted by the following personnel:

- Vessels of length overall (LOA) 30 metres or more including barges and dredgers should be conducted by a licensed marine pilot unless the master holds a Certificate of Local Knowledge or Marine Pilotage Exemption Certificate
- Immersed tube tunnel movements should be conducted by a licensed marine pilot
- All other vessel movements should be conducted by a master and crew holding a commercial qualification or certificate of competency.

Furthermore, it is a requirement of the PANSW Harbour Master that vessels of length overall (LOA) 30 metres or over when east of Dobroyd Head participate in the Vessel Traffic Service (refer to **Section 4.4.1**).

It will be a requirement of PANSW that all construction equipment including stationary barges and transport vessels will be fitted with automatic identification system (AIS) that is turned on at all times. This recommendation limits the requirement to report the vessels position under the Vessel Traffic Service (VTS).

Notwithstanding the above, PANSW requires all vessels, irrespective of size, to seek approval from the Harbour Master before moving from all construction sites

All marine construction equipment and immersed tube tunnel units should be fitted with operational navigation lights at all times, including while moored or anchored at a location other than their registered (everyday) mooring location. The navigation lights should be turned on between sunset and sunrise.

6.2 Wave climate

6.2.1 Marine construction traffic

During construction of the immersed tube tunnel and construction activities associated with the construction support sites at White Bay (WHT3), Berrys Bay (WHT7) and Yurulbin Point (WHT4), there is expected to be a significant increase in boating traffic in the Inner Harbour. The construction vessels would primarily include:

- Barges for delivering material, removing tunnel spoil, removing dredged material, or for other construction activities
- Tugboats for manoeuvring barges
- Transport vessels for workers.

While there would be significant increase in larger marine traffic, the boat wash produced by these larger vessels such as tugboats and barges are expected to be similar to or less than other vessels using the waterway. This is partially due to the speed limit of six knots upstream of a line between Balls Head and Ballast Point and 10 knots downstream of this line for vessels exceeding 30 metres in length in accordance with NSW Marine Safety Regulation 2016.

It should be noted that a vessel speed of six to 10 knots is significantly less than the critical speed for a water depth of 15 metres for a vessel length of 30 metres and as such, the wave height would be less than the theoretical maximum wave height (refer **Section 3.3.2**).

Smaller transport vessels (up to 8-10 metres) could operate at speeds in excess of 10 knots (except where speed restrictions apply [eg Darling Harbour] and within 30 metres of moored vessels or fixed structures). These smaller vessels could be operated in excess of the critical speed in deepwater (about nine knots for a vessel length of eight metres). As such, there are points in time when they could accelerate or decelerate through the critical threshold speed and produce a maximum wave height for that particular vessel. These vessels should:

1. Keep wash to a minimum
2. Avoid acceleration and deceleration phases through the critical threshold speeds and avoid operating at or near the critical threshold speed
3. Consider the location of acceleration and deceleration to avoid producing large waves that would propagate towards sensitive areas (eg near moorings, private structures, ferry wharves etc).

6.2.2 Other waterway users

PANSW states that vessels must not exceed four knots within 100 metres of:

- Any dredger or floating plant
- Any construction or any works in progress.

This restriction is in addition to requirements in the Marine Safety Regulation 2016 that states the operator of a vessel must not cause wash that damages or impacts unreasonably on dredgers, floating plant or construction works in progress. These restrictions would have an influence on the potential impact of the proposed works on navigation.

The requirement for all vessels to slow to less than four knots in the vicinity of dredging or construction activities is likely to result in a reduction in vessel wash produced by recreational and commercial vessels in the vicinity of the Western Harbour Crossing and temporary construction support sites. However, as vessels accelerate beyond the construction support site/s, the critical threshold speed is attained whereby the maximum theoretical wave height is produced. While boat wash may decrease in the immediate vicinity of the construction works, a higher wave climate may be produced either side of the construction works. If this causes an issue, Roads and Maritime and/or PANSW may wish to implement a speed restriction either side of the immersed tube tunnel works area of about six knots so that not all vessels accelerate through the critical threshold speed at the same location. This would distribute boat wash over a larger area.

6.2.3 Transport of Immersed Tube Tunnel units

The maximum advised conditions for local transportation of the immersed tube tunnel units are significant wave height (H_s) less than one metre and peak period (T_p) less than six seconds.

The one year ARI event wind waves at the Western Harbour Crossing, outlined in **Section 3.3**, are less than 0.7 metres with a period of two seconds. However, the one year ARI combined wind waves and boat waves exceed the maximum conditions for local transport. Ambient wind wave conditions would need to be considered and/or a speed restriction may need to be imposed on all waterway users to ensure that the wave conditions for local transport of the immersed tube tunnel units are not exceeded. However, it is noted that it is extremely unlikely that the units would be transported in a one year ARI period wind wave event.

6.2.4 Wave impact on the shoreline

There is not expected to be an appreciable increase in the vessel wash resulting from the construction activities. However, during certain construction activities, marine construction vessels or other vessels may navigate close to a shoreline. Vessel wash would not attenuate to the same degree and therefore, a higher localised wave climate could potentially be experienced near the shoreline. Due to the presence of the cofferdams near the edges of the navigation channel at the Western Harbour Crossing, vessels would generally be required to navigate near the centre of the channel.

The potential increase in the wave climate near the shoreline would be negligible. However, the project should avoid arrangements that require navigation close to a shoreline. This would ensure that the wave impact on the shoreline or on shoreline infrastructure would be similar to existing.

6.3 Water depths

During construction of the immersed tube tunnel, navigable water depth within the dredged footprint would exceed the existing water depth at all times. Following construction, the immersed tube tunnel would be covered by about one to two metres of fill and rock protection. The level of the bottom of the dredged trench would be designed such that there would be no reduction in navigable water depths during or following construction.

Further, it is noted that the water depth in the vicinity of the Western Harbour Crossing is -15 to -17 metres CD. This water depth exceeds the maximum water depth of -13.7 metres CD at the entrance to Sydney Harbour. The water depth at the entrance to the Harbour dictates the draught of vessels that enter the Harbour and traverse the Wester Harbour Crossing.

6.4 Navigation restrictions

6.4.1 Obstructions to navigation

Nearshore water depths near the vicinity of the Western Harbour Crossing are relatively deep resulting in a wide existing navigable waterway. The proposed construction works would restrict navigation. These restrictions include:

- Reduced navigation width due to construction of the cofferdams. The cofferdams are about 25 metres from the shoreline and 25 metres wide. It would be constructed with a flat top barge 50 metres by 20 metres. It is assumed a marine exclusion zone would be established around the cofferdams. The exclusion zone would be minimum 25 metres from the cofferdam and/or flat top

barge (about 80 metres from the shoreline). The navigable width between the cofferdams would be reduced to about 460 metres

- The dredging of the navigation channel would result in restrictions in navigation. In particular:
    - dredging of the sediment unsuitable for offshore disposal, with a backhoe dredger, requires environmental controls including use of a closed environmental clamshell and a silt curtain positioned round the dredger. The silt curtain is not readily relocatable
    - dredging of rock with a CSD, which is a stationary dredge that uses winches and anchors to allow the vessel to swing the cutter head from side to side to cut/dredge the tunnel trench. The dredger is not readily relocatable once they are positioned. Dredgers would need to be clear of the navigation channel when oil tankers are approaching or departing Gore Bay

- It is understood seven 48 hour navigation restrictions are proposed for immersion/placement of the immersed tube tunnel units

- Temporary closure and/or relocation of the Birchgrove Ferry wharf

- Temporary occupation of the waterway in the vicinity of Snails Bay dolphins. Snails Bay dolphins are an existing mooring location for larger vessels. The impact of mooring immersed tube tunnel units in Snails Bay would be similar to any other large vessel moored at this location

- Temporary occupation of the waterway at Berrys Bay (WHT7) and Yurulbin Point (WHT4) construction support sites. Both sites are located in relatively sheltered areas away from the main navigation channel. While they do occupy the waterway, they pose an insignificant obstruction to navigation.

Smaller vessels would be able to pass the navigation restrictions provided they do not all occur in parallel. Immersed tube tunnel immersion would not occur concurrently with other activities including dredging and construction of the cofferdam. Immersion of the immersed tube tunnel would have the greatest impact on navigation as it requires partial closure of the Inner Harbour.

The immersion should take place during weekdays to limit the disturbance on the recreational boating. Small vessels including ferries would be able to pass during the 48 hour navigation restrictions with controls including escorts and speed restrictions. Escort vessels should be provided. However, the navigation restrictions would prohibit larger vessels including oil tankers.

It is understood that PANSW would require dredgers to be clear of the navigation channel when oil tankers are approaching or departing Gore Bay.

Further, it would be a requirement that following tunnel immersion, the maximum speed for the larger vessels such as tankers accessing Gore Bay would be two to three knots until the locking fill has been installed and stabilised.

Ferry services to the Birchgrove Wharf could not be kept in operation at the current location during construction of the southern cofferdam and interface structure. Alternative arrangements for this wharf would be investigated during the detailed design phase.

A key issue for navigation would be during events such as the New Year's Eve fireworks display. Navigation restrictions have historically applied (refer **Section 4.5.4**), which limit navigation to the edge of the waterway. Roads and Maritime would need to make appropriate arrangements. At a minimum, all large construction equipment including dredgers, barges etc should be removed from the works area and relocated to White Bay or an alternate suitable location. Smaller vessels should patrol the area in the vicinity of the cofferdams to ensure the works are not damaged by passing traffic during this period.

6.4.2 Special Event Marine Notices and Marine Traffic Management Plan

Special Event Marine Notices should be issued in accordance with Section 12 of the *Marine Safety Act 1998* notifying all marine users of the navigation restrictions. It is recommended that exclusion zones are formed around the temporary cofferdams and construction support sites at Berrys Bay (WHT7) and Yurulbin Point (WHT4). The exclusion zones are intended to separate the public from construction works. Where necessary, navigation channels would need to be delineated to indicate safe passage for recreational vessels through the exclusion zones.

As part of the Special Event Marine Notices, it is recommended that Roads and Maritime prepares a Marine Traffic Management Plan that specifically notes exclusions zones delineated by special marks and navigation channels delineated by navigation marks. The plan should indicate distance from the works area, marker spacing and the like. Where possible, manoeuvring of marine construction equipment should take place within the exclusion zones.

All structures occupying part of the waterway or any exclusion mark or navigation mark placed in the water should be adequately lit. Where necessary, cardinal markers and/or navigation aids should be fixed to any structure or exclusion marker to clarify the side that vessels should pass. The position, colour and light characteristic of all buoyage used for the works must be agreed in advance with the Harbour Master and Roads and Maritime.

6.5 Relocation of moorings

Moorings in the vicinity of the Berrys Bays construction support site (WHT7) and on approach to the site would need to be relocated. Roads and Maritime should liaise with the mooring licence holders and make appropriate arrangements for relocating the vessels. All efforts would be made to relocate mooring as close as possible to their original locations as possible. Impacted mooring licence holders may be entitled to a fee waiver or fee reimbursement where appropriate.

6.6 Berthing restrictions at Snails Bay and the historic Coal Loader

Due to occupation of the waterway in the vicinity of the Snails Bay dolphins and the historic Coal Loader wharf, there would be restrictions to the number and type of vessels that can berth at these facilities.

6.7 Vessel interaction

Vessel interactions in the Outer Harbour and Inner Harbour would be considered tolerable. There is a requirement in the Marine Safety Regulation 2016 that power vessels must give way to large vessels restricted in their manoeuvrability.

6.8 User groups

The construction activities would impose speed restrictions around construction equipment and result in increased transit time for recreational, commercial and government vessels past the Western Harbour Crossing. The construction zone in the vicinity of the Western Harbour Crossing would be about 300

metres wide. A vessel travelling at a typical speed of 20 knots would take 30 seconds to travel through the construction zone. During construction, a speed limit of four knots would be imposed and a vessel may be required to travel an additional 300 metres to avoid construction plant and equipment. Therefore, it could take up to five minutes to transit the construction zone. This is a worst case scenario as vessels would rarely be required to travel an additional 300 metres to avoid construction plant and equipment.

The increased transit time of up to four minutes and 30 seconds would be unavoidable.

The impacts and mitigation measures discussed herein are mainly a result of works associated with the immersed tube tunnel, including cofferdams. The construction support sites at White Bay (WHT3), Berrys Bay (WHT7) and Yurulbin Point (WHT4) are programmed over a longer duration. However, the impact on other waterway users resulting from works in these areas is significantly less than the impact caused by construction of the immersed tube tunnel.

6.8.1 Community groups and clubs

Community groups most likely to be affected by the proposed construction activities include sailing clubs and Marine Rescue.

It is highly likely that sailing clubs would prefer to alter their courses to achieve a good competitive outcome for the competing vessels while the construction activities are underway. With the exception of immersed tube tunnel unit immersion, the waterway would not be closed. However, restrictions posed by construction equipment such as dredgers and cofferdams combined with the proximity and frequency of marine construction traffic, that may have limited manoeuvrability, is likely to result in unfavourable sailing conditions. It is recommended that the sailing clubs affected by the proposed works are consulted and encouraged to alter sail racing courses that are impacted by the works.

Marine Rescue would not be directly impacted by the construction activities. Transiting past the Western Harbour Crossing at high speed would need to be restricted during construction. However, these speed restrictions would not apply to Marine Rescue in an emergency situation in accordance the Marine Safety Regulation 2016.

A number of major events are held on Port Jackson throughout the year as outlined in **Section 4.7.1.6**. These events occur in the Outer Harbour and it is assumed that where necessary, an aquatic licence is obtained from Roads and Maritime. Marine construction traffic in the Outer Harbour should be avoided when these events are underway. If a clash with marine traffic is unavoidable, the event organisers should be consulted so that they can either delay the start of the event or alter the course.

Furthermore, Port Jackson is highly congested on most weekends during summer, particularly between about 12pm and 5pm when a number of clubs hold their weekly sailing races. Construction hours are limited to 8am to 1pm on Saturdays with no work on Sunday. However, TSHD operations would be 24 hours a day seven days a week. Therefore, after 1pm on a Saturday and all day Sunday, marine construction traffic in the Outer Harbour would be limited to the TSHD transiting to and from the offshore disposal grounds about every four to five hours. This would not be expected to have any significant impact on other Outer Harbour users.

6.8.2 Commercial operators

6.8.2.1 White Bay and Glebe Island Precinct

The White Bay and Glebe Island precinct would be substantially altered as a result of the proposed construction activities to enable construction of the Works. However, with the exception of White Bay

Berth 3 that is proposed to be used for handling dredged material, the remaining berths at White Bay (2, 4, 5 [Cruise Terminal], Baileys Marine Fuels and Sydney Harbour Boat Storage) and Glebe Island (1, 2, 7 and 8) would not be impacted by the construction activities including casting and fit out of the immersed tube tunnel units. Departures from Glebe Island Berths 7 & 8 will be affected when dredge spoil barges occupy White Bay Berth 3. There would need to be co-operation between occupants of White Bay during arrival and departure of cargo ships, bulk carriers or cruise liners, particularly when vessels are manoeuvring in the Darling Harbour and Johnstons Bay turning basins. However, this level of co-operation is status quo.

Furthermore, construction equipment affiliated with the immersed tube tunnel would need to give way to large vessels approaching or departing White Bay and Glebe Island in the Outer Harbour or offshore. Harbour Master directions including the requirement that vessels must not pass between an escort vessel and a seagoing vessel, or within 30 metres of the seagoing vessel (refer **Section 3.4.1**) would apply to construction equipment.

6.8.2.2 Overseas Passenger Terminal

The OPT would not be impacted by the proposed construction activities. Construction equipment affiliated with the construction activities would need to give way to cruise liners approaching or departing the OPT either in the Outer Harbour or offshore.

6.8.2.3 Gore Bay Terminal (Viva Energy)

Gore Bay would be substantially impacted by the proposed construction activities. However, the impact would be mitigated where possible. It is understood that PANSW would require dredgers to be clear of the navigation channel when oil tankers are approaching or departing Gore Bay.

However, bunkering vessels that exceed 100 metres in length would be affected by the works. The main impact would be the increased transit time between Gore Bay and White Bay or the OPT.

6.8.2.4 Commercial fishing

Due to the primary mooring location of the commercial fishing fleet being in Blackwattle Bay and permitted fishing grounds being located offshore, there is unlikely to be any significant impact on the commercial fishing fleet.

Furthermore, construction equipment affiliated with the immersed tube tunnel and commercial fishing vessels transiting the Inner Harbour and Outer Harbour would need to give way to one another. Standard navigation rules outlined in **Section 4.3** would apply.

6.8.2.5 Harbour City Ferries and Captain Cook Cruises

Captain Cook Cruises Lane Cove to City ferry service and the HCF Service to Cockatoo Island and Parramatta would be directly impacted by the proposed construction activities. Impacts include the need to amend routes to cater for a relocated Birchgrove Ferry Wharf and increased transit times due to speed restrictions in the vicinity of construction plant and equipment. These impacts would be relatively minor and unavoidable.

6.8.2.6 Water taxis, charter companies and boat storage facilities

With the exception of increased transit time in and around the Inner Harbour resulting from speed restrictions in the vicinity of dredgers, construction plant and equipment, and a requirement to give way to construction plant and equipment, water taxis, charter companies and boat storage facilities are unlikely to be impacted significantly by the proposed construction activities.

6.8.3 Government

6.8.3.1 Royal Australian Navy

The immersed tube tunnel crosses immediately south of HMAS Waterhen. The impacts of the works may include increased transit time in the works area.

6.8.3.2 Water Police, Roads and Maritime, and Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources)

Transiting past the Western Harbour Crossing at high speed would need to be restricted during construction. However, these speed restrictions would not apply to Water Police in an emergency in accordance with Marine Safety Regulation 2016.

6.9 Summary of mitigation measures

The following is a summary of mitigation measured discussed herein.

Vessel interaction and requirements for marine construction vessels

- Marine construction traffic shall:
  - keep wash to a minimum
  - avoid acceleration and deceleration phases through the critical threshold speeds and avoid operating at or near the critical threshold speed
  - consider the location of acceleration and deceleration to avoid producing large waves that would propagate towards sensitive areas (eg near moorings, private structures, ferry wharves etc).
- Large construction equipment including dredgers and barges would be removed from the immersed tube tunnel works area and relocated to an alternate suitable location during New Year's Eve for the fireworks display
- All structures occupying part of the waterway or any exclusion marker placed in the water should be adequately lit. This includes wharves, jetties and cofferdams
- All marine construction equipment and immersed tube tunnel units should be fitted with operational navigation lights at all times, including while moored or anchored at a location other than their registered (everyday) mooring location
- All movements of large construction equipment including barges, immersed tube tunnel units and dredgers would need to be in accordance with PANSW requirements
- All construction equipment including stationary barges and transport vessels should be fitted with AIS that are turned on at all times.

Impact on other waterway users

- The Birchgrove Wharf would not be serviceable in its current location and alternatives will be investigated during detailed design
- Moorings would need to be relocated from near the Berrys Bay construction support site (WHT7)
- Roads and Maritime and Water Police should consider increased patrols on the upstream side and downstream side of the Western Harbour Crossing during construction.

7 References

- Department of Army Coastal Engineering Research Centre (1984), *Shore Protection Manual Fourth Edition*
- Greater Sydney Commission *(2018), Greater Sydney Region Plan – A Metropolis of Three Cities.*
- Manly Hydraulic Laboratory [MHL] (2012), *OEH NSW Tidal Planes Analysis: 1990-2010 Harmonic Analysis*, Report MHL2053, prepared for NSW Office of Environment and Heritage, October.
- NSW Maritime Authority (2005), *Design Guidelines for Waterside Works Subject to Rivercat and Harbourcat Ferry Wash (Sydney Harbour and the Parramatta River),* Issue No. 4, May
- Port Authority of NSW (2016), *Harbour Master's Directions Sydney Harbour and Botany Bay*, July.
- Roads and Maritime (2017), *Boating Handbook*, prepared by Roads and Maritime, NSW Transport Maritime, December 2016
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- Transport for NSW (2014), *Boating Safety Plan: Sydney Harbour and its tributaries*, prepared by Maritime Management Centre, July
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- United States Army Corps of Engineers (USACE, 2008), *Coastal Engineering Manual.*

Appendix A – Maps

DRAWING No.
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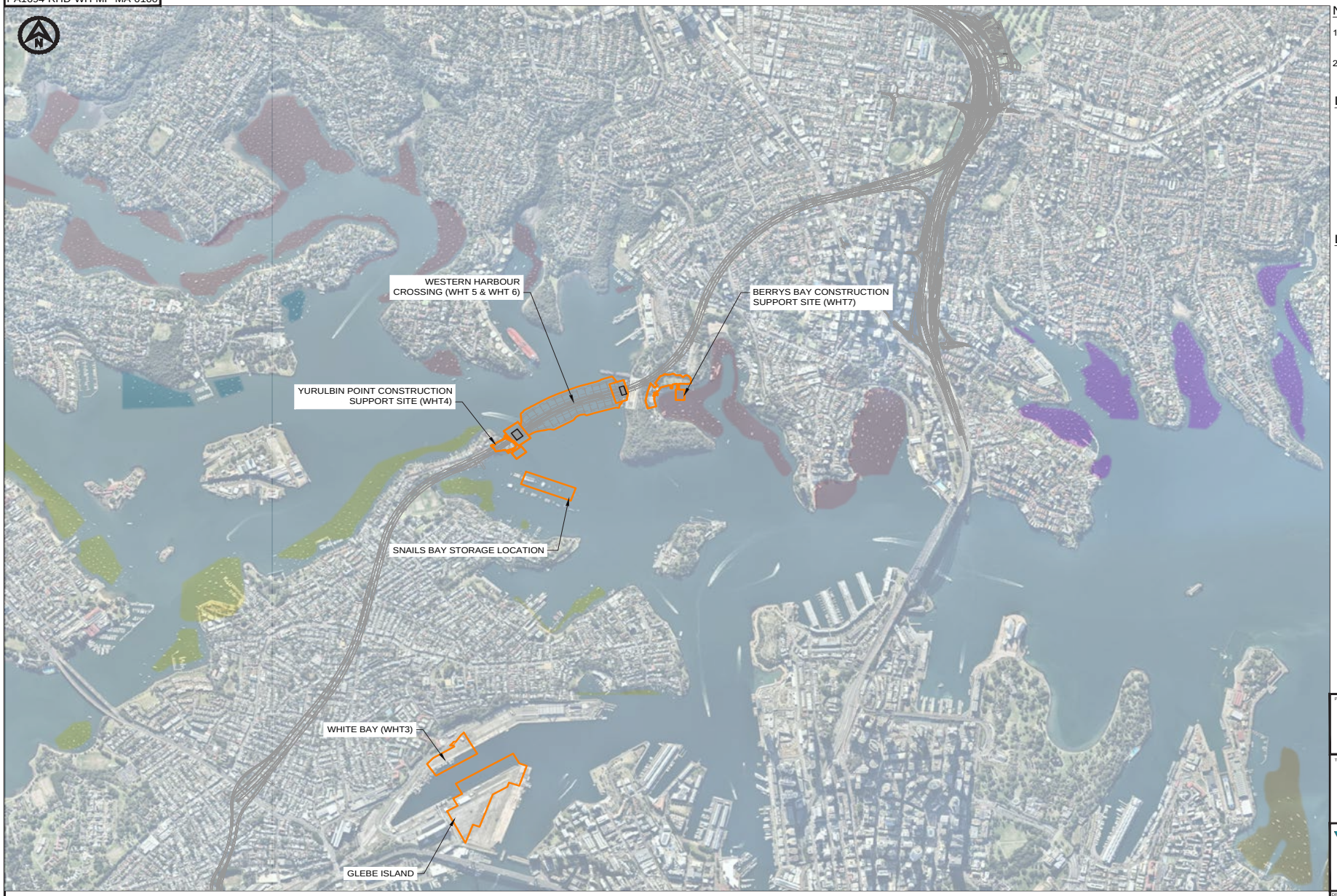
DO NOT SCALE



NOTES

1. AERIAL OBTAINED FROM NEARMAP ON 22.07.2019
2. WESTERN HARBOUR TUNNEL SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.

LEGEND

- WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES
- WESTERN HARBOUR TUNNEL PROPOSED PROJECT

LEGEND MOORINGS

- SYDNEY A
- SYDNEY B
- SYDNEY C
- SYDNEY D
- SYDNEY E
- SYDNEY F

200 0 200 400 600 800 1000m

1:20000 (A3) 1:10000 (A1)

NOT FOR CONSTRUCTION

PROJECT

WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE

MAP 1
PORT JACKSON OVERVIEW
& MOORING AREAS

Level 14, 56 Berry Street
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Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
JPC	MGA ZONE 56	AHD	15.10.2019

SCALE AT A1	REF.
AS SHOWN	PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS

DRAWING No. PA1694-RHD-WH-MP-MA-0100

REVISION

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DRAWING No.
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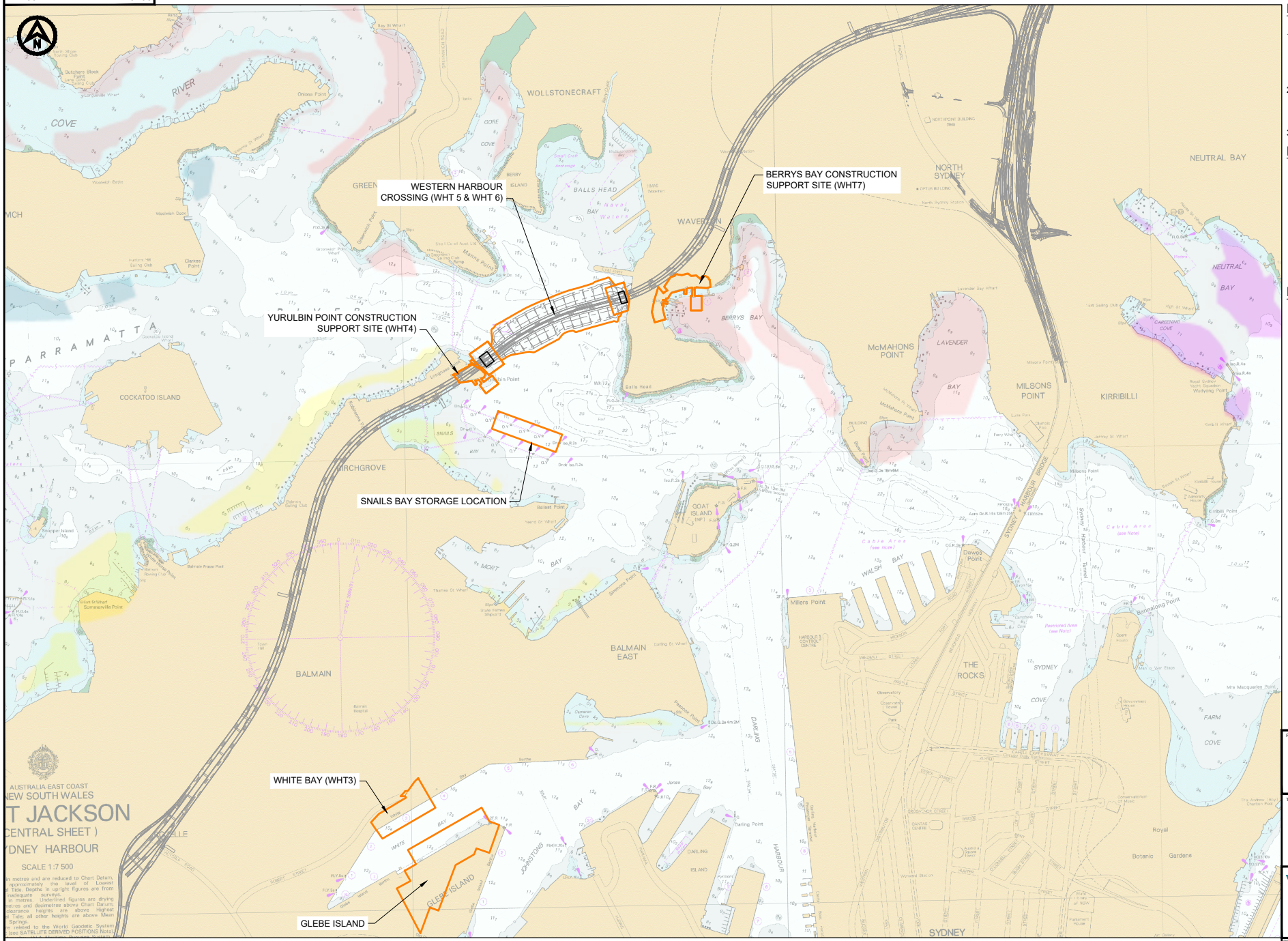

NOTES

1. MOORING MAP OF SYDNEY HARBOUR OBTAINED FROM ROADS & MARITIME SERVICES 05.02.2016
2. WESTERN HARBOUR TUNNEL SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.
3. NAUTICAL CHART AUS 202

LEGEND

- WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES
- WESTERN HARBOUR TUNNEL PROPOSED PROJECT

MOORING LEGEND

- SYDNEY A
- SYDNEY B
- SYDNEY C
- SYDNEY D
- SYDNEY E
- SYDNEY F

150 0 150 300 450 600 750m

1:15000 (A3) 1:7500 (A1)

PROJECT

WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE

MAP 2
MARITIME & NAVIGATION FEATURES OF PORT JACKSON

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DRAWN	COORD. SYSTEM	DATUM	DATE
JPC	MGA ZONE 56	AHD	15.10.2019
SCALE AT A1 AS SHOWN	REF. PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS		

DRAWING No. PA1694-RHD-WH-MP-MA-0200 REVISION

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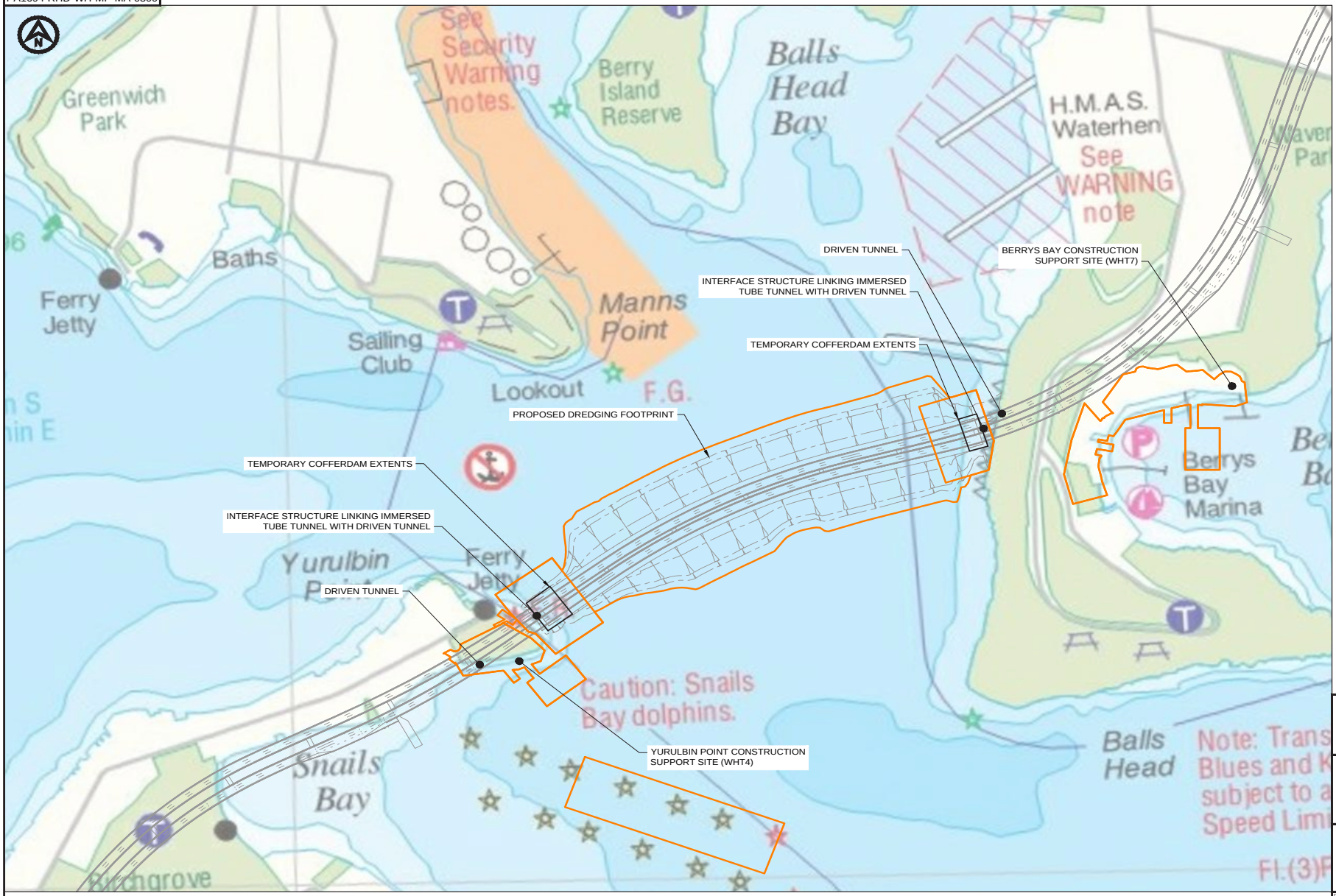

NOTES

1. ROADS & MARITIME SERVICES BOATING MAP OF PORT JACKSON - EAST OF SYDNEY HARBOUR BRIDGE
2. ROADS & MARITIME SERVICES BOATING MAP OF PORT JACKSON - WESTERN AREA LOWER PARRAMATTA & LANE COVE RIVERS
3. WESTERN HARBOUR TUNNEL SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.

LEGEND

- WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES
- WESTERN HARBOUR TUNNEL PROPOSED PROJECT

50 0 50 100 150 200 250m

1:5000 (A3) 1:2500 (A1)

NOT FOR CONSTRUCTION

PROJECT: WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE: MAP 3 PROPOSED CONSTRUCTION PLAN AND NAVIGATION RESTRICTIONS

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DRAWN	COORD. SYSTEM	DATUM	DATE
JPC	MGA ZONE 56	AHD	15.10.2019

SCALE AT A1	REF.
AS SHOWN	PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS

DRAWING No. PA1694-RHD-WH-MP-MA-0300

REVISION

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DRAWING No. PA1000-RHD-00-MP-MA-0400

DO NOT SCALE

LEGEND

PADDLE CRAFT CLUBS, TOURS AND HIRE CENTRES:

1. OZPADDLE ROSE BAY
2. BONDI OUTRIGGER CANOE CLUB
3. KAYAKING TOURS SYDNEY
4. POINT PIPER KAYAK CENTRE
5. OZPADDLE WOOLLOOMOOLOO BAY
6. BLACKWATTLE BAY DRAGON BOAT CLUB
7. ACCA DRAGON BOAT RACING TEAM
8. SYDNEY TSUNAMI DRAGON BOAT CLUB INC.
9. NAGA SPIRIT DRAGON BOAT CLUB
10. SLOTHS DRAGON BOAT CLUB
11. GLEBE ROWING CLUB
12. SYDNEY UNIVERSITY BOT CLUB
13. BALMAIN ROWING CLUB
14. MOSMAN ROWING CLUB

NOTE: ONLY THE CLOSEST ROWING CLUB ON THE PARRAMATTA AND LANE COVE RIVERS TO THE WESTERN HARBOUR CROSSING ARE LISTED AS THE REMAINING CLUBS ARE UNLIKELY TO BE IMPACTED BY THE PROPOSED WORKS.

SAILING AND YACHT CLUBS:

1. VAUCLUSE YACHT CLUB
2. VAUCLUSE AMATEUR 12FT SAILING CLUB
3. WOOLLAHRA SAILING CLUB
4. ROYAL MOTOR YACHT CLUB OF NSW
5. ROYAL PRINCE EDWARD YACHT CLUB
6. 18 FOOTERS SAILING CLUB, DOUBLE BAY
7. DOUBLE BAY SAILING CLUB
8. RAN SAILING ASSOCIATION
9. CRUISING YACHT CLUB OF AUSTRALIA (CYCA)
10. BALMAIN SAILING CLUB
11. DRUMMOYNE SAILING CLUB
12. HUNTERS HILL SAILING CLUB
13. LANE COVE 12 FOOT SKIFF SAILING CLUB
14. GREENWICH FLYING SQUADRON
15. GREENWICH SAILING CLUB
16. ROYAL SYDNEY YACHT SQUADRON
17. SYDNEY FLYING SQUADRON
18. SYDNEY AMATEUR SAILING CLUB

NOTE: ALL SAILING CLUBS IN THE OUTER AND INNER HARBOUR ARE RECORDED ALONG WITH CLUBS ON THE LOWER REACHES OF THE PARRAMATTA AND LANE COVE RIVERS.

SEA SCOUT AND GUIDE GROUPS:

1. MOSMAN SEA SCOUTS
2. CLIFTON GARDENS SEA SCOUTS

NOTE: ONLY SCOUT AND GUIDE GROUPS ON THE OUTER HARBOUR AND INNER HARBOUR ARE RECORDED AS THE GROUPS ON THE PARRAMATTA AND LANE COVE RIVERS ARE UNLIKELY TO BE IMPACTED BY THE PROPOSED WORKS.

MARINE RESCUE:

1. MARINE RESCUE PORT JACKSON

NOTES

1. AERIAL OBTAINED FROM NEARMAP ON 22.07.2019
2. WESTERN HARBOUR SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.

LEGEND

- WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES
- WESTERN HARBOUR TUNNEL PROPOSED PROJECT

300 0 300 600 900 1200 1500m

1:30000 (A3) 1:15000 (A1)

NOT FOR CONSTRUCTION

PROJECT: WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE: MAP 4 COMMUNITY GROUPS & CLUBS

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Australia
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Fax +61 2 9929 0960
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Website: www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
JPC	MGA ZONE 56	AHD	23.07.2019

SCALE AT A1: AS SHOWN

REF: PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS

DRAWING No. PA1694-RHD-WH-MP-MA-0400

REVISION

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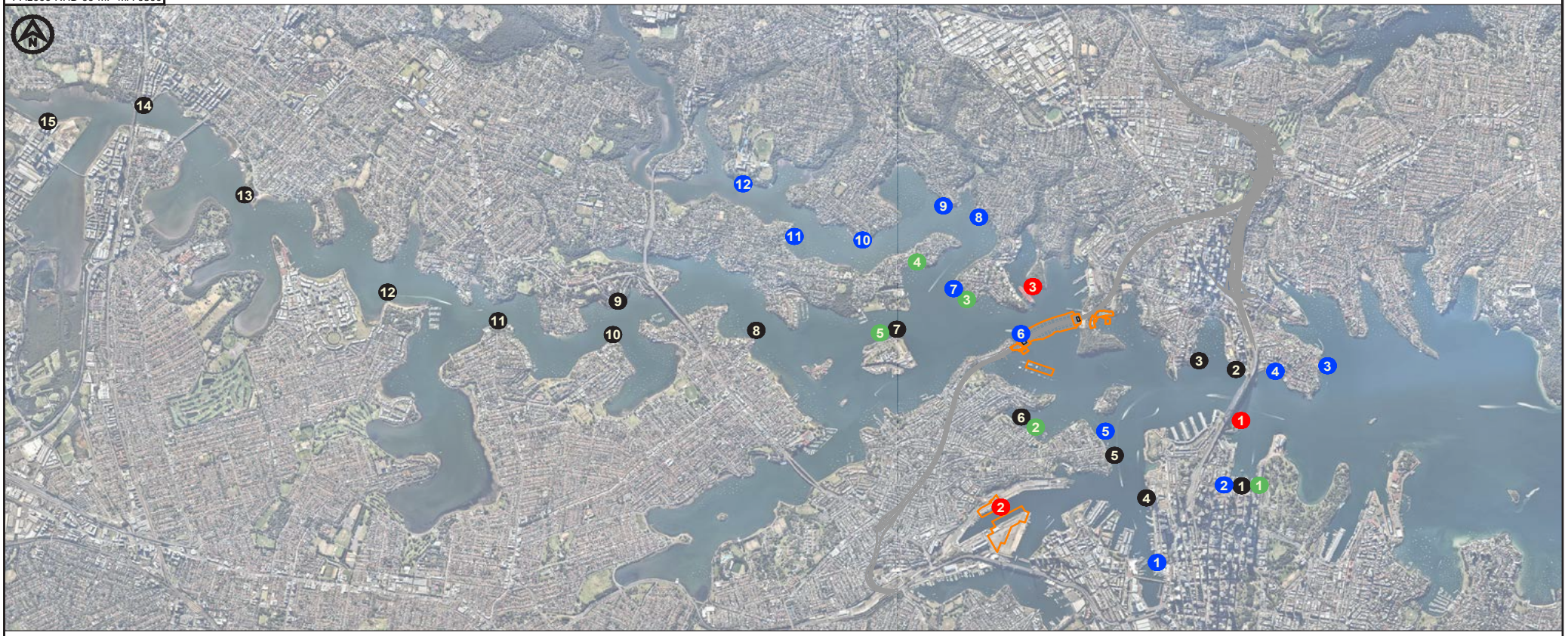
DRAWING No.
PA1000-RHD-00-MP-MA-0500

DO NOT SCALE



LEGEND

CRUISE, TANKER AND BULK SHIPPING TERMINALS:

1. OVERSEAS PASSENGER TERMINAL
2. WHITE BAY AND GLEBE ISLAND
3. GORE BAY TERMINAL

CAPTAIN COOK CRUISES LANE COVE TO CITY FERRY SERVICE WHARVES:

1. DARLING HARBOUR
2. CIRCULAR QUAY
3. KIRRIBILLI
4. NORTH SYDNEY
5. BALMAIN
6. BIRCHGROVE
7. GREENWICH POINT
8. GREENWICH WHARF
9. NORTHWOOD
10. LONGUEVILLE
11. HUNTERS HILL
12. LANE COVE

HARBOUR CITY FERRIES (F3) PARRAMATTA RIVER FERRY SERVICE/WHARVES:

1. CIRCULAR QUAY
2. MILSONS POINT
3. MCMAHONS POINT
4. BARANGAROO
5. BALMAIN EAST
6. BALMAIN
7. COCKATOO ISLAND
8. DRUMMOYNE
9. HUNTLEYS POINT
10. CHISWICK
11. ABBOTSFORD
12. CABARITA
13. KISSING POINT
14. MEADOWBANK
15. SYDNEY OLYMPIC PARK

HARBOUR CITY FERRIES (F8) COCKATOO ISLAND FERRY SERVICE/WHARVES:

1. CIRCULAR QUAY
2. BALMAIN
3. GREENWICH POINT
4. WOOLWICH
5. COCKATOO ISLAND

NOTE: THE F8 FERRY SERVICE TYPICALLY STOPS AT BIRCHGROVE. HOWEVER, THE WHARF IS CURRENTLY UNDER CONSTRUCTION AND AS SUCH, THE WHARF HAS BEEN EXCLUDED FROM THE CURRENT TIMETABLE.

NOTES

1. AERIAL OBTAINED FROM NEARMAP ON 22.07.2019
2. WESTERN HARBOUR SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.

LEGEND

- WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES
- WESTERN HARBOUR TUNNEL PROPOSED PROJECT

400 0 400 800 1200 1600 2000m

1:40,000 (A3) 1:20,000 (A1)

NOT FOR CONSTRUCTION

PROJECT
WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE
MAP 5
COMMERCIAL OPERATORS

Level 14, 56 Berry Street
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Australia
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JPC	MGA ZONE 56	AHD	23.07.2019

SCALE AT A1: AS SHOWN
REF: PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS

DRAWING No.: PA1694-RHD-WH-MP-MA-0500
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DRAWING No.
PA1000-RHD-00-MP-MA-0600

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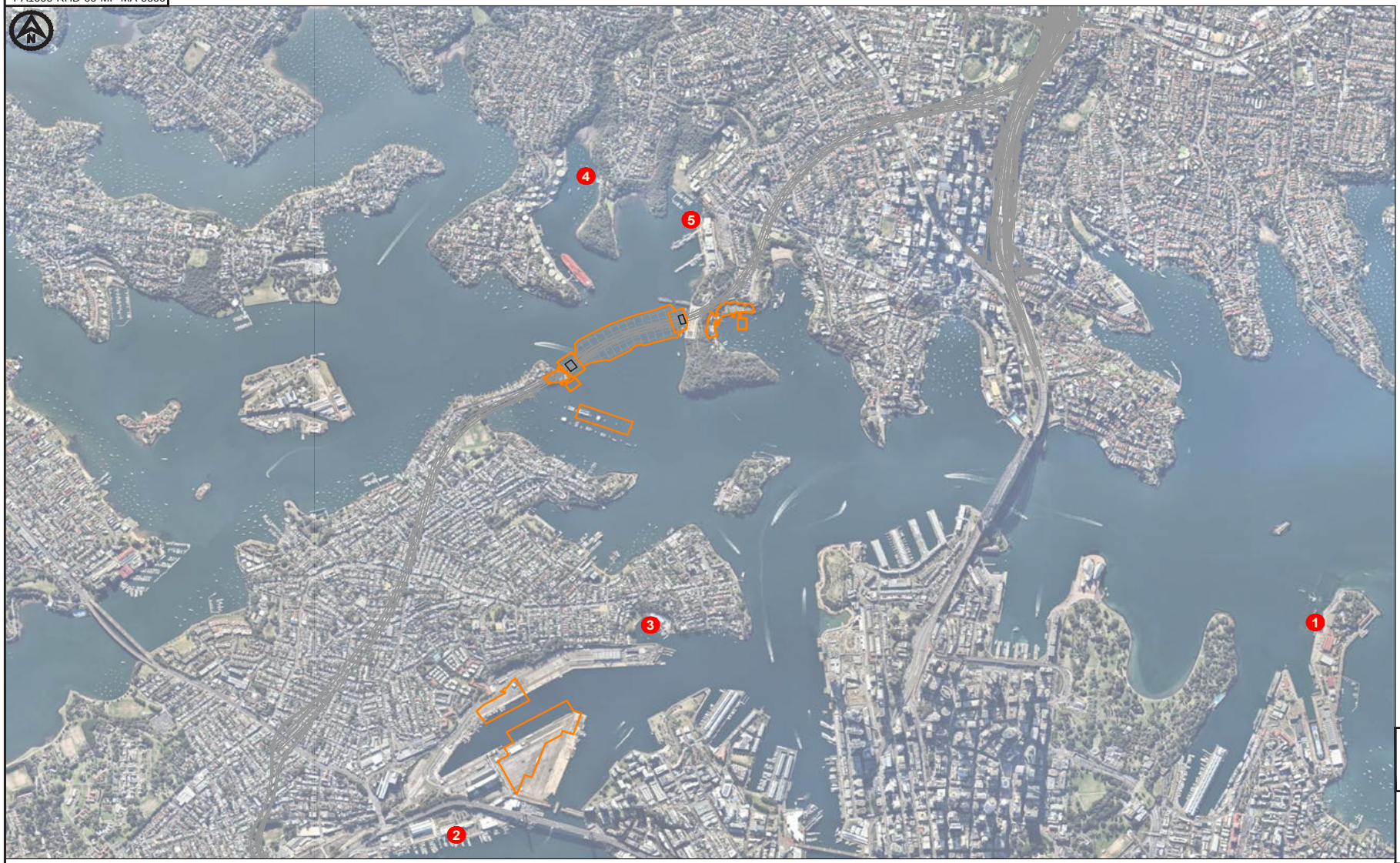

200 0 200 400 600 800 1000m

1:20000 (A3) 1:10000 (A1)

LEGEND

GOVERNEMENT ORGANISATIONS:

1. H.M.A.S KUTTABUL (GARDEN ISLAND)
2. NSW ROADS AND MARITIME SERVICES
3. NSW POLICE MARINE AREA COMMAND
4. NSW DEPARTMENT OF PRIMARY INDUSTRIES FISHERIES
5. H.M.A.S WATERHEN

NOTES

1. AERIAL OBTAINED FROM NEARMAP ON 22.07.2019
2. WESTERN HARBOUR SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.

LEGEND

WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES

WESTERN HARBOUR TUNNEL PROPOSED PROJECT

NOT FOR CONSTRUCTION

PROJECT
WESTERN HARBOUR TUNNEL
NAVIGATIONAL IMPACT
ASSESMENT

TITLE
MAP 6
GOVERNMENT ORGANISATIONS

Level 14, 56 Berry Street
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JPC	MGA ZONE 56	AHD	23.07.2019

SCALE AT A1: AS SHOWN
REF: PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS

DRAWING No.: PA1694-RHD-WH-MP-MA-0600
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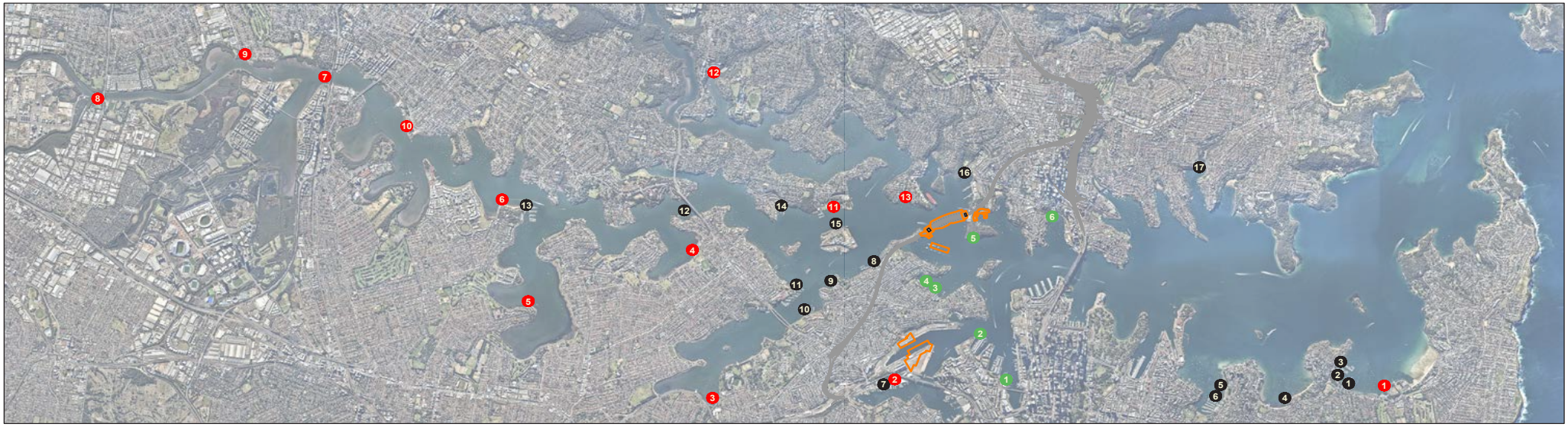
DRAWING No.
PA1000-RHD-00-MP-MA-0700

DO NOT SCALE



LEGEND

INNER HARBOUR CHARTER COMPANIES:

1. SYDNEY MOTOR YACHT CHARTERS, SYDNEY
2. AUSTRALIAN SUPERYACHTS, PYRMONT
3. LIQUID EDGE YACHT CHARTERS, BALMAIN
4. DEEP BLUE CHARTERS, BALMAIN
5. SYDNEY HARBOUR YACHT CHARTER, WAVERTON
6. SAILCORP YACHT CHARTERS, MCMAHONS POINT

NOTE: ONLY CHARTER COMPANIES IN THE INNER HARBOUR ARE RECORDED.

PRIVATE AND COMMERCIAL MARINAS:

1. ROSE BAY MARINA, ROSE BAY
2. POINT PIPER MARINA, POINT PIPER
3. ROYAL MOTOR YACHT CLUB MARINA, POINT PIPER
4. DOUBLE BAY MARINA, DOUBLE BAY
5. D'ALBORA MARINA, DARLING POINT
6. CYCA MARINA, DARLING POINT
7. SYDNEY SUPERYACHT MARINA, ROZELLE
8. PRIVATE MARINA AT 2-8 WATER STREET, BIRCHGROVE
9. BALMAIN MARINA AND CAMERONS MARINA, BALMAIN
10. PRIVATE MARINA AT 1A WULUMAY CLOSE, ROZELLE
11. BIRKENHEAD POINT MARINA, BIRKENHEAD
12. GLADESVILLE BRIDGE MARINA, DRUMMOYNE
13. D'ALBORA MARINAS CABARITA POINT, CABARITA
14. PULPIT POINT MARINA, HUNTERS HILL
15. WOOLWICH MARINA, WOOLWICH
16. PRIVATE MARINA AT KING STREET, WOLLSTONECRAFT
17. MOSMAN BAY MARINA, MOSMAN

NOTE: ONLY MARINAS WITH MORE THAN ~ 15 BERTHS ARE RECORDED.

BOAT RAMPS AND DRY STORAGE FACILITIES:

1. LYNE PARK BOAT RAMP, ROSE BAY
2. SYDNEY BOATHOUSE DRY BOAT STORAGE, ROZELLE
3. HAWTHORNE CANAL, LILYFIELD
4. TAPLIN PARK BOAT RAMP, DRUMMOYNE
5. BAYVIEW PARK BOAT RAMP, CONCORD
6. KENDALL BAY, CABARITA PARK
7. BLAXLAND ROAD BOAR RAMP, RHODES
8. SILVERWATER PARK, SILVERWATER
9. WHARF ROAD BOAT RAMP, ERMINGTON
10. KISSING POINT BOAT RAMP, PUTNEY
11. WOOLWICH BOAT RAMP, MARGARET STREET, WOOLWICH
12. BURNS BAY RESERVE BOAT RAMP, RIVERVIEW
13. MANNS POINT BOAT RAMP, GREENWICH

NOTE: ONLY BOAT RAMPS AND DRY STORAGE FACILITIES FOR TRAILERABLE CRAFT (SAY 4 TO 7.5 M) ARE RECORDED.

NOTES

1. AERIAL OBTAINED FROM NEARMAP ON 22.07.2019
2. WESTERN HARBOUR SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.

LEGEND

- WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES
- WESTERN HARBOUR TUNNEL PROPOSED PROJECT

600 0 1000 2000 3000m

1:60000 (A3) 1:30000 (A1)

NOT FOR CONSTRUCTION

PROJECT
WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE
MAP 7
BOAT LAUNCHING, DRY STORAGE AND MARINA FACILITIES

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JPC	MGA ZONE 56	AHD	23.07.2019

SCALE AT A1: AS SHOWN
REF: PA1694-RHD-WH-M2-MA-0001-CONSTRAINTS

DRAWING No.
PA1694-RHD-WH-MP-MA-0700

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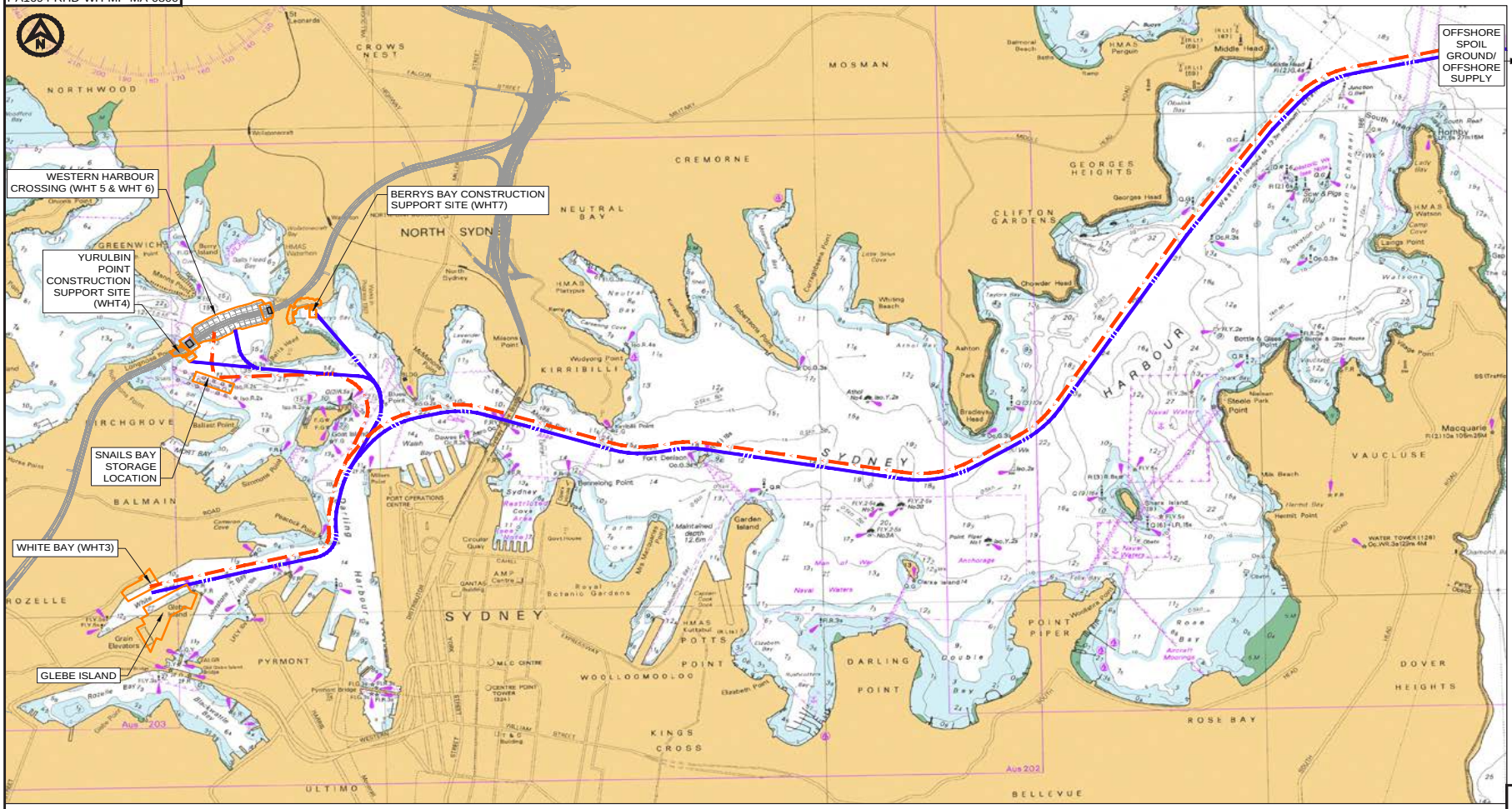
DRAWING No.
PA1694-RHD-WH-MP-MA-0800

DO NOT SCALE



LEGEND

IMMERSED TUBE TUNNEL UNIT TRANSPORT

1. **OFFSHORE SUPPLY TO WHITE BAY** - POTENTIAL ROUTE FOR SUPPLY OF OTHER MATERIALS AND EQUIPMENT
2. **WHITE BAY TO SNAILS BAY STORAGE LOCATION**
3. **SNAILS BAY STORAGE LOCATION TO WESTERN HARBOUR CROSSING** - FOR IMMERSION

MARINE CONSTRUCTION TRAFFIC

1. **WHITE BAY TO/FROM WESTERN HARBOUR CROSSING** - FOR SUPPLY OF EQUIPMENT/MATERIALS TO WESTERN HARBOUR CROSSING FOR CONSTRUCTION OF COFFERDAMS AND TRANSITION STRUCTURES AND REMOVAL OF DREDGED MATERIAL
2. **WHITE BAY TO/FROM BERRYS BAY** - FOR SUPPLY OF EQUIPMENT/MATERIALS TO BERRYS BAY AND REMOVAL OF DRIVEN TUNNEL SPOIL FROM BERRYS BAY
3. **WHITE BAY TO/FROM YURULBIN POINT** - FOR SUPPLY OF EQUIPMENT/MATERIALS TO YURULBIN POINT AND REMOVAL OF DRIVEN TUNNEL SPOIL FROM YURULBIN POINT
4. **WESTERN HARBOUR CROSSING TO/FROM OFFSHORE SPOIL GROUND** - FOR UNCONFINED SEA DISPOSAL OF SUITABLE DREDGED MATERIAL

300 0 300 600 900 1200 1500m

1:30000 (A3) 1:15000 (A1)

LEGEND

WESTERN HARBOUR TUNNEL CONSTRUCTION SUPPORT SITES REQUIRED FOR MARINE ACTIVITIES

WESTERN HARBOUR TUNNEL PROPOSED PROJECT

NOTES

1. WESTERN HARBOUR SITE PLAN PROVIDED BY ROADS & MARITIME SERVICES.
2. NAUTICAL CHART AUS 200

NOT FOR CONSTRUCTION

PROJECT
WESTERN HARBOUR TUNNEL NAVIGATIONAL IMPACT ASSESMENT

TITLE
MAP 8
PROPOSED MARINE CONSTRUCTION TRAFFIC ROUTE FOR CIVIL WORKS

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Website: www.royalhaskoningdhv.com

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JPC	MGA ZONE 56	AHD	15.10.2019

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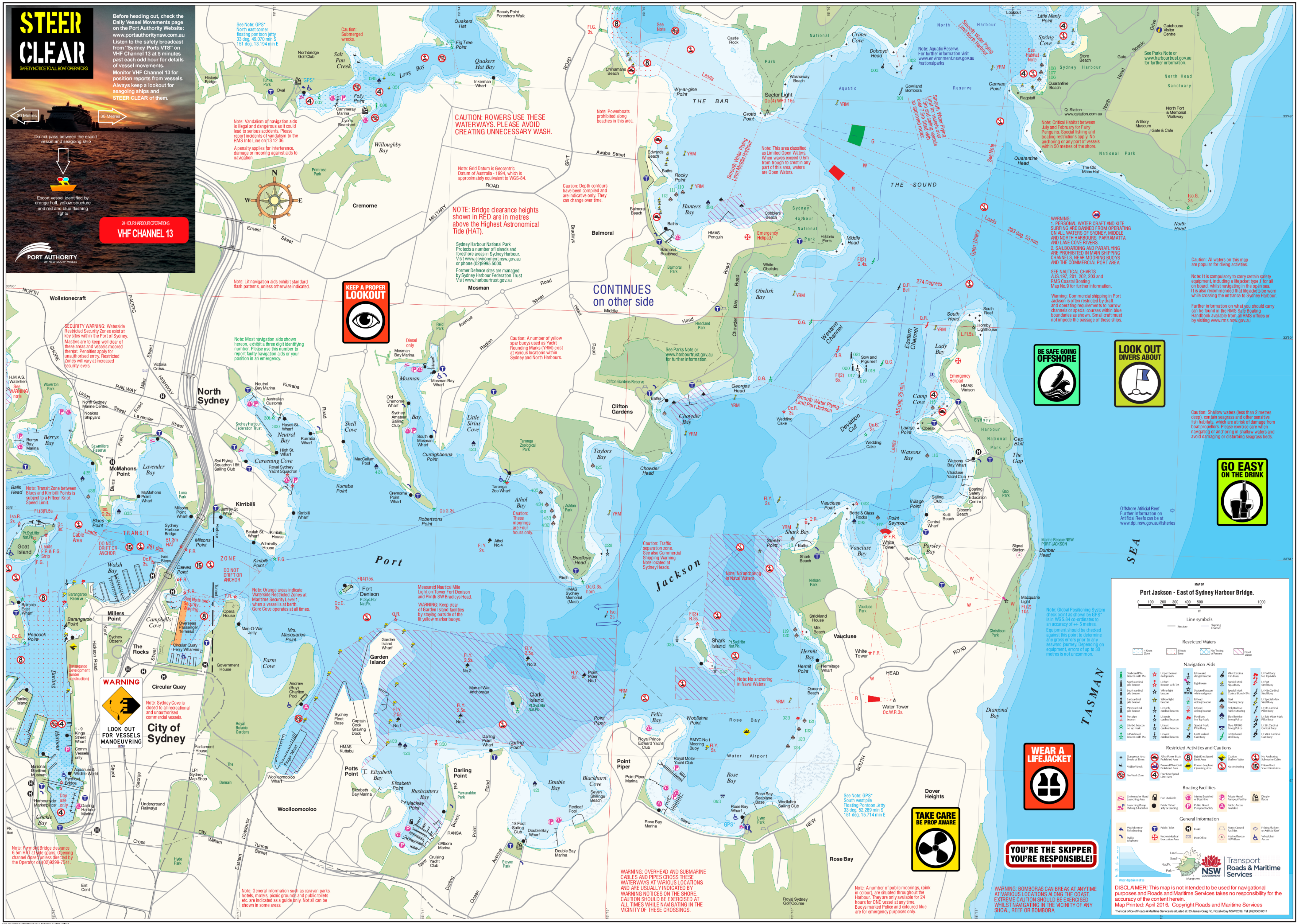
Appendix B – Roads and Maritime Services Boating Map

Map 1 – Port Jackson – East of Sydney Harbour Bridge

Map 2 – Port Jackson – Western Area Lower Parramatta and Lane Cove Rivers



STEER CLEAR
SAFETY NOTICE TO ALL BOAT OPERATORS
Before heading out, check the Daily Vessel Movements page on the Port Authority Website: www.portauthoritynsw.com.au
Listen to the safety broadcast from "Sydney Ports VTS" on VHF Channel 13 at 5 minutes past each odd hour for details of vessel movements.
Monitor VHF Channel 13 for position reports from vessels.
Always keep a lookout for seagoing ships and STEER CLEAR of them.
30 Metres
30 Metres
Do not pass between the escort vessel and seagoing ship
Escort vessel identified by orange hull, yellow structure and red and blue flashing lights
24 HOUR HARBOUR OPERATIONS
VHF CHANNEL 13
PORT AUTHORITY OF NEW SOUTH WALES
CAUTION: ROWERS USE THESE WATERWAYS. PLEASE AVOID CREATING UNNECESSARY WASH.
NOTE: Bridge clearance heights shown in RED are in metres above the Highest Astronomical Tide (HAT).
Note: Grid Datum is Geocentric Datum of Australia - 1994, which is approximately equivalent to WGS-84.
Caution: Depth contours have been compiled and are indicative only. They can change over time.
Note: Vandalism of navigation aids is illegal and dangerous as it could lead to serious accidents. Please report incidents of vandalism to the RMS Info Line on 13 12 36.
A penalty applies for interference, damage or mooring against aids to navigation.
Note: Lit navigation aids exhibit standard flash patterns, unless otherwise indicated.
Sydney Harbour National Park Protects a number of islands and foreshore areas in Sydney Harbour. Visit www.environment.nsw.gov.au or phone (02)9995 5000.
Former Defence sites are managed by Sydney Harbour Federation Trust Visit www.harbourtrust.gov.au
KEEP A PROPER LOOKOUT
CONTINUES on other side
SECURITY WARNING: Waterside Restricted Security Zones exist at key sites within the Port of Sydney. Masters are to keep well clear of these areas and vessels moored thereat. Penalties apply for unauthorised entry. Restricted Zones will vary at increased security levels.
Note: Most navigation aids shown hereon, exhibit a three digit identifying number. Please use this number to report faulty navigation aids or your position in an emergency.
Caution: A number of yellow spar buoys used as Yacht Rounding Marks (YRM) exist at various locations within Sydney and North Harbours.
See Parks Note or www.harbourtrust.gov.au for further information.
Note: This area classified as Limited Open Waters. When waves exceed 0.5m from trough to crest in any part of this area, waters are Open Waters.
Note: Powerboats prohibited along beaches in this area.
Note: Aquatic Reserve. For further information visit www.environment.nsw.gov.au /nationalparks
See Parks Note or www.harbourtrust.gov.au for further information.
Note: Critical Habitat between July and February for Fairy Penguins. Special fishing and anchoring restrictions apply. No anchoring or any part of vessels within 50 metres of the shore.
WARNING:
1. PERSONAL WATERCRAFT AND KITE SURFING ARE BANNED FROM OPERATING ON ALL WATERS OF SYDNEY, MIDDLE AND NORTH HARBOURS, PARRAMATTA AND LANE COVE RIVERS.
2. SAILBOARDING AND PARAFLYING ARE PROHIBITED IN MAIN SHIPPING CHANNELS, NEAR MOORING BUOYS AND THE COMMERCIAL PORT AREA.
SEE NAUTICAL CHARTS AUS 197, 201, 202, 203 and RMS Coastal Boating Map No.9 for further information.
Warning: Commercial shipping in Port Jackson is often restricted by draft and operating requirements to narrow channels or special courses within blue boundaries as shown. Small craft must not impede the passage of these ships.
Caution: All waters on this map are popular for diving activities.
Note: It is compulsory to carry certain safety equipment, including a lifejacket type 1 for all on board, whilst navigating in the open sea. It is also recommended that lifejackets be worn while crossing the entrance to Sydney Harbour.
Further information on what you should carry can be found in the RMS Safe Boating Handbook available from all RMS offices or by visiting www.rms.nsw.gov.au
BE SAFE GOING OFFSHORE
LOOK OUT DIVERS ABOUT
Caution: Shallow waters (less than 2 metres deep), contain seagrass and other sensitive fish habitats, which are at risk of damage from navigating or anchoring in shallow waters. Please exercise care when navigating or anchoring to avoid damaging or disturbing seagrass beds.
GO EASY ON THE DRINK
Offshore Artificial Reef Further information on Artificial Reefs can be at www.dpi.nsw.gov.au/fisheries
Caution: Traffic separation zone. See also Commercial Shipping Warning Note located at Sydney Heads.
Note: No anchoring in Naval Waters
Note: Orange areas indicate Waterside Restricted Zones at Maritime Security Level 1, when a vessel is at berth. Gore Cove operates at all times.
Measured Nautical Mile Light on Tower Fort Denison and Plinth SW Bradleys Head.
WARNING: Keep clear of Garden Island facilities by staying outside of the lit yellow marker buoys.
Note: Transit Zone between Blues and Kirribilli Points is subject to a Fifteen Knot Speed Limit.
Note: Global Positioning System check point as shown by GPS* is in WGS 84 co-ordinates to an accuracy of +/- 5 metres. Equipment should be checked against this point to determine any gross errors prior to any seaward journey. Depending on equipment, errors of up to 30 metres is not uncommon.
Port Jackson - East of Sydney Harbour Bridge.
WARNING
LOOK OUT FOR VESSELS MANOEUVRING
Note: Sydney Cove is closed to all recreational and unauthorised commercial vessels.
City of Sydney
WEAR A LIFEJACKET
TAKE CARE BE PROP AWARE
YOU'RE THE SKIPPER YOU'RE RESPONSIBLE!
Note: Pyrmont Bridge clearance 6.5m HAT at side spans. Opening channel closed unless directed by the Operator on (02)9299-7541.
Note: General information such as caravan parks, hotels, motels, picnic grounds and public toilets etc are indicated as a guide only. Not all can be shown in some areas.
WARNING: OVERHEAD AND SUBMARINE CABLES AND PIPES CROSS THESE WATERWAYS AT VARIOUS LOCATIONS AND ARE USUALLY INDICATED BY WARNING NOTICES ON THE SHORE. CAUTION SHOULD BE EXERCISED AT ALL TIMES WHILE NAVIGATING IN THE VICINITY OF THESE CROSSINGS.
Note: A number of public moorings, (pink in colour), are situated throughout the Harbour. They are only available for 24 hours for ONE vessel at any time. Buoys marked Police and coloured blue are for emergency purposes only.
WARNING: BOMBORAS CAN BREAK AT ANYTIME AT VARIOUS LOCATIONS ALONG THE COAST. EXTREME CAUTION SHOULD BE EXERCISED WHILST NAVIGATING IN THE VICINITY OF ANY SHOAL, REEF OR BOMBORA.
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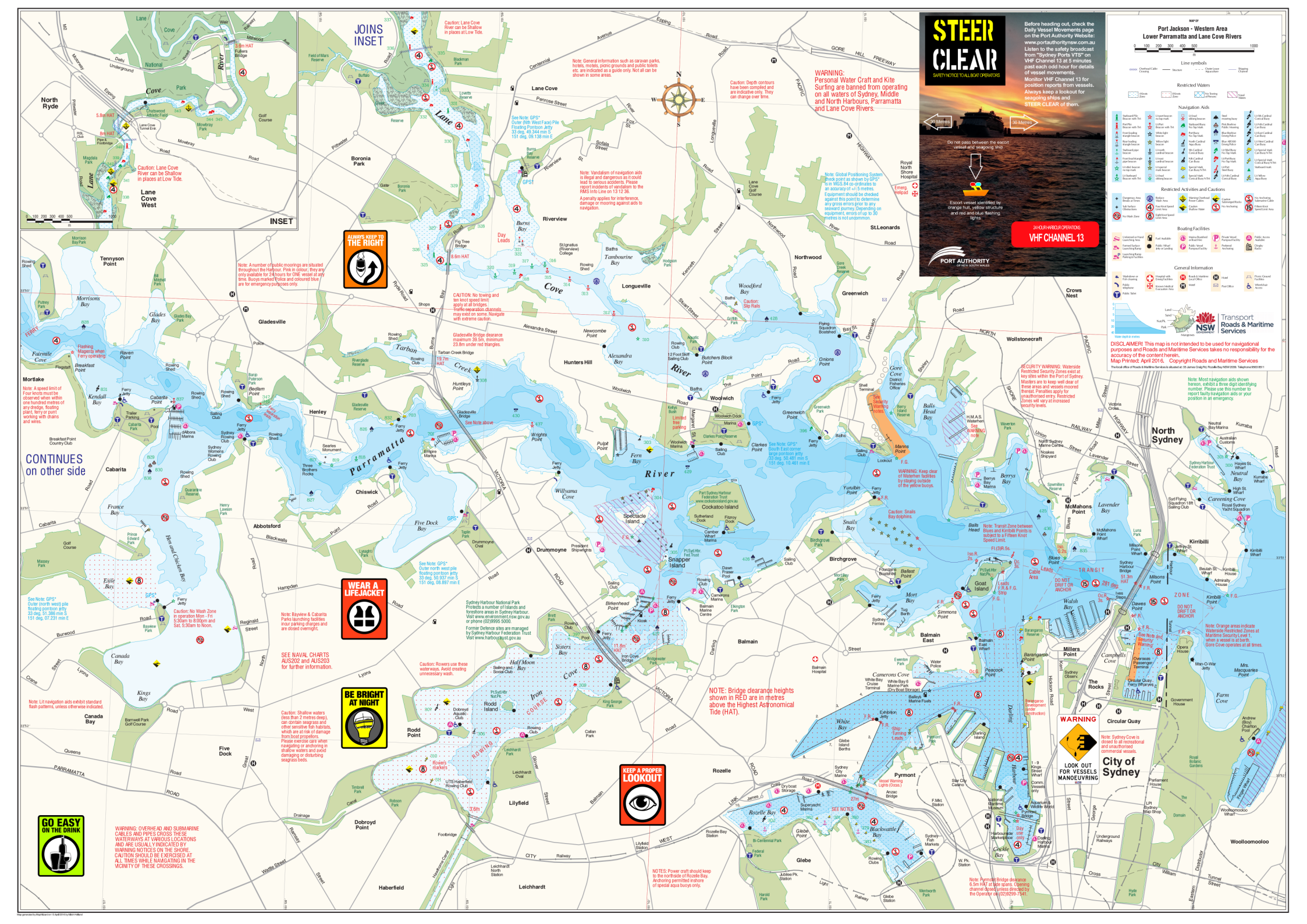
Transport Roads & Maritime Services
NORTH HARBOUR
THE SOUND
PORT JACKSON
TASMAN SEA
North Sydney
Cremorne
Mosman
Balmoral
Clifton Gardens
Vaucluse
Garden Island
Fort Denison
Shark Island
Clark Island
Rose Bay
Double Bay
Darling Point
Elizabeth Bay
Woolloomooloo
Kirribilli
Circular Quay
Middle Head
North Head
South Head
Watsons Bay
Manly


INSET
JOINS INSET
CONTINUES on other side
STEER CLEAR
SAFETY NOTICE TO ALL BOAT OPERATORS
Before heading out, check the Daily Vessel Movements page on the Port Authority Website: www.portauthoritynsw.com.au
Listen to the safety broadcast from "Sydney Ports VTS" on VHF Channel 13 at 5 minutes past each odd hour for details of vessel movements.
Monitor VHF Channel 13 for position reports from vessels.
Always keep a lookout for seagoing ships and STEER CLEAR of them.
30 Metres
30 Metres
Do not pass between the escort vessel and seagoing ship
Escort vessel identified by orange hull, yellow structure and red and blue flashing lights.
24 HOUR HARBOUR OPERATIONS
VHF CHANNEL 13
PORT AUTHORITY OF NEW SOUTH WALES
WARNING: Personal Water Craft and Kite Surfing are banned from operating on all waters of Sydney, Middle and North Harbours, Parramatta and Lane Cove Rivers.
Caution: Lane Cove River can be Shallow in places at Low Tide.
Caution: Depth contours have been compiled and are indicative only. They can change over time.
Note: General information such as caravan parks, hotels, motels, picnic grounds and public toilets etc. are indicated as a guide only. Not all can be shown in some areas.
Note: Vandalism of navigation aids is illegal and dangerous as it could lead to serious accidents. Please report incidents of vandalism to the RMS Info Line on 13 12 36.
A penalty applies for interference, damage or mooring against aids to navigation.
Note: Global Positioning System check point as shown by GPS* is in WGS 84 co-ordinates to an accuracy of +/- 5 metres. Equipment should be checked against this point to determine any gross errors prior to any seaward journey. Depending on equipment, errors of up to 30 metres is not uncommon.
ALWAYS KEEP TO THE RIGHT
Note: A number of public moorings are situated throughout the Harbour. Pink in colour, they are only available for 24 hours for ONE vessel at any time. Buoys marked Police and coloured blue are for emergency purposes only.
CAUTION: No towing and ten knot speed limit apply at all bridges. Traffic separation channels may exist on some. Navigate with extreme caution.
Gladesville Bridge clearance maximum 39.5m, minimum 23.8m under red triangles.
Note: A speed limit of Four knots must be observed when within one hundred metres of any dredge, floating plant, ferry or punt working with chains and wires.
WEAR A LIFEJACKET
Note: Bayview & Cabarita Parks launching facilities incur parking charges and are closed overnight.
SEE NAVAL CHARTS AUS202 and AUS203 for further information.
Caution: Rowers use these waterways. Avoid creating unnecessary wash.
BE BRIGHT AT NIGHT
Note: Lit navigation aids exhibit standard flash patterns, unless otherwise indicated.
Caution: Shallow waters (less than 2 metres deep), can contain seagrass and other sensitive fish habitats, which are at risk of damage from boat propellors. Please exercise care when navigating or anchoring in shallow waters and avoid damaging or disturbing seagrass beds.
KEEP A PROPER LOOKOUT
NOTE: Bridge clearance heights shown in RED are in metres above the Highest Astronomical Tide (HAT).
NOTES: Power craft should keep to the northside of Rozelle Bay. Anchoring permitted inshore of special aqua buoys only.
Note: Pyrmont Bridge clearance 6.5m HAT at side spans. Opening channel closed unless directed by the Operator on (02)9298-7541
WARNING
LOOK OUT FOR VESSELS MANOEUVRING
Note: Sydney Cove is closed to all recreational and unauthorised commercial vessels.
City of Sydney
GO EASY ON THE DRINK
WARNING: OVERHEAD AND SUBMARINE CABLES AND PIPES CROSS THESE WATERWAYS AT VARIOUS LOCATIONS AND ARE USUALLY INDICATED BY WARNING NOTICES ON THE SHORE. CAUTION SHOULD BE EXERCISED AT ALL TIMES WHILE NAVIGATING IN THE VICINITY OF THESE CROSSINGS.
Note: Most navigation aids shown hereon, exhibit a three digit identifying number. Please use this number to report faulty navigation aids or your position in an emergency.
Note: Orange areas indicate Waterside Restricted Zones at Maritime Security Level 1, when a vessel is at berth. Gore Cove operates at all times.
SECURITY WARNING: Waterside Restricted Security Zones exist at key sites within the Port of Sydney. Masters are to keep well clear of these areas and vessels moored therein. Penalties apply for unauthorised entry. Restricted Zones will vary at increased security levels.
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The local office of Roads & Maritime Services is situated at: 33 James Craig Rd, Rozelle Bay NSW 2039. Telephone 9563 8511
MAP OF
Port Jackson - Western Area
Lower Parramatta and Lane Cove Rivers
Line symbols
Restricted Waters
Navigation Aids
Restricted Activities and Cautions
Boating Facilities
General Information
Transport Roads & Maritime Services

Appendix C – Sailing Course Maps

Royal HaskoningDHV

Balmain Sailing Club

Combined Clubs West Harbour Summer Series 2018

Course Maps

Note: Refer to '2018 Combined Clubs West Harbour Summer Series Sailing Instructions' for full race information

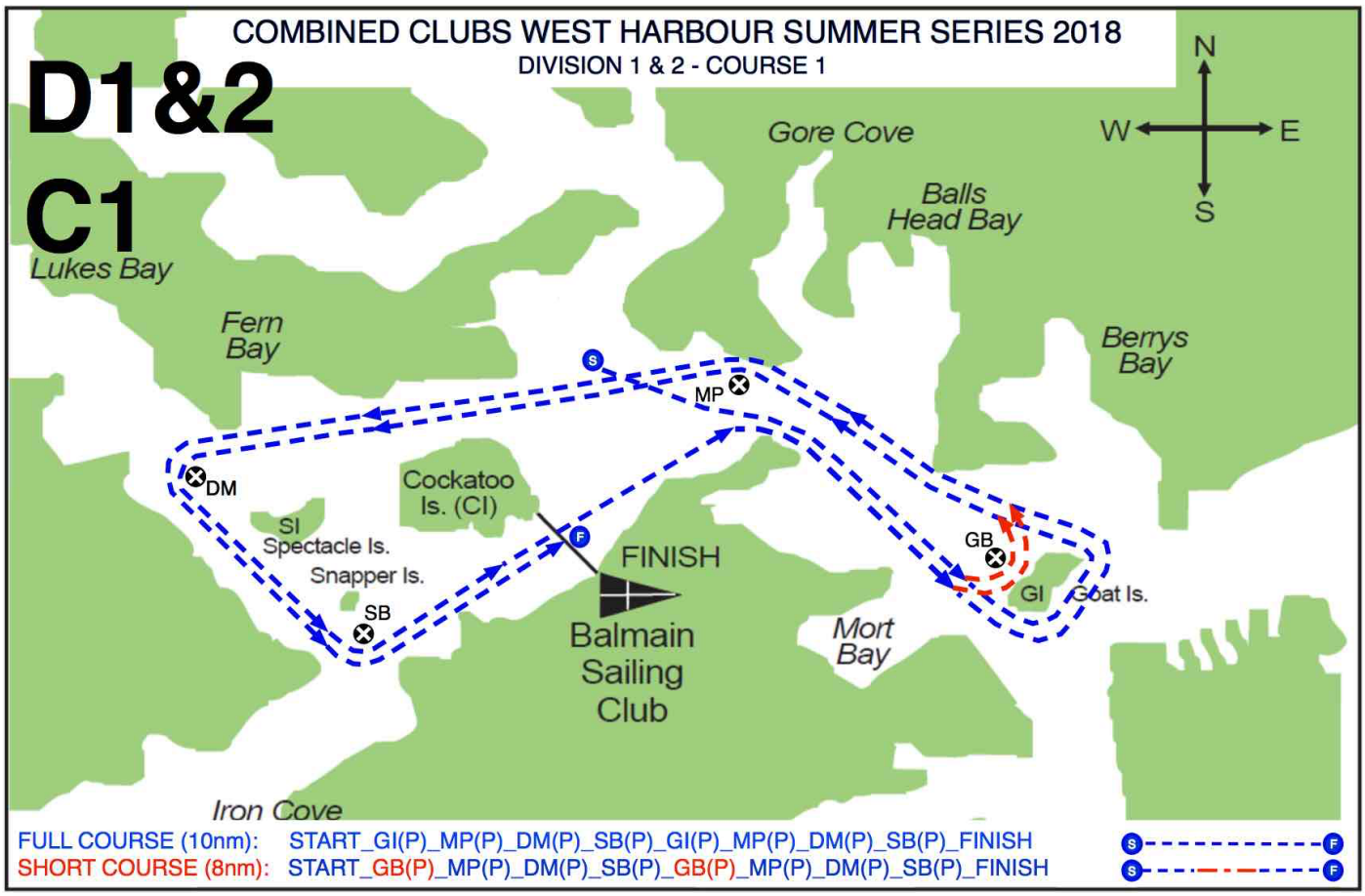
Race Dates & Start Time

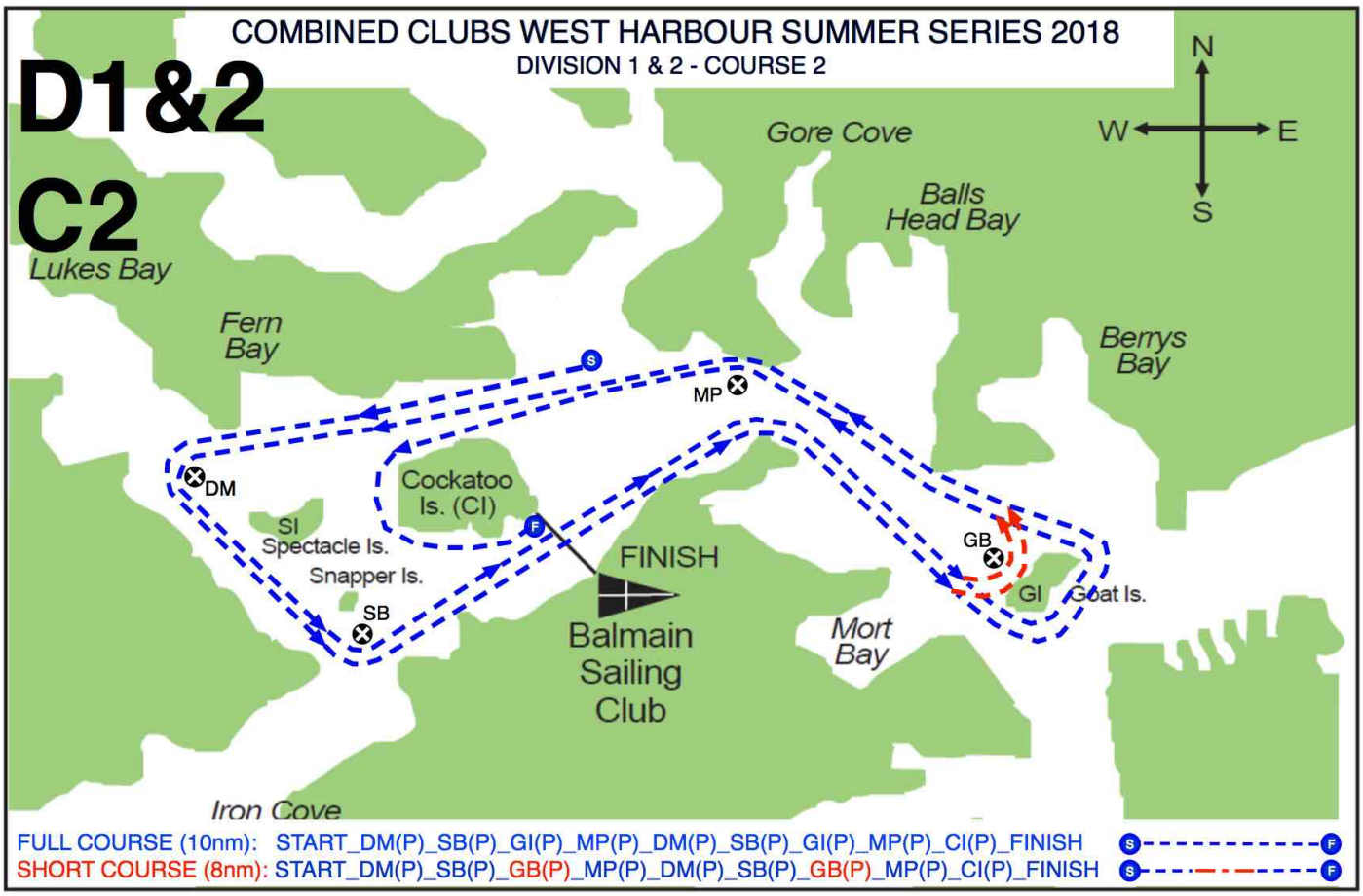
Race	Date	5 Minute Warning Signal
1	14 January 2018	13:25
2	28 January	
3	11 February	
4	25 February	
5	11 March	
6	25 March	

Start Signals

Time	Description	Starter's Visual Signal	Starter's Aural Signal
T – 5 minutes	5 minute warning	Orange Flag raised	1 sound signal
T – 4 minutes	4 minute preparatory	'P' Flag raised	1 sound signal
T – 1 minute	1 minute	'P' Flag lowered	1 sound signal
T = 0	0 start	Numeral Board 00	1 sound signal
T + 1 minutes	1 start	Numeral Board 01	
T + 2 minutes	2 start	Numeral Board 02	
…	…	…	...

Radio: Channel 77 **Time limit**: 1700 hours


COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
DIVISION 1 & 2 - COURSE 1
D1&2
C1
N
W
E
S
Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
MP
DM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
FINISH
Balmain Sailing Club
GB
GI
Goat Is.
Mort Bay
Iron Cove
FULL COURSE (10nm): START_GI(P)_MP(P)_DM(P)_SB(P)_GI(P)_MP(P)_DM(P)_SB(P)_FINISH
SHORT COURSE (8nm): START_GB(P)_MP(P)_DM(P)_SB(P)_GB(P)_MP(P)_DM(P)_SB(P)_FINISH


COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
DIVISION 1 & 2 - COURSE 2
D1&2
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
FINISH
Balmain Sailing Club
GB
GI
Goat Is.
Mort Bay
Iron Cove
FULL COURSE (10nm): START_DM(P)_SB(P)_GI(P)_MP(P)_DM(P)_SB(P)_GI(P)_MP(P)_CI(P)_FINISH
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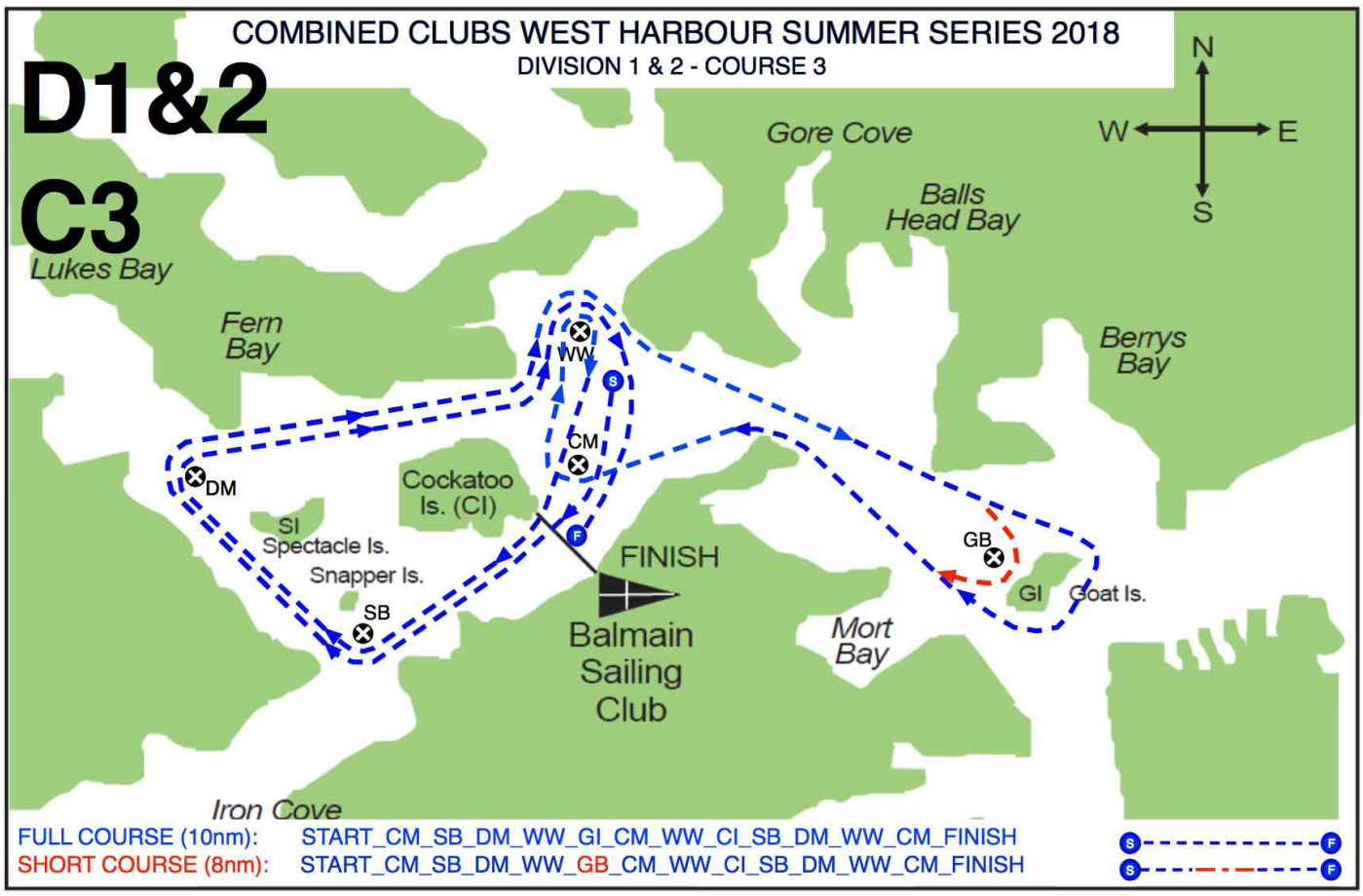
COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
DIVISION 1 & 2 - COURSE 3
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
WW
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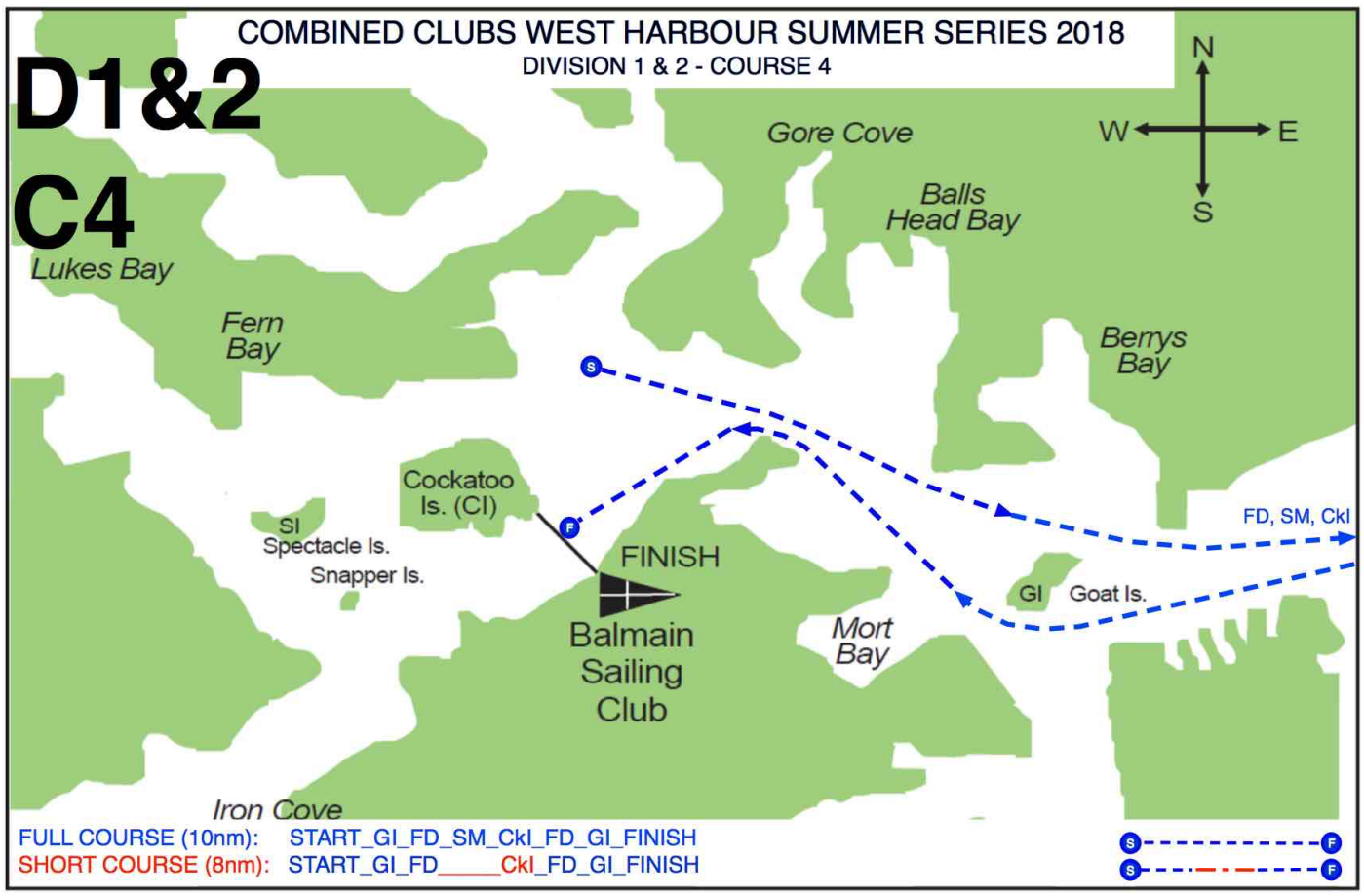
DM
Cockatoo Is. (CI)
SI Spectacle Is.
Snapper Is.
SB
FINISH
Balmain Sailing Club
GB
GI Goat Is.
Mort Bay
Iron Cove
FULL COURSE (10nm): START_CM_SB_DM_WW_GI_CM_WW_CI_SB_DM_WW_CM_FINISH
SHORT COURSE (8nm): START_CM_SB_DM_WW_GB_CM_WW_CI_SB_DM_WW_CM_FINISH


COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
DIVISION 1 & 2 - COURSE 4
D1&2
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
Cockatoo Is. (CI)
SI Spectacle Is.
Snapper Is.
FINISH
Balmain Sailing Club
FD, SM, CkI
GI Goat Is.
Mort Bay
Iron Cove
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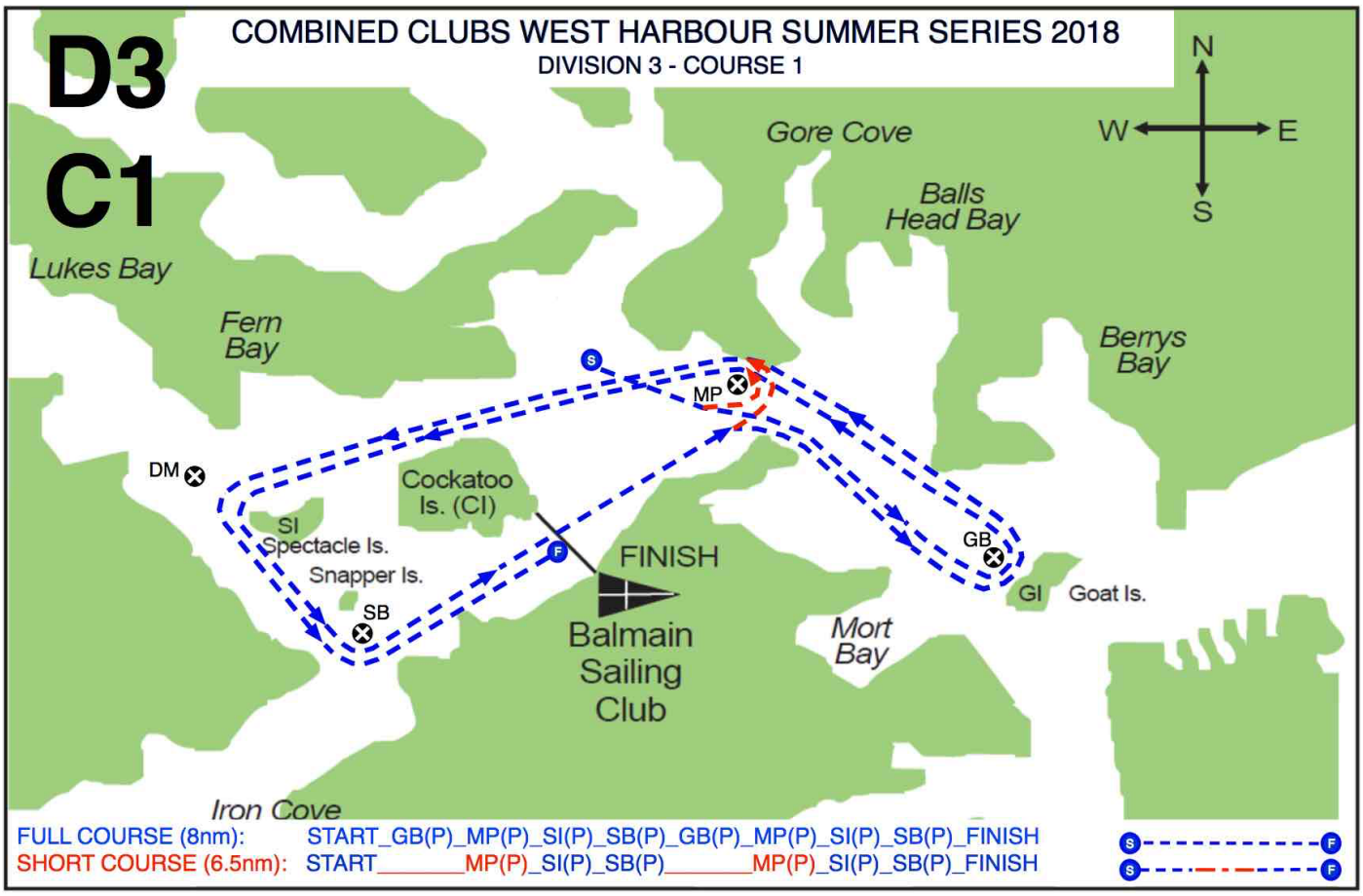
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COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
DIVISION 3 - COURSE 1
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
FINISH
GB
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE (8nm): START_GB(P)_MP(P)_SI(P)_SB(P)_GB(P)_MP(P)_SI(P)_SB(P)_FINISH
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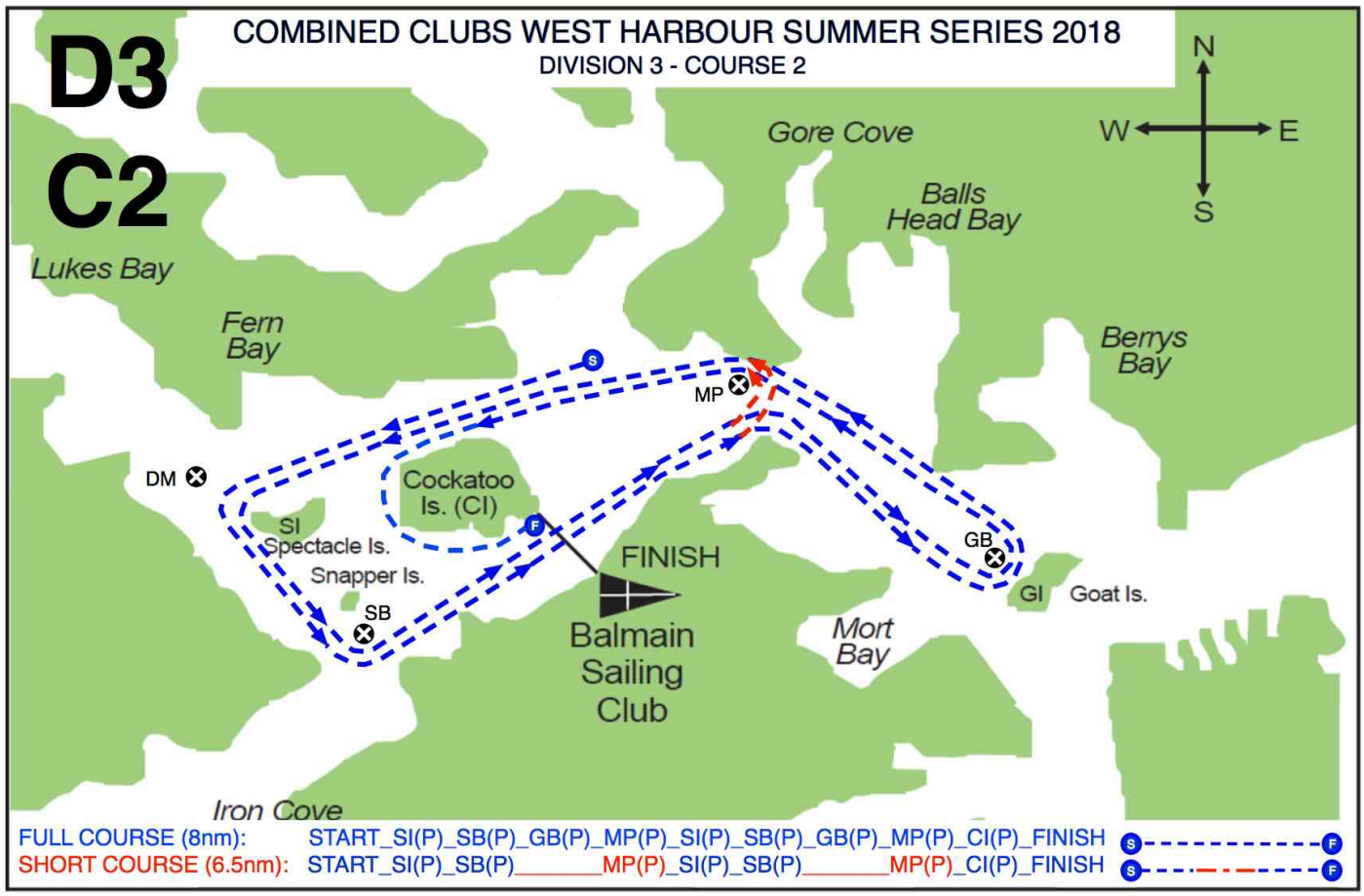
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DIVISION 3 - COURSE 2
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Lukes Bay
Fern Bay
Berrys Bay
MP
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Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
FINISH
GB
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE (8nm): START_SI(P)_SB(P)_GB(P)_MP(P)_SI(P)_SB(P)_GB(P)_MP(P)_CI(P)_FINISH
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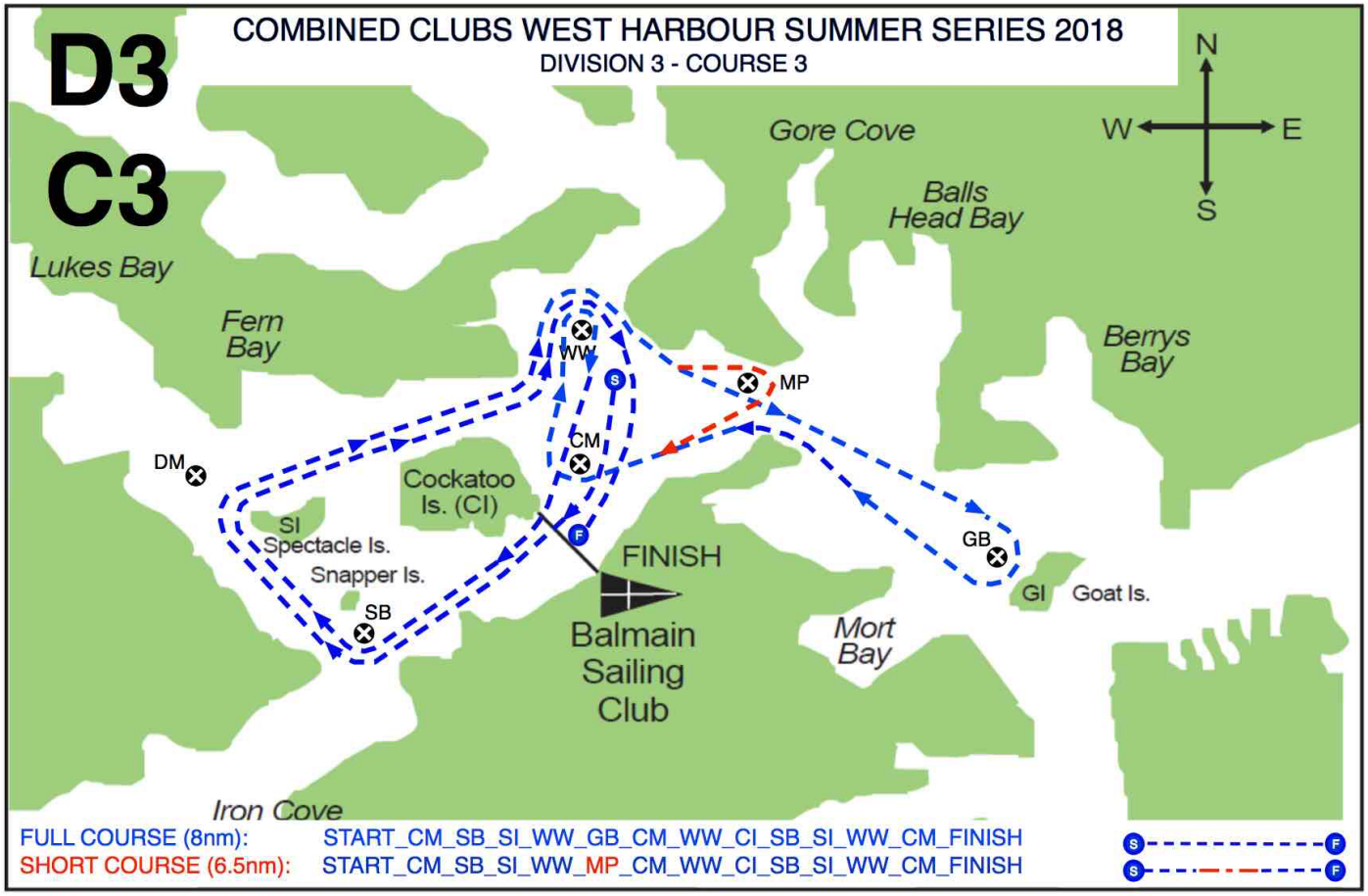
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C3
COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
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Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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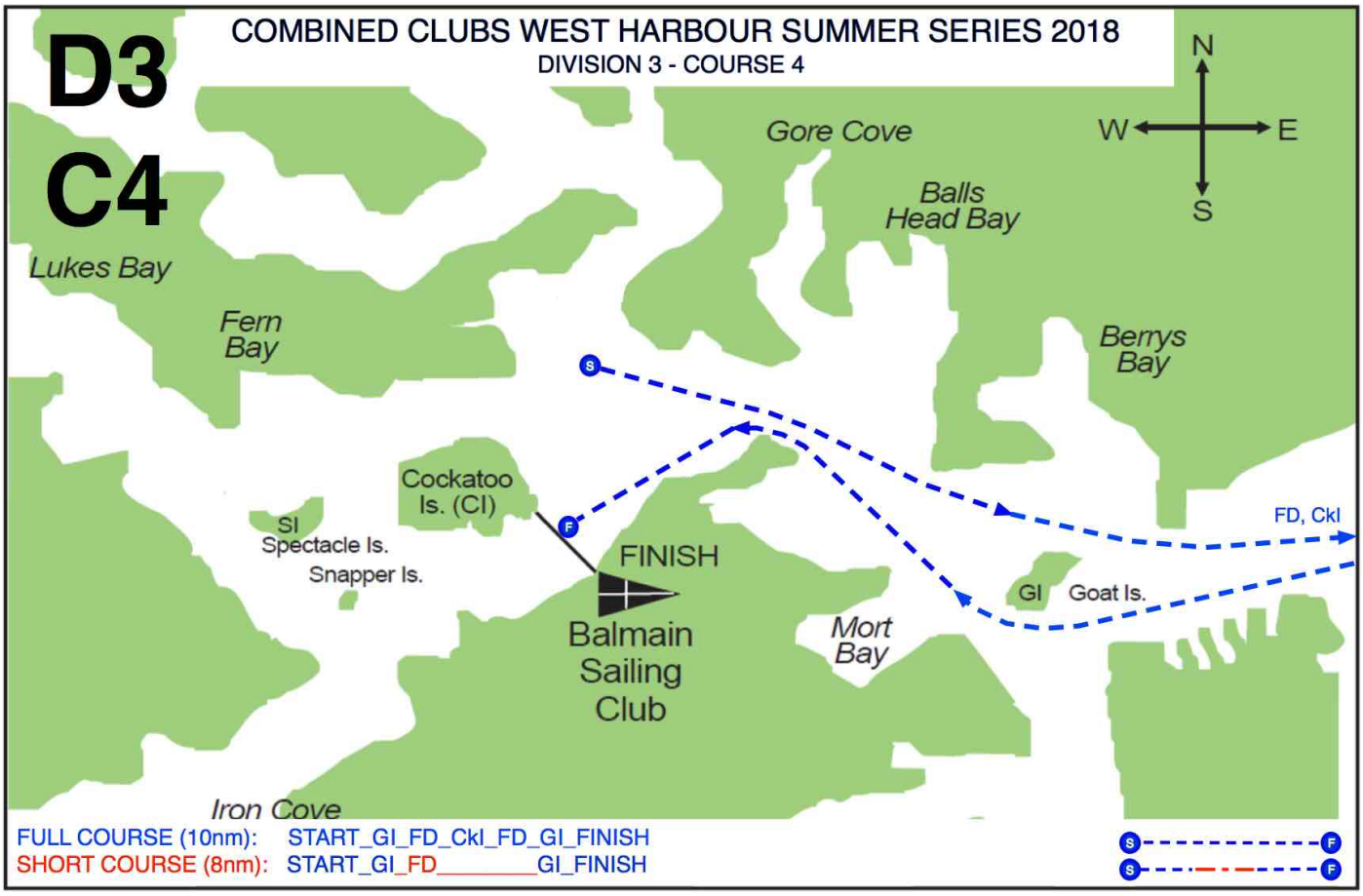
MP
CM
DM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
GB
GI
Goat Is.
FINISH
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE (8nm): START_CM_SB_SI_WW_GB_CM_WW_CI_SB_SI_WW_CM_FINISH
SHORT COURSE (6.5nm): START_CM_SB_SI_WW_MP_CM_WW_CI_SB_SI_WW_CM_FINISH


D3
C4
COMBINED CLUBS WEST HARBOUR SUMMER SERIES 2018
DIVISION 3 - COURSE 4
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
FD, CkI
GI
Goat Is.
FINISH
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE (10nm): START_GI_FD_CkI_FD_GI_FINISH
SHORT COURSE (8nm): START_GI_FD_____GI_FINISH

Friday Twilight Series 2017-18

Course Maps

Note: Refer to 2017-18 Twilight Series Sailing Instructions for full race information

Start Times & Time Limits

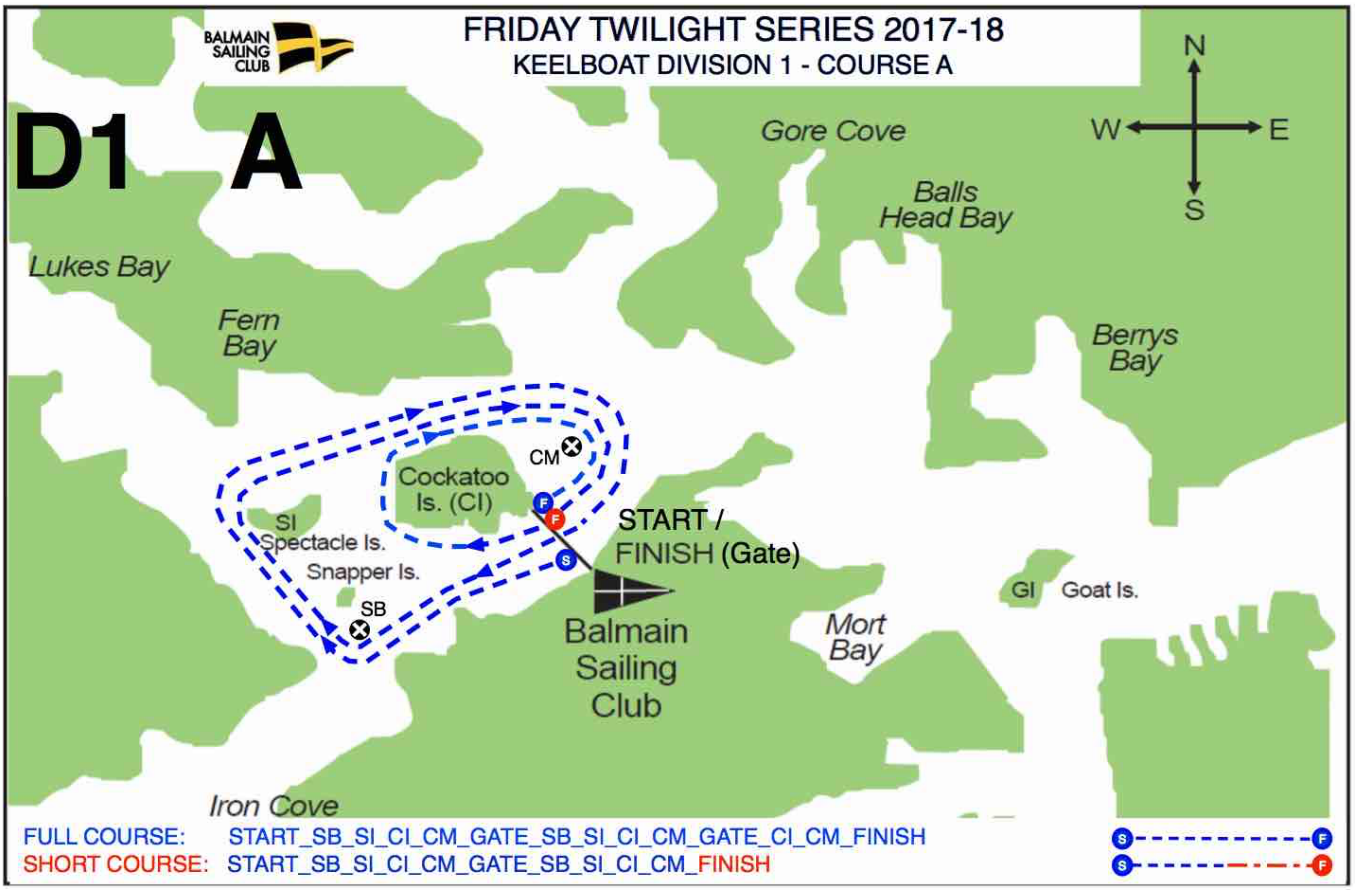
Division	Pennant	Warning Signal	Start Time
4	Green	17:50	17:55
3	Black	17:55	18:00
2	Blue	18:00	18:05
1	Yellow	18:05	18:10

Starting Signals

Warning	5 mins - long sound
Preparatory	4 mins - short sound
One-minute	1 min - short sound
Start	Long sound

Radio: Channel 73

Race Day	Time Limit
2017 Pre-Christmas	
Oct 6	19.05
Oct 13	19:10
Oct 20	19:15
Oct 27	19:20
Nov 3	19:30
Nov 10	19:35
Nov 17	19:40
Nov 24	19:50
Dec 1	19:55
Dec 8	20:00
Dec 15	20:00
2018 Post-Christmas	
Jan 5	20:00
Jan 12	20:00
Jan 19	20:00
Feb 2	20:00
Feb 9	19:55
Feb 16	19:45
Feb 23	19:40
Mar 2	19:30
Mar 9	19:20
Mar 16	19:10
Mar 23	19:10
Mar 31	19:00


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 1 - COURSE A
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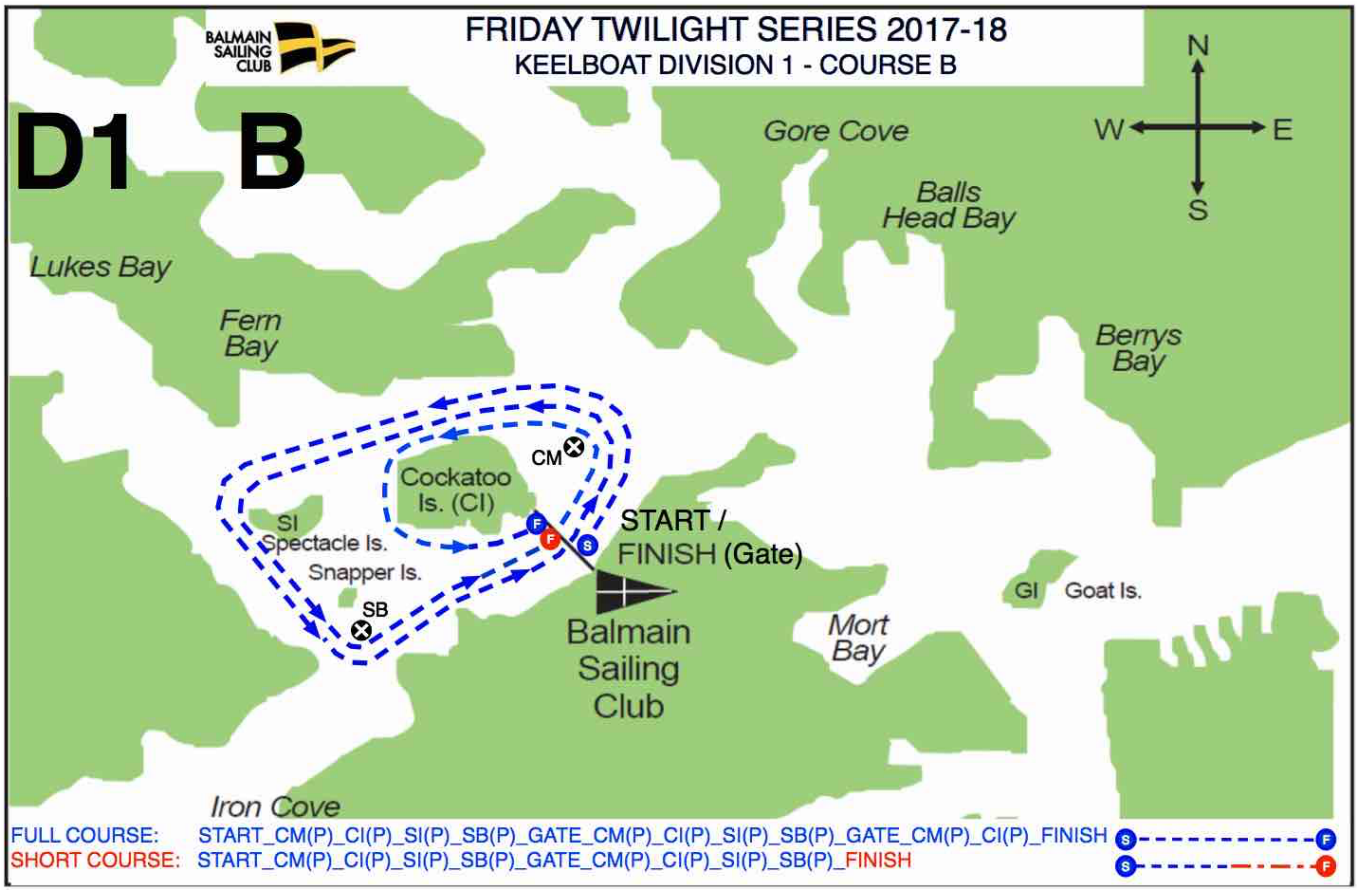
Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GI
Goat Is.
Mort Bay
Balmain Sailing Club
Iron Cove
FULL COURSE: START_SB_SI_CI_CM_GATE_SB_SI_CI_CM_GATE_CI_CM_FINISH
SHORT COURSE: START_SB_SI_CI_CM_GATE_SB_SI_CI_CM_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 1 - COURSE B
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Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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Cockatoo Is. (CI)
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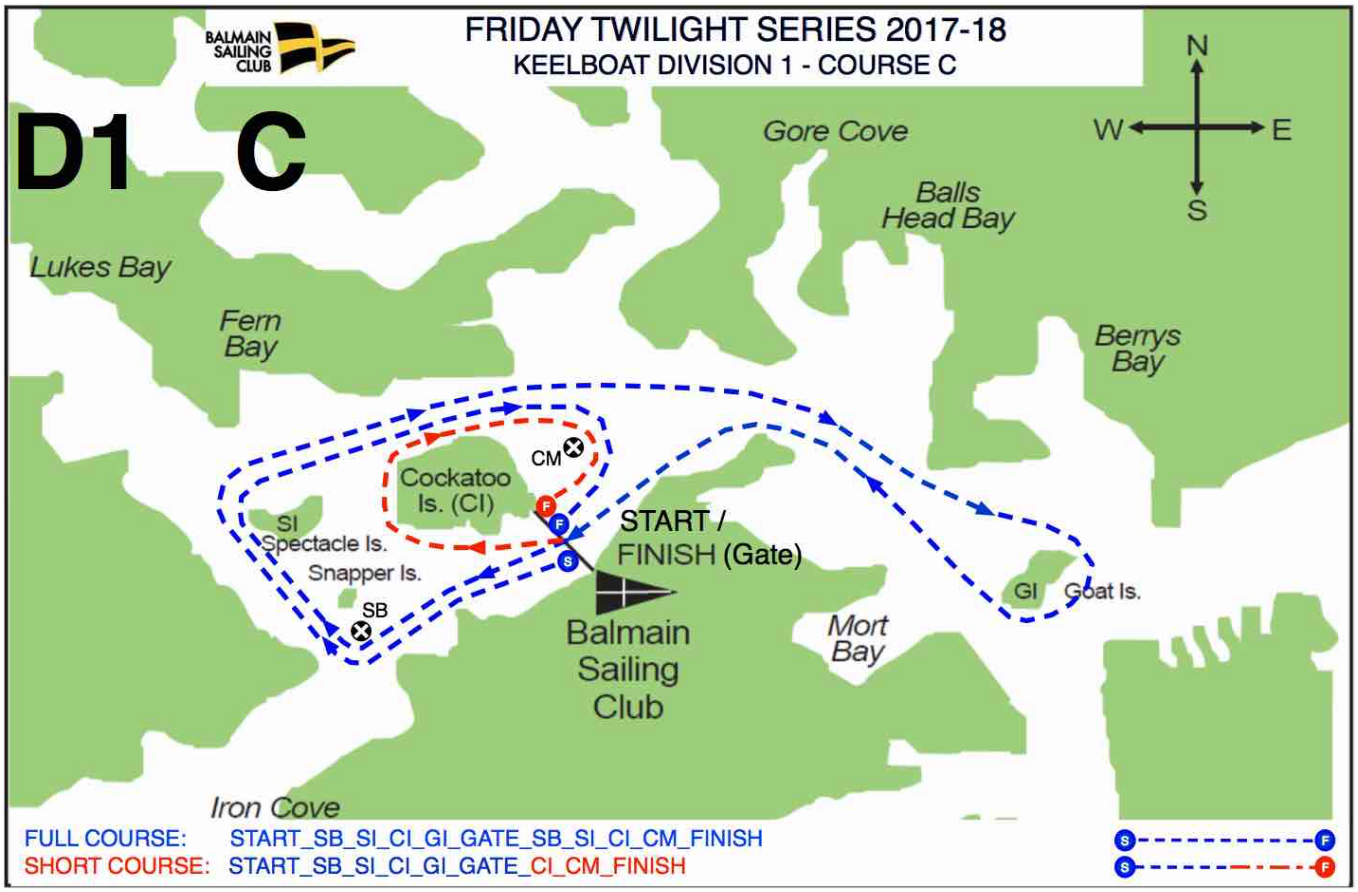
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GI
Goat Is.
Mort Bay
Balmain Sailing Club
Iron Cove
FULL COURSE: START_CM(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_FINISH
SHORT COURSE: START_CM(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_SI(P)_SB(P)_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 1 - COURSE C
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Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
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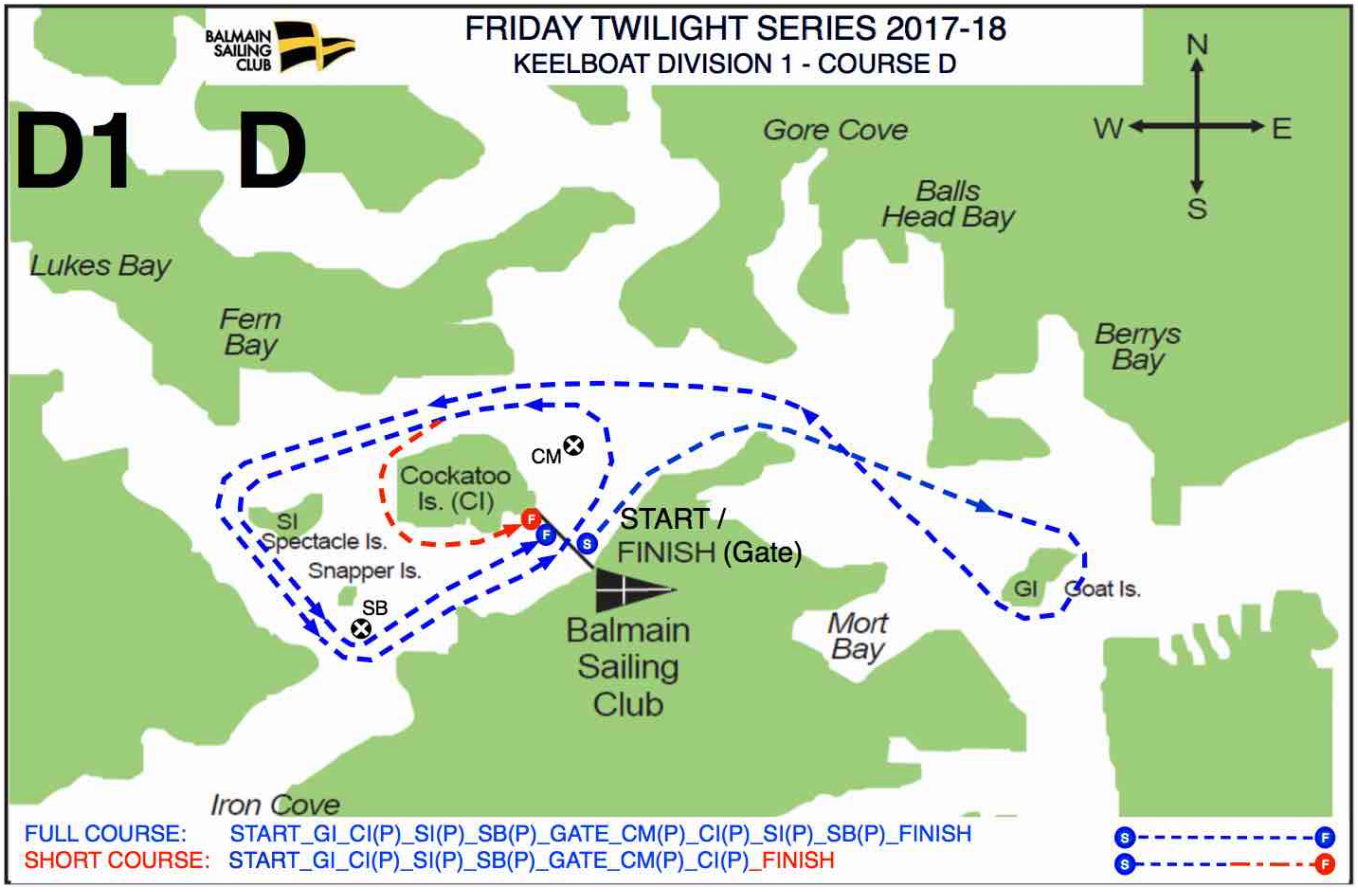
SHORT COURSE: START_SB_SI_CI_GI_GATE_CI_CM_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 1 - COURSE D
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Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
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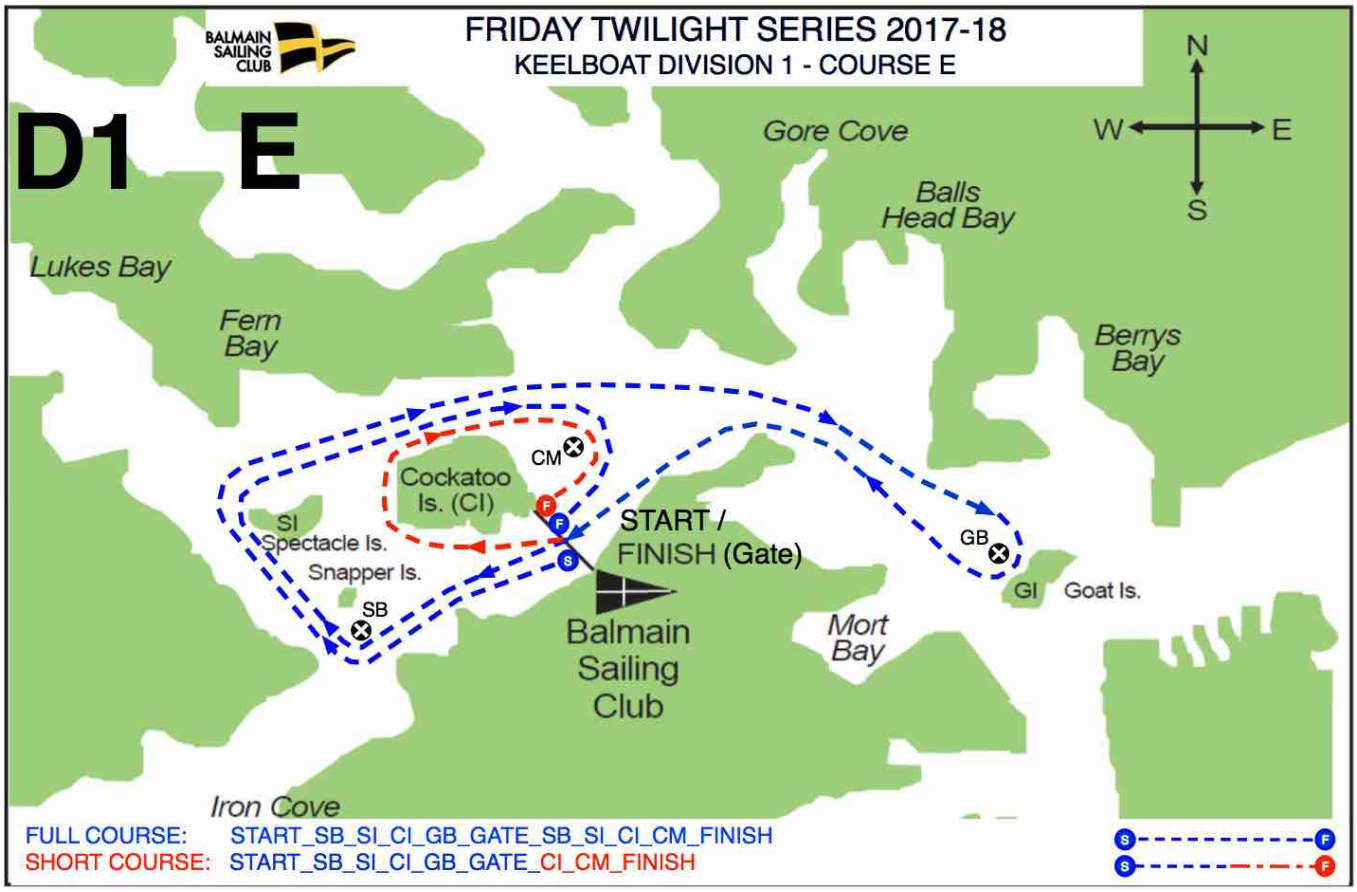
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_GI_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_SI(P)_SB(P)_FINISH
SHORT COURSE: START_GI_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_FINISH


FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 1 - COURSE E
D1 E
BALMAIN SAILING CLUB
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
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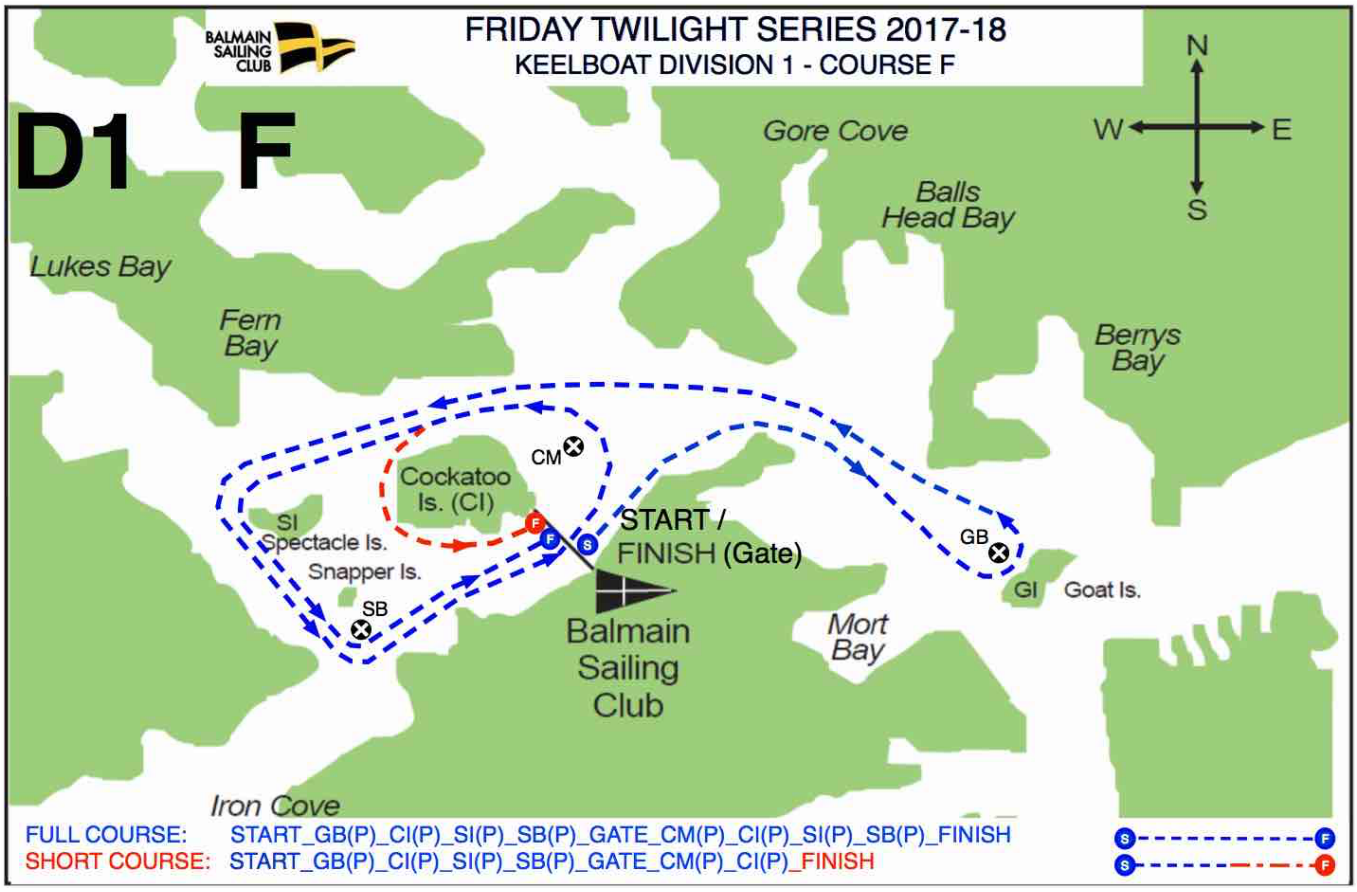
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GB
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_SB_SI_CI_GB_GATE_SB_SI_CI_CM_FINISH
SHORT COURSE: START_SB_SI_CI_GB_GATE_CI_CM_FINISH


FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 1 - COURSE F
D1 F
BALMAIN SAILING CLUB
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
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Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_GB(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_SI(P)_SB(P)_FINISH
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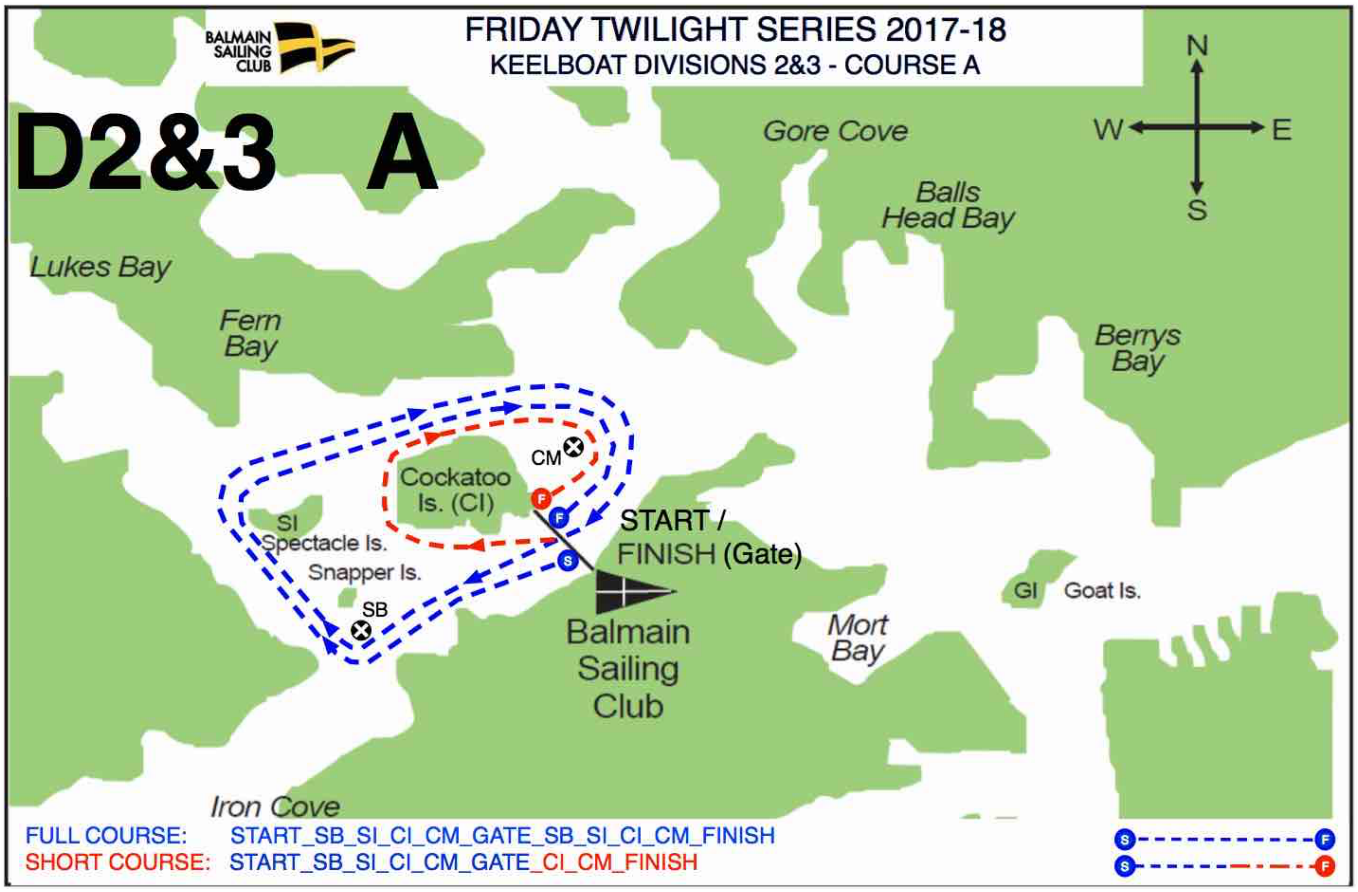
BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISIONS 2&3 - COURSE A
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Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
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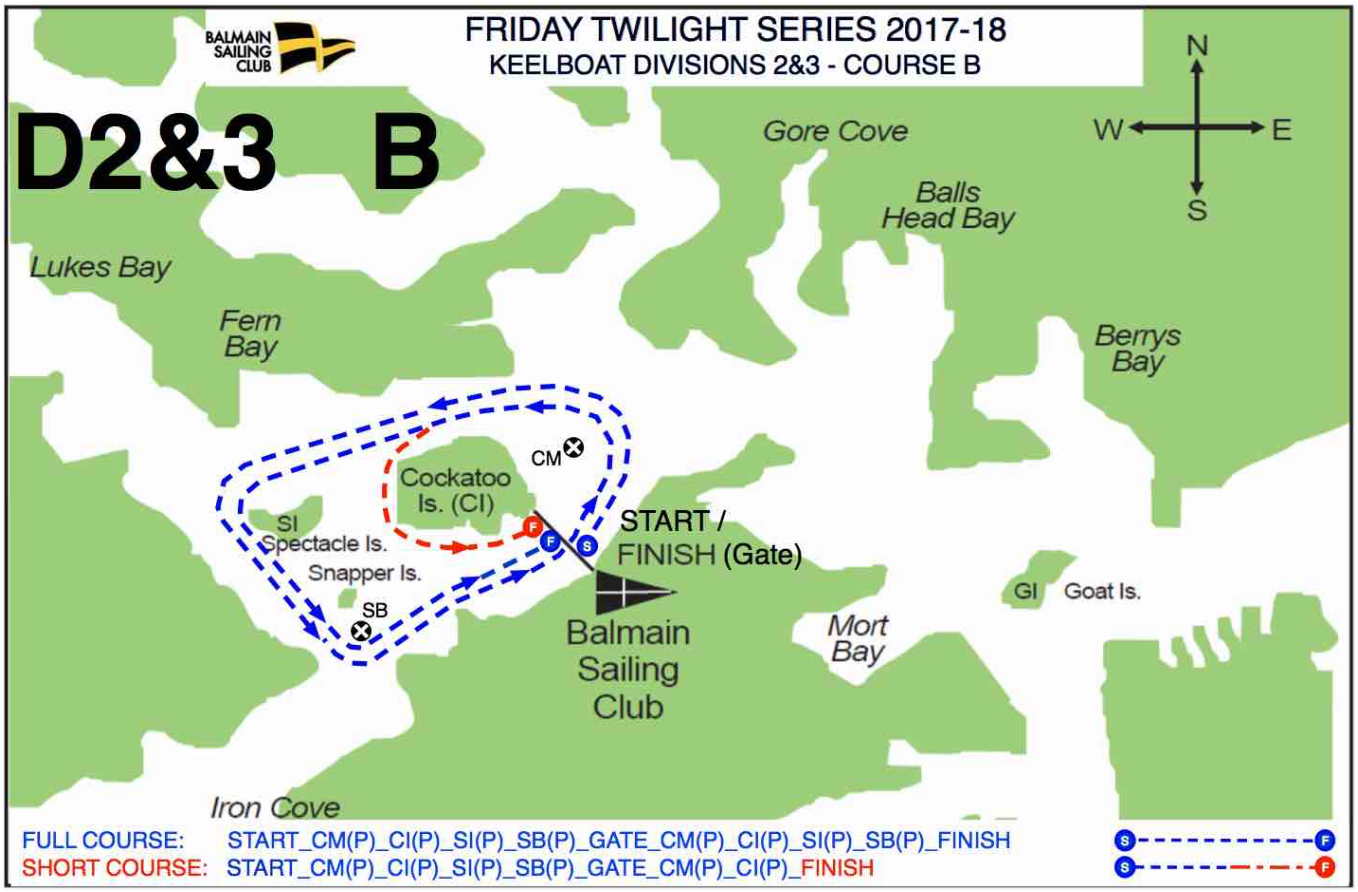
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
Balmain Sailing Club
GI
Goat Is.
Mort Bay
Iron Cove
FULL COURSE: START_SB_SI_CI_CM_GATE_SB_SI_CI_CM_FINISH
SHORT COURSE: START_SB_SI_CI_CM_GATE_CI_CM_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISIONS 2&3 - COURSE B
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
Balmain Sailing Club
GI
Goat Is.
Mort Bay
Iron Cove
FULL COURSE: START_CM(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_SI(P)_SB(P)_FINISH
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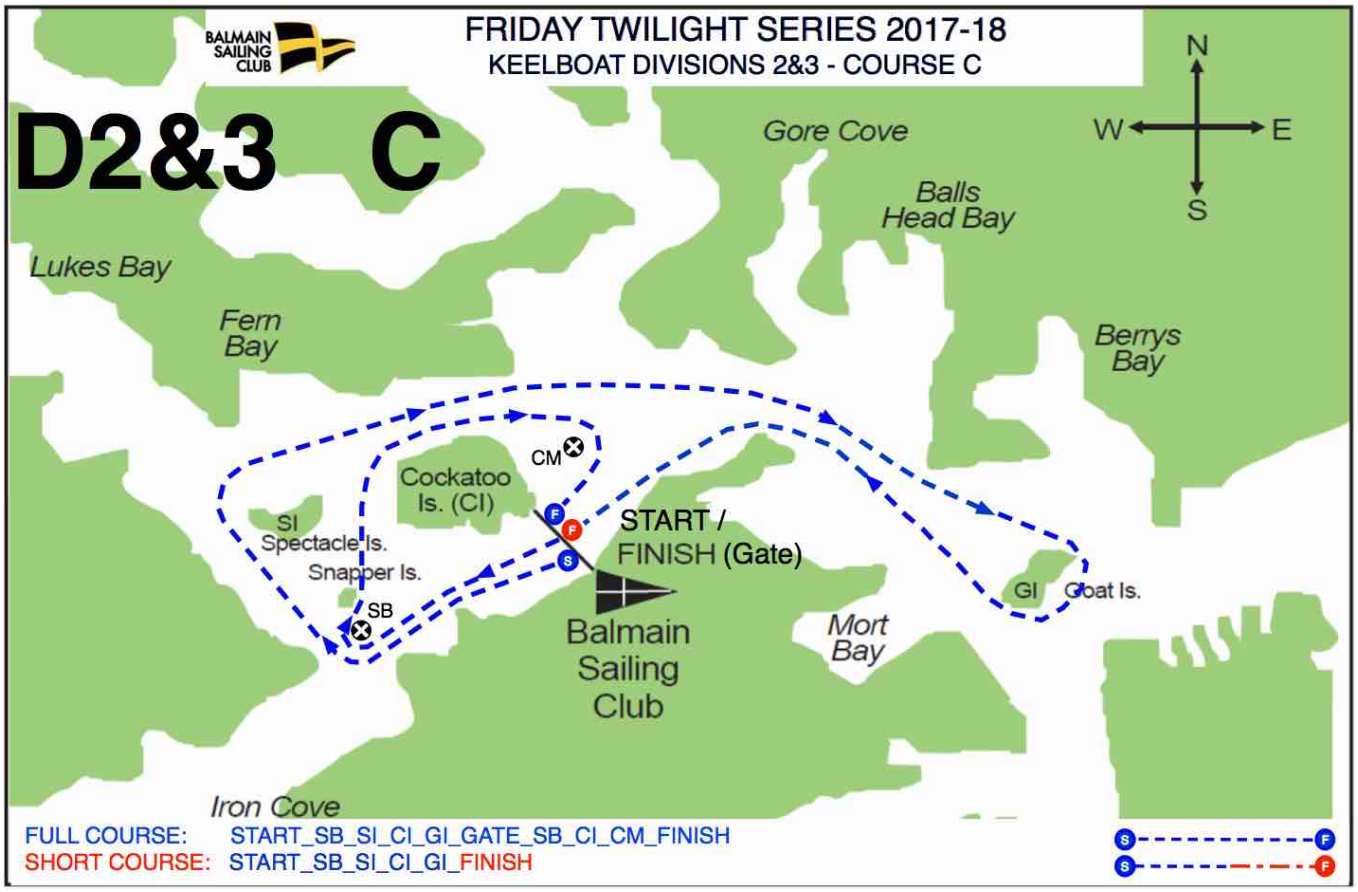
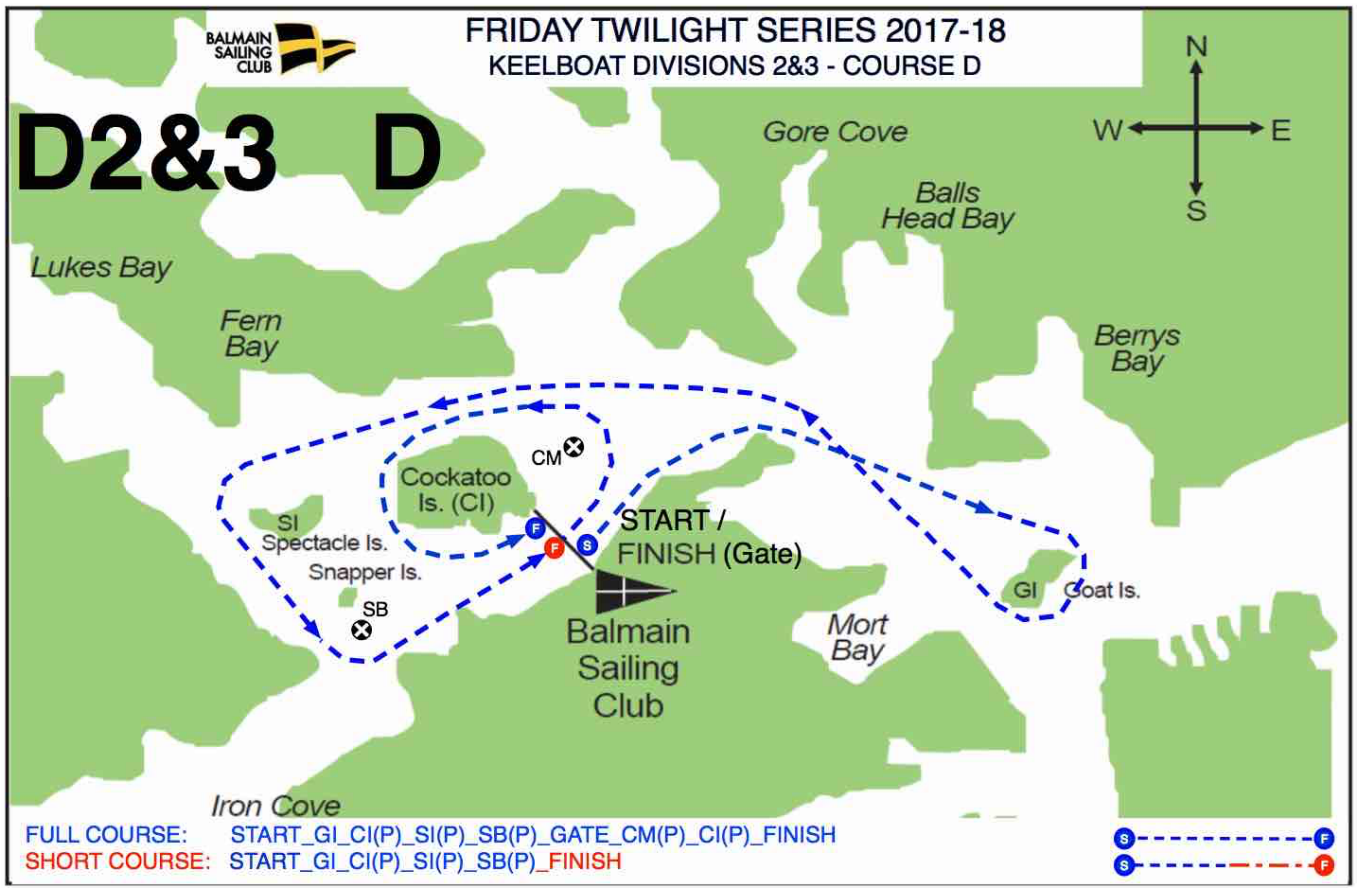
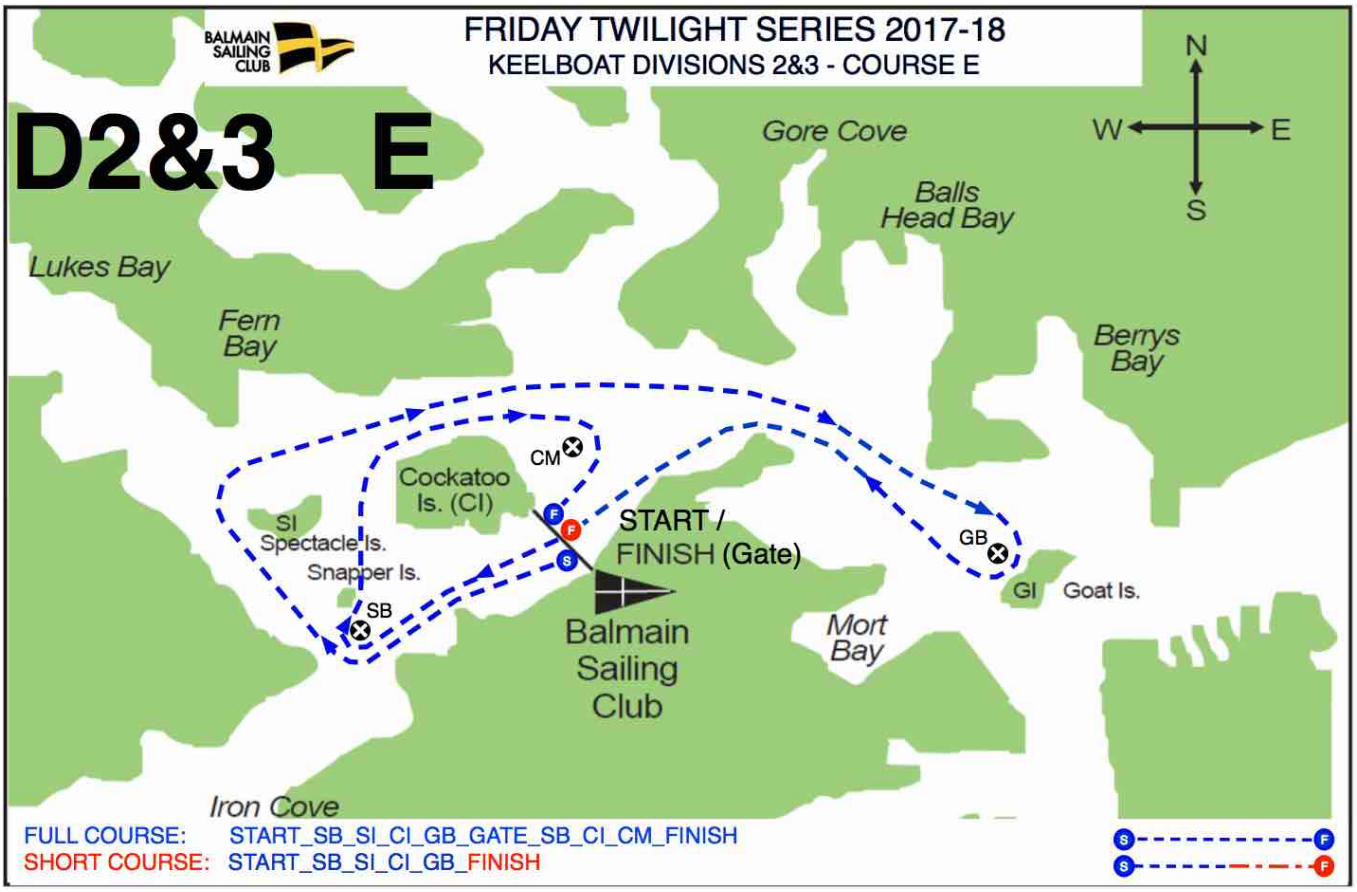
DIVISIONS 2 & 3 C & D



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FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISIONS 2&3 - COURSE E
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Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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Cockatoo Is. (CI)
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Spectacle Is.
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GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
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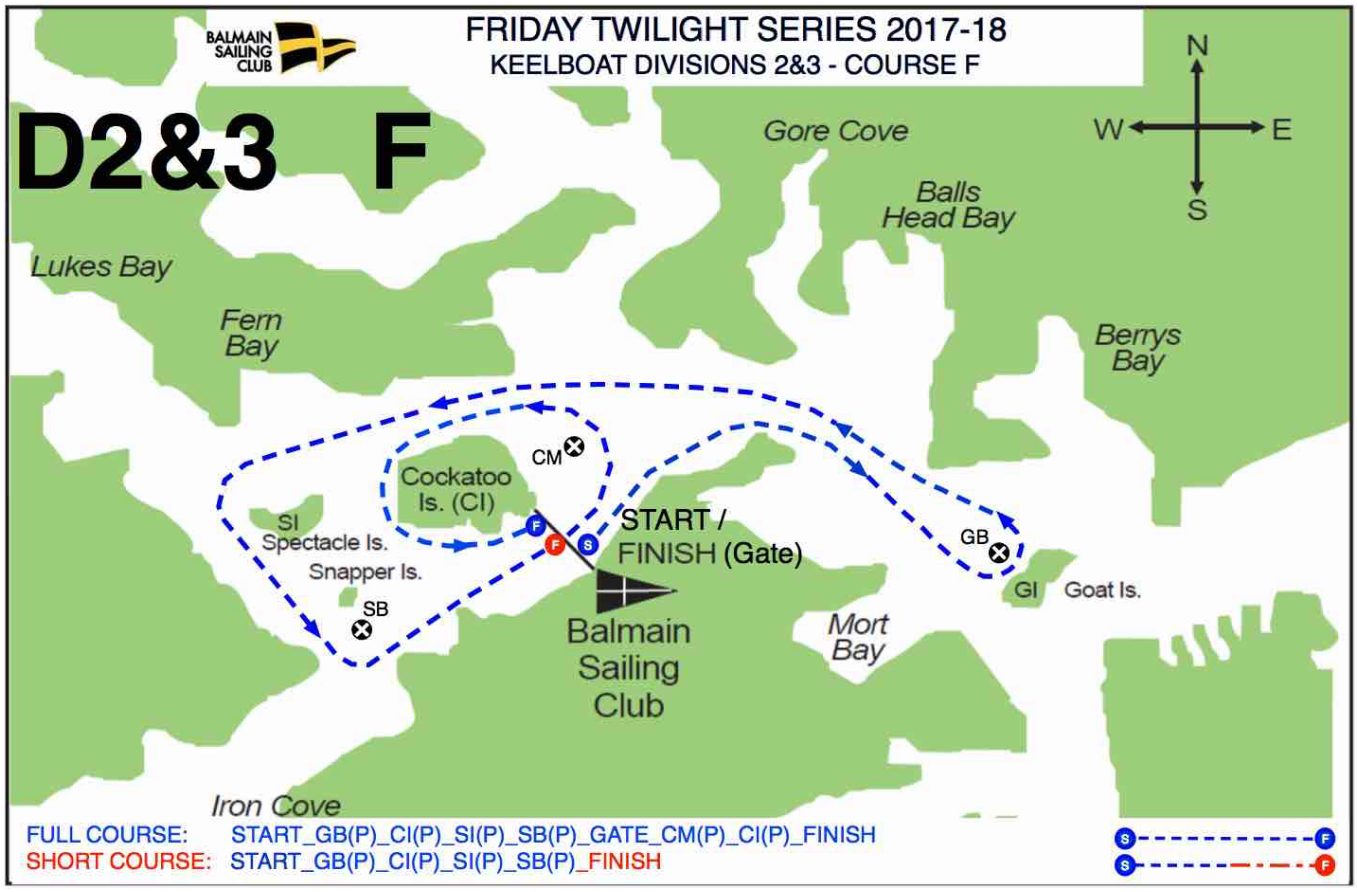
SHORT COURSE: START_SB_SI_CI_GB_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISIONS 2&3 - COURSE F
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Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
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Cockatoo Is. (CI)
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Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
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Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_GB(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_FINISH
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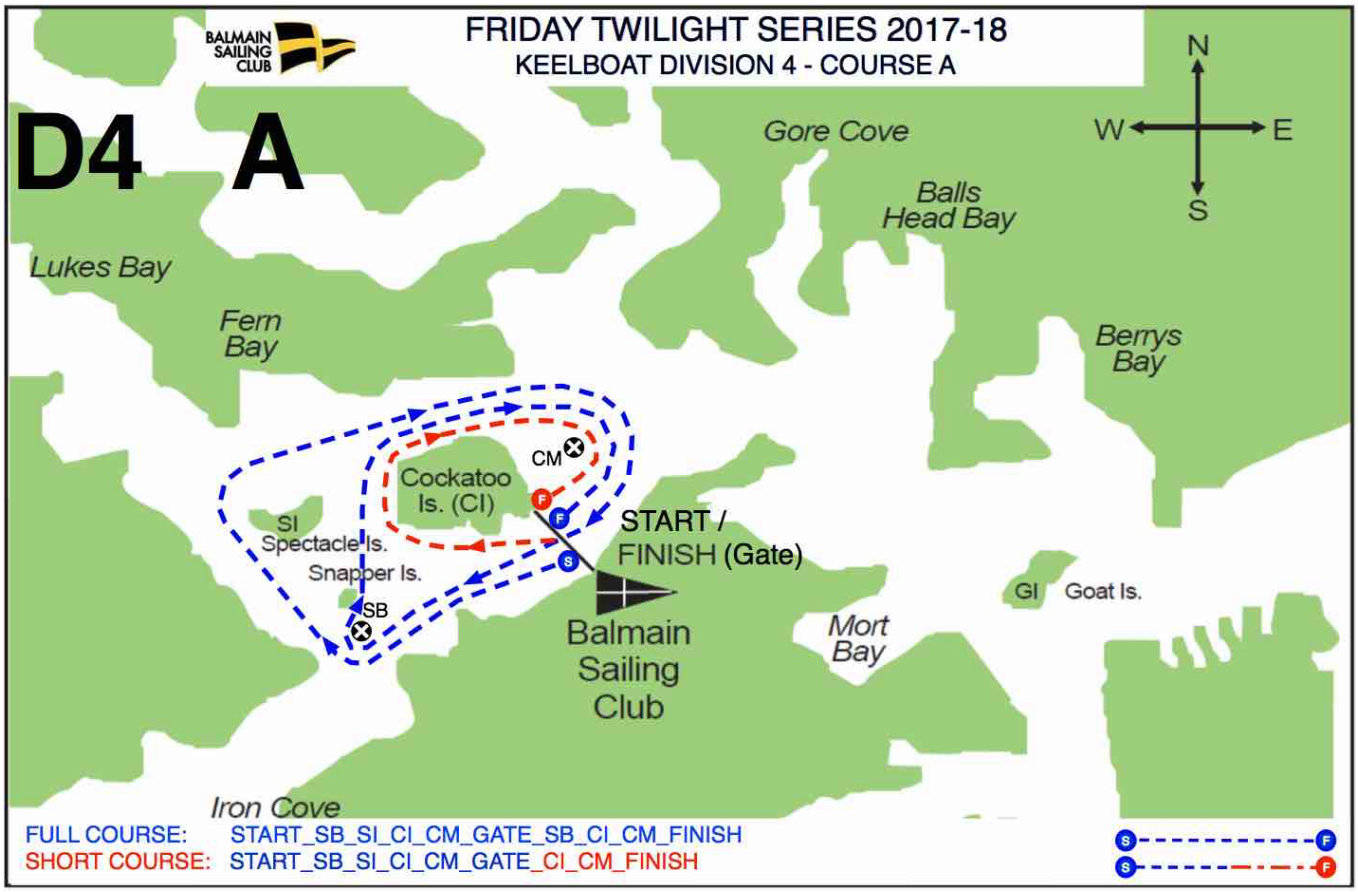
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 4 - COURSE A
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BALMAIN SAILING CLUB
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
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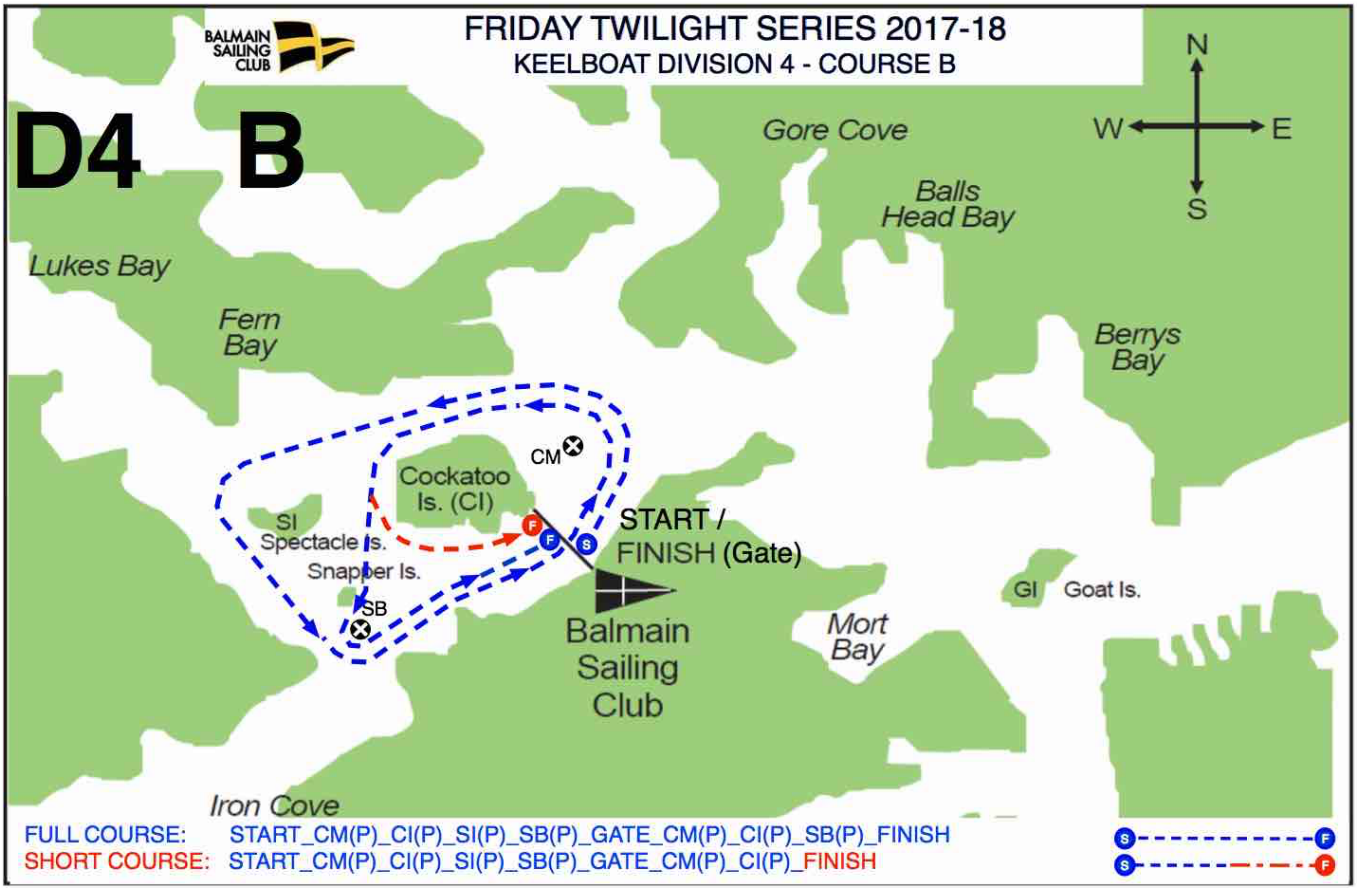
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
Balmain Sailing Club
GI
Goat Is.
Mort Bay
Iron Cove
FULL COURSE: START_SB_SI_CI_CM_GATE_SB_CI_CM_FINISH
SHORT COURSE: START_SB_SI_CI_CM_GATE_CI_CM_FINISH


FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 4 - COURSE B
D4 B
BALMAIN SAILING CLUB
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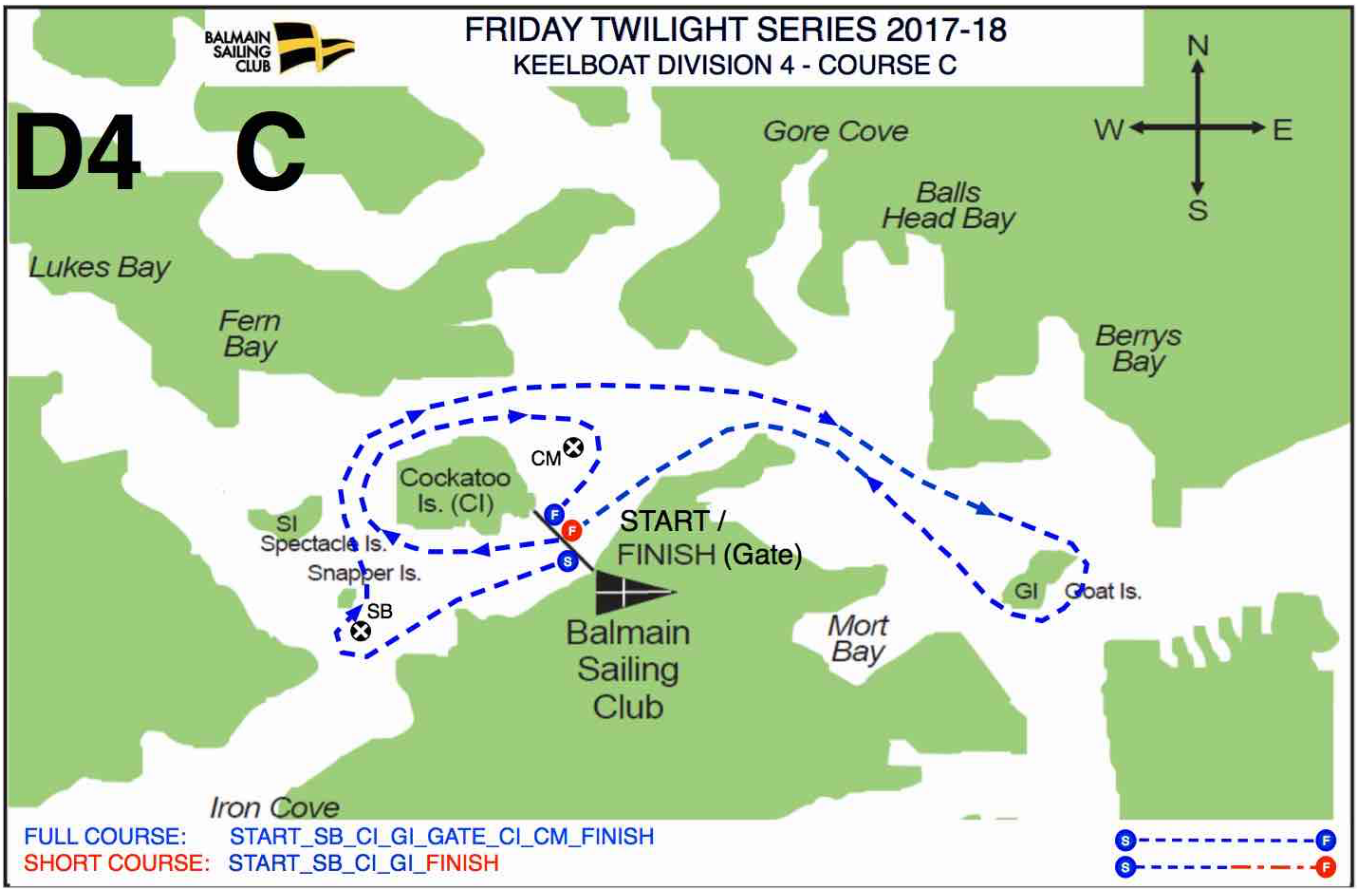
Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
Balmain Sailing Club
GI
Goat Is.
Mort Bay
Iron Cove
FULL COURSE: START_CM(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_SB(P)_FINISH
SHORT COURSE: START_CM(P)_CI(P)_SI(P)_SB(P)_GATE_CM(P)_CI(P)_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 4 - COURSE C
D4 C
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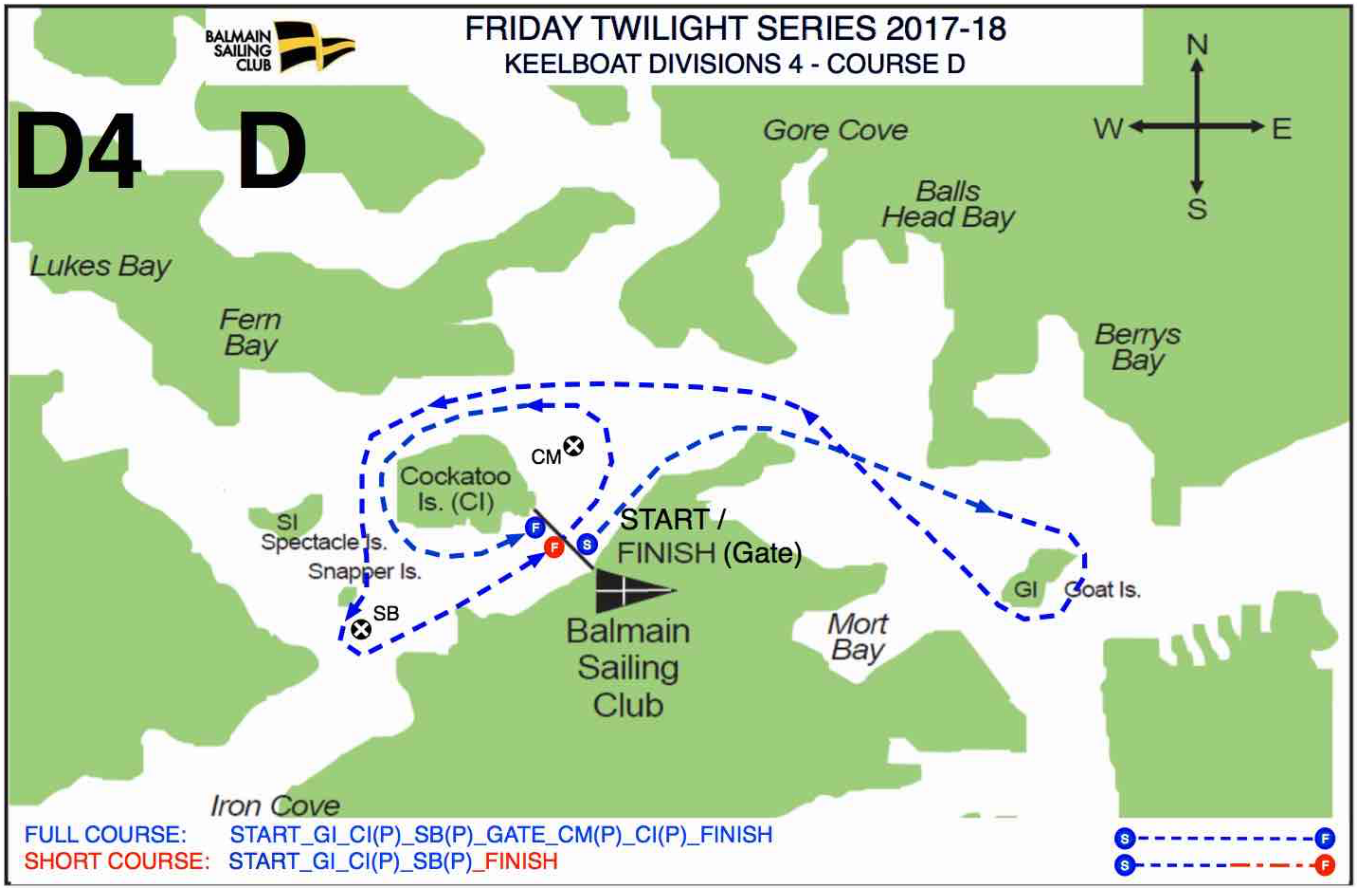
Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_SB_CI_GI_GATE_CI_CM_FINISH
SHORT COURSE: START_SB_CI_GI_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
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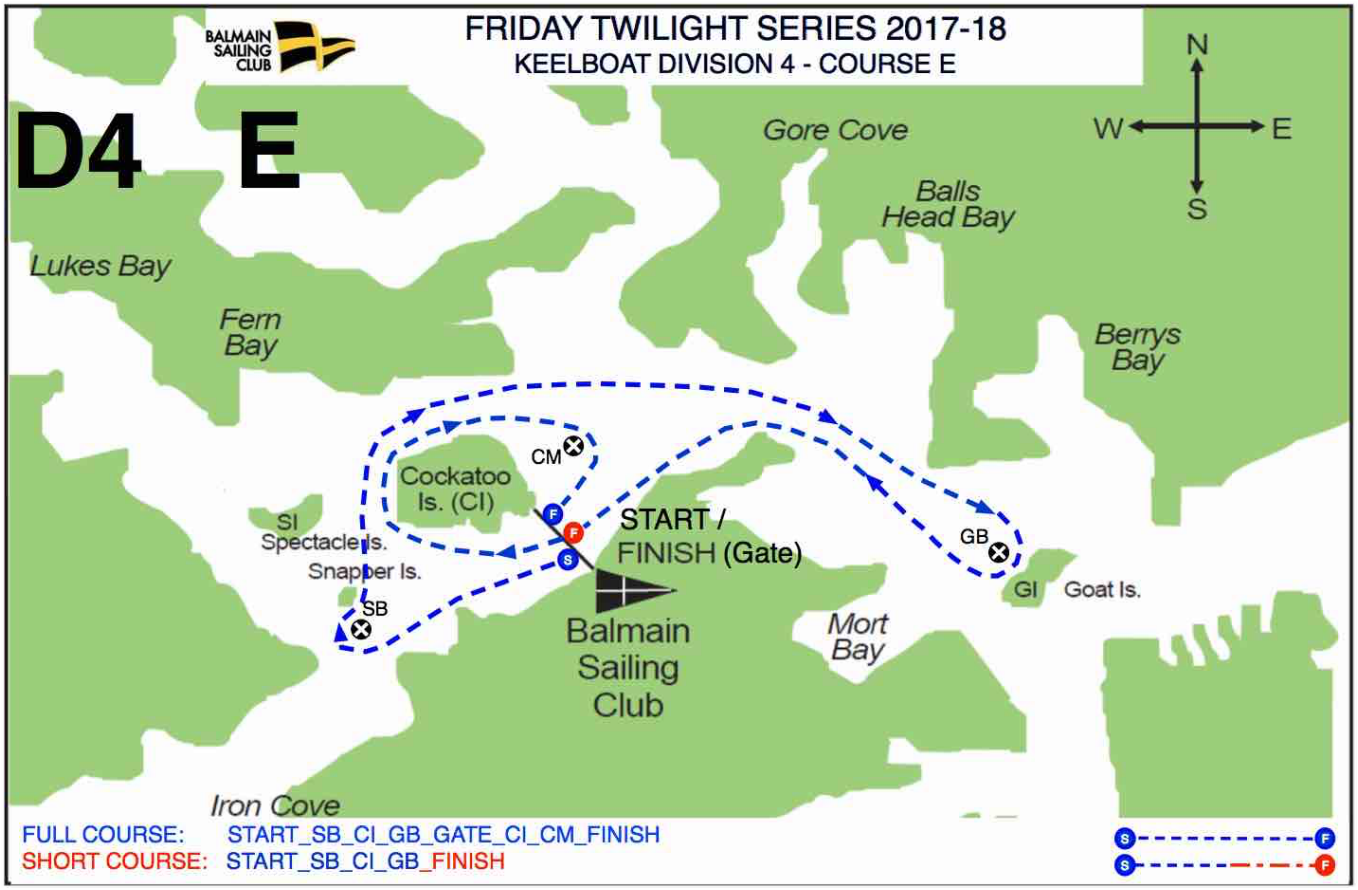
D4 D
N
W
E
S
Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_GI_CI(P)_SB(P)_GATE_CM(P)_CI(P)_FINISH
SHORT COURSE: START_GI_CI(P)_SB(P)_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
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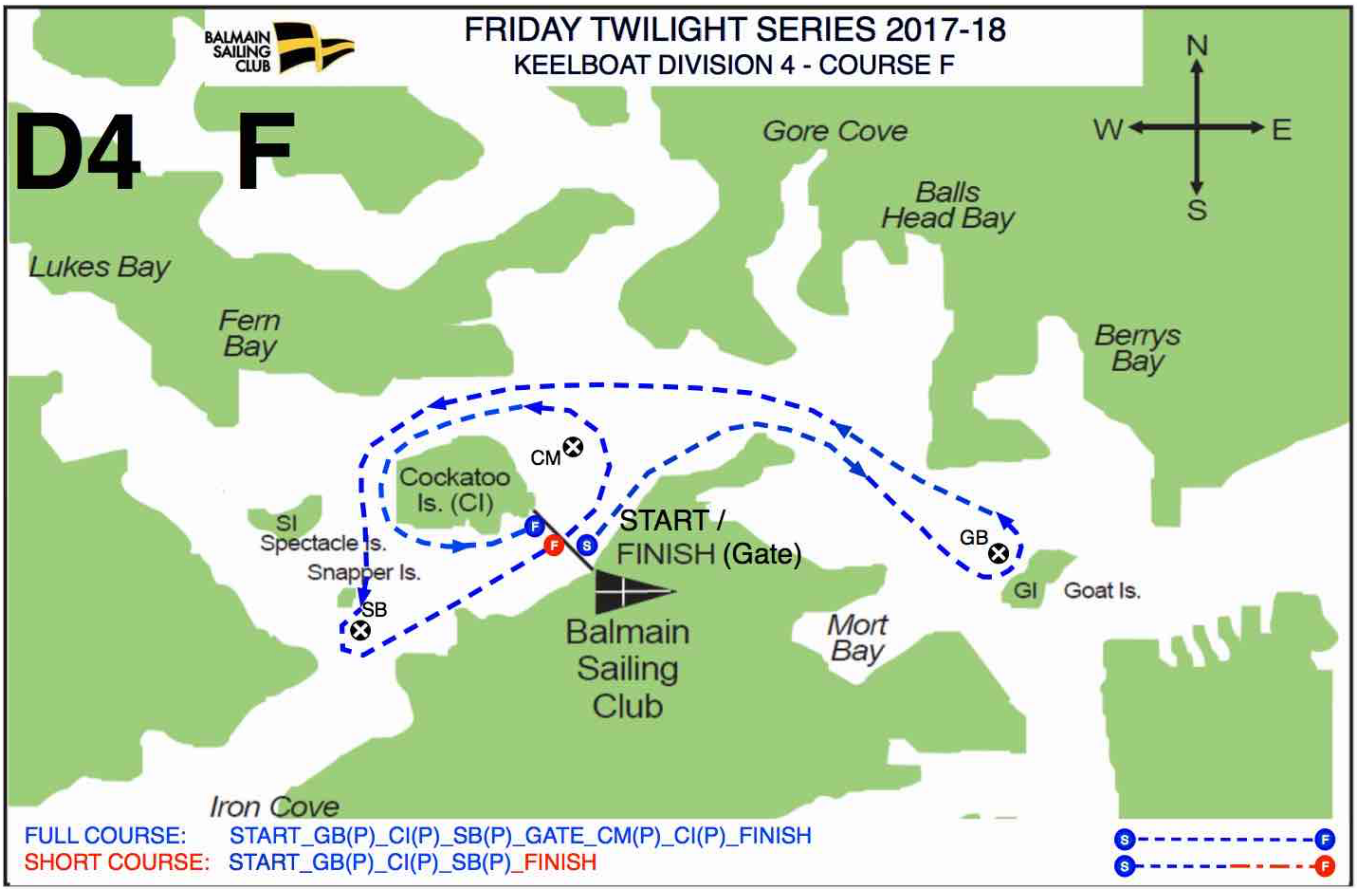
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GB
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_SB_CI_GB_GATE_CI_CM_FINISH
SHORT COURSE: START_SB_CI_GB_FINISH


BALMAIN SAILING CLUB
FRIDAY TWILIGHT SERIES 2017-18
KEELBOAT DIVISION 4 - COURSE F
D4 F
N
W
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Gore Cove
Balls Head Bay
Lukes Bay
Fern Bay
Berrys Bay
CM
Cockatoo Is. (CI)
SI
Spectacle Is.
Snapper Is.
SB
START / FINISH (Gate)
GB
GI
Goat Is.
Balmain Sailing Club
Mort Bay
Iron Cove
FULL COURSE: START_GB(P)_CI(P)_SB(P)_GATE_CM(P)_CI(P)_FINISH
SHORT COURSE: START_GB(P)_CI(P)_SB(P)_FINISH

Royal HaskoningDHV

Drummoyne Sailing Club

14. COURSES

Twilight Green

Course	Courses	Finish	
1 NE	1-CI-Spec-1-CI-Spec-1	Vicinity 4	(All P)
2 E	6-CI-1-Spec-CI	Vicinity 1	(All S)
3 S/SE	15-4-CI-15-4-1-Spec-SI	Vicinity 1	(All S)
4 W	4-CI-Spec-1-CI-Spec	Vicinity 1	(All P)
6 SW	4-1-Spec-4-1-Spec-4	Vicinity 1	(All S)

Twilight Blue / Yellow / Black

Course	Courses	Finish	
1 NE	1-7-5-1-7-5-1	Vicinity 4	(All P)
2 E	6-7-1-5-7	Vicinity 1	(All S)
3 S/SE	15-4-1-5-15-4-1-5-15	Vicinity 1	(All S)
4 W	4-5-1-7-5-1-7-5	Vicinity 1	(All P)
6 SW	4-1-5-7-1-5-7	Vicinity 1	(All S)

SUMMER All Divisions – All to S unless otherwise indicated

Course	Courses	Finish	
1 NE	1-3-5-1-3-1-3-5-1-3	Vicinity 1	(All P)
2 E	5-3-1-5-3-5-3-1-5-7	Vicinity 1	
3 S/SE	10-Spec-CI(P)-7(P)-8(P)-Spec-1-8(P)-Spec-CI(P)-7(P)-8(P)	Vicinity 1	
4 W	7-8(P)-Spec-CI(P)-3(P)-8(P)-3(P)-8-(P)	Vicinity 1	
5 NW	6-8-7-1-8-Spec-1-8-Spec-1-8-Spec	Vicinity 1	
6 SW	7-1-5-3-1-3-5-3	Vicinity 1	
7	CH-Spec-CI-GI-FD-Clark-Shark-Clark-FD-GT-CI	Vicinity SI	
8	CH-Spec-CI-GT-FD-GT-CI	Vicinity SI	
9	CH-Spec-CI-GT-CI	Vicinity SI	
10	CH-YA Mark NW of Morrison Bay-CI	Vicinity SI	
11	4-6(P)-1(P)-3(P)-6(P)-3-1(P)-4(P)	Vicinity 1	

Courses 7-11 may start and finish between Club flagpole or starter's boat and the palm tree on Snapper Island. The course to be sailed on the day will be indicated by a numbered flag or board, displayed on the starting boat or Club flagpole, corresponding to the selected course. The channel mark to the North of Spectacle Island must be observed.

Course Map

Attachment 2

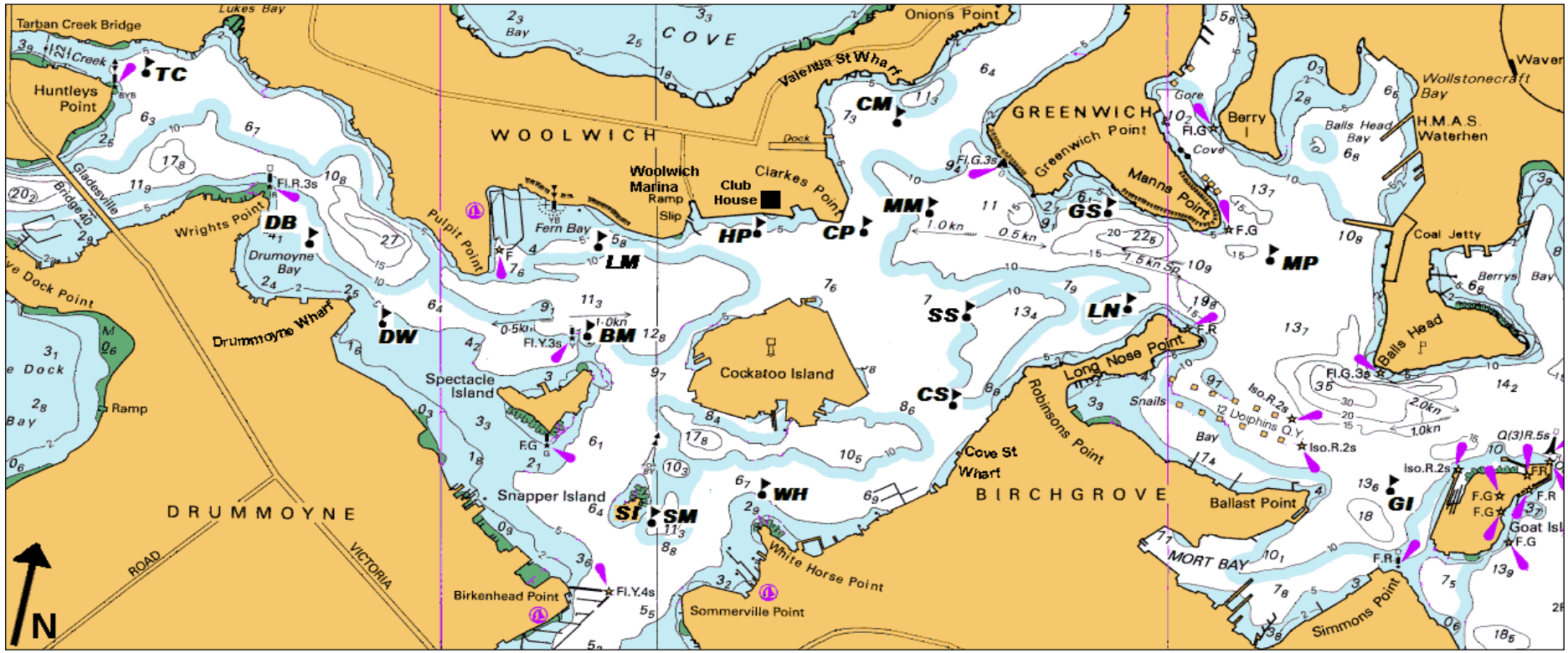
ARBITRATION

T1 POST-RACE PENALTIES

Royal HaskoningDHV

Hunters Hill Sailing Club

Attachment B – Courses



Key	Name	Location
BM	Beacon	30m E of Port Channel Mark
CI	Cockatoo Island	100m East of Cockatoo Is
CM	Compass	250m south of Valencia St Wharf
CP	Clarkes Point	100m ESE of Clarkes Point
CS	Cove Street	100m NW of Cove Street Wharf
DB	Drummoyne Bay	200m SE of Wrights Point
DW	Drummoyne Wharf	250m SE of Drummoyne Wharf
GI	Goat Island	200m W of Goat Island
GS	Greenwich SC	150 SW Greenwich SC ramp
HP	Horse Paddock	100m SW of HHSC ramp

Key	Name	Location
LM	Le Merle	SE Fern Bay cardinal mark
LN	Long Nose Point	100m WNW of Long Nose Point
MM	Middle Mouth	200m E of Clarkes Point
MP	Manns Point	200m SE of Manns Point
SI	Snapper Island	
SM	Snapper Mark	100m E of Snapper Island wharf
SS	Ships	200m WNW of Robinson Point
TC	Tarban Creek	100m NE of Huntleys Point
WH	White Horse	100m N of White Horse Point

Attachment B – Courses

B2 – SENIOR RIVER COURSES – 1 RACE PER DAY

	Course R1 North East	Course R2 East	Course R3 South East	Course R4 South	Course R5 West	Course R6 Alternate East	Course R7 South West
LASER	Start Compass (S) White Horse Manns Point Ships Manns Point Beacon ** Compass (S) White Horse Manns Point Beacon Finish	Start Manns Point Ships (S) Compass Beacon Manns Point Beacon ** Manns Point Ships (S) Compass Beacon Finish	Start Ships Compass (S) Goat Island Clarkes Point Ships ** Compass (S) Goat Island Clarkes Point Ships Finish	Start Snapper Is. (S) Tarban Creek Snapper Island Beacon Drum. Bay ** Snapper Island Le Merle (S) Compass (S) Ships (S) Finish	Start Drum. Wharf Compass (S) Ships (S) Drum. Wharf Compass (S) Ships (S) ** Drum. Wharf Ships (S) Finish	Start Long Nose Compass Drum. Wharf (S) Long Nose Drum. Wharf (S) ** Long Nose Compass Drum. Wharf (S) Finish	Start Snapper Mark Greenwich Cove Street Greenwich Compass Snapper Mark Greenwich ** Cove Street Greenwich Cove Street Greenwich Compass Finish
FLYING 11, MIRROR	Start Compass (S) White Horse Manns Point Beacon ** Compass (S) White Horse Manns Point Beacon Finish	Start Manns Point Ships (S) Compass Beacon Compass Beacon ** Manns Point Ships (S) Compass Beacon Finish	Start Ships Compass (S) Long Nose (S) Clarkes Point Ships ** Compass (S) Long Nose (S) Clarkes Point Ships Finish	Start Snapper Is. (S) Drum. Bay Snapper Island Beacon Drum. Bay ** Snapper Island Le Merle (S) Compass (S) Ships (S) Finish	Start Drum. Wharf Compass (S) Ships (S) Drum. Wharf Compass (S) Ships (S) ** Drum. Wharf Ships (S) Finish	Start Ships Compass Drum. Wharf (S) Ships Drum. Wharf (S) ** Ships Compass Drum. Wharf. (S) Finish	Start Snapper Mark Greenwich Cove Street Greenwich Compass ** Snapper Mark Greenwich Compass Finish
29er	Start Compass (S) White Horse Manns Point Beacon Compass (S) White Horse Manns Point Beacon ** Compass (S) White Horse Manns Point Beacon Finish	Start Manns Point Ships (S) Compass Beacon Manns Point Ships (S) Compass Beacon ** Manns Point Ships (S) Compass Beacon Finish	Start Ships Compass (S) Goat Island Compass (S) Goat Island Clarkes Point Ships ** Compass (S) Goat Island Clarkes Point Ships Finish	Start Snapper Is. (S) Tarban Creek Snapper Island Beacon Drum. Bay Snapper Island Beacon Drum. Bay ** Snapper Island Le Merle (S) Compass (S) Ships (S) Finish	Start Drum. Wharf Snapper Island Compass (S) Ships (S) Drum. Wharf Snapper Island Compass (S) Ships (S) ** Drum. Wharf Snapper Island Compass (S) Ships (S) Finish	Start Long Nose Compass Drum. Wharf (S) Long Nose Compass Drum. Wharf (S) ** Long Nose Compass Drum. Wharf (S) Finish	Start Snapper Mark Greenwich Cove Street Greenwich Compass Snapper Mark Greenwich ** Cove Street Greenwich Compass Snapper Mark Compass Finish

All marks to Port except where indicated (S)

** Final rounding mark when the course is shortened before the start

Attachment B – Courses

B3 – SENIOR RIVER COURSES – 2 RACES PER DAY

		Course R1 North East	Course R2 East	Course R3 South East	Course R4 South	Course R5 West	Course R6 Alternate East	Course R7 South West
LASER, 29er	Race 1	Start Compass (S) White Horse Manns Point Beacon Finish	Start Manns Point Ships (S) Compass Beacon Finish	Start Ships Compass (S) Long Nose (S) Clarkes Point Ships Finish	Start Snapper Mark Le Merle (S) Snapper Mark Le Merle (S) Compass (S) Ships (S) Finish	Start Drum. Wharf Clarkes Point (S) Ships (S) Beacon Clarkes Point (S) Finish	Start Long Nose Drum. Wharf (S) Clarkes Point Beacon Finish	Start Snapper Mark Greenwich Cove Street Greenwich Compass Finish
	Race 2	Start Compass (S) Beacon Compass (S) Beacon Clarkes Point Beacon Finish	Start Manns Point Beacon Manns Point Beacon Finish	Start Ships Compass (S) Long Nose (S) Compass (S) Long Nose (S) Finish	Start Snapper Is. (S) Drum. Bay Snapper Island Le Merle (S) Compass (S) Ships (S) Finish	Start Drum. Wharf Ships (S) Beacon Ships (S) Finish	Start Long Nose Compass Drum. Wharf (S) Clarkes Point Beacon Finish	Start Snapper Mark Greenwich Cove Street Greenwich Compass Finish
FLYING 11, MIRROR	Race 1	Start Compass (S) White Horse Ships Beacon Finish	Start Manns Point Ships (S) Compass Beacon Finish	Start Ships Compass (S) Long Nose (S) Finish	Start Snapper Mark Le Merle (S) Compass (S) Ships (S) Finish	Start Drum. Wharf Clarkes Point (S) Beacon Clarkes Point (S) Finish	Start Long Nose Compass Drum. Wharf. (S) Finish	Start Snapper Mark Greenwich Compass Finish
	Race 2	Start Compass (S) Beacon Compass (S) Beacon Finish	Start Manns Point Beacon Ships (S) Beacon Finish	Start Ships Compass (S) Long Nose (S) Finish	Start Snapper Is. (S) Drum. Bay Snapper Island Le Merle (S) Compass (S) Finish	Start Drum. Wharf Ships (S) Beacon Clarkes Point (S) Finish	Start Long Nose Beacon Clarkes Point Beacon Finish	Start Snapper Mark Greenwich Cove Street Greenwich Compass Finish

All marks to Port except where indicated (S)

B4 – JUNIOR RIVER COURSES

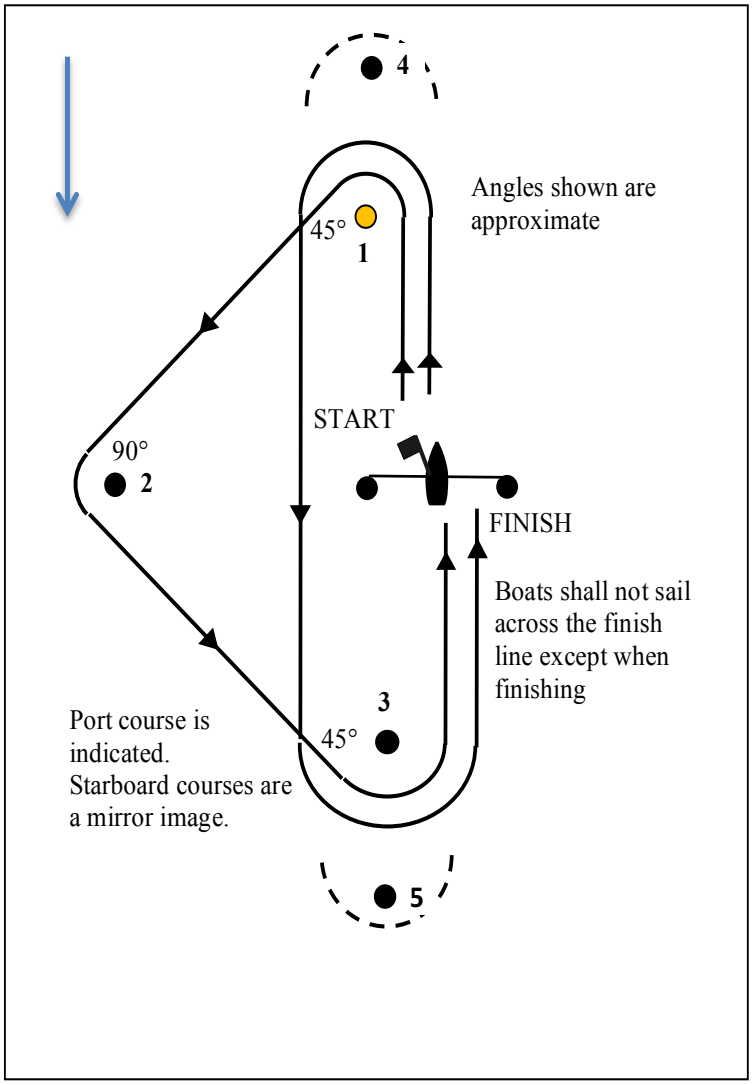
Laser 4.7, Junior Race Fleet Course R6	Laser 4.7, Junior Race Fleet Course R7
Start Greenwich Compass Horse Paddock Greenwich Horse Paddock ** Greenwich Compass Horse Paddock Finish	Start Beacon (S) Horse Paddock (S) Ships (S) Beacon (S) Ships (S) ** Beacon (S) Horse Paddock (S) Ships (S) Finish

All marks to Port except where indicated (S)

** Final rounding mark when the course is shortened before the start

Attachment B – Courses

B5 – WINDWARD-LEEWARD-TRIANGULAR COURSES



JUNIOR COURSES

Course 1	Start-1-3-Finish
Course 2	Start-1-2-3-Finish
Course 3	Start-1-2-3-1-3-Finish
Course 4	Start-1-2-3-1-3-1-2-3-Finish

SENIOR COURSES

All Classes except 29er

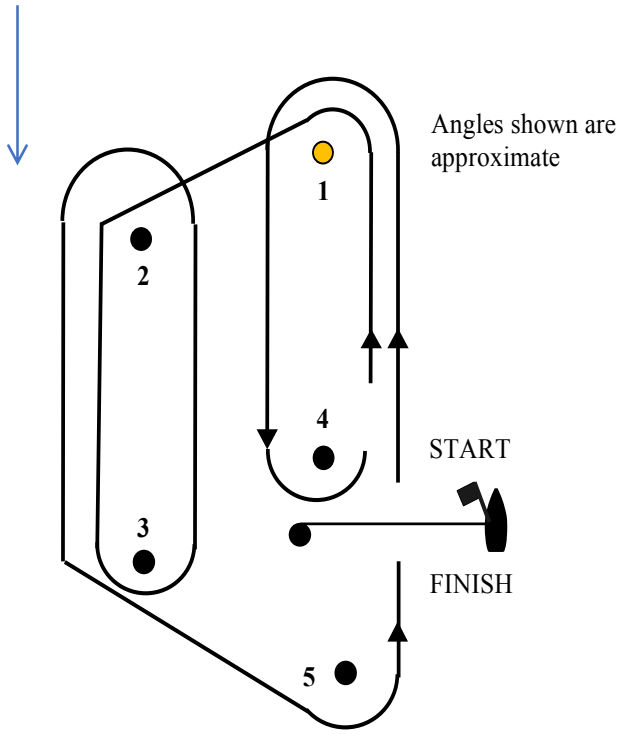
Course 1	Start-1-3-Finish
Course 2	Start-1-2-3-1-3-Finish
Course 3	Start-1-2-3-1-3-1-2-3-Finish
Course 4	Start-1-2-3-1-3-1-2-3-1-3-Finish

29er

Course 1	Start-4-5-Finish
Course 2	Start-4-5-4-5-Finish
Course 3	Start-4-5-4-5-4-5-Finish
Course 4	Start-4-5-4-5-4-5-4-5-Finish

Attachment B – Courses

B6 – TRAPEZOID COURSES



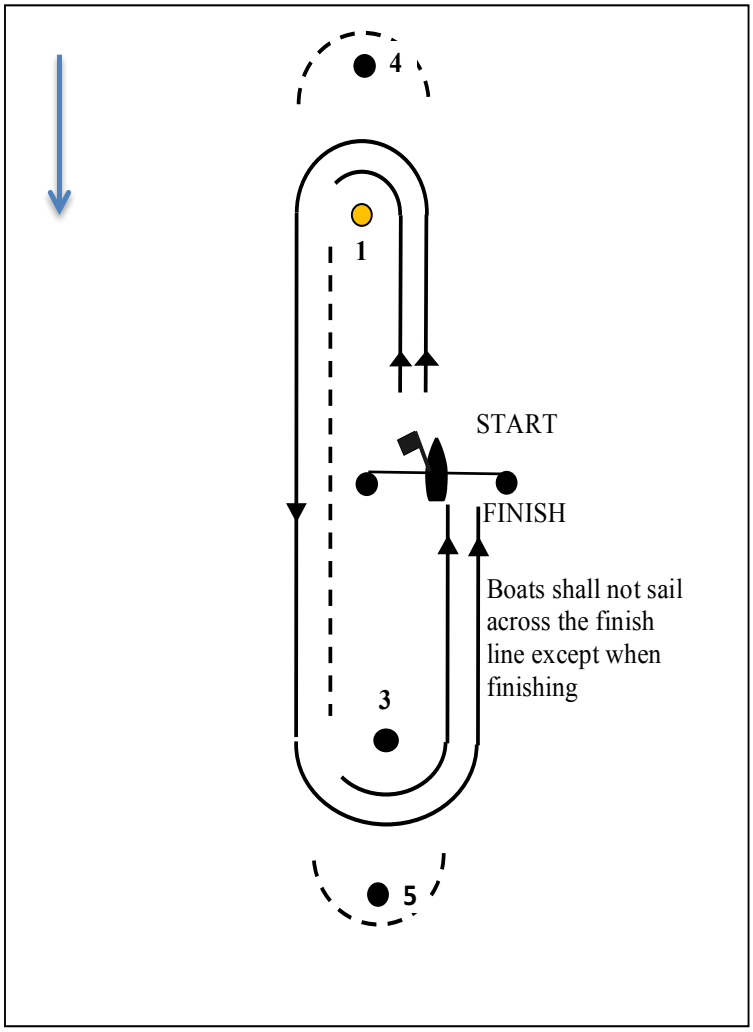
TRAPEZOID COURSES

Course I2	Start-1-4-1-2-3-5-Finish
Course I3	Start-1-4-1-4-1-2-3-5-Finish
Course I4	Start-1-4-1-4-1-4-1-2-3-5-Finish
Course O1	Start-1-2-3-5-Finish
Course O2	Start-1-2-3-2-3-5-Finish
Course O3	Start-1-2-3-2-3-2-3-5-Finish
Course O4	Start-1-2-3-2-3-2-3-2-3-5-Finish

Mark 3 may be a gate
Mark 4 may be a gate

Attachment B – Courses

B7 – WINDWARD-LEEWARD COURSES



JUNIOR COURSES

Course W1	Start-1-3-Finish
Course W2	Start-1-3-1-3-Finish
Course W3	Start-1-3-1-3-1-3-Finish
Course W4	Start-1-3-1-3-1-3-1-3-Finish

SENIOR COURSES

All Classes except 29er

Course W1	Start-1-3-Finish
Course W2	Start-1-3-1-3-Finish
Course W3	Start-1-3-1-3-1-3-Finish
Course W4	Start-1-3-1-3-1-3-1-3-Finish

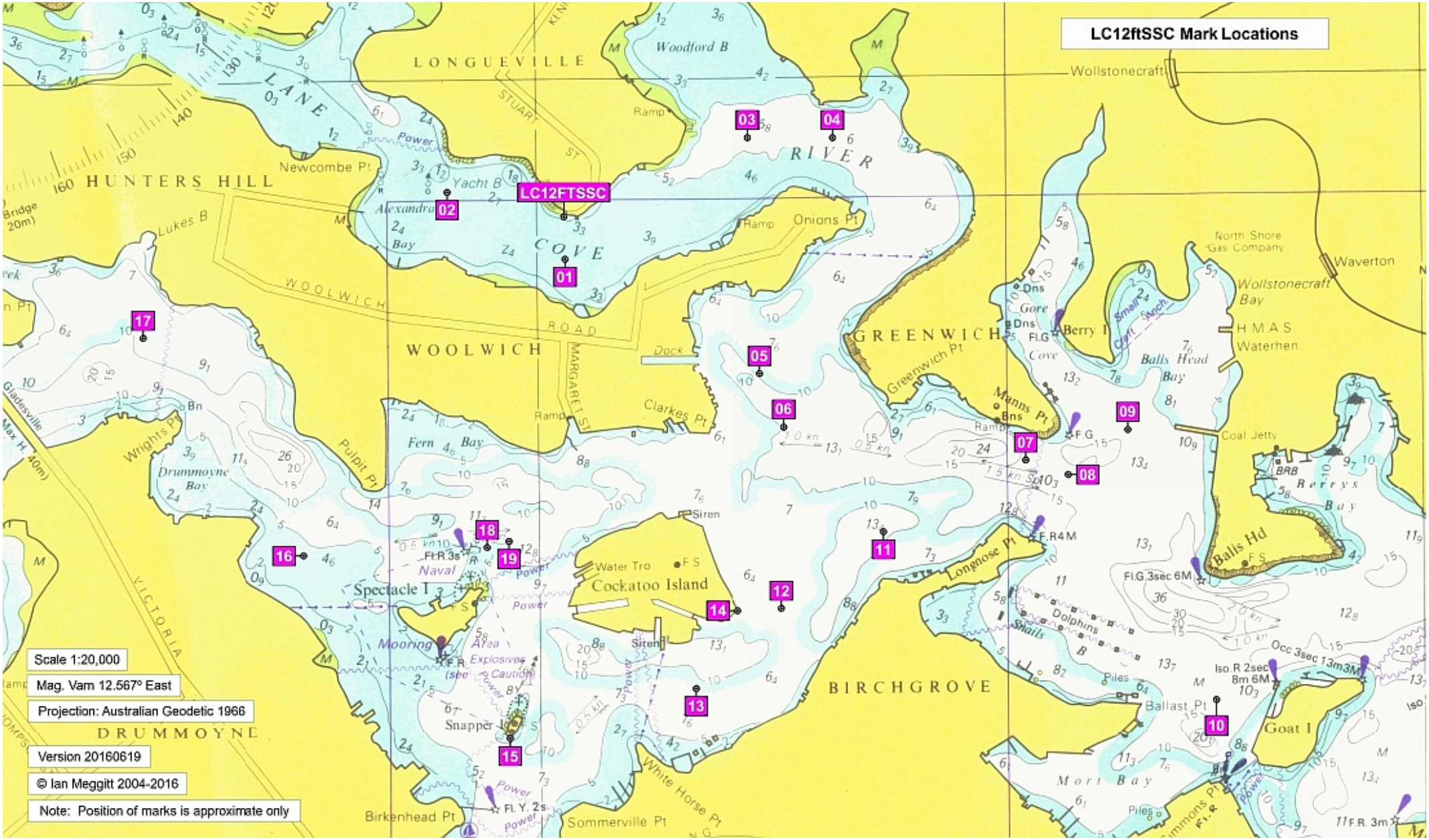
29er

Course W1	Start-4-5-Finish
Course W2	Start-4-5-4-5-Finish
Course W3	Start-4-5-4-5-4-5-Finish
Course W4	Start-4-5-4-5-4-5-4-5-Finish

Royal HaskoningDHV

Lane Cove 12 Foot Skiff Sailing Club

10.3 Approximate Mark Positions



11 COURSES

11.1 The course will be designated by the Starter, by number, according to wind direction. Each course lists the order in which the marks are to be passed and the hand on which each mark is to be left.

(P)-Port Hand (S)-Starboard Hand

11.1.1 12ft Skiff Courses

1	North East Wind
1	Start Clubhouse
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
19	Spectacle Island - flag mark (S)
8	Manns Point - flag mark (P)
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
19	Spectacle Island - flag mark (S)
4	Northwood - flag mark (P)
1	Finish Clubhouse

2	East Wind
1	Start Clubhouse
5	Valentia Street - flag mark (P)
7	Manns Point West - flag mark (P)
16	Drummoyne - flag mark (S)
7	Manns Point West - flag mark (P)
5	Valentia Street - flag mark (P)
19	Spectacle Island - flag mark (S)
7	Manns Point West - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

3	South Wind
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
5	Valentia Street - flag mark (P)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

4	West Wind
1	Start Clubhouse
2	Alexandra Street - flag mark (P)
11	Birchgrove - flag mark (P)
8	Manns Point - flag mark (P)
16	Drummoyne - flag mark (P)
15	Snapper Island (P)
8	Manns Point - flag mark (P)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

5	South Wind (Alternate)
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
14	Cockatoo Island (S)
15	Snapper Island (S)
17	Tarban Creek - flag mark (P)
15	Snapper Island (P)
18	Spectacle Island (P) observe channel mark
17	Tarban Creek - flag mark (P)
15	Snapper Island (P)
14	Cockatoo Island (P)
5	Valentia St flag mark (S)
12	Cove Street - flag mark (P)
1	Finish Clubhouse

11.1.2 Cherub Courses

1	North East Wind
1	Start Clubhouse
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
19	Spectacle Island - flag mark (S)
8	Manns Point - flag mark (P)
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
19	Spectacle Island - flag mark (S)
4	Northwood - flag mark (P)
1	Finish Clubhouse

2	East Wind
1	Start Clubhouse
5	Valentia Street - flag mark (P)
7	Manns Point West - flag mark (P)
16	Drummoyne - flag mark (S)
7	Manns Point West - flag mark (P)
5	Valentia Street - flag mark (P)
19	Spectacle Island - flag mark (S)
7	Manns Point West - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

3	South Wind
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
5	Valentia Street - flag mark (P)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

4	West Wind
1	Start Clubhouse
2	Alexandra Street - flag mark (P)
11	Birchgrove - flag mark (P)
8	Manns Point - flag mark (P)
16	Drummoyne - flag mark (P)
15	Snapper Island (P)
8	Manns Point - flag mark (P)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

5	South Wind (Alternate)
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
14	Cockatoo Island (S)
15	Snapper Island (S)
17	Tarban Creek - flag mark (P)
15	Snapper Island (P)
18	Spectacle Island (P) observe channel mark
17	Tarban Creek - flag mark (P)
15	Snapper Island (P)
14	Cockatoo Island (P)
5	Valentia St - flag mark (S)
12	Cove Street - flag mark (P)
1	Finish Clubhouse

11.1.3 Laser Courses

1	North East Wind
1	Start Clubhouse
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
6	Clarkes Point - flag mark (P)
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
19	Spectacle Island - flag mark (S)
4	Northwood - flag mark (P)
1	Finish Clubhouse

2	East Wind
1	Start Clubhouse
5	Valentia Street - flag mark (P)
7	Manns Point West - flag mark (P)
11	Birchgrove – flag mark (S)
5	Valentia Street - flag mark (P)
19	Spectacle Island - flag mark (S)
7	Manns Point West - flag mark (P)
11	Birchgrove - flag mark (S)
5	Valentia Street - flag mark (P)
19	Spectacle Island - flag mark (S)
7	Manns Point West - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

3	South Wind
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
5	Valentia Street - flag mark (P)
10	Goat Island - flag mark (S)
7	Manns Point West - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
7	Manns Point West - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

4	West Wind
1	Start Clubhouse
2	Alexandra Street - flag mark (P)
1	Pass Start Mark to Port (P)
11	Birchgrove - flag mark (P)
8	Manns Point - flag mark (P)
16	Drummoyne - flag mark (P)
15	Snapper Island (P)
8	Manns Point - flag mark (P)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

5	South Wind (Alternate)
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
14	Cockatoo Island (S)
15	Snapper Island (S)
17	Tarban Creek - flag mark (P)
15	Snapper Island (P)
14	Cockatoo Island (P)
5	Valentia St - flag mark (S)
12	Cove Street - flag mark (P)
5	Valentia St - flag mark (S)
12	Cove Street - flag mark (P)
1	Finish Clubhouse

11.1.4 Flying Eleven Courses

1	North East Wind
1	Start Clubhouse
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
6	Clarkes Point - flag mark (P)
13	White Horse Point - flag mark (P)
8	Manns Point - flag mark (P)
19	Spectacle Island - flag mark (S)
4	Northwood - flag mark (P)
1	Finish Clubhouse

2	East Wind
1	Start Clubhouse
5	Valentia Street - flag mark (P)
7	Manns Point West - flag mark (P)
5	Valentia Street - flag mark (P)
16	Drummoyne - flag mark (S)
7	Manns Point West - flag mark (P)
5	Valentia Street - flag mark (P)
19	Spectacle Island - flag mark (S)
1	Finish Clubhouse

3	South Wind
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
5	Valentia Street - flag mark (P)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
9	Balls Head Bay - flag mark (S)
10	Goat Island - flag mark (S)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

4	West Wind
1	Start Clubhouse
2	Alexandra Street - flag mark (P)
11	Birchgrove - flag mark (P)
8	Manns Point - flag mark (P)
16	Drummoyne - flag mark (P)
15	Snapper Island (P)
8	Manns Point - flag mark (P)
5	Valentia Street - flag mark (P)
11	Birchgrove - flag mark (S)
1	Finish Clubhouse

5	South Wind (Alternate)
1	Start Clubhouse
3	Woodford Bay - flag mark (S)
16	Cockatoo Is (S)
15	Snapper Island (S)
17	Tarban Creek - flag mark (P)
15	Snapper Island (P)
14	Cockatoo Island (P)
5	Valentia St - flag mark (S)
12	Cove Street - flag mark (P)
1	Finish Clubhouse

Royal HaskoningDHV

Greenwich Flying Squadron

GFS 2017 - 2018 Season Keelboat Courses for Down Harbour and Saturday Series Racing.

Down Harbour Courses

Course 1 Long Harbour
Start - at Clubhouse
Nielsen Park [YA Mark] R
Lady Bay Nth. [YA Mark] W
Manly West [YA Mark] B
Manly East [YA Mark] B
Shark Is. [YA Mark] B,W,R
Finish B,W,R

Course 2 Short Harbour
Start - at Clubhouse
Nielsen Park [YA Mark] W
Lady Bay Nth [YA Mark] B
Shark Is. [YA Mark] B,W,R
Finish B,W,R

Course 3 Harbour Picnic
Start – at Clubhouse
Clark Is. R
Shark Is. [YA Mark] W
Nielsen Park [YA Mark] B
Finish B,W,R

Course 4 Harbour Five Is.
Start – at Clubhouse
Fort Denison A
Goat Is.
Snapper Is.
Spectacle Is.
Cockatoo Island (P)***
Finish

Course 5 Harbour West
Start – at Clubhouse
Start
Snapper Island
Spectacle Island
Cockatoo Island (P)
Snapper Island
Spectacle Island
Finish

Course 6 Harbour East
Start – at Clubhouse
Shark Is. [YA Mark]
Finish

Course 7 Harbour Marathon
Start - at Clubhouse
Manly West - YA Mark B
Manly East - YA Mark B
Obelisk Bay– YA Mark W
Taylors Bay -YA Mk R
Shark Is. - YA Mark B,W,R
Finish B,W,R

Course 8 Harbour City
Start – at Clubhouse
Clark Is.
Finish

Course 9 Manly
Start - at Clubhouse
Manly West - YA Mark
Manly East - YA Mark
Finish

Saturday Series Courses

Division 1 always sails the **Blue Course**

Division 2 the **Green or White Course** corresponding to the flag used for the start.

All courses **may** start at the clubhouse.

Finish at clubhouse or club launch.

Course 10 Wind N
Start – Near Whitehorse
Compass B,G,W
Goat Buoy **(P)** B,G,W
Coal Loader **(P)** B,G,W
Whitehorse B,G,W
Compass B,G,W
Goat Buoy **(P)** B,G,W
Coal Loader **(P)** B,G,W
Whitehorse A B,G,W
Compass B,G
Goat Buoy **(P)** B,
Coal Loader **(P)** B,G
Whitehorse B
Finish B,G,W

Course 11 Wind N/NW
Start - Near Long Nose Pt
Compass B,G,W
Goat Buoy B,G,W
Snapper Is. B,G,W
Spectacle Is. B,G,W
Compass B,G,W
Goat buoy B,G,W
Cockatoo Is. A B,G
Compass B,G
Goat Buoy B
Finish B,G,W

Course 12 Wind N/NE
Start – near Compass
Goat Buoy **(P)** B,G,W
Berry's Bay **(P)** B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Compass B,G,W
Goat Buoy **(P)** B,G,W
Berry's Bay **(P)** A B,G,W
Spectacle Is. **(P)** B,G
Snapper Is. **(P)** B,G
Cockatoo Is *** B,G,W
Compass B
Cockatoo Is. B
Finish B,G,W

Course 13 Wind NE/E
Start – Clubhouse or Compass
Goat Is B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Goat Is A B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Cockatoo Is. (P)*** B,G,W
Finish B,G,W

Course 14 Wind NE/E
Start – near Compass
Goat Buoy **(P)** B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Goat Buoy **(P)** A G,B,W
Spectacle Is. **(P)** B,G
Snapper Is. **(P)** B,G
Cockatoo Is. (P)*** B,G,W
Finish B,G,W

Course 15 Wind NE/E
Start – near Compass
Goat Buoy B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Goat Buoy A B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Cockatoo Is.*** B,G,W
Finish B,G,W

Course 16 Wind NE
Start – near Compass
Berry's Bay B,G,W
Goat Buoy B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Berry's Bay B,G,W
Goat Buoy A B,G,W
Spectacle Is. **(P)** B,G
Snapper Is. **(P)** B,G
Berry's Bay B
Goat Buoy B
Finish B,G,W

Course 17 Wind NE/E
Start – near Compass
Manns Point B,G,W
Goat Buoy B,G,W
Snapper Is B,G,W
Spectacle Is B,G,W
Manns Point B,G,W
Snapper Is B,G,W
Spectacle Is B,G,W
Compass B,G
Cockatoo Is [A] B,G
Snapper Is B
Spectacle Is B
Finish B,G,W

Course 18 Wind NE/E
Start – near Compass
Berry's Bay B,G,W
Goat Buoy B,G,W
Compass **(P)** B,G,W
Berry's Bay B,G,W
Goat Buoy A B,G,W
Compass **(P)** B,G
Spectacle Is. **(P)** B,G
Snapper Is. **(P)** B,G
Cockatoo Is *** B,G
Finish B,G,W

Course 19 Wind E
Start – near Compass
Goat Buoy B,G,W
Compass B,G,W
Goat Is B
Goat Buoy A G,W
Snapper Is. B,G,W
Spectacle Is. B,G,W
Goat Is B
Goat Buoy G
Finish B,G,W

Course 20 Wind E
Start – near Compass.
Berry's Bay B,G,W
Goat Buoy B,G,W
Snapper Is. B,G,W
Spectacle Is. B,G,W
Berry's Bay B,G,W
Goat Buoy A B,G,W
Snapper Is. B,G
Spectacle Is. B,G
Finish - B,G,W

Course 21 Wind SE
Start – near Compass
Goat Buoy **(P)** B,G,W
Berry's Bay **(P)** B,G,W
Compass **(P)** B,G,W
Cockatoo Is B,G,W
Snapper Is. B,G,W
Spectacle Is. A B,G,W
Goat Buoy **(P)** B,G,W
Berry's Bay **(P)** B,G,W
Compass **(P)** B,G
Cockatoo Is B,G
Snapper Is. B
Spectacle Is. B
Finish B,G,W

Course 22 Wind SE
Start – near Greenwich Point
Snapper Is B,G,W
Spectacle Is. B,G,W
Compass B,G,W
Goat Buoy (P) B,G,W
Snapper Is B,G,W
Spectacle Is. A B,G,W
Compass B,G
Goat Buoy (P) B,G
Cockatoo B
Finish B,G,W

Course 23 Wind SE
Start – near Compass
Long Nose B,G,W
Cockatoo Is (P) *** B,G,W
Snapper Is. B,G,W
Spectacle Is. B,G,W
Compass B,G,W
Goat Buoy . A B,G,W
Cockatoo Is. (P) B,G
Finish B,G,W

Course 24 Wind SE
Start – near Compass
Longnose (P) B,G,W
Coal Loader B,G,W
Goat Buoy B,G,W
Cockatoo Is B,G,W
Compass B,G,W
Longnose (P) A B,G,W
Coal Loader B,G,W
Goat Buoy B
Finish B,G,W

Course 25 Wind S
Start – Clubhouse or Compass
Snapper Is. B,G,W
Spectacle Is. B,G,W
Compass B,G,W
Snapper Is. B,G,W
Spectacle Is. B,G,W
Compass B,G,W
Snapper Is. B,G
Spectacle Is. B,G
Finish B,G,W

Course 26 Wind S
Start – near Compass
Cockatoo Is B,G,W
Snapper Is B,G,W
Spectacle Is B,G,W
Compass B,G,W
Goat Buoy . A B,G,W
Snapper Is B,G,W
Spectacle Is. B,G,W
Cockatoo Is (P)*** B,G
Finish B,G,W

Course 27 Wind S/SE
Start - Clubhouse
Cockatoo Is B,G,W
Goat Is B,G,W
Cockatoo Is (P) *** B,G,W
Snapper Is B,G,W
Spectacle Is B,G,W
Finish B,G,W

Course 28 Wind S/SW
Start – Clubhouse or Compass
Cockatoo Is (P) B,G,W
Manns Point B,G,W
Goat Buoy B,G,W
Compass (P) B,G,W
Cockatoo Is (P)*** B,G,W
Snapper Is B,G,W
Spectacle Is B,G,W
Manns Point B,G
Finish B,G,W

Course 29 Wind S/SW
Start – Clubhouse or Compass
Cockatoo Is. B,G,W
Snapper Is. B,G,W
Spectacle Is. B,G,W
Compass B,G,W
Goat Buoy **(P)** B,G,W
Coal Loader **(P)** B,G,W
Compass B,G,W
Goat Buoy **(P)** B,G,
Coal Loader **(P)** B,G
Finish B,G,W

Course 30 Wind SW/W
Start – near Greenwich Point
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Long Nose B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Long Nose A B,G,W
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Long Nose B,G
Finish B,G,W

Course 31 Wind W
Start – near Greenwich Pt.
Spectacle Is. **(P)** B,G,W
Snapper Is. **(P)** B,G,W
Berry's Bay **(P)** B,G,W
Spectacle Is. B,G,W
Snapper Is. **(P)** A B,G,W
Berry's Bay B,G
Finish B,G,W

***** Denotes that Cockatoo Island must be left on the designated side (when marked *** you are NOT required to round the island completely). RRS 28 does not apply.**

GFS 2017 – 2018 Twilight and Saturday Island Courses – Clubhouse Start

Start – Cockatoo - Goat

Course 32
Start
Cockatoo Is
Goat I
Finish

Course 33
Start
Cockatoo I
Goat Is (P)
Finish

Course 34
Start
Cockatoo Is
Goat I
Cockatoo Is
Goat I
Finish

Course 36
Start
Cockatoo Is
Goat Is (P)
Cockatoo Is
Goat Is (P)
Finish

Course 37
Start
Cockatoo Is
Goat Is
Snapper Is
Spectacle Is
Goat Is
Finish

Course 38
Start
Cockatoo Is
Goat Is (P)
Snapper Is
Spectacle Is
Goat Is (P)
Finish

Course 39
Start
Cockatoo Is (P)
Goat Is
Finish

Course 38
Start
Cockatoo Is (P)
Goat Is (P)
Finish

Course 40
Start
Cockatoo Is (P)
Goat Is
Cockatoo Is (P)
Goat Is
Finish

Course 41
Start
Cockatoo Is (P)
Goat Is (P)
Cockatoo Is (P)
Goat Is (P)
Finish

Course 42
Start
Cockatoo Is (P)
Goat Is
Cockatoo Is (P)
Goat I
Cockatoo Is (P)
Finish

Course 43
Start
Cockatoo Is (P)
Goat Is (P)
Cockatoo Is (P)
Goat Is (P)
Cockatoo Is (P)
Finish

Course 44
Start
Cockatoo Is (P)
Goat Is
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is ***
Finish

Course 45
Start
Cockatoo Is (P)
Goat Is (P)
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is (P) ***
Finish

Course 46
Start
Cockatoo Is (P)
Goat Is
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is (P)
Goat Is
Finish

Course 47
Start
Cockatoo Is (P)
Goat Is (P)
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is (P)
Goat Is (P)
Finish

Start – Spectacle - Snapper

Course 48
Start
Spectacle Is (P)
Snapper Is (P)
Goat Is
Cockatoo Is (P)
Finish

Course 49
Start
Spectacle Is (P)
Snapper Is (P)
Goat Is (P)
Cockatoo Is (P)
Finish

Start
Spectacle Is (P)
Snapper Is (P)
Goat Is
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is (P) ***
Finish

Course 51
Start
Spectacle Is (P)
Snapper Is (P)
Goat Is (P)
Cockatoo Is (P)
Goat Is (P)
Cockatoo Is (P)
Finish

Course 52
Start
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is (P)
Spectacle Is (P)
Snapper Is (P)
Cockatoo Is (P) ***
Finish

Start - Goat

Course 53
Start
Goat Is
Finish

Course 54
Start
Goat Is (P)
Finish

Course 55
Start
Goat Is
Cockatoo Is (P)
Finish

Start
Goat Is (P)
Cockatoo Is (P)
Finish

Course 57
Start
Goat Is
Cockatoo Is
Finish

Course 58
Start
Goat Is (P)
Cockatoo Is
Finish

Course 59
Start
Goat Is
Cockatoo Is (P)
Goat Is
Cockatoo Is (P)
Finish

Course 60
Start
Goat Is
Cockatoo Is
Goat Is
Cockatoo Is
Finish

Course 61
Start
Goat Is (P)
Cockatoo Is
Goat Is (P)
Cockatoo Is
Finish

Course 62
Start
Goat Is (P)
Cockatoo Is (P)
Goat Is (P)
Cockatoo Is (P)
Finish

Course 63
Start
Cockatoo Is
Snapper Is
Spectacle Is
Cockatoo Is
Snapper Is
Spectacle Is
Finish

Course 64
Start
Cockatoo Is
Snapper Is
Spectacle Is
Goat Is
Cockatoo Is
Finish

Course 65
Start
Cockatoo Is
Snapper Is
Spectacle Is
Goat Is (P)
Cockatoo Is
Finish

Course 66
Start
Cockatoo Is
Snapper Is
Spectacle Is
Cockatoo Is
Finish

Start – Cockatoo – Spectacle

Course 67
Start
Cockatoo Is
Spectacle Is (P)
Snapper Is (P)
Goat Is)
Cockatoo Is
Goat Is
Finish

Sail the course indicated and take **all** marks to starboard, **except** those indicated with **(P).**

The code A denotes the final rounding mark of the alternative course. Sail the alternative course when the course number displayed is followed by the letter "A".

You must not sail on the wrong side of Lateral Channel Markers (Goat Island, Balls Head, Greenwich Point , Beacon) or the wrong side of Cardinal Marks (NE of Snapper Is).

***** Denotes that Cockatoo Island must be left on the designated side. When marked *** you are NOT required to round the island completely. RRS 28 does not apply.**

Royal HaskoningDHV

Greenwich Sailing Club


Greenwich Sailing Club
C
W
F
X
R
M
Z
P
S
K
I
L
B
N
G
D
Woolwich
Cockatoo Island
Birchgrove
Balmain
Spectacle Island
Snapper Island
Goat Island
Greenwich Point
Manns Point
Balls Head Bay
Berrys Bay
Balls Head
Snails Bay
Ballast Point
Mort Bay
Birkenhead Point
Pulpit Point
Simmons Point
Caution: Snails Bay dolphins.
Locations of Greenwich Sailing Club Marks

29er COURSES GREENWICH SAILING CLUB Version 1, September 2010

Course Letter						
A	**B**	**C**	**D**	**E**	**F**	**G**
Wind Direction						
North East	East	South East	South	South West	West	North West
29er - Long Course						
Start Location						
I	F	X	W	X	X	I
M D M W D M D M W D (X)	G W M B W G W G W (X)	G M G W G M G M G W (X)	B W B W B M G W B W B W (X)	D W M D M D W M D M (X)	S M W B M S M W B M (X)	W M B W G W M B W G (X)
All to Port	All to St'b	All to Port	All to Port	All to St'b	All to Port	All to St'b
29er - Short Course 1						
Start Location						
I	F	R	I	L	F	I
M W B M B (I)	M B W M S	G M G W (R)	B C B C	DM DWM (L)	S M W B M (F)	W D SL W D S L (I)
	M W (F)		B C (I)			
All to Port	All to St'b	All to Port	All to Port	All to Port	All to Port	All to Port
29er - Short Course 2						
Start Location						
I	F	R	I	L	F	I
M W B M B	M D S M S	G M G M	D W R W	D M D W M (X)	S M W B M (X)	W D S L W D S L (X)
M B (X)	M K (X)	G W (X)	B W (X)			
All to Port	All to St'b	All to Port	All to Port	All to St'b	All to Port	All to Port
29er - Sprint						
Start Location						
I	I	M	K	L	I	I
M D (I)	G K (I)	G W (M)	D C (K)	B Z (L)	S M (I)	W N (I)
All to St'b	All to St'b	All to St'b	All to St'b	All to St'b	All to St'b	All to St'b

Legend: **B** Birchgrove **C** Compass **D** Whitehorse **F** Greenwich Wharf **G** Goat Island
I Mid Stream **K** Cockatoo Island **L** Longnose Pt **M** Manns Pt **N** Dolphin **P** Pulpit Pt
R Club **S** Spectacle **W** Woolwich **X** Greenwich Club **Z** Coal Loader
( ) = Finish Location

FLYING 11 COURSES GREENWICH SAILING CLUB Version 4, September 2012

Course Letter						
A	**B**	**C**	**D**	**E**	**F**	**G**
Wind Direction						
North East	East	South East	South	South West	West	North West
Flying 11 - Long Course						
Start Location						
I	F	X	W	X	X	I
M B M W B M B M W B (X)	M K M G M G W M K W (X)	G W G M W G W (X)	G M G M W G M G W (X)	D W M D M D M B (X)	W M B W M W M B W M W M (X)	W G W G W G (X)
All to Port (11.7km)	All to St'b (11.7km)	All to Port (12.2km)	All to Port (12.6km)	All to St'b (12.7km)	All to Port (13.6km)	All to St'b (11.7km)
Flying 11 - Short Course 1						
Start Location						
I	F	R	I	L	F	I
M B R W B (I)	R D W R W (F)	N M F N F (R)	B R C B C (I)	B M B W R (L)	W B R W M (F)	W B L C W B L (I)
All to Port (4.8km)	All to St'b (5.8km)	All to Port (4.7km)	All to Port (4.5km)	All to St'b (4.8km)	All to Port (4.9km)	All to Port (4.6km)
Flying 11 - Short Course 2						
Start Location						
I	F	R	I	L	F	I
M B M W B (X)	M D S W (X)	G F M N F (X)	D R C B W (X)	D W R B M (X)	S R W B R (X)	W S D L W L (X)
All to Port (5.9km)	All to St'b (4.8km)	All to Port (5.6km)	All to Port (5.6km)	All to St'b (5.6km)	All to Port (5.8km)	All to Port (5.6km)
Flying 11 - Sprint						
Start Location						
I	I	M	K	L	I	I
R D (I)	L S (I)	G M N M (M)	D C (K)	B Z (L)	S L (I)	W N (I)
All to St'b (3.0km)	All to St'b (3.3km)	All to St'b (3.1km)	All to St'b (2.8km)	All to St'b (2.8km)	All to St'b (3.3km)	All to St'b (3.1km)

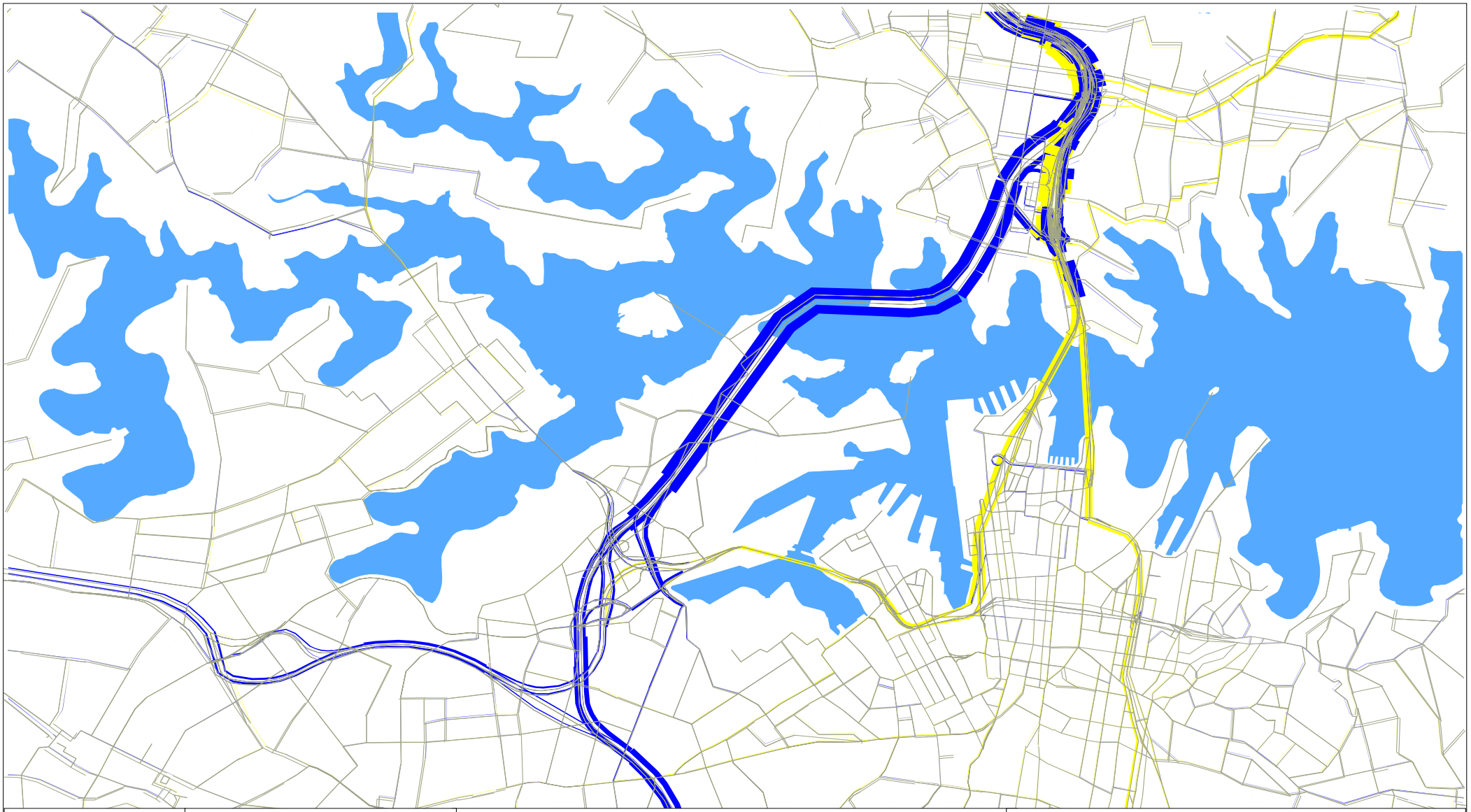
Legend: **B** Birchgrove **C** Compass **D** Whitehorse **F** Greenwich Wharf **G** Goat Island
I Mid Stream **K** Cockatoo Island **L** Longnose Pt **M** Manns Pt **N** Dolphin **P** Pulpit Pt
R Club **S** Spectacle **W** Woolwich **X** Greenwich Club **Z** Coal Loader
( ) = Finish Location

LASER COURSES GREENWICH SAILING CLUB Version 3, September 2010

Course Letter						
A	**B**	**C**	**D**	**E**	**F**	**G**
Wind Direction						
North East	East	South East	South	South West	West	North West
Laser - Long Course						
Start Location						
I	F	X	W	X	X	I
M W D M B W B M B (X)	M K M G M G K W K (X)	G M K M W G W K (X)	B M W G M G W B (X)	D W M B M B W B M (X)	K B M K M W B W M (X)	W M B M G B W B (X)
All to Port (11.0km)	All to St'b (9.7km)	All to Port (11.1km)	All to Port (10.6km)	All to St'b (10.4km)	All to Port (8.9km)	All to St'b (9.4km)
Laser - Short Course 1						
Start Location						
I	F	R	I	L	F	I
R B R W B (I)	M B W R W (F)	G M N F (R)	D R W B W (I)	B W R B M (L)	W B R W B R (F)	C L C B L (I)
All to Port (4.3km)	All to St'b (4.8km)	All to Port (4.2km)	All to Port (4.7km)	All to St'b (4.7km)	All to Port (4.9km)	All to Port (4.6km)
Laser - Short Course 2						
Start Location						
I	F	R	I	L	F	I
M B R W B (X)	M D S W (X)	G M F N F (X)	B W D R W (X)	D W R B R (X)	S W B W M (X)	W D L C L (X)
All to Port (5.4km)	All to St'b (5.2km)	All to Port (5.6km)	All to Port (5.2km)	All to St'b (5.2km)	All to Port (5.1km)	All to Port (5.2km)
Laser - Sprint						
Start Location						
I	I	M	K	L	I	I
M B (I)	M K (I)	G R (M)	D W (K)	B M (L)	K M (I)	C L (I)
All to St'b (2.3km)	All to St'b (2.5km)	All to St'b (2.3km)	All to St'b (2.2km)	All to St'b (2.3km)	All to St'b (2.5km)	All to St'b (2.1km)

Legend: **B** Birchgrove **C** Compass **D** Whitehorse **F** Greenwich Wharf **G** Goat Island
I Mid Stream **K** Cockatoo Island **L** Longnose Pt **M** Manns Pt **N** Dolphin **P** Pulpit Pt
R Club **S** Spectacle **W** Woolwich **X** Greenwich Club **Z** Coal Loader
( ) = Finish Location

Appendix B. Forecast traffic volume difference plots for year 2037



Transport Roads & Maritime Services
NSW GOVERNMENT

Disclaimer: This strategic model output is suitable for use in planning and conceptual studies and should not be used without prior written authority being obtained.

Model : SMPM_Compare_WHTBL_EIS_v1
Scenario 1 :
14061 - SMPM_2037_M1406 - Daily
Scenario 2 :
8081 - SMPM_2037_M0808 - Daily
View:NSydney_Rozelle_v2
Printed : 2019-02-18 11:48:46

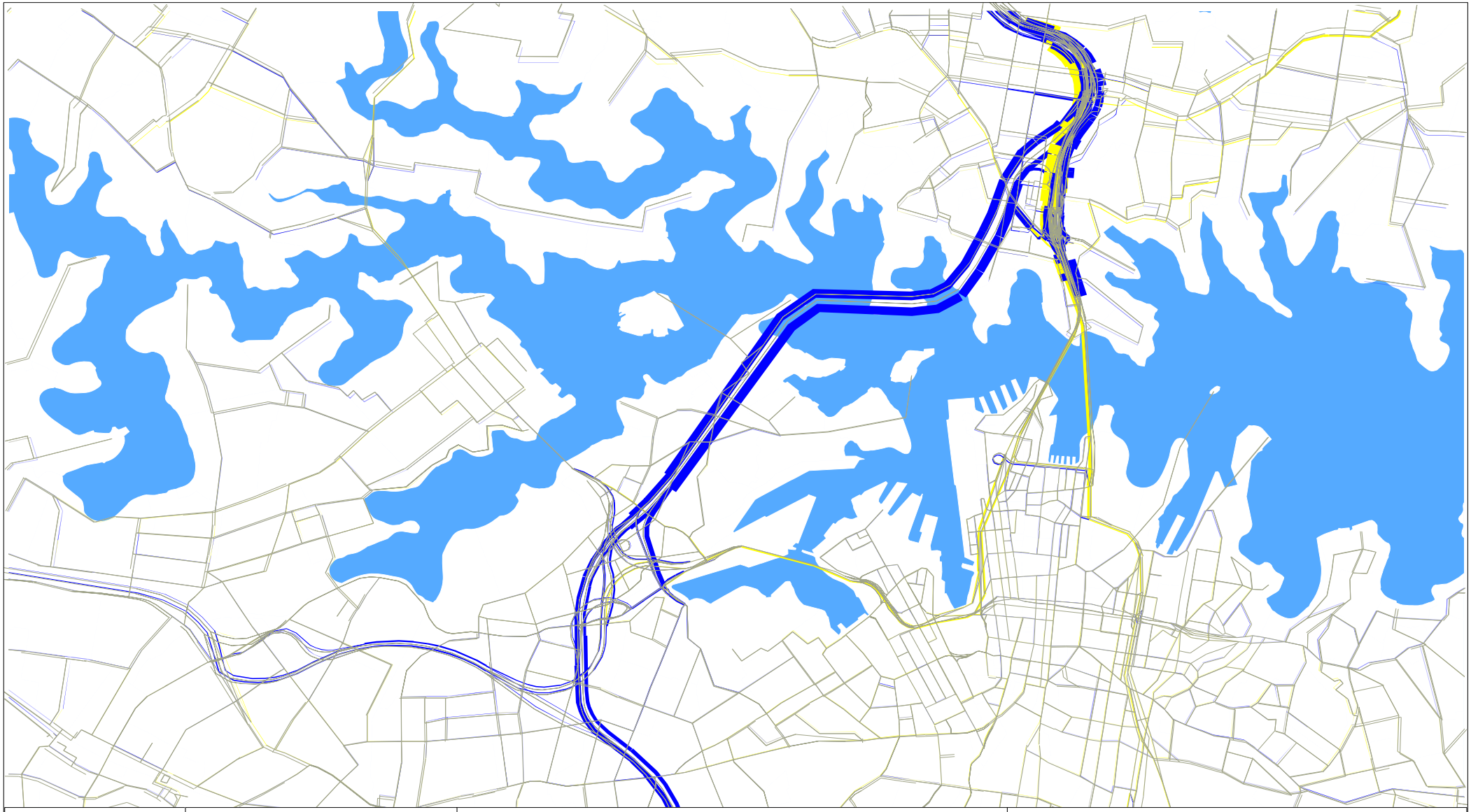
Average Weekday Daily Total Vehicle Volume Comparison
SMPM1.0 - LU16
2037 M1406 Cumulative Case Dec 2018 Design
(WCX + Gateway + F6 Ext + WHT + BL + WFU)
vs
2037 M0808 Base Case (WCX only)

LEGEND
Difference in Daily Vehicle Volumes Average Weekday Traffic
(Scenario 1 - Scenario2)

Decrease in flows
Increase in flows

Daily Vol
20000 40000 60000 80000 100000

Scale: 5000



Transport Roads & Maritime Services
NSW GOVERNMENT

Disclaimer: This strategic model output is suitable for use in planning and conceptual studies and should not be used without prior written authority being obtained.

Model : SMPM_Compare_WHTBL_EIS_v1
Scenario 1 :
14061 - SMPM_2037_M1406 - Daily
Scenario 2 :
8081 - SMPM_2037_M0808 - Daily
View:NSydney_Rozelle_v2
Printed : 2019-02-18 11:47:55

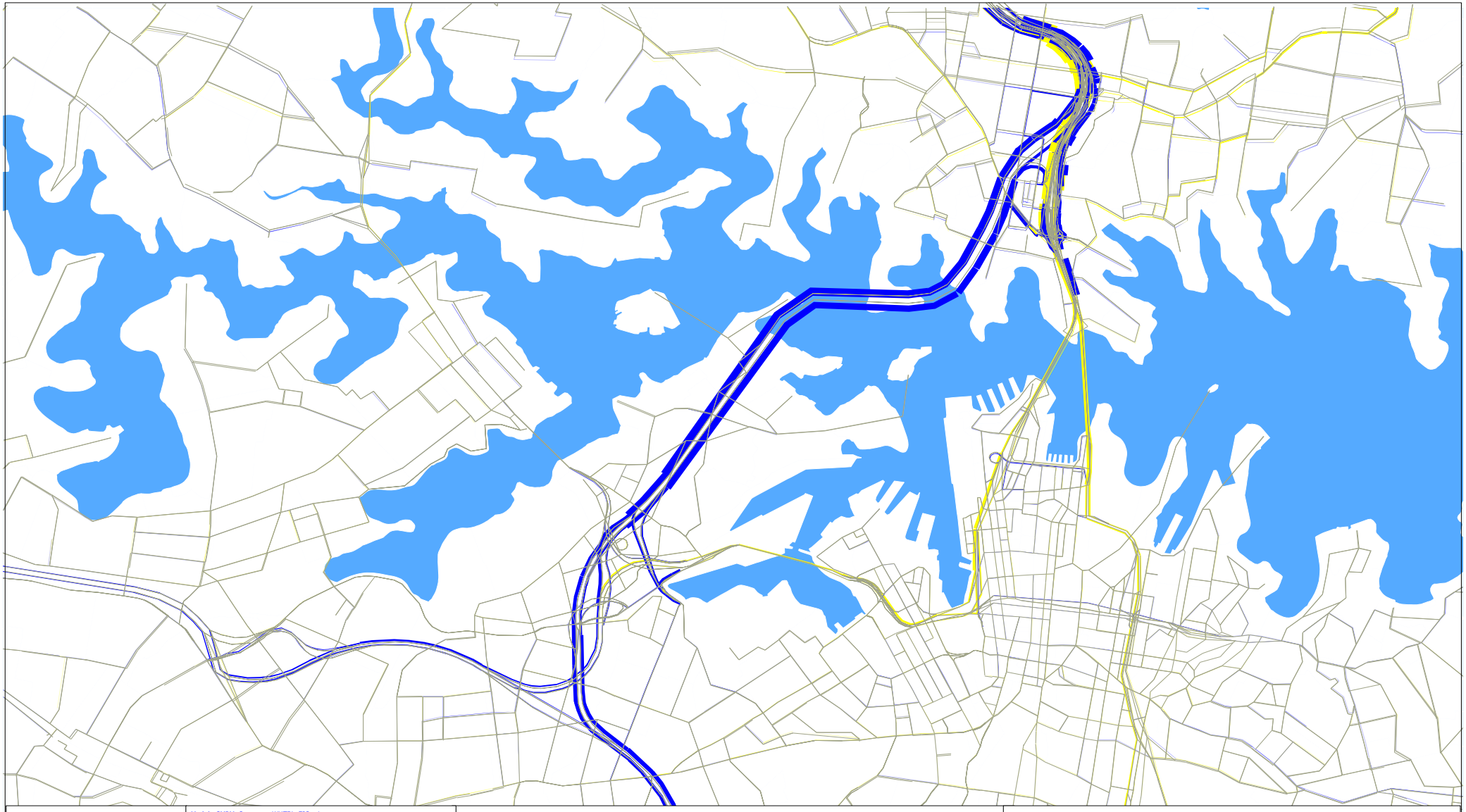
Total AM Hourly Volumes Comparison
SMPM1.0 - LU16
2037 M1406 Cumulative Case Dec 2018 Design
(WCX + Gateway + F6 Ext + WHT + BL + WFU)
vs
2037 M0808 Base Case (WCX only)

LEGEND
Difference in AM Hourly Vehicle Volumes Average Weekday Traffic
(Scenario 1 - Scenario2)

Decrease in flows
Increase in flows

Hourly Vol
2000 4000 6000 8000 10000

Scale: 500



Transport Roads & Maritime Services
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Disclaimer: This strategic model output is suitable for use in planning and conceptual studies and should not be used without prior written authority being obtained.

Model : SMPM_Compare_WHTBL_EIS_v1
Scenario 1 :
14061 - SMPM_2037_M1406 - Daily
Scenario 2 :
8081 - SMPM_2037_M0808 - Daily
View:NSydney_Rozelle_v2
Printed : 2019-02-18 11:48:21

Total PM Hourly Volumes Comparison
SMPM1.0 - LU16
2037 M1406 Cumulative Case Dec 2018 Design
(WCX + Gateway + F6 Ext + WHT + BL + WFU)
vs
2037 M0808 Base Case (WCX only)

LEGEND
Difference in PM Hourly Vehicle Volumes Average Weekday Traffic
(Scenario 1 - Scenario2)

Decrease in flows
Increase in flows

Hourly Vol
2000 4000 6000 8000 10000

Scale: 500

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