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Appendix A Concept Channel Design

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Channel Width Factors

PIANC 2014 provides the following formula for determining the channel width for concept design:

- One-Way Channel Width (W) = $W_{BM} + 2\Sigma W_i + W_{Br} + W_{Bg}$
- Two-Way Channel Width (W) = $2W_{BM} + 2\Sigma W_i + W_{Br} + W_{Bg} + \Sigma W_p$

Where:

- W_{BM} is the width of basic manoeuvring lane as a multiple of the design ship's beam
- ΣW_i additional widths to allow for the effect of wind, current, waves etc
- W_{Br}, W_{Bg} is the bank clearance on the 'red' and 'green' sides of the channel
- ΣW_p is the passing distance, comprising the sum of a separation distance between both manoeuvring lanes and an additional distance for traffic density.

A number of the criteria are subjective and the following sections discuss the rationale behind the criteria that has been used.

Inner/Outer Channel

PIANC 2014 gives the following description for outer and inner channels:

- An outer channel in open water and exposed to waves that can produce significant vertical ship motions of heave, pitch, and roll.
- An inner channel that lies in relatively sheltered waters and is not subject to wave action of any significance to large ships.

A swell wave model setup by the Hydrodynamic work stream (HAS-CEPO-HY-REP-0001) found that once the swell waves reached Sandy Point the H_s is 0.2m and T_p is 7 seconds (refer to Figure 8-1). Within Western Channel 2 and 3, H_s is between 0.7-1.3m and T_p is between 7-11 seconds.

Long duration swell waves affect the heave, pitch and roll of vessels and Western Channel 1-3 are considered as Outer Channel while the remainder is considered as Inner Channel.

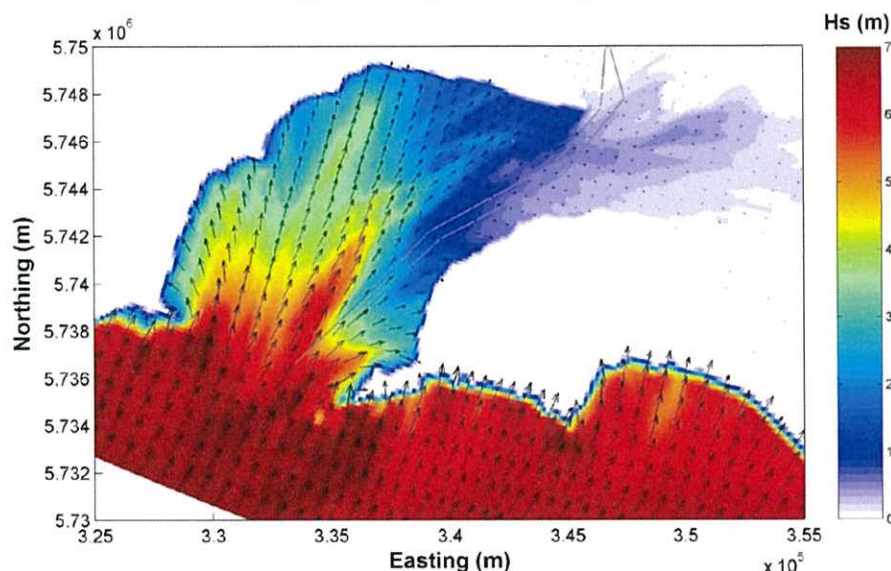


Figure 5. H_s and wave vectors for the largest wave height with a 0.01% probability of exceedance at waverider buoy Sweetwaves at Point Nepean (Figure 6 from HAS-CEPO-HY-REP-0001)

Basic Manoeuvring Lane

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PIANC 2014 recommends moderate manoeuvring characteristics (1.5B) for container vessels and poor manoeuvring characteristics (1.8B) for container vessels.

Vessel Speed

PIANC characterises vessel speed into the following categories:

- Fast - $V_s \geq 12$ kts
- Moderate - $8 \text{ kts} \leq V_s < 12$ kts
- Slow - $5 \text{ kts} \leq V_s < 8$ kts

Faster speeds result in a narrower channel because the ship is more controllable, however this is offset by the need to have a deeper channel. For container vessels both fast and moderate vessel speeds have been considered while for tankers only moderate speed has been considered. It was found that the differences between the speeds are minimal (0-3m for one way and 0-18m for two way) and the larger dimensions have been used.

Prevailing Cross Wind

Table 8-1 outlines the PIANC wind categories and the percentage exceedance for a 10 minute duration wind at an industrial site near Hastings (HAS-CEPO-HY-REP-0001). A wind category of moderate has been used.

Table 8-1. PIANC Wind Categories and Percentage Exceedance for an Industrial Site Near Hastings

PIANC wind category	% Exceedance (10 min duration)
Mild - $V_{cw} < 15$ kts (< Beaufort 4)	20%
Moderate - $15 \text{ kts} \leq V_{cw} < 33$ kts (Beaufort 4 - Beaufort 7)	0.1%
Strong - $33 \text{ kts} \leq V_{cw} < 48$ kts (Beaufort 7 - Beaufort 9)	>0.1%

Prevailing Cross Current

A 2-Dimensional depth-averaged hydrodynamic model of Western Port was run for a 30 day period by the Hydrodynamic workstream (HAS-CEPO-HY-REP-0001) and the modelled peak flood and ebb tides are outlined in Figure 8-1.

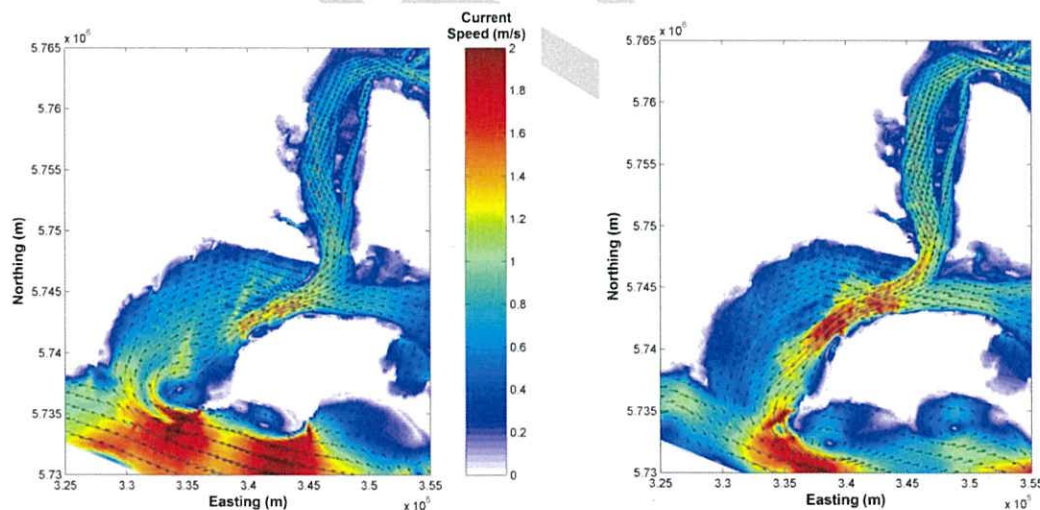


Figure 8-1. Modelled Peak Flood and Ebb Tides

PIANC categories the prevailing cross current as follows:

- Negligible $V_{cc} < 0.2$ kts
- Low $0.2 \text{ kts} \leq V_{cc} < 0.5$ kts

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- Moderate $0.5 \text{ kts} \leq V_{cc} < 1.5 \text{ kts}$
- Strong $1.5 \text{ kts} \leq V_{cc} < 2.0 \text{ kts}$

The tide largely follows the path of the channel and the prevailing cross current has been considered the be Low.

Prevailing Longitudinal Current

PIANC categories the prevailing longitudinal current as follows:

- Low $V_{lc} < 1.5 \text{ kts}$
- Moderate $1.5 \text{ kts} \leq V_{lc} < 3 \text{ kts}$
- Strong $V_{lc} \geq 3 \text{ kts}$

Figure 8-1 shows that the maximum current in the Western Channel is about 2kts whereas in the North Arm Channel the maximum current does not appear to exceed 1.5kts. Therefore the Western Channel has been categorised as Moderate and the North Arm has been categorised as Low

Beam and Stern Quartering Wave Height

PIANC categories the beam and stern quartering wave height as follows:

- $H_s \leq 1 \text{ m}$
- $1 \text{ m} < H_s < 3 \text{ m}$
- $H_s \geq 3 \text{ m}$

Figure 8-1 outlines that waves with a H_s of up to 3m can occur in Western Channel 1, however they tend to be on the bow or stern based on the initial modelling undertaken. Given the exposure to waves within Western Channel 1 the largest wave category has been considered. Once past the first bend in the channel the waves have a significant wave height of less than 3m and the middle categories was considered for the remainder of the Western Channel.

Within the port near wind driven waves with a 1 year ARI was found to produce a significant wave height (H_s) of up to 1m with a period (T_p) of 3.5 seconds. A significant wave height of less than 1m was considered for the North Arm and Port Area.

Aids to Navigation

Excellent corresponds to paired lit buoys with radar reflectors, lit leading lights and VTS along with the availability of pilots, DGPS and ECDIS. It is assumed that this level of aids to navigation will be provided.

Depth of Waterway

In the Western Channel the depth is generally between 1.25-1.5T, however in some sections it is much deeper.

In the North Arm the depth will generally be $< 1.15T$

Width for Bank Clearance

Slopes in Western Channel segments C1-3 are generally much wider and deeper than required with slopes less than 1:10

In Western channel segment 4 and up to the port area the slopes are around 1:5, however they are steeper in some sections, dredged slopes are likely to be around 1:3.

Traffic Density

The average traffic density throughout the forecast period is less than 3 vessels per day throughout the forecast period.

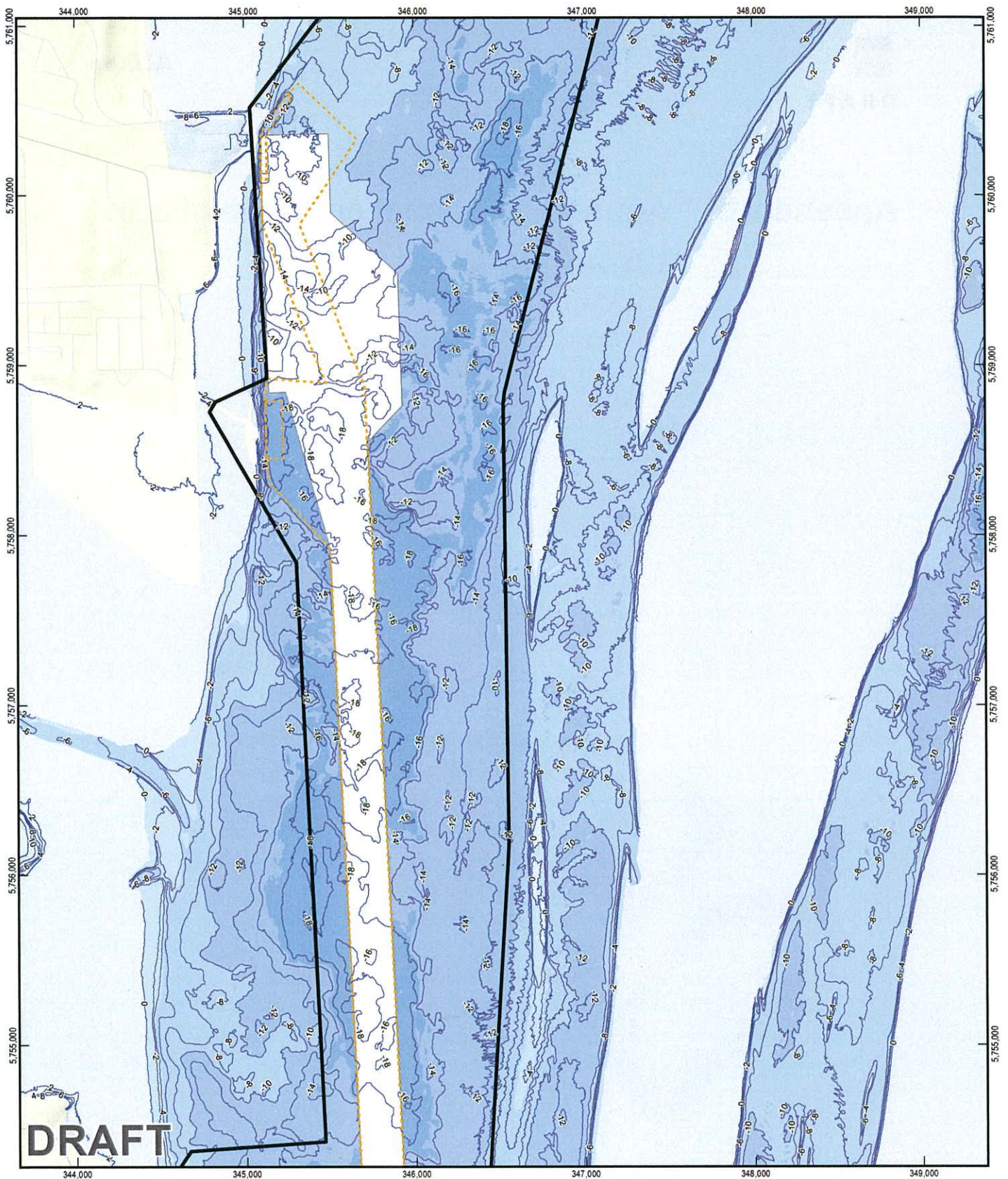


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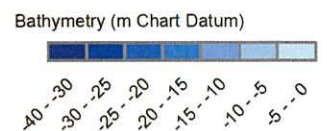
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Appendix B Approach Channel and Swing Basin Layout Plans

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- Stage 1 Swing Basin Alignment
- Port of Hastings Limits
- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Highway
- Arterial
- Local



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Fig AGH_CEP0_DE_FIG_0129
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Preliminary Approach Channel and Stage 1 Swing Basin Alignment

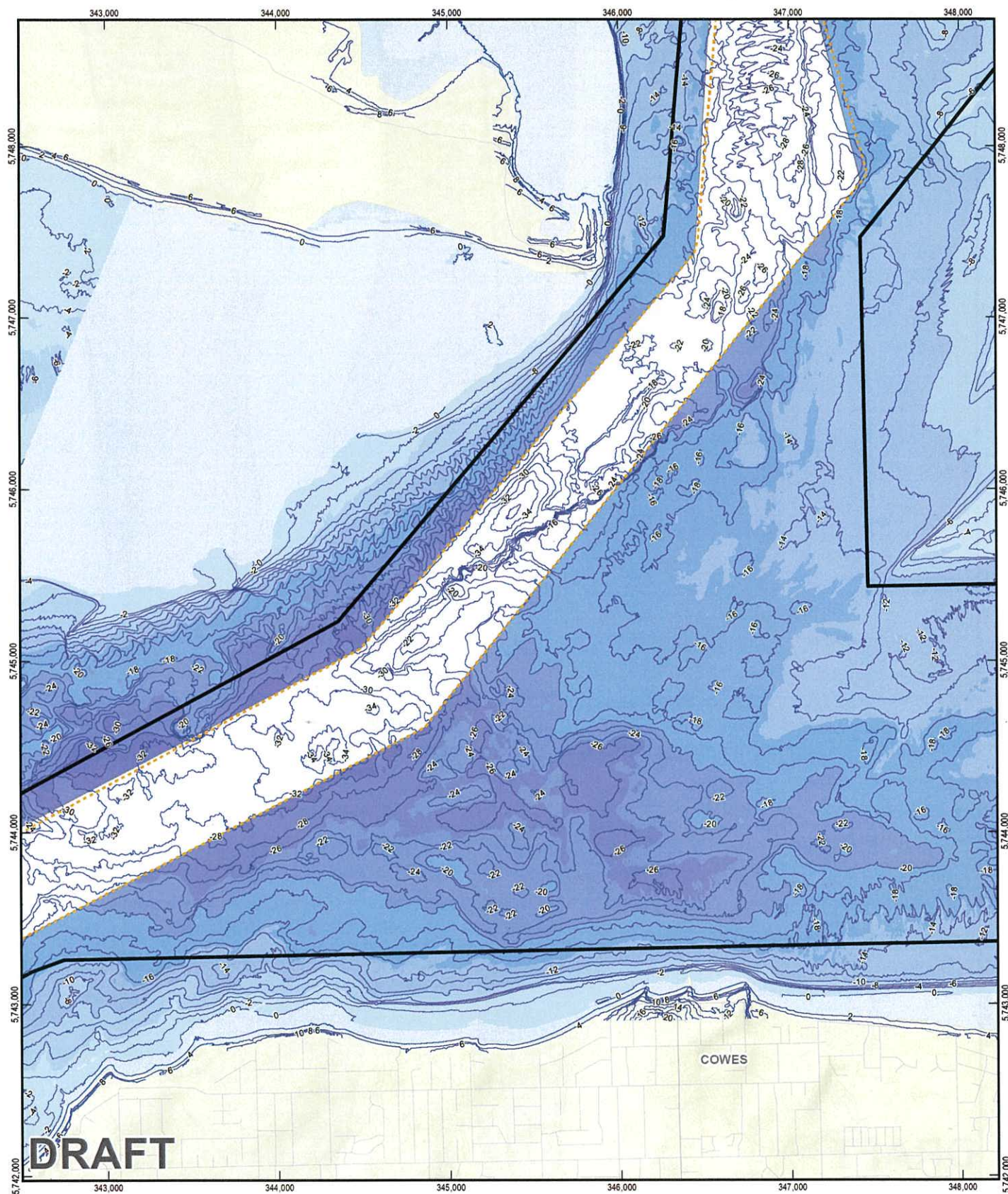
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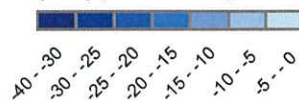
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- Stage 1 Swing Basin Alignment
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Bathymetry (m Chart Datum)



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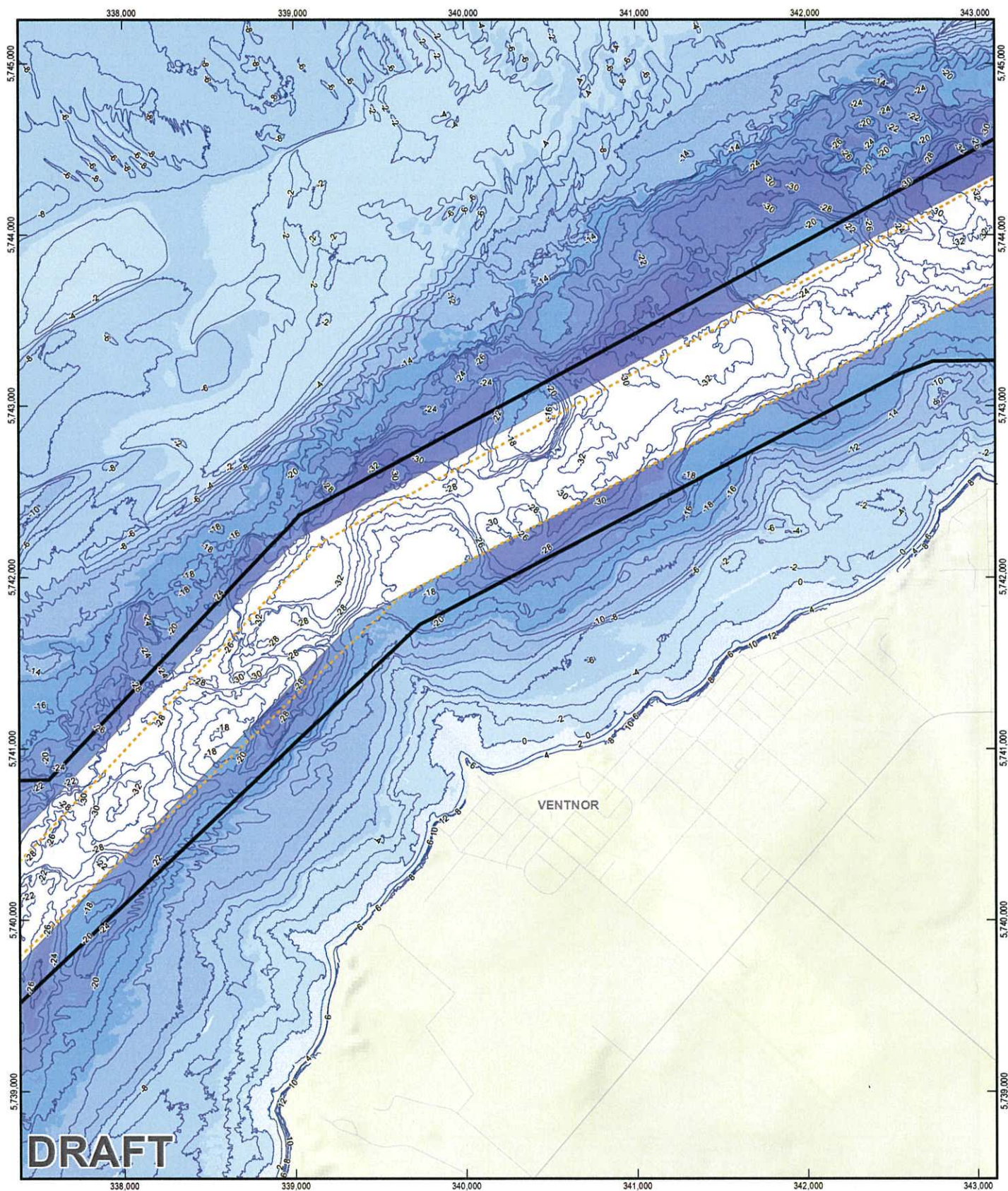
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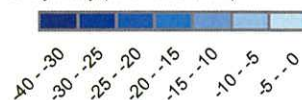
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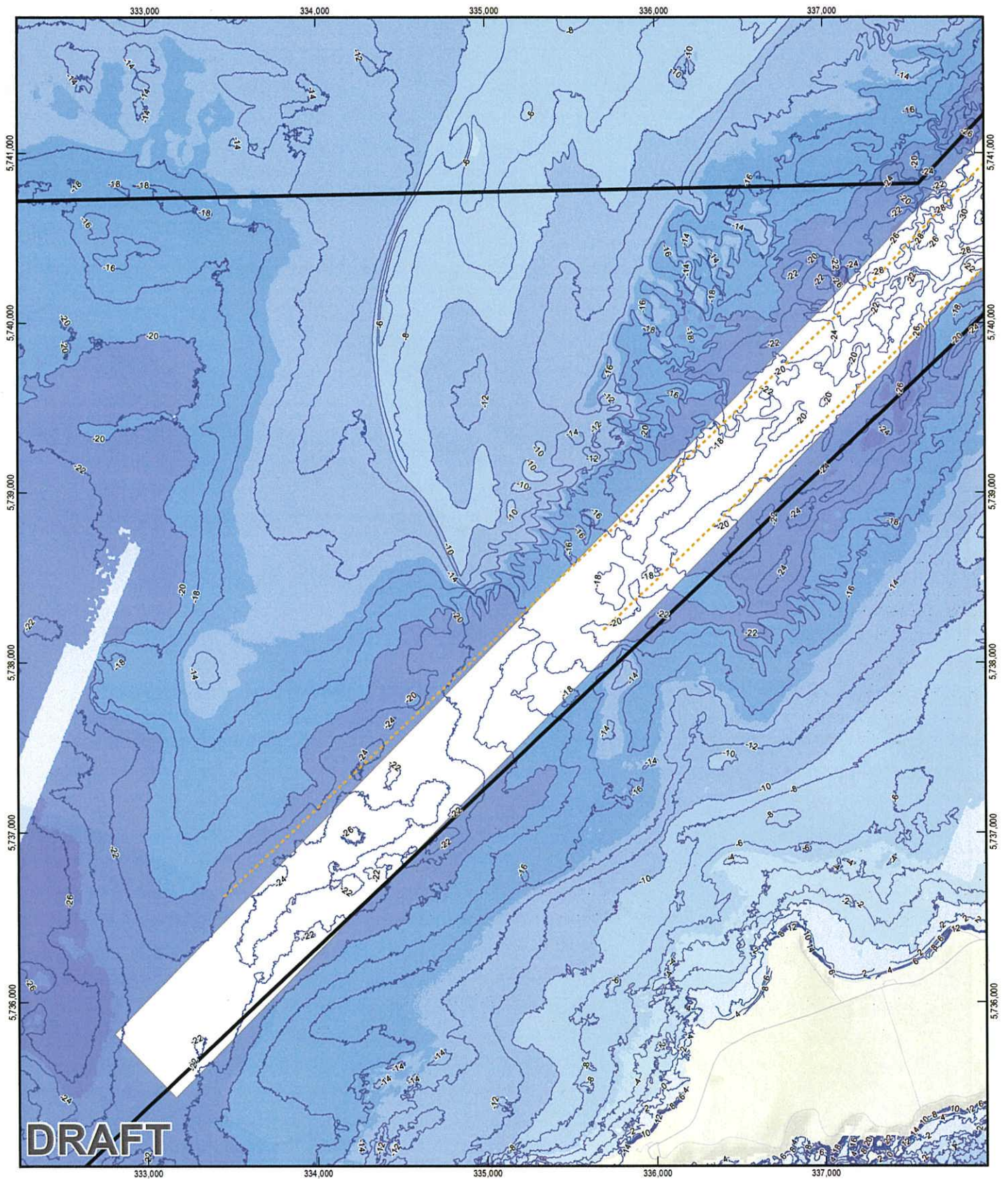
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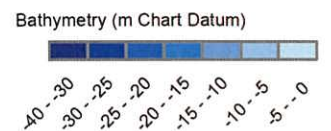
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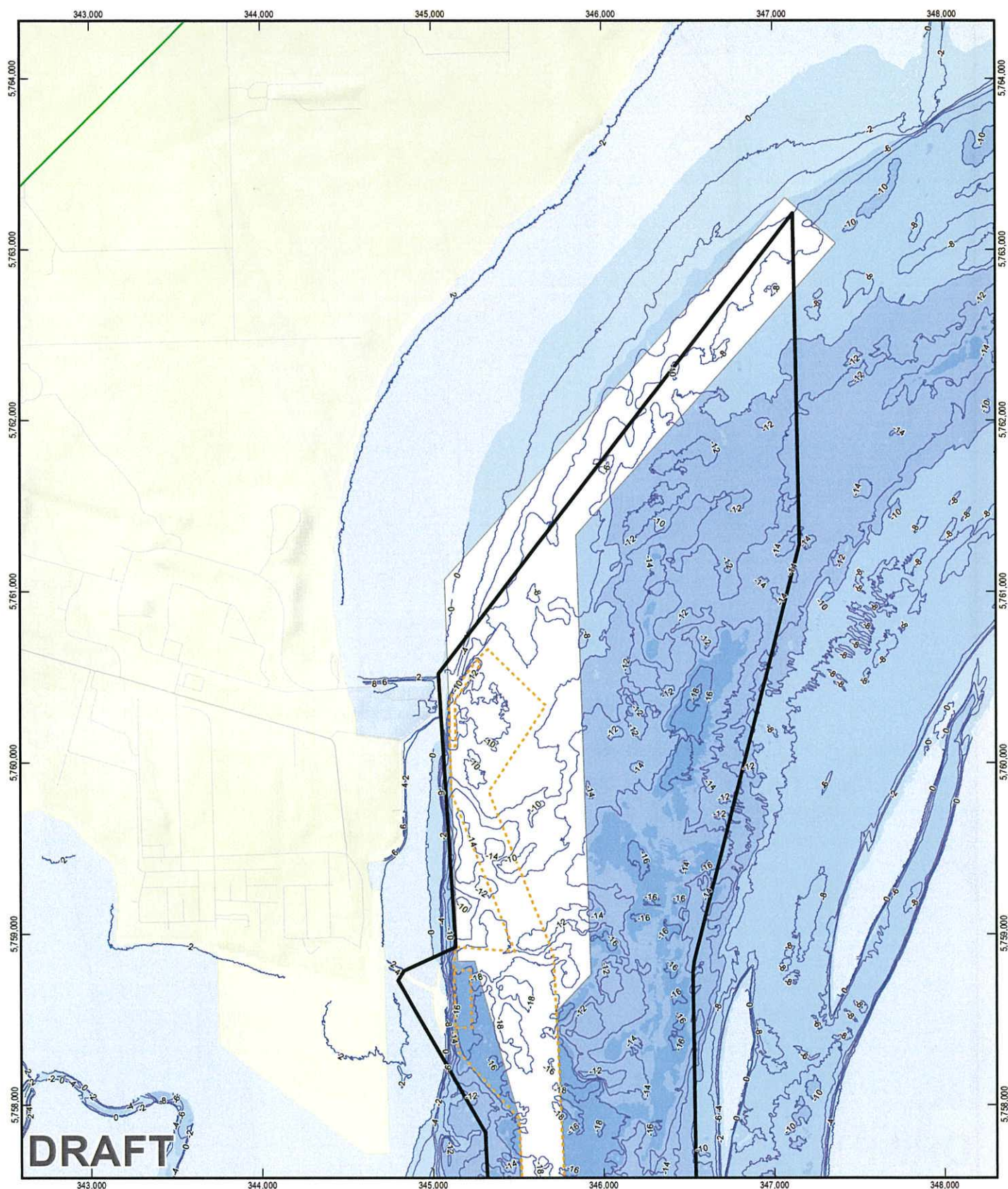
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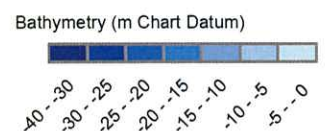
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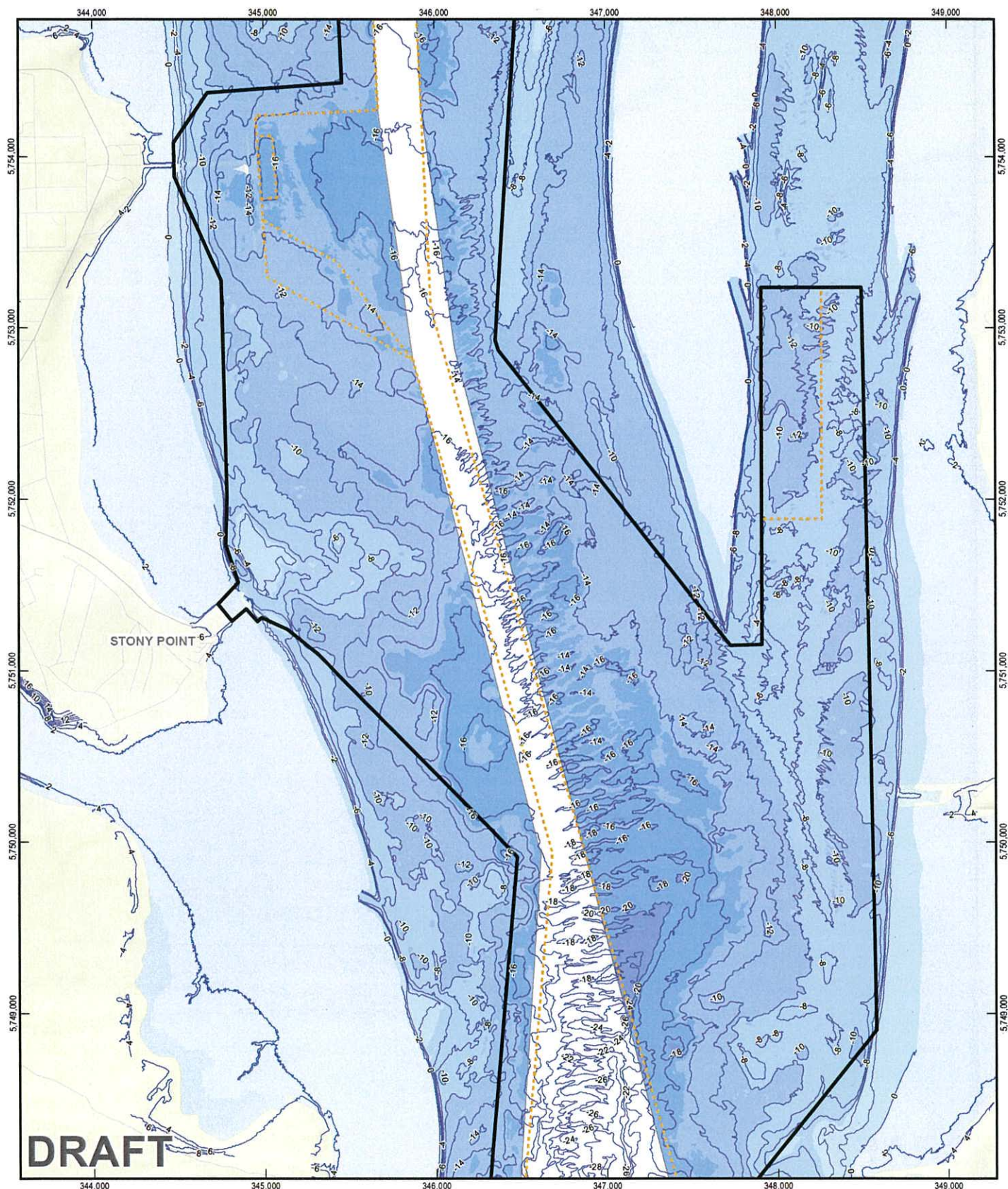
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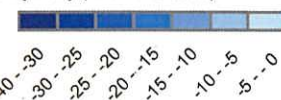
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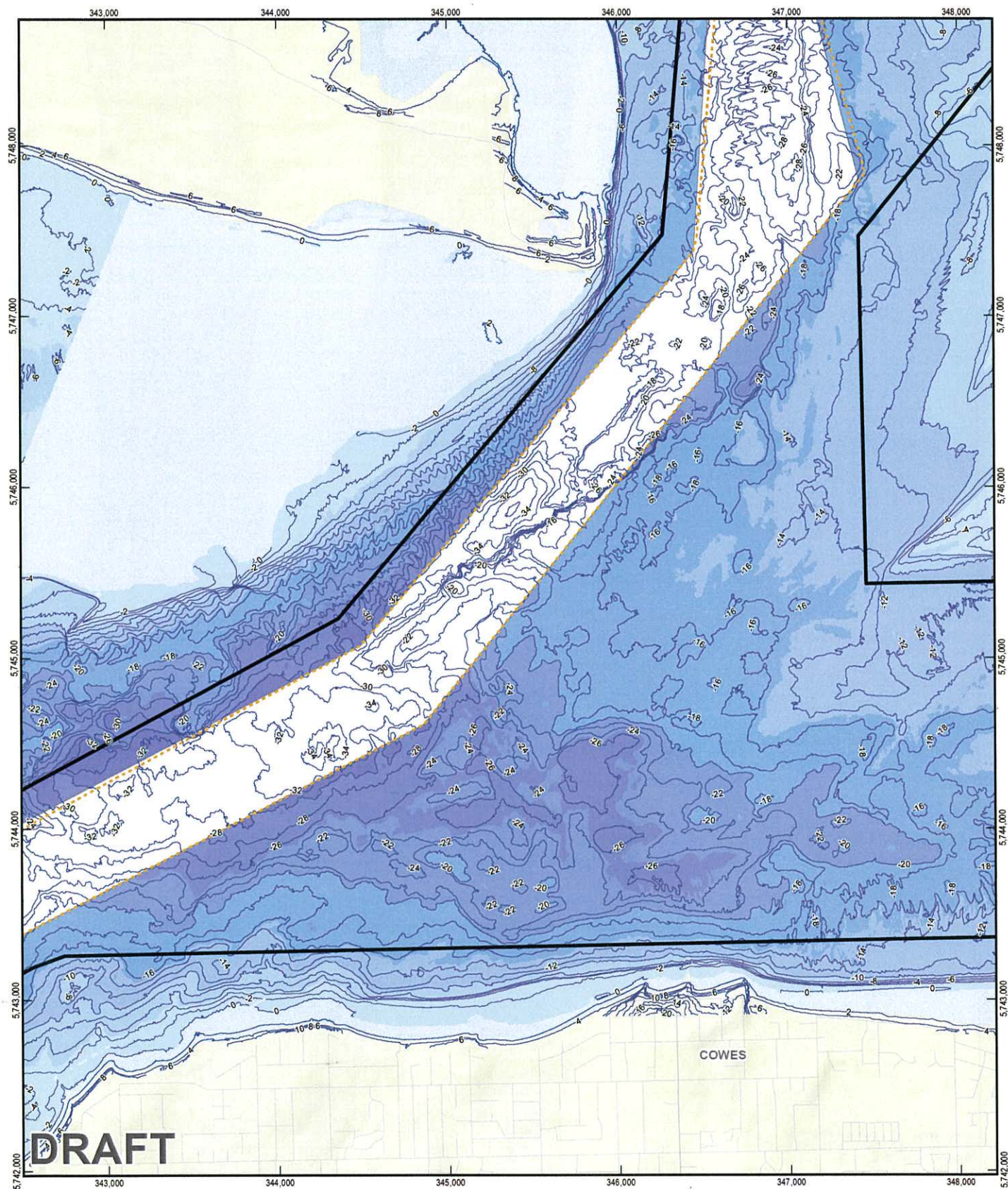
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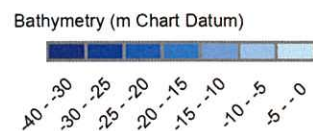
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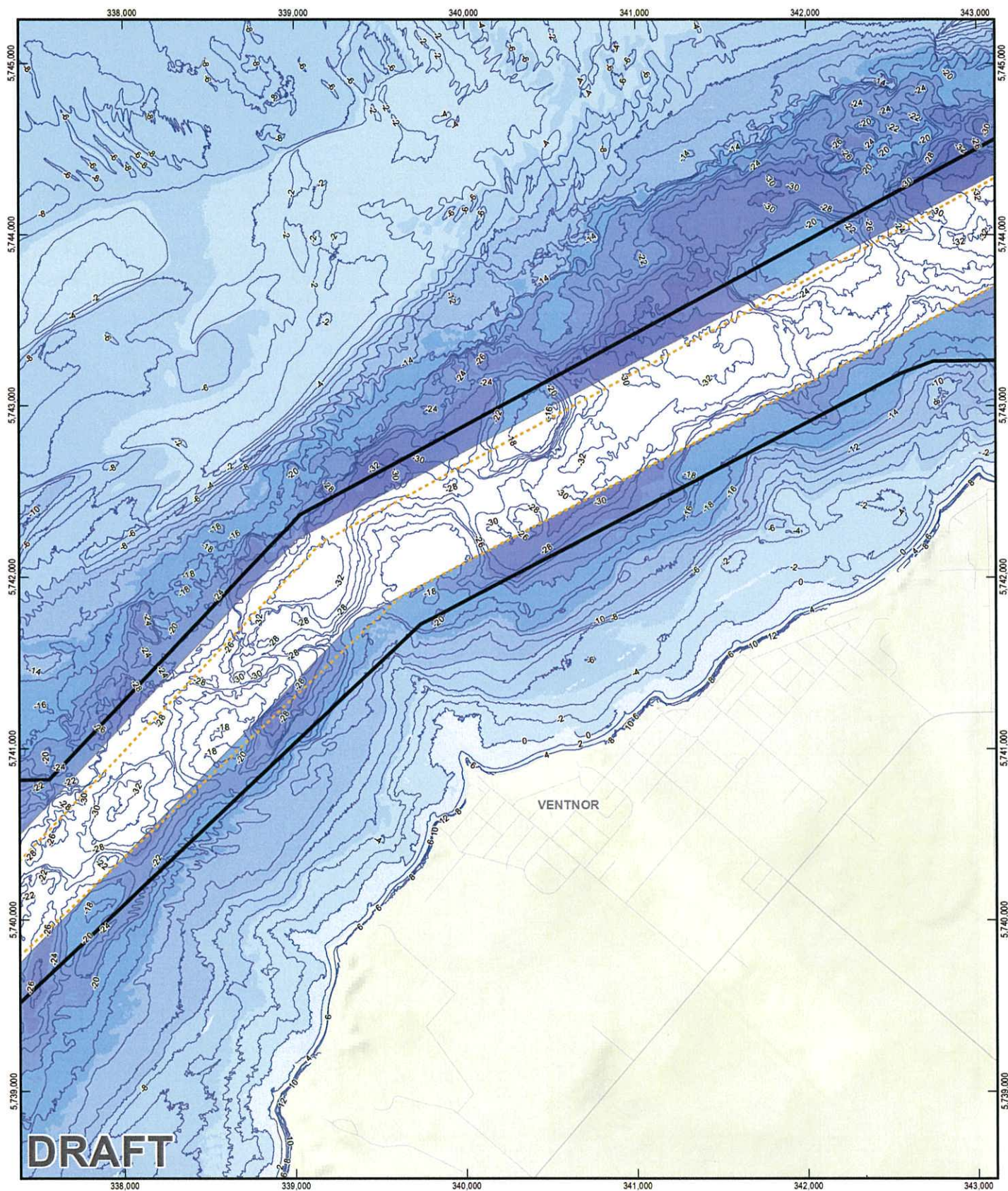
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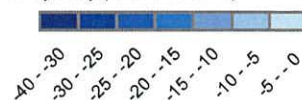
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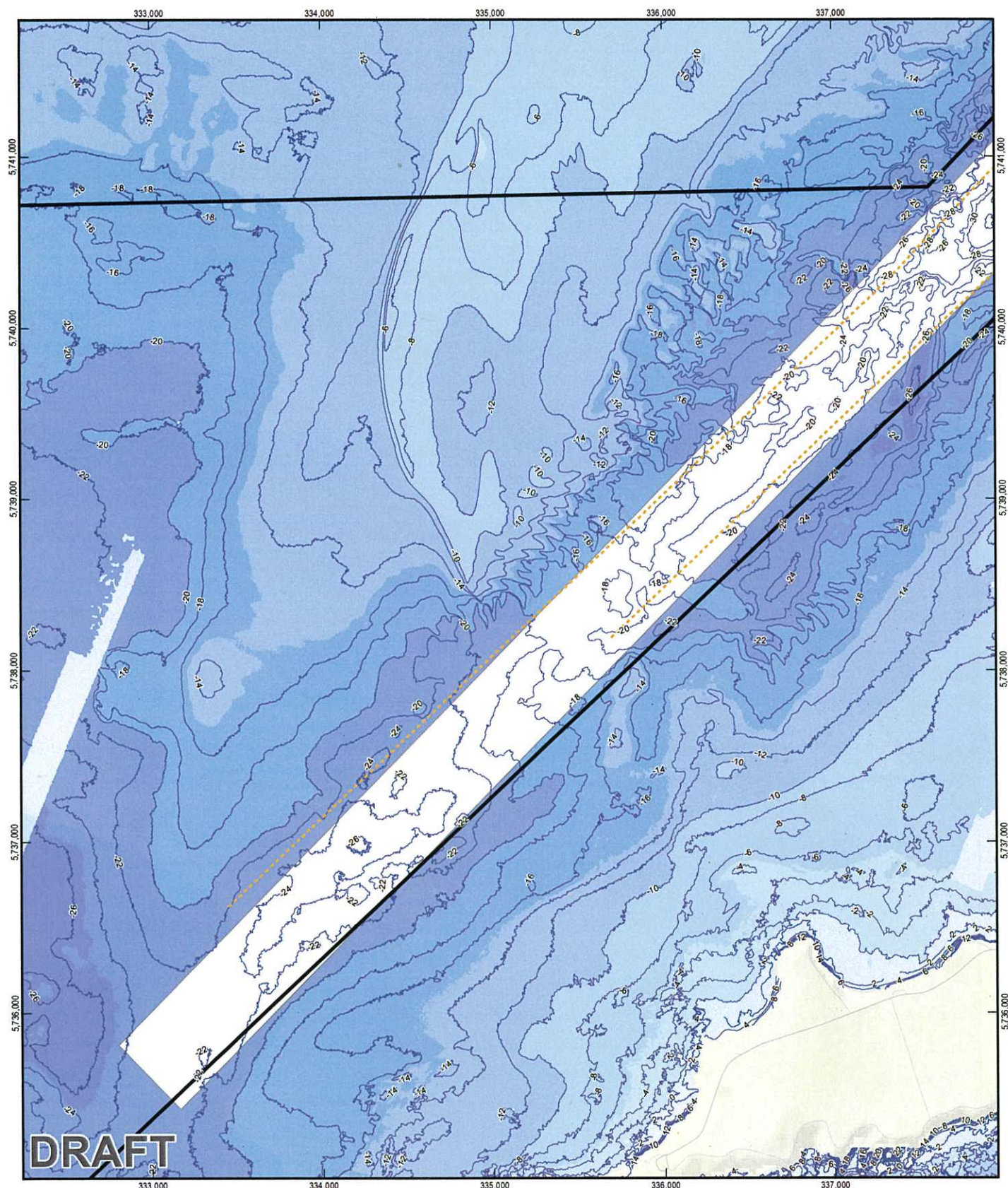
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Bathymetry (m Chart Datum)



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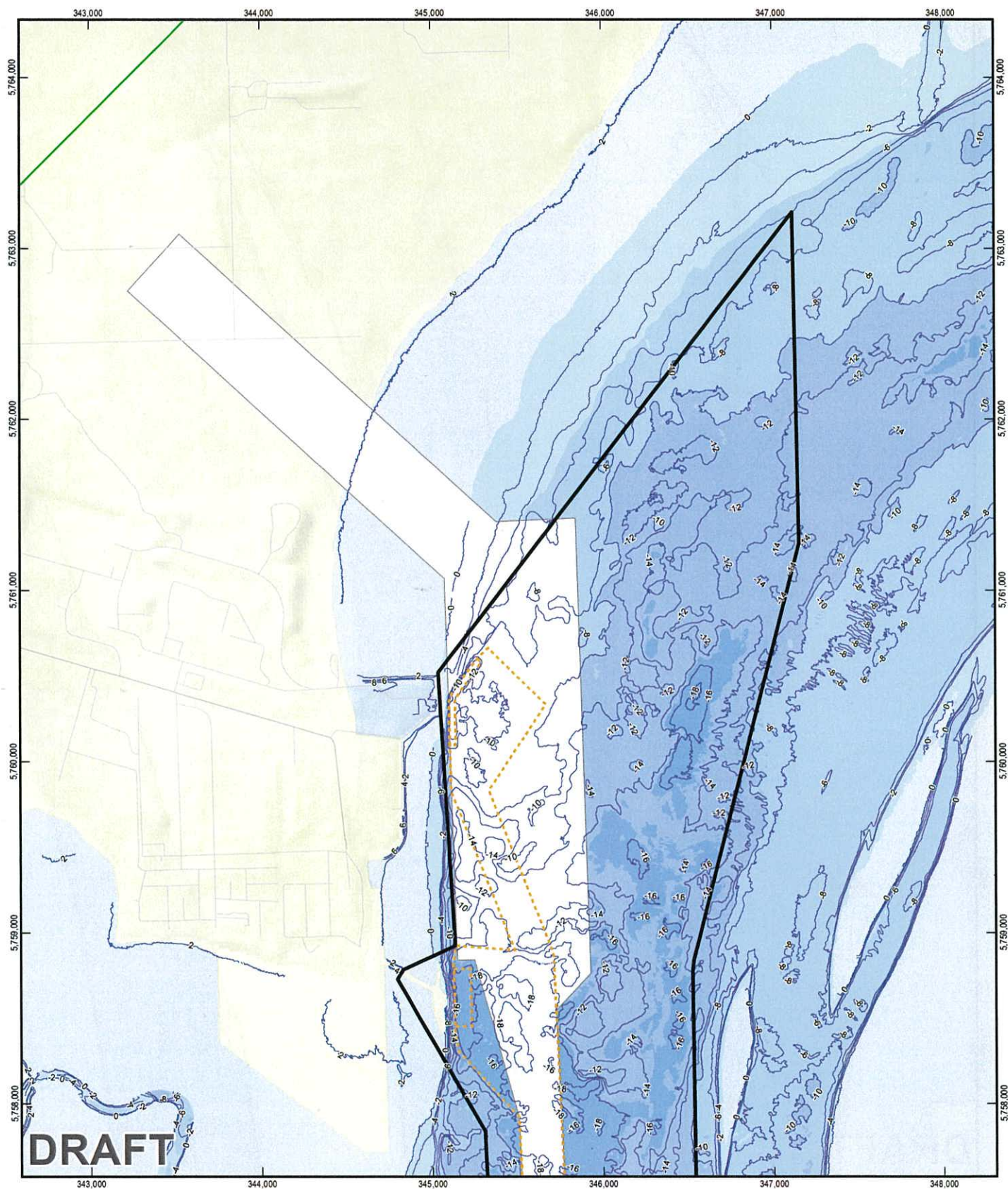
Preliminary Approach Channel and
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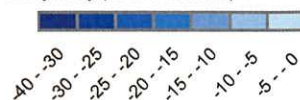
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- Basin Option Swing Basin Alignment
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Preliminary Approach Channel and
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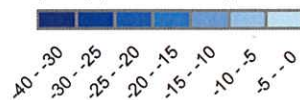
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- Basin Option Swing Basin Alignment
- Port of Hastings Limits
- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Highway
- Arterial
- Local

Bathymetry (m Chart Datum)



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 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



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Fig AGH_CEP0_DE_FIG_0131
Revision A
Date 29 Apr 2015

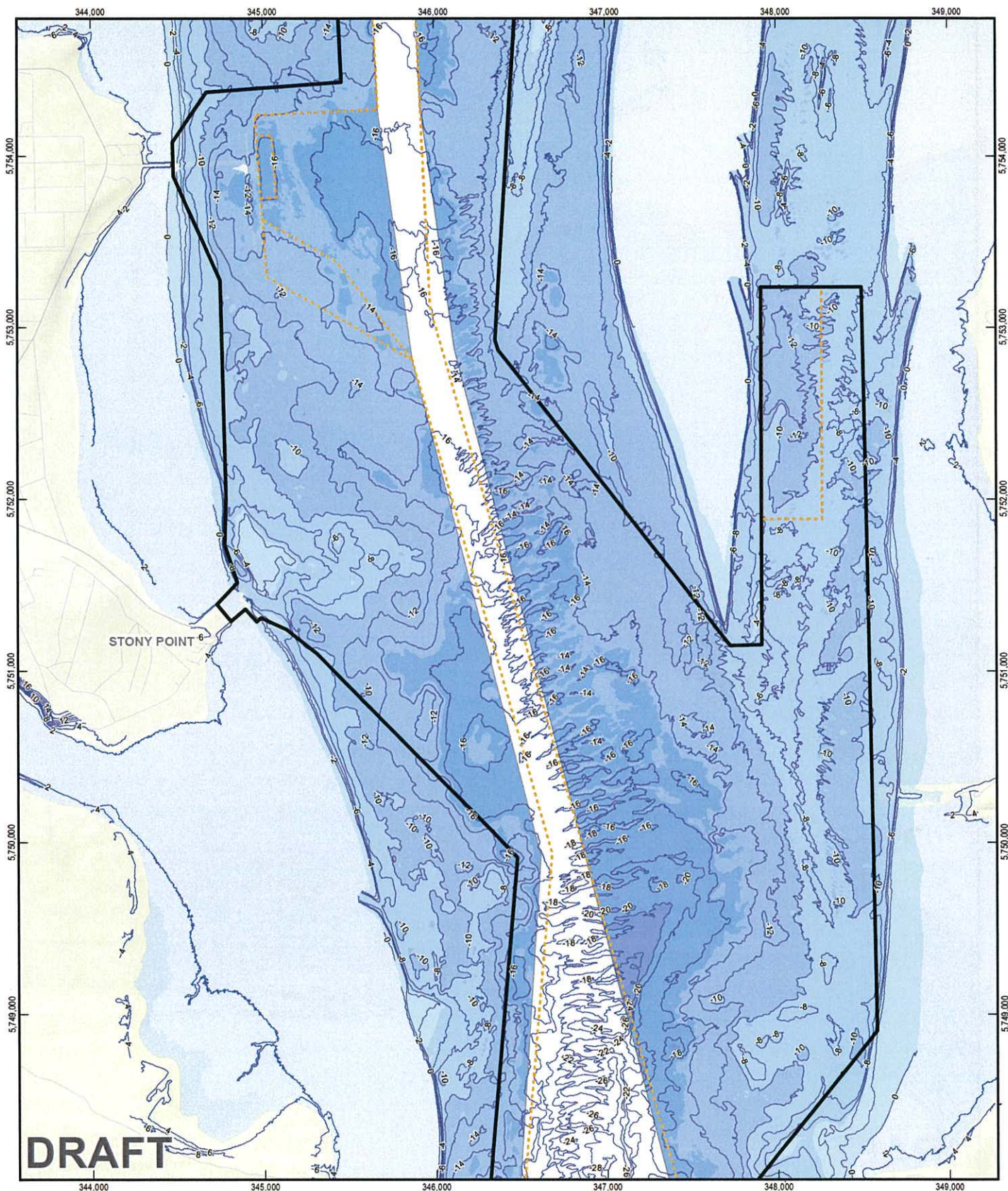
Preliminary Approach Channel and
Basin Option Swing Basin Alignment

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2/34 High Street Hastings VIC 3915 Australia T 1300 149 478 F 61 3 5979 5500 E enquiries@portofhastings.com W www.portofhastings.com
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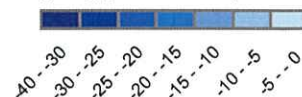
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- Basin Option Swing Basin Alignment
- Port of Hastings Limits
- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Highway
- Arterial
- Local

Bathymetry (m Chart Datum)



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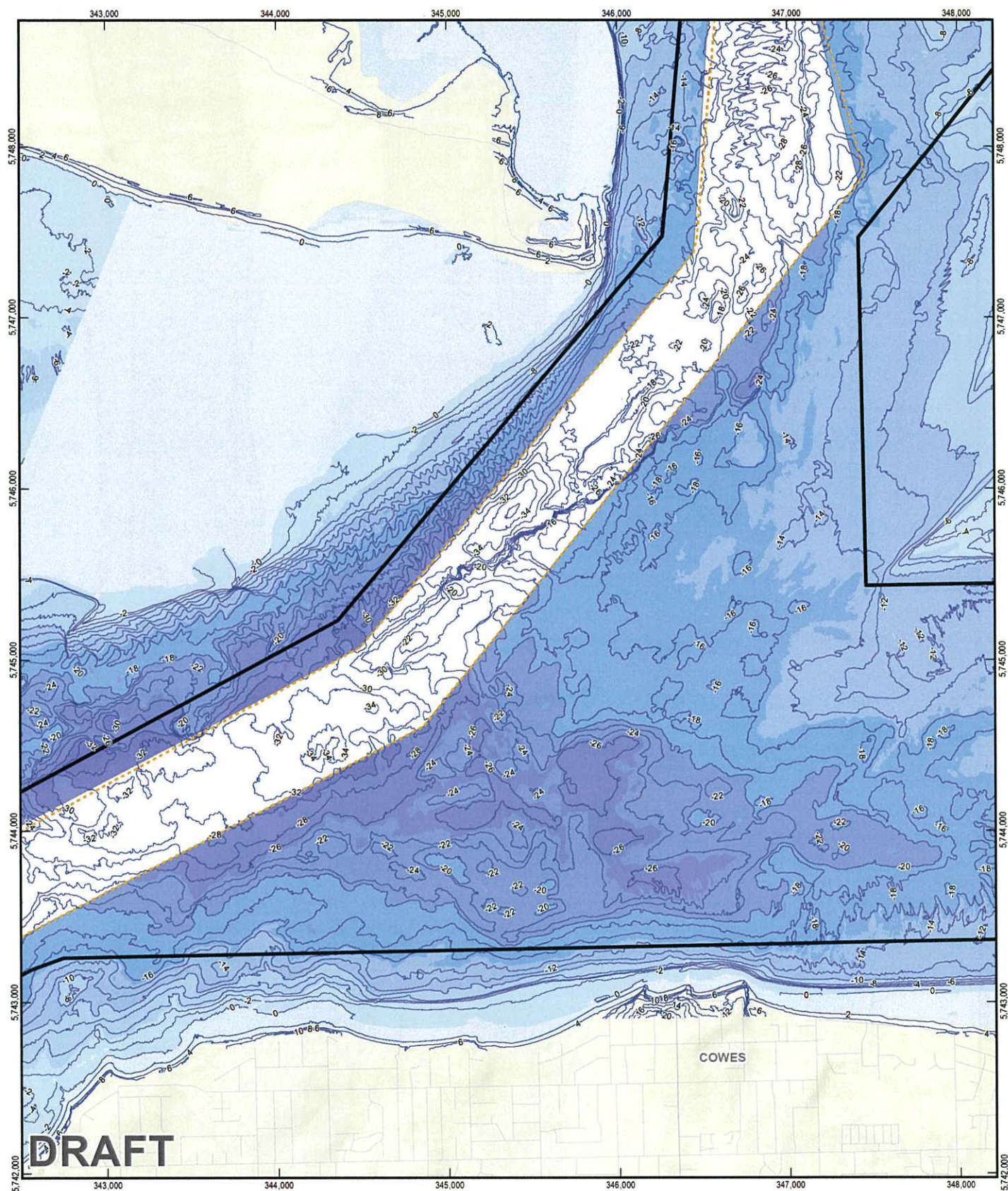
Preliminary Approach Channel and
 Basin Option Swing Basin Alignment

Fig AGH_CEP0_DE_FIG_0131
 Revision A
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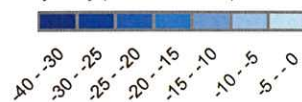
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 Data source: VicMap Background Layers(DEPI, 2014); Channel (Port of Hastings Authority, 2015) Created by: cillingworth



- Basin Option Swing Basin Alignment
- Port of Hastings Limits
- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Highway
- Arterial
- Local

Bathymetry (m Chart Datum)



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 Design and Engineering

Fig AGH_CEP0_DE_FIG_0131
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 Date 29 Apr 2015

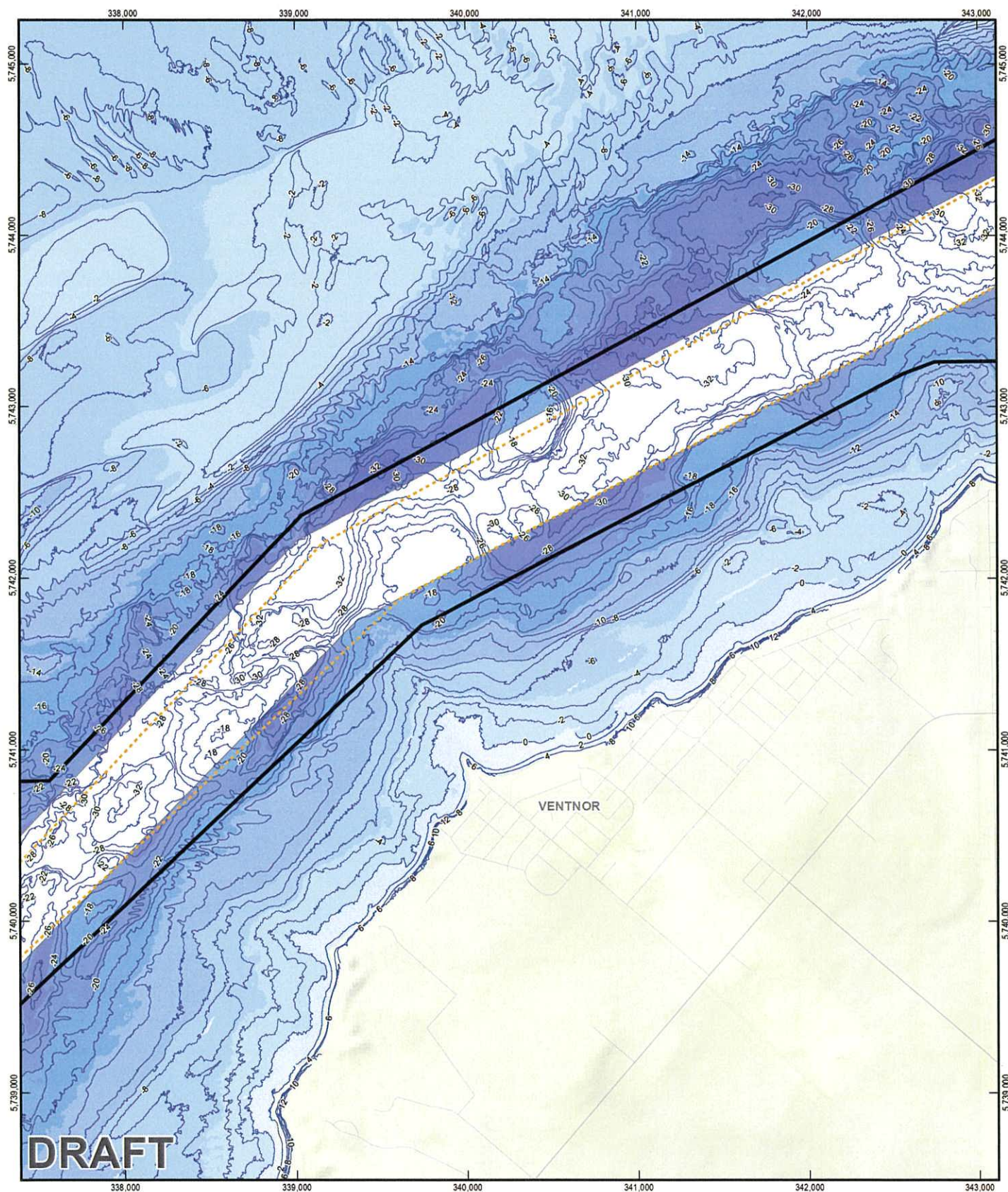
Preliminary Approach Channel and
 Basin Option Swing Basin Alignment

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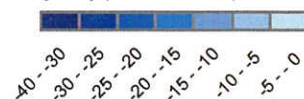
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Data source: VicMap Background Layers(DEPI, 2014); Channel (Port of Hastings Authority, 2015) Created by: cillingworth



- Basin Option Swing Basin Alignment
- Port of Hastings Limits
- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Highway
- Arterial
- Local

Bathymetry (m Chart Datum)



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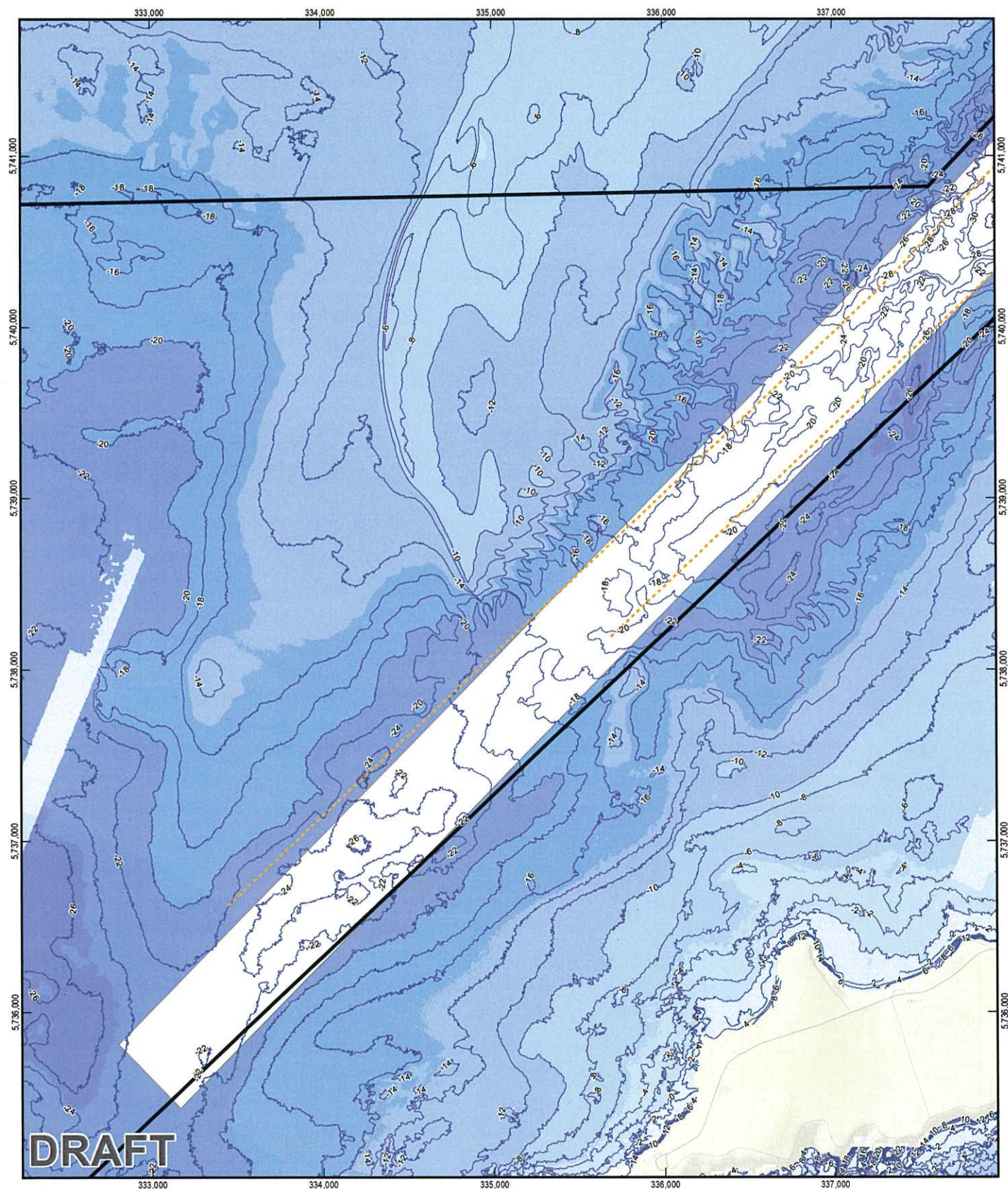
Preliminary Approach Channel and
Basin Option Swing Basin Alignment

Fig AGH_CEP0_DE_FIG_0131
Revision A
Date 29 Apr 2015

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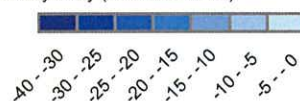
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 Data source: VicMap Background Layers (DEPI, 2014); Channel (Port of Hastings Authority, 2015) Created by: cillingworth



- Basin Option Swing Basin Alignment
- Port of Hastings Limits
- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Highway
- Arterial
- Local

Bathymetry (m Chart Datum)



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 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



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Preliminary Approach Channel and
Basin Option Swing Basin Alignment

Fig AGH_CEP0_DE_FIG_0131
Revision A
Date 29 Apr 2015

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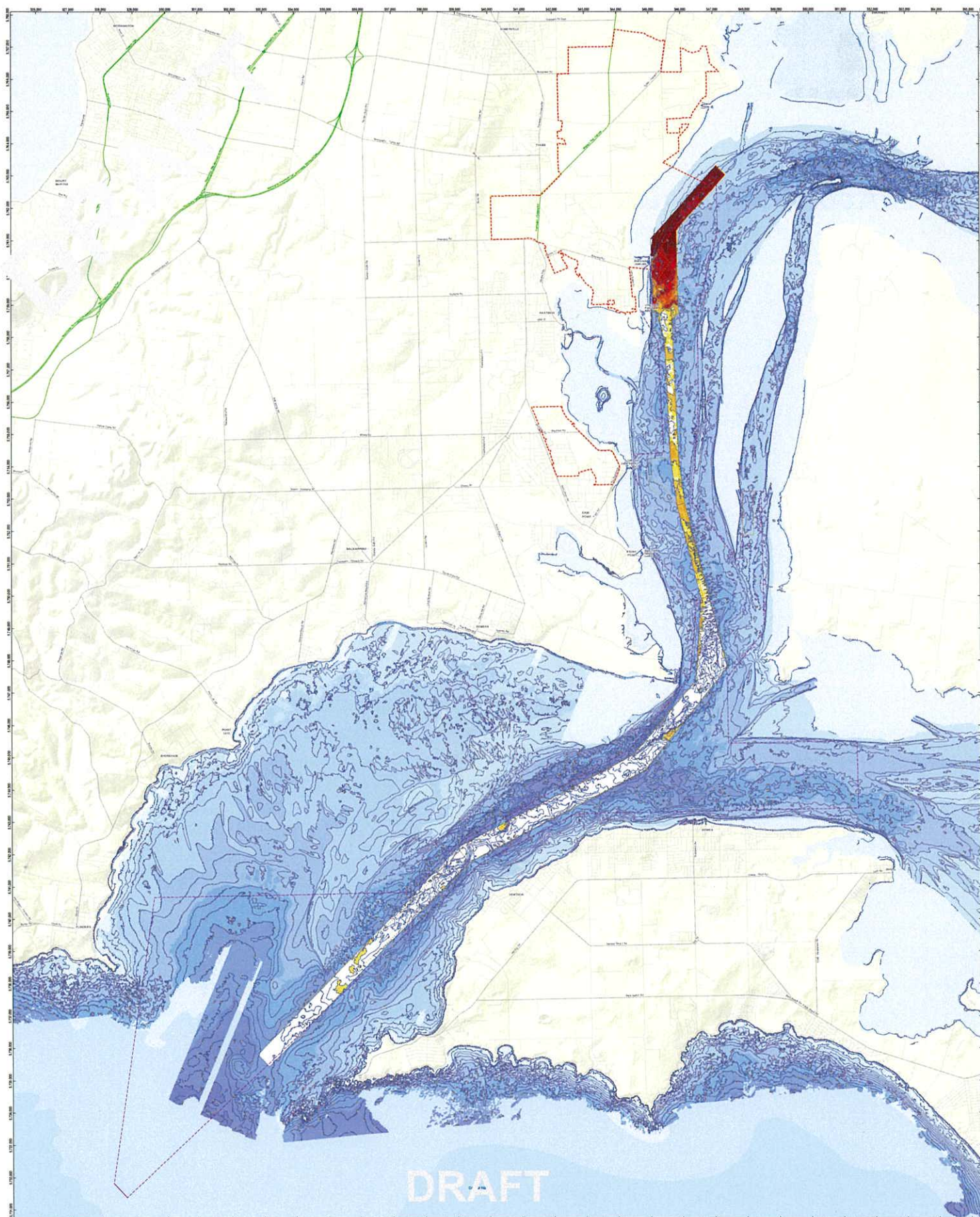


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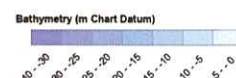
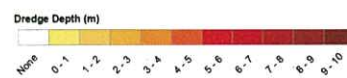
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Appendix C Dredging Figures

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- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- PoH limits
- Along Shore Option
- Highway
- Arterial
- Local



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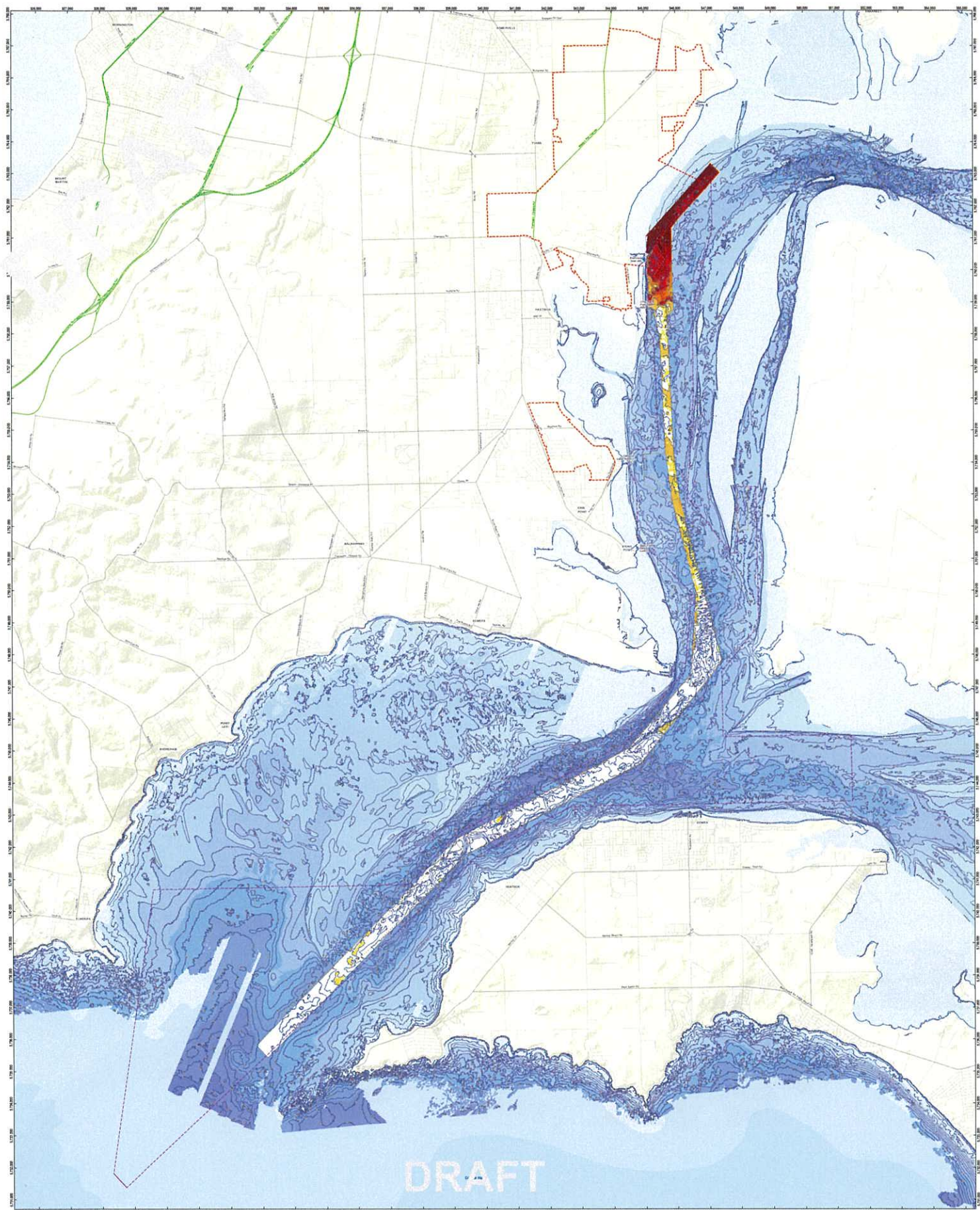
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Preliminary Design Along the Shore Alignment - Scenario A
Dredge Areas incl Additional Depth for the Over Dredge Allowance

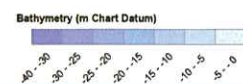
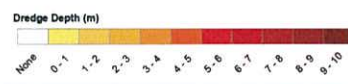
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- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- PoH limits
- Along the Shore Alignment
- Highway
- Arterial
- Local

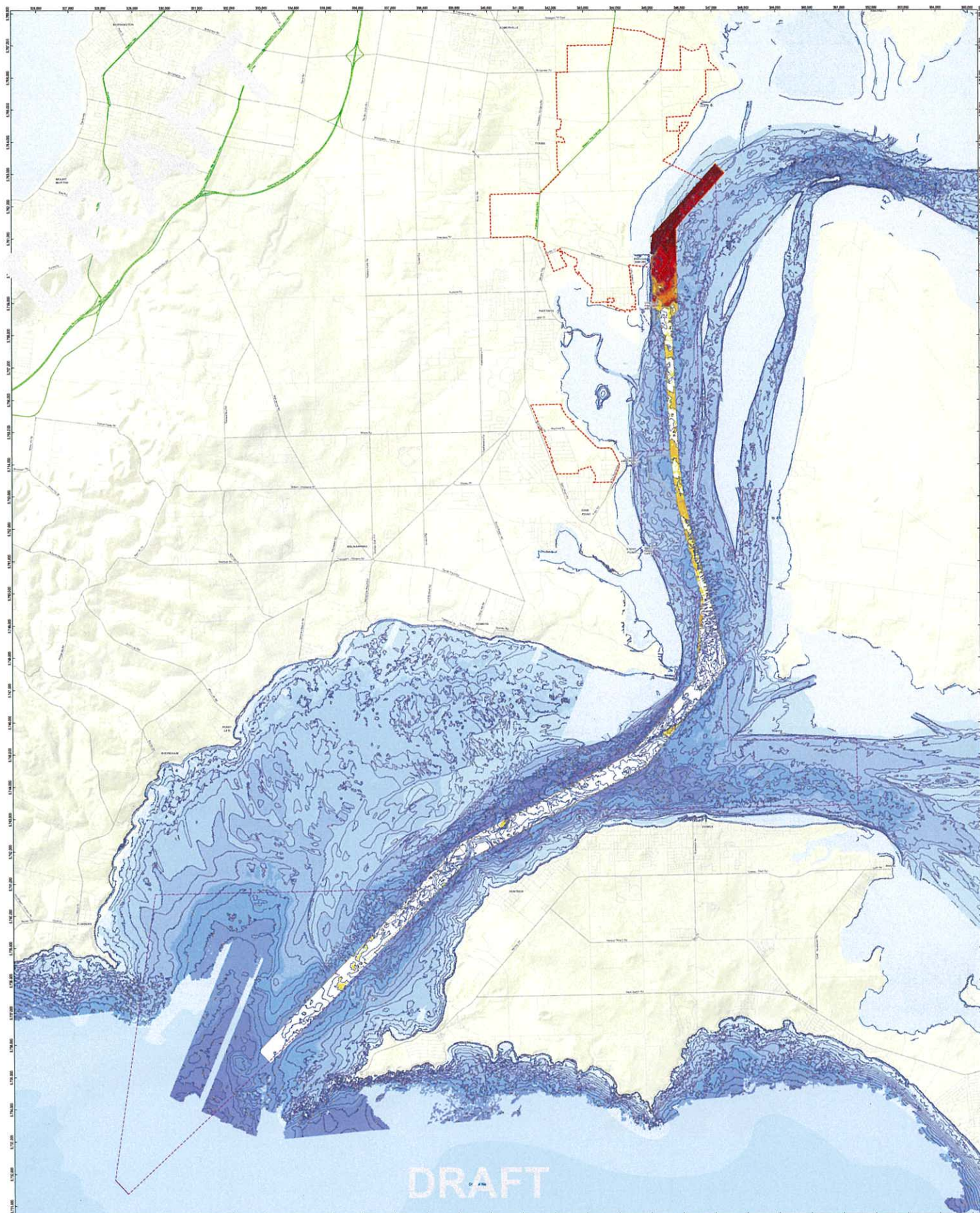


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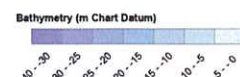
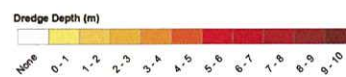
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Preliminary Design Along the Shore Alignment - Scenario A
Dredge Areas to the Dredge Clearance Depth

AGH-CEP0-DE-FIG-0139



- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- PoH limits
- Along the Shore Alignment
- Highway
- Arterial
- Local

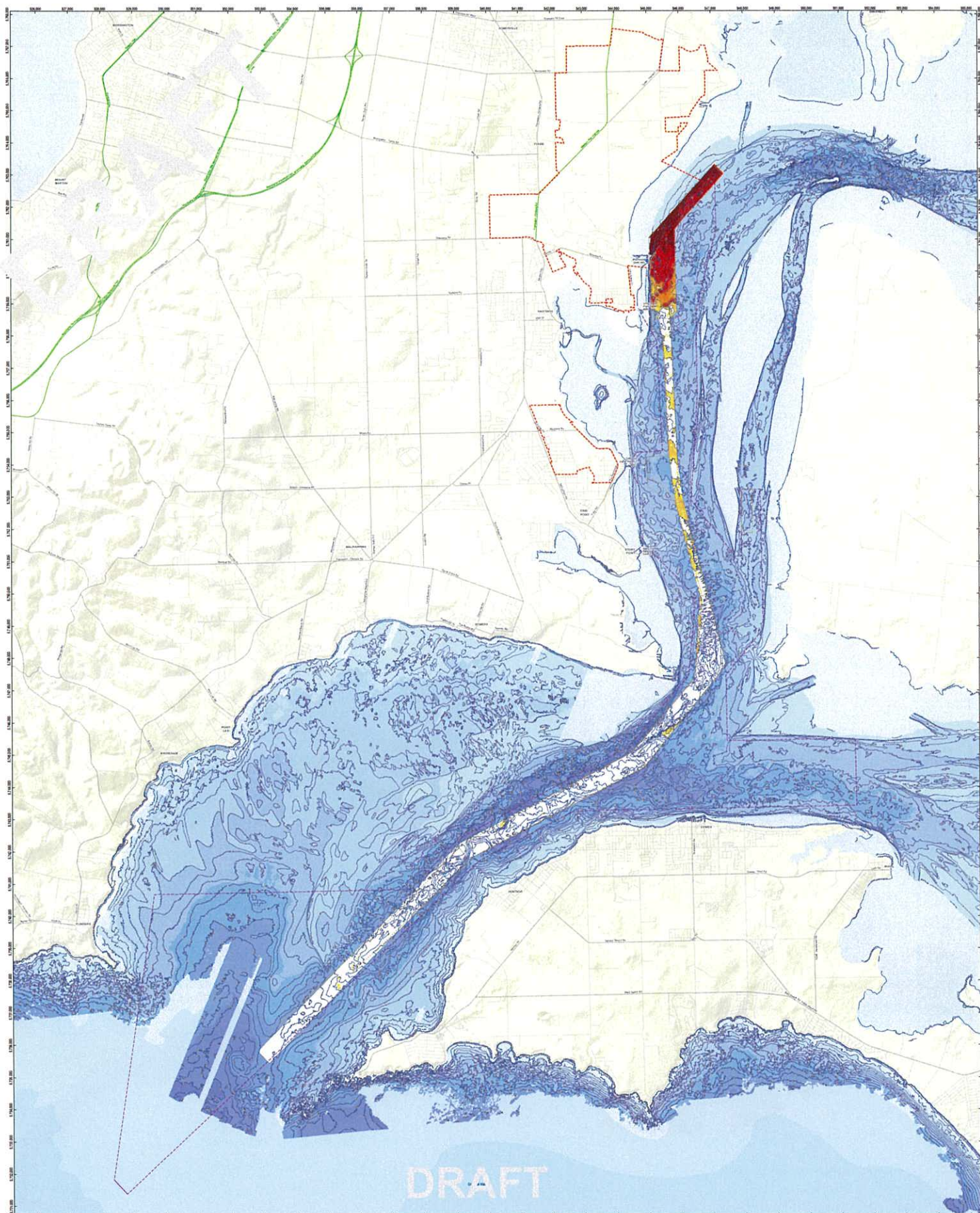


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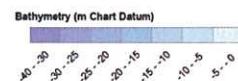
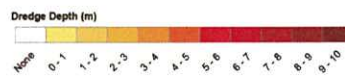
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Preliminary Design Along the Shore Alignment - Scenario B
Dredge Areas incl Additional Depth for the Over Dredge Allowance

AGH-CEP0-DE-FIG-0140



- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- PoH limits
- Along the Shore Alignment
- Highway
- Arterial
- Local



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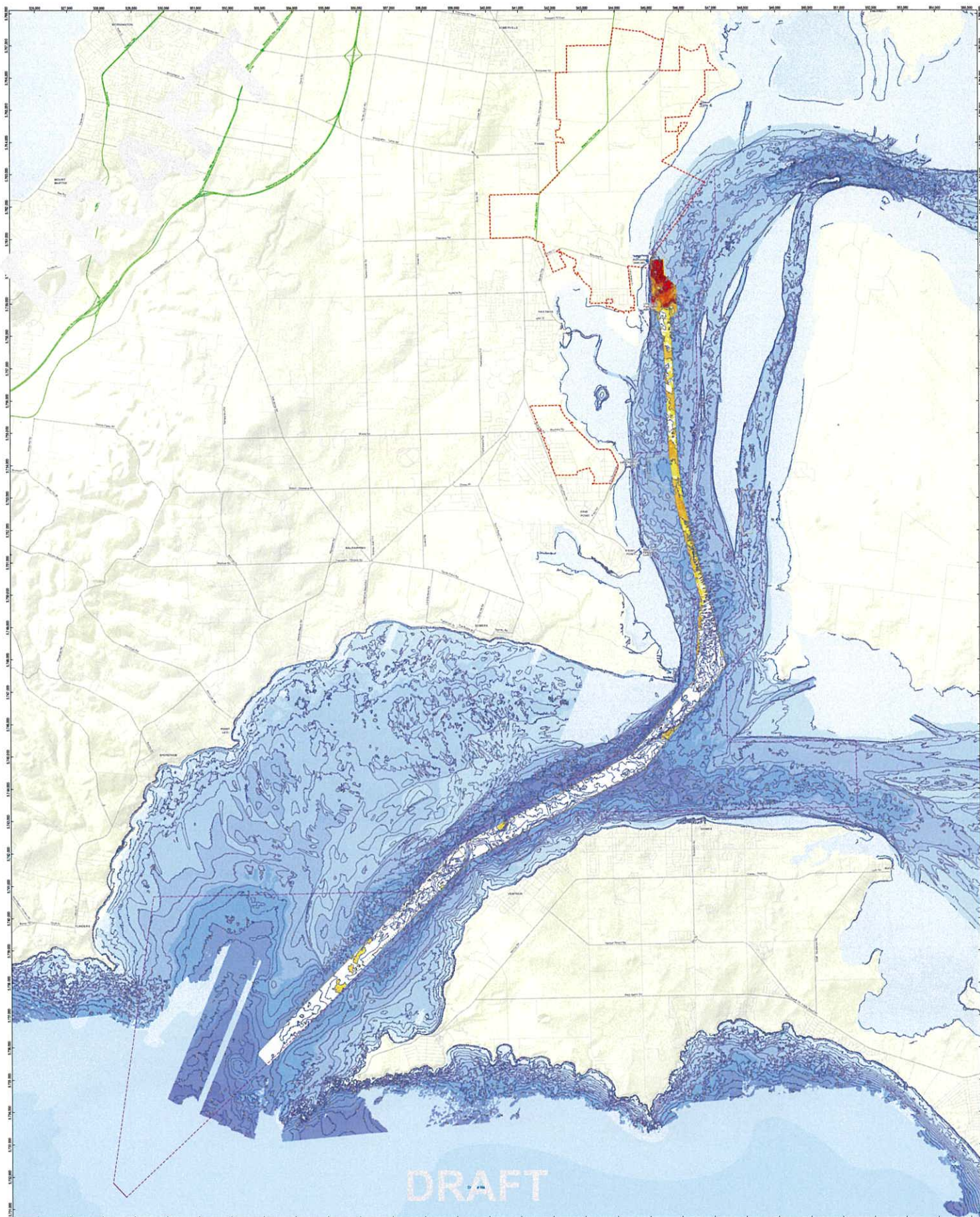
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Preliminary Design Along the Shore Alignment - Scenario B
Dredge Areas to the Dredge Clearance Depth

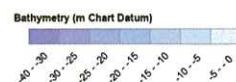
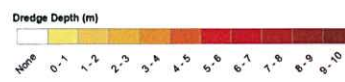
AGH-CEP0-DE-FIG-0141

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- Existing Channel Toolines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- POH limits
- Stage 1 Development
- Highway
- Arterial
- Local



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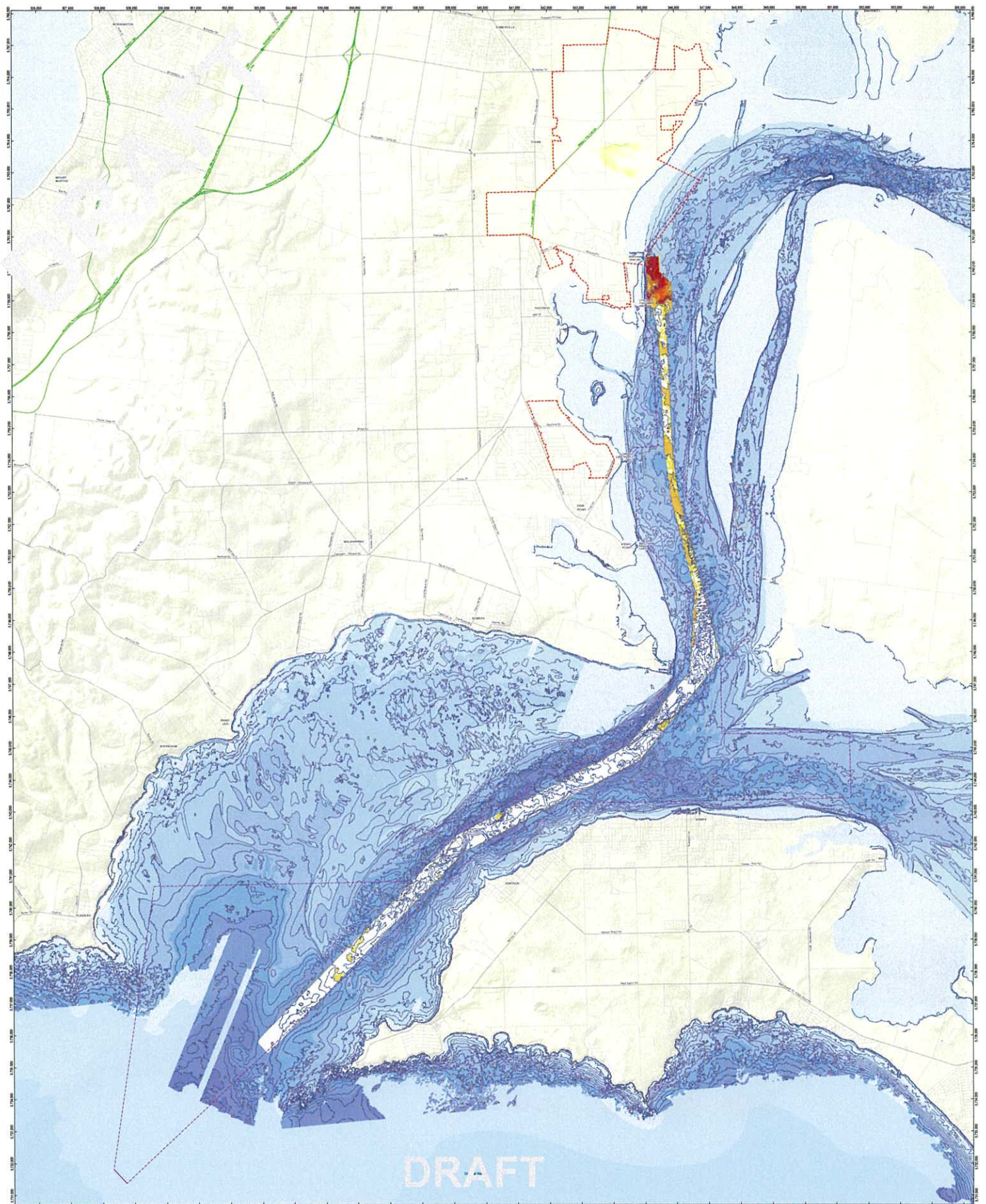


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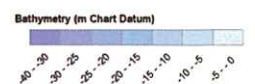
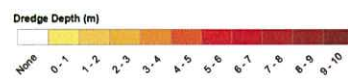
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Preliminary Design Stage 1 Development - Scenario A
 Dredge Areas incl Additional Depth for the Over Dredge Allowance

AGH-CEP0-DE-FIG-0142



- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- POH limits
- Stage 1 Development
- Highway
- Arterial
- Local

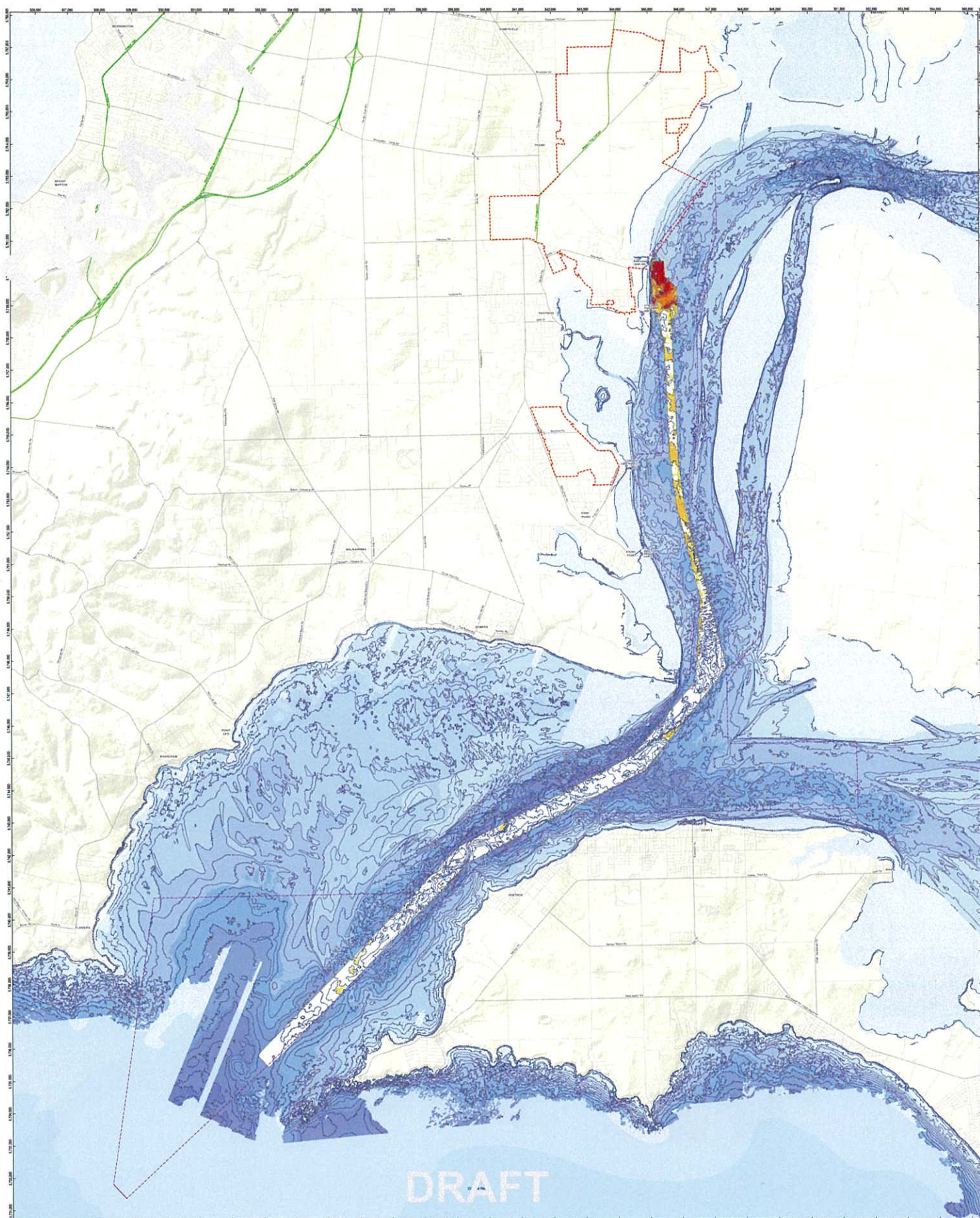


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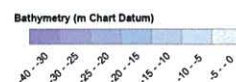
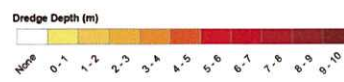
Revision
Date
A
15 May 2015

Preliminary Design Stage 1 Development - Scenario A
Dredge Areas to the Dredge Clearance Depth

AGH-CEP0-DE-FIG-0143



- Existing Channel Toolines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- Port Limits
- Stage 1 Development
- Highway
- Arterial
- Local



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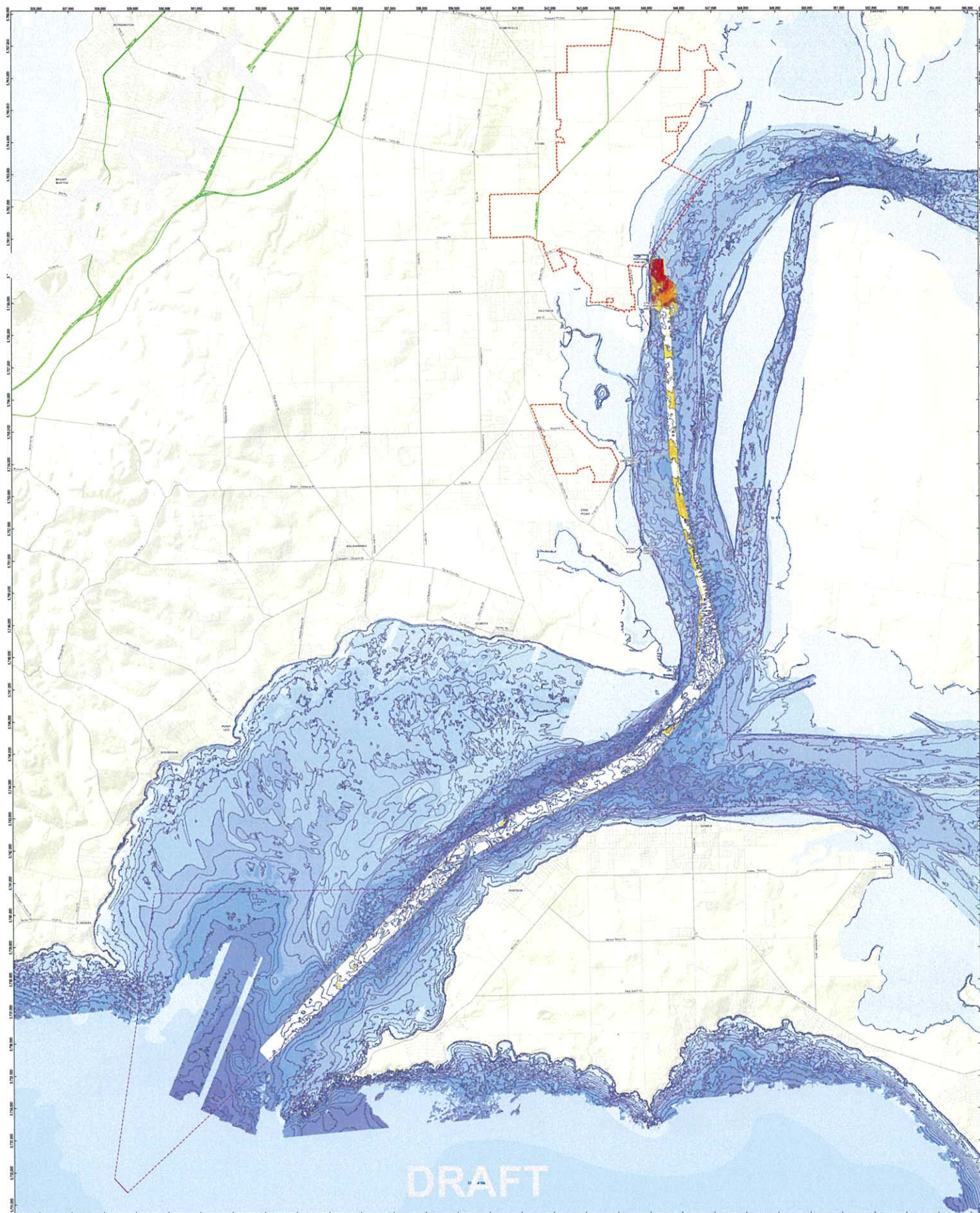


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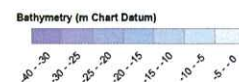
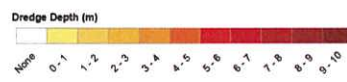
Revision A
 Date 15 May 2015

Preliminary Design Stage 1 Development - Scenario B
 Dredge Areas incl Additional Depth for the Over Dredge Allowance

AGH-CEP0-DE-FIG-0144



- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- POH limits
- Stage 1 Development
- Highway
- Arterial
- Local

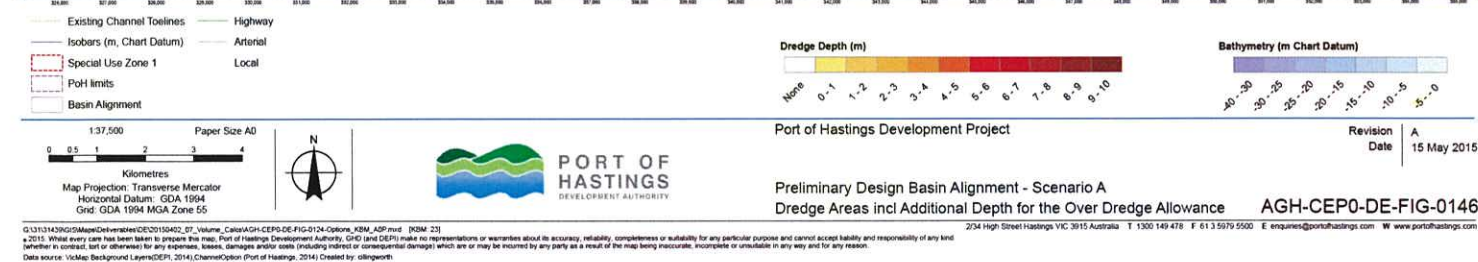
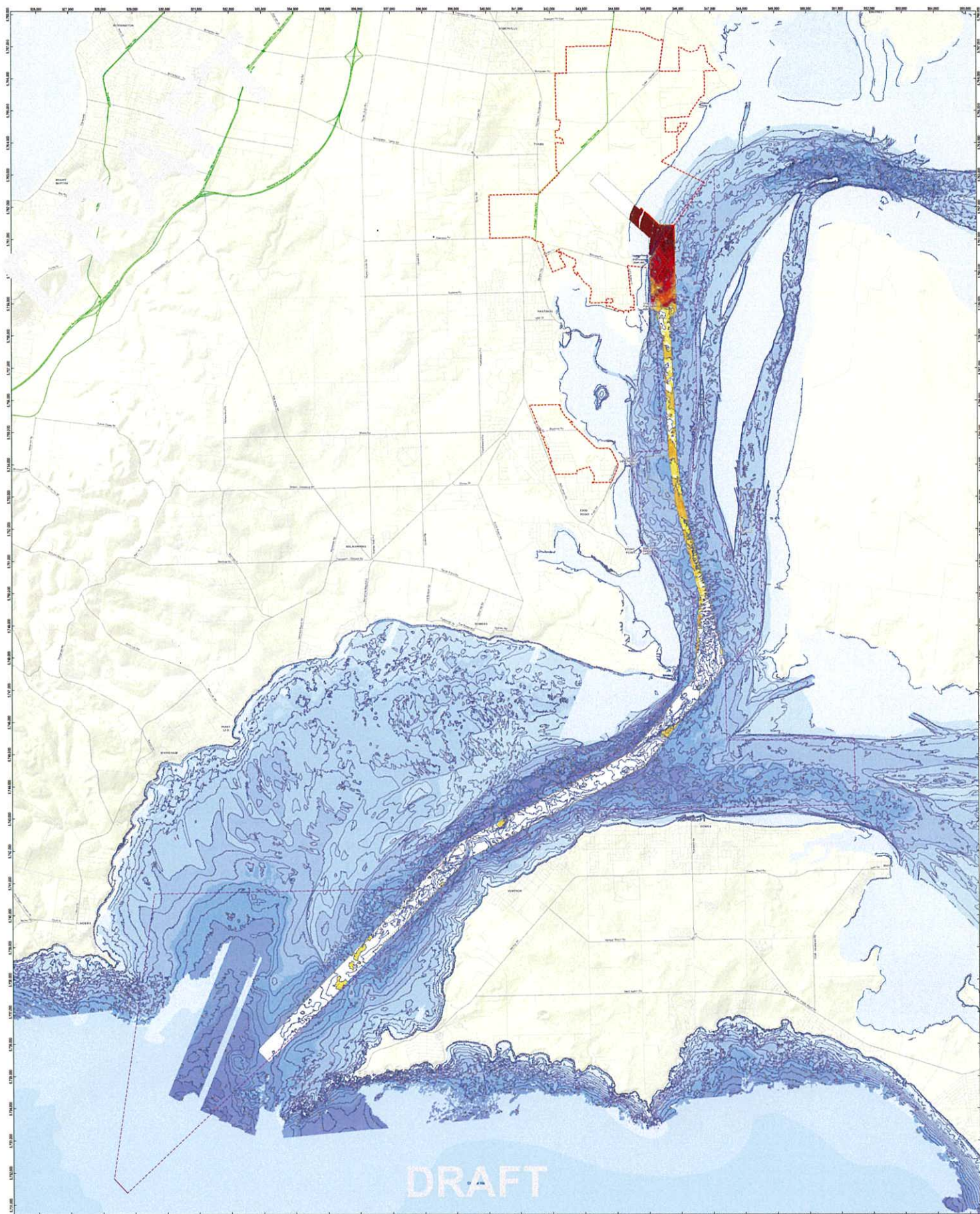


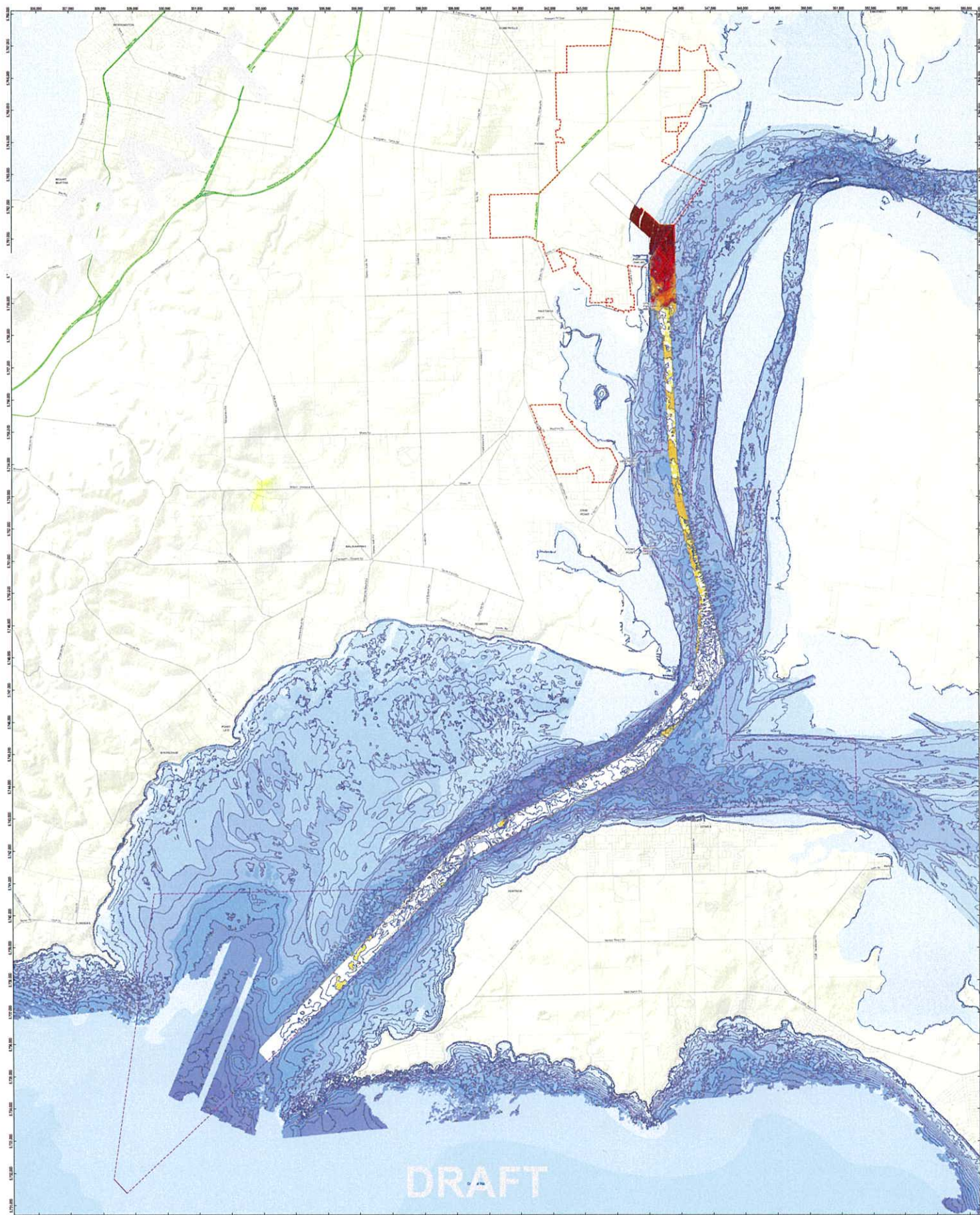
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15 May 2015

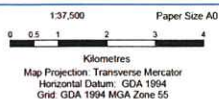
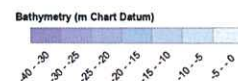
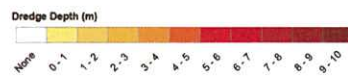
Preliminary Design Stage 1 Development - Scenario B
Dredge Areas to the Dredge Clearance Depth

AGH-CEP0-DE-FIG-0145





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- Special Use Zone 1
- Pot limits
- Basin Alignment
- Highway
- Arterial
- Local



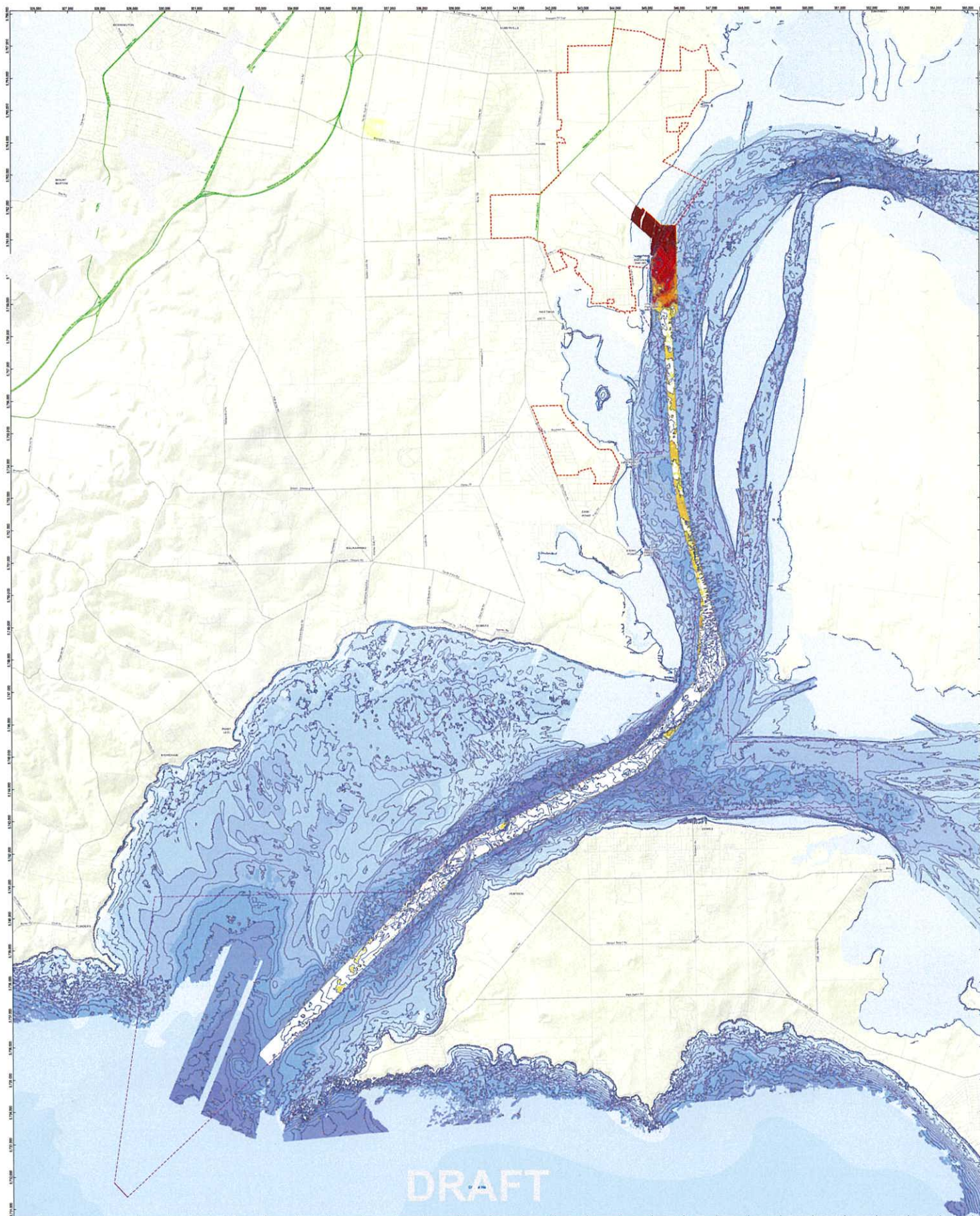
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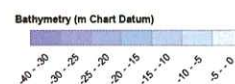
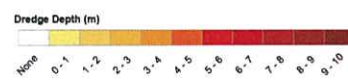
Revision
Date A
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**Preliminary Design Basin Alignment - Scenario A
Dredge Areas to the Dredge Clearance Depth**

AGH-CEP0-DE-FIG-0147



- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- PoH limits
- Basin Alignment
- Highway
- Arterial
- Local



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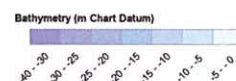
Preliminary Design Basin Alignment - Scenario B
Dredge Areas incl Additional Depth for the Over Dredge Allowance

Revision A
Date 15 May 2015

AGH-CEP0-DE-FIG-0148



- Existing Channel Toelines
- Isobars (m, Chart Datum)
- Special Use Zone 1
- PoH limits
- Basin Alignment
- Highway
- Arterial
- Local



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Date A
15 May 2015

Preliminary Design Basin Alignment - Scenario B
Dredge Areas to the Dredge Clearance Depth

AGH-CEP0-DE-FIG-0149

