BURNETT RIVER FLOODPLAIN ACTION PLAN

COMMUNITY REFERENCE GROUP MEETING

THURSDAY 31 OCTOBER 2013 – 4PM

COMMITTEE ROOM, BUNDABERG MAIN ADMINISTRATION OFFICE, 190 BOURBONG STREET, BUNDABERG

MINUTES

ATTENDANCE:

Rowan Bond (Chairperson), Kay Amsler, Helen Dayman, Rob Marshman, John Olsen, Barry Ehrke, John Lee, Jon Carman, Steve Cooper, Andrew Fulton (General Manager Infrastructure & Planning), Rob Calligaris (Council's Design Team Leader), Robyn Laing (Administration Support) and Snr Sergent Grantley Marcus, (QPS Liaison Officer between Disaster Management and Minister for Local Government, Community Recovery & Resilience, Hon David Crisafulli).

APOLOGY:

An apology was tendered for John Bailey, Dwayne Honor (Council's Design Manager and Project Manager) and Mark Pressler.

CONFIRMATION OF MINUTES:

CRG MEMBERS STEVE COOPER AND JOHN OLSEN MOVED that the Minutes of the CRG Meeting held on 8 October 2013 (as tabled at this Meeting) be confirmed and made available on Council's website.

The motion was put CARRIED.

MULTI CRITERIA ANALYSIS (MCA):

CRG MEMBERS, HELEN DAYMAN AND STEVE COOPER MOVED that the amended criteria and weightings for assessing the flood resilience submissions (as tabled at this meeting) be adopted.

The motion was put CARRIED.

FLOOD RESILIENCE SUBMISSIONS:

Dan Copelin (GHD Flood Consultant) joined the Meeting via teleconference to provide explanation on the tabled flood resilience options summarised from community consultation (copy attached to these Minutes).

Andrew Fulton attended the Meeting at 4.15pm

The Meeting discussed in detail the additional flood resilience options tabled at the Meeting by CRG Members, Jon Carman, Barry Ehrke and Rob Marshman. Dan Copelin offered support for the idea from Jon Carman (Option 10) to construct levees to reduce the depth and velocity of water in North Bundaberg in the event of major floods; noting that such a large volume of water as experienced in the 2013 flood event, cannot be kept out of North Bundaberg all together without causing adverse effects in other areas with regard to increased velocities and peak flood heights.

CRG Member, Jon Carman referred to the idea of raising the North Perry Railway Line (Option 14) and Dan Copelin advised that a levee could be built along the rail corridor instead of raising the railway line. He discussed the method of using concrete infill panels in the rail corridor and also temporary lift-in panels on roads to provide flood resilience.

CRG Member, Barry Ehrke outlined the reasons for his proposal to open up Skyringville (Option 30) and stated that from his experience, you always start at the mouth and open it up first. In reply, Dan Copelin advised that preliminary modelling had shown that removal of certain restrictions in the river had a greater effect than opening up the mouth. The recent dredging undertaken at Port Bundaberg had been included in the model. Preliminarily testing (for a 2013 flood event) of diversion channels and re-opening the Skyringville passage (as described in options 30 and 21) only provided a benefit to the area around the Port of Bundaberg and offered no benefit to the populated areas further upstream. He further stated that widening the river at Millaquin Bend (Option 31) offered a substantial benefit to the city area. Whilst the river mouth is a constraint, there are so many places for the flood waters to release, that widening the mouth does not provide much relief to the flooded areas of the city.

CRG Member, Jon Carman enquired about the extent of benefits to be received from the proposed Rubyanna diversion channel (Option 20) and Dan Copelin advised that early preliminary testing had shown that the benefits depleted upstream of Paddy's Island.

Andrew Fulton asked if Option 31 to improve the restrictions in the river in the Millaquin area increased the backwater flood levels. Dan Copelin advised that preliminary testing in the flood model showed that the widening of the river at Harriet Island (Option 35) and Millaquin bend (Option 31) decreased the quantity of backwater experienced in East Bundaberg and also offered improvements to North Bundaberg and upstream areas. As all the flood water rejoins the river down near the Fairymead levee, no significant increase was modelled for downstream areas. Dan clarified that whilst substantial benefit was modelled from widening the river at the Millaquin bend, greater improvements were modelled when the river was widened from Harriet Island to Millaquin bend.

In reply to questions raised by CRG Member, Rob Marshman with reference to Option 31, Dan Copelin advised that preliminary modelling had shown that dredging works at Millaquin bend had potential to reduce flood levels in East Bundaberg in the order of 600mm. Further, the east Bundaberg levy (option 2) would prevent backwater in East Bundaberg without affecting the flood heights elsewhere. As some properties in East Bundaberg flood regularly, widening the river at Millaquin would assist in all events not just major events; which was a matter to be noted for consideration.

With reference to Option 19, Dan Copelin advised the Meeting that structures to prevent flood waters breaking the bank at Perry Street caused increased peak flood heights and velocities in other areas of North Bundaberg. If the levee was continued to Mariners Way the peak flood heights on the southern side of the river increase in the order of 1 – 1.5 metres. Dan Copelin confirmed Rob Marshman's comments that efforts to prevent flooding of North Bundaberg resulted in adverse affects somewhere else. It was noted that more benefit could be received mitigating against flooding that happened every 20-30 years, than the one major event that happened once every 100 years or more.

Option 10 would provide additional time for evacuation in a major flood event and whilst flooding would still be experienced, this proposed levee would provide immunity for medium flooding; which is experienced more frequently than the 2013 event.

Helen Dayman drew the Meeting's attention to option 38 to upgrade regional Bridges and enquired about the modelling undertaken to date. She stated that whilst the community would like Booyal Crossing upgraded, given the width and velocity of flood water, she did not think it would be realistic to construct a bridge. However, raising the crossing a couple metres above regular flood height and heights experienced during Paradise Dam releases, would offer great benefit to the community. It was noted that Pine Creek, Cherry Creek and Log Creek should be included. Dan Copelin advised that he could make a preliminary recommendation on what heights the bridges/crossings should be subject to additional hydraulic work and agreed that there would be substantial benefit received from modest upgrading of bridges/crossings in these regional areas. At this stage, the Meeting discussed the possibility of upgrading a road through the State Forest and private property via Promiseland Road to be used in times of evacuation in lieu of upgrading bridges/crossings over Pine Creek and Cherry Creek.

John Olsen spoke regarding this proposal to remove Ben Anderson Barrage (Option 28) and tabled additional information (attached to these Minutes). In reply to John Olsen's comments, Dan Copelin clarified his comments of 'major implications for water supply' by stating that he did not mean it was impossible but would incur high costs to secure and deliver an alternative water supply. Dan Copelin also pointed out that securing a supply of water in drought years would need to be considered. John Olsen reiterated previous comments that modelling should be undertaken from a pristine state of the river to fully understand the elevated state of the river since construction of Ben Anderson Barrage. At this stage, Dan Copelin referred the Meeting to his email circulated prior to this Meeting, answering the concerns raised by John Olsen (copy attached). To address the first issue, he stated that preliminary modelling showed the removal of Ben Anderson Barrage to offer a reduction of 1 – 2 cm in flood height during a 2013 flood event. Whilst it looks like a large imposing structure, the barrage has a crest level of about 2m and the flood level in 2013 was approximately 14 metres. The structure is low compared to 2013 flood levels so it is not exerting an impact on peak flood levels upstream or downstream of the barrage. He further stated that this does not mean that the barrage would not have an affect in smaller flooding. He reiterated previous comments by stating that restrictions other than the barrage (such as Millaquin bend) were driving the high flood levels rather than other structures built in the river. The second issue raised by John Olsen was the affect on flood levels caused by increased rate of sedimentation upstream of the structure. Dan Copelin agreed that it was probably true that the barrage had caused sedimentation upstream of the structure and referred to previous studies undertaken after the barrage was built. These sediment transport studies found that the barrage did not substantially contribute to reduction in river depth. It was noted that sedimentation occurs naturally and that sedimentation may have built up even if the barrage had not been constructed. Currently, the barrage is likely holding back sedimentation upstream of the structure and it can only be concluded from our limited knowledge that the barrage is not contributing to sedimentation downstream. The hydraulic studies undertaken in the 1980s and 1990s are not clear about a moderately silted up river flooding to higher depths given that flooding scours sediment anyway. Dan Copelin stated that the removal of Ben Anderson Barrage was omitted from the list of proposed flood resilience projects in view of the preliminary modelling results, the findings in the 1980s and 1990s hydraulic studies and major implications for water delivery and security of supply in drought conditions.

John Lee asked Dan Copelin if the barrage had any impact on the flow of the river in the 2013 event and Dan Copelin replied stating that the barrage is located on a straight reach of the river and had no affect on direction of flood waters. Whilst there is evidence of the river meandering in the lower reaches throughout time, there is no evidence of this happening in the stretch of river where the barrage is located.

Rob Marshman referred to the flow velocities in GHD's email dated 31 October 2013 (copy attached to these minutes) and stated that many of these recorded velocities seem to be less than what was observed at the time of the 2013 Flood. Dan Copelin explained that the surface velocity is higher than the average velocity taken in a cross section and that whilst some of those surface velocities were excessively high; such velocities will not be shown in GHD's results which only reflect averaged velocities.

Rob Marshman referred to Option 25 and asked regarding the frequency of dredging at Millaquin bend. Dan advised that all dredging and widening has yet to be determined after receiving input from Bundaberg Port Authority. Rob Marshman raised further questions concerning costings and Dan Copelin advised that only the highest order costing would be utilised in assessing and comparing these flood resilience options.

Helen Dayman asked questions regarding the proposed levees in North Bundaberg (Option 10). The Meeting was advised that the proposed levees would offer flood immunity for a flood greater than the 2010/11 event but smaller than the 2013 event. Historically, flood levees have been built to the height of the last flood but the height of a flood levee can be built to offer flood immunity for smaller flooding such as a one in 50 year event.

The Meeting discussed the benefit of combining flood resilience options. Dan Copelin confirmed that the reduced flood heights from Option 31 - Millaquin bend would greatly reduce the height and engineering required for the East levee in Option 2. It was noted that the homes and properties benefiting from the North levee proposed in Option 2 only came into effect for a 2013 flood event and that these properties did not flood below this level of flooding.

Dan Copelin agreed with comments by CRG Members that widening the full reach or just Millaquin bend and raising evacuation roads seemed to make the most sense at this early stage of the investigations.

The CRG Members were asked to comment on the Wallaville levee (option 12). Dan Copelin stated that it might be better to address evacuation routes rather than leave a small community isolated in a flood event.

Helen Dayman asked if Paradise Dam had been modelled in the event of a failure. Snr Sergent Grantley Marcus stated that he was expecting a report from Sunwater on this matter and that he would put forward a submission to provide the CRG with some sort of appreciation of those questions. Dan Copelin stated that modelling had been undertaken for the Probable Maximum Flood which would be greater than a dam break. He further stated that upgrading Paradise

Dam to a flood mitigation dam would require a tripling of the dam's volume to reduce the current 100-year flood to the equivalent of the current 50-year flood.

CRG Chair, Rowan Bond referred the Meeting's attention to Option 38 – regional bridge upgrades. It was agreed to include Pine Creek, Cherry Creek and Log Creek (at the end of School Lane / Pine Creek Road) as these roads are cut off with frequent minor flooding. It was noted that there are a number of creek crossings that require upgrading to maintain access during minor to medium flood flooding and the Meeting suggested that these crossings be identified for submission to Council to commence a program of upgrades. Upgrading of alternative access routes in lieu of bridge/ crossing upgrades was discussed at length.

CRG Chair, Rowan Bond thanked Dan Copelin for his time and concluded the teleconference.

The Meeting resolved to adopt the summarised list of flood resilience options prepared by GHD for assessment with the agreed multi criteria and designated weightings subject to the following amendments:

Option 12 – Open up the Wallaville Ring Levee to protect those properties flooded in the 2013 event.

Option 20 – Rubyanna Diversion Channel would significantly reduce safe anchorage for boats.

Option 21 – Amend to include an option to take a channel from the apex in the bend of the river at Fairymead across to Skyringville.

Option 26 – Include the option of removing a 5 metre high ridge separating Fairymead from Skyringville to encourage flood waters to flow to Skyringville.

Option 25 – Clarify area of dredging at Fairymead Bend in the vicinity of Rubyanna Creek and the old Fairymead Molasses Wharf.

Option 27 – Amend to include responsible removal of mangroves from the town reach.

Option 29 – Seek clarification if Perry Island is Paddy's Island and whether this option is for the removal of sedimentation only.

Option 36 – Amend to include removal of part of Harriett Island – being the southern bank above Tallon Bridge to straighten the flow path.

Option 38 – Amend to include Pine Creek, Cherry Creek and Log Creek (in the vicinity of Pine Creek Road / School lane) and/or an alternative evacuation route for Wallaville Bridge.

OTHER MATTERS:

Paradise Dam:

Snr Sergent Grantley Marcus offered to arrange for a Sunwater representative to present emergency plans for Paradise Dam to CRG. It was noted that notification of releases from dams was now compulsory and that Paradise Dam was to be upgraded with sensors to give warning of impending failure.

Removal of debris from banks of Burnett River:
John Olsen referred to the build up of debris in the Burnett River and reported the following sites for attention:

1. Rubyanna Creek (near Millaquin pond)
2. Kirbys Wall Boat Ramp – just past the wash out
3. Finemore Caravan Park, Quay Street

NEXT MEETING DATE:

It was agreed to make a tentative date of Tuesday 19 November 2013 to commence at 4pm in the Bundaberg Office for the next CRG Meeting. *Meeting Date to be confirmed by the CRG Chair.*

This concluded the business of the Meeting at 8.15 pm.

Memorandum

28 October 2013

To	Rob Calligaris		
Copy to	Dwayne Honor; Robyn Laing		
From	Daniel Copelin	Tel	0733163608
Subject	List of Options for Multi Criteria Analysis	Job no.	41/26909

In consultation with BRC, GHD have prepared a list of options for the multi criteria analysis (MCA). The list has been compiled based on feedback received from the community, direct input from the Community Reference Group and consultation with Council officers. The list represents a range of potentially viable large-scale floodplain risk management options that will be taken forward for consideration in the MCA, with a view to establishing the "top five" options by December. A total of 40 items are presented in Table 1 below, with 24 of those to be considered in the MCA. Where an option has been excluded from further consideration, preliminary justification is provided. Further detail and explanation will be provided as part of the final Options Report. A schematic map of each option, showing possible alignments and extents of works, is also attached.

The options in Table 1 are generally large and complex projects that would require a substantial commitment of resources. The high-level MCA process will help to rank these large projects, so that a smaller list can be taken forward for more detailed investigation. Future detailed investigations into the most favourable options will include cost-benefit assessments and other investigations in project constraints and risks.

The alignment and extent of the works are preliminary and suitable for high-level assessment only. Further investigation may reveal that, for example, only a part of a levee is required or that an alternate alignment is more appropriate.

It is noted that a wide range of other options and suggestions have been tabled as part of the community consultation process across the broad categories of Property Modification Measures, Development Controls, Response Modification Measures and Flood Modification Measures. Many of these suggestions (such as improved flood information for residents, flood warning systems, additional rain / stream gauges, and better provisions for recovery centres) are relatively simple and low cost or are already planned for implementation, and have hence been excluded from the current MCA process. These other suggestions will be discussed as part of the overarching Floodplain Risk Management Study to be completed in 2014.

Regards

Daniel Copelin

GHD 145 Ann Street Brisbane QLD 4000 GPO Box 668 Brisbane QLD 4001 Australia
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Memorandum

Table 1 – List of Options for Multi Criteria Analysis

ID	Type	Name	Description.	Include in MCA (Yes / No)
1	Levee	North Levee	A levee extending north along the high ground from North School hill, protecting parts of Bundaberg North and low lying areas in Gooburrum south of Tantitha Road. The levee could be constructed to protect against a major flood (2013 or greater).	Yes
2	Levee	East Levee & Floodgate	A levee along Quay St East, and extending north past the mill. The flood protection system would include a flood gate at Bundaberg Creek. The levee could be constructed to protect significant areas in Bundaberg East, South and Central against a major flood (2013 or greater).	Yes
3	Levee	Perry St to Mariners Way Levee	A levee along Perry Street extending to Mariners Way, to prevent flood waters breaking out of the river into Bundaberg North during a major flood event.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
4	Levee	North Bank and East Levees	A levee along the north bank of the town reach, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor.	Yes
5	Levee	North and East Levees	A levee along the high ground north of North School Hill, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor, while allowing breakout flows across Perry Street during a major flood event.	Yes

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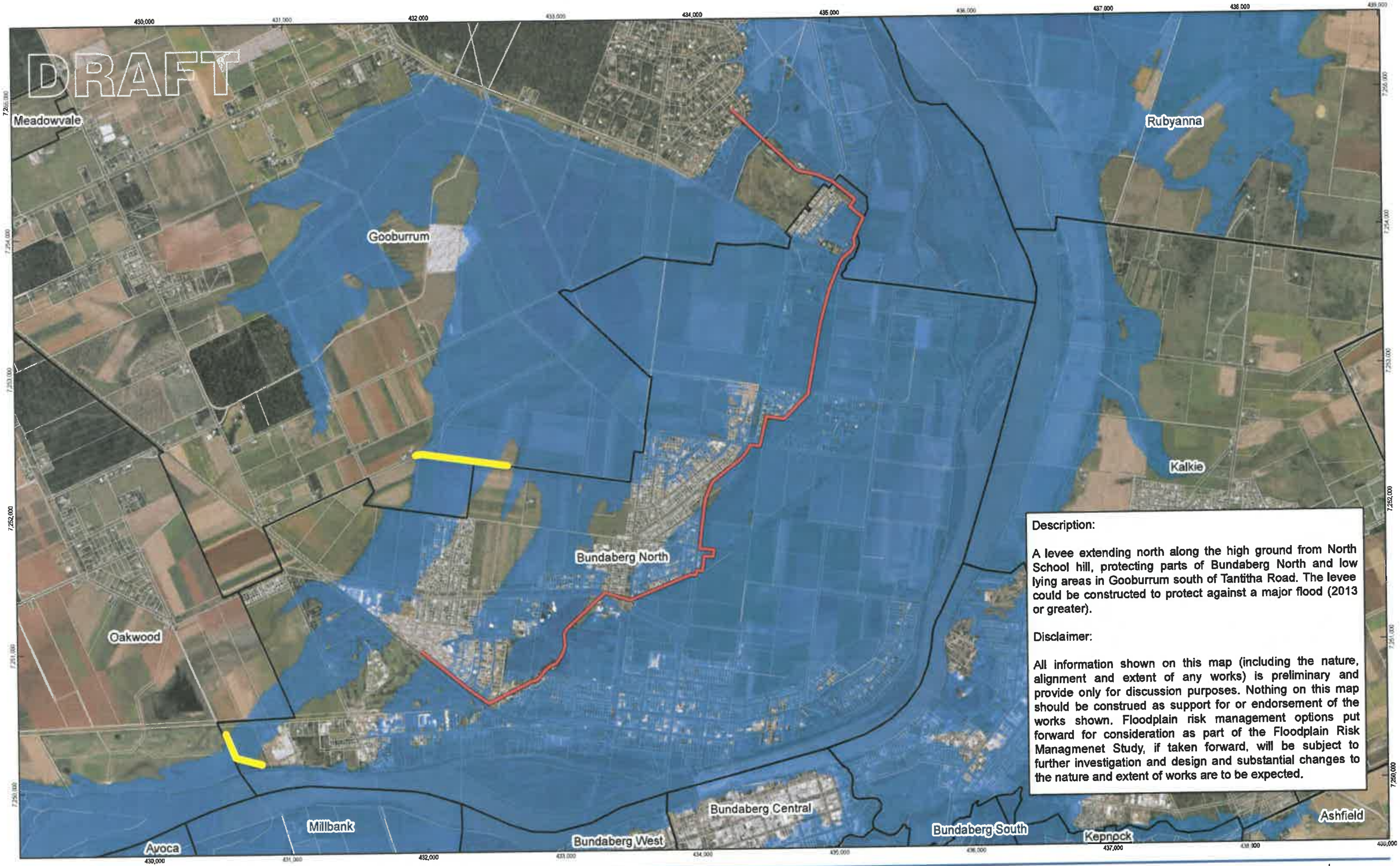
6	Levee	West Hinkler Ave Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
7	Levee	Perry & Wilmot St Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
8	Levee	Perry St & Hinker Ave Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
9	Levee	Hinker Ave to Cameron St Levee	A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.	No. Severe adverse hydraulic impacts, including on river stability, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
10	Levee	Low Level North Bundaberg Levees	A system of low-level levees to protect parts of Bundaberg North from flood events smaller than the 2013 event. The first levee is along Perry Street and would act to prevent the breakout of flow from the river, and the second levee between Mount Perry Road and Mariners Way would prevent the ingress of backwater flooding.	Yes
11	Levee	Port of Bundaberg Levee	A levee or sea wall along the river bank in the urban area at the Port of Bundaberg.	Yes
12	Levee	Wallaville Levee	A ring levee to protect the urban areas in Wallaville from major flooding.	Yes

13	Levee & Channel	West Hinkler Ave Levee & Gardens Channel 1	A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.	No. Adverse hydraulic impacts, safety concerns (levee subject to high velocities, increases in flood hazard elsewhere, consequences of levee failure).
14	Levee & Channel	Rail Levee & Perry St to Cameron St Levee with Gardens Channel 2	A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.	No. Similar to other options.
15	Levee & Channel	Gardens Channel 2 with Adjacent Levee	A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.	No. Levee offers no additional benefits compared to channel alone.
16	Levee & Channel	North Bank and East Levees with Gardens Channel 2	A levee along the north bank of the town reach, combined with the East Levee and floodgate option and a large bypass channel near the botanical gardens. The levee systems would constrain all flood flows to the river corridor, while the bypass channel would provide relief for floodwaters during a major event.	Yes
17	Levee & Channel	North and East Levees with Gardens Channel 2	A levee along the high ground north of North School Hill, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor, while allowing breakout flows across Perry Street during a major flood event. The bypass channel would provide relief for floodwaters during a major event.	Yes
18	Channel	Gardens Channel 1	A 100m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.	No. Limited hydraulic benefits compared to cost.
19	Channel	Gardens Channel 2	A 250m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.	Yes
20	Channel	Rubyanna Bypass Channel	A 500m wide diversion channel with an invert level of -2m AHD (nominal dimensions only) to improve the flood carrying capacity of the river in the Rubyanna area.	Yes

21	Channel	Fairymead Diversion Channel 1	A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel discharges to the sea near the mouth of Skyringville Passage.	Yes
22	Channel	Fairymead Diversion Channel 2	A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel reconnects with the river downstream of the bend opposite the port.	No. Diverts too much water towards Port, increasing flood levels,without significant upstream benefits.
23	Dredging	Town Reach Dredging	Lower the river along the town reach by a nominal 3m by dredging.	Yes
24	Dredging	Barrage to Port Dredging	Lower the river between the barrage and the port by a nominal 3m by dredging.	Yes
25	Dredging	Selective dredging at foundry, Miliquin Bend and Fairymead Bend	Selective dredging (deepen river by a nominal 3m) at critical constrictions at the Foundry, Millaquin Bend and the Fairymead Bend.	Yes
26	Floodplain works	Removal of Fairymead Levees	Removal of existing levees at Fairymead to allow flood waters from the river to escape over the floodplain to the north and west.	Yes
27	River works	Removal of mangroves from town reach	Removal of riparian vegetation along the town reach to increase the flood carrying capacity of the river.	Yes
28	River works	Removal of Ben Anderson Barrage	Removal of Ben Anderson Barrage to directly reduce peak water levels during a flood event.	No. No significant hydraulic benefit, major implications for water supply.
29	River works	Removal of sediment from north bank, Harriet Island and Perry Island	Removal of accumulated sediment (to a nominal depth of 0.5m) along the north bank of the town reach, but allow mangroves to re-establish on the inter-tidal mud flats to help preserve river bank stability.	Yes
30	River works	Reopen Skyringville Passage	Removal of the north sea wall opposite the Port of Bundaberg, and dredging of the old river mouth to a nominal depth of 5m to reopen Skyringville Passage.	Yes
31	River works	Millaquin Bend widening (north bank)	Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.	Yes



Description:

A levee extending north along the high ground from North School hill, protecting parts of Bundaberg North and low lying areas in Gooburrum south of Tantitha Road. The levee could be constructed to protect against a major flood (2013 or greater).

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- North Levee (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
North Levee

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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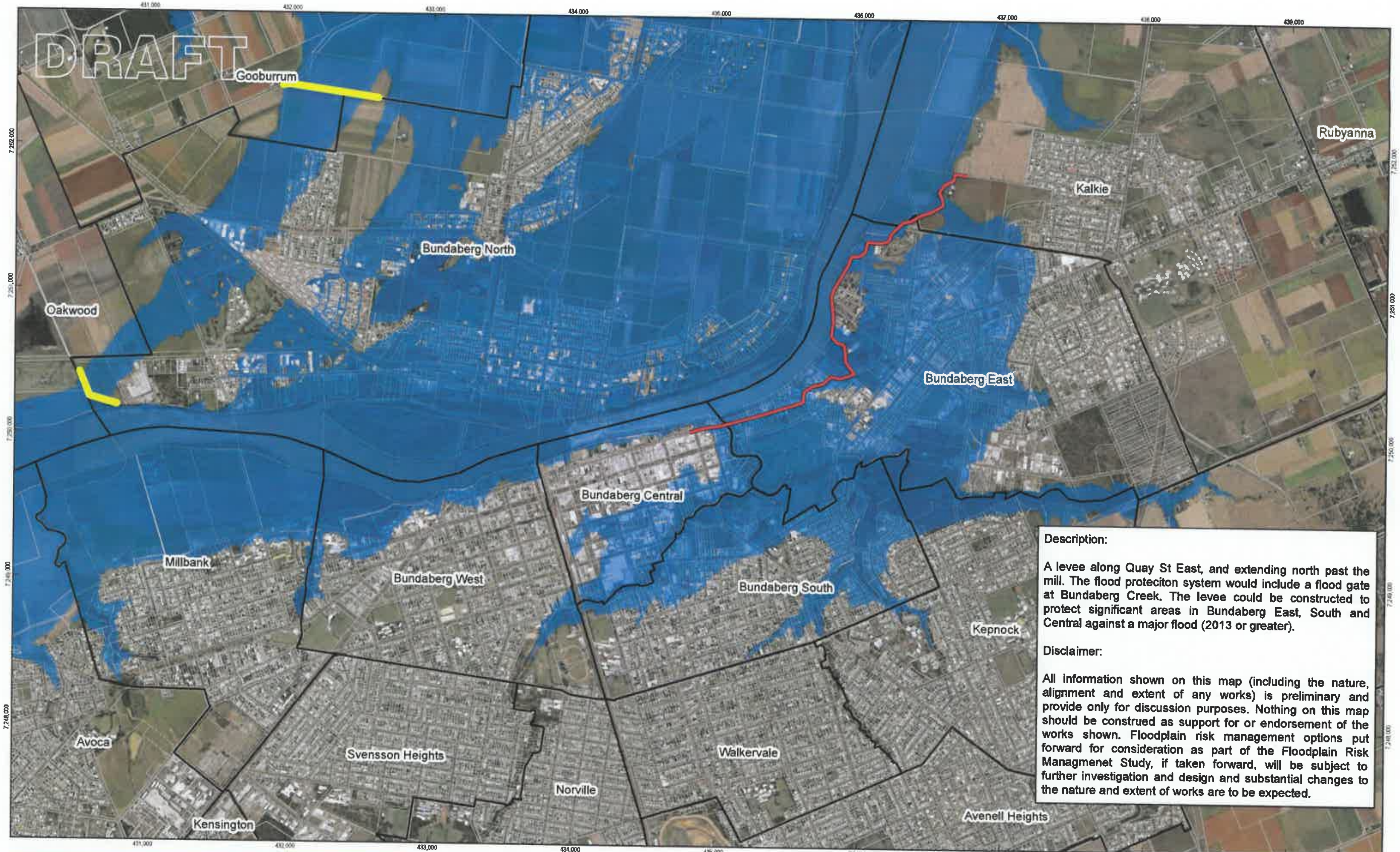

Description:

A levee along Quay St East, and extending north past the mill. The flood proteciton system would include a flood gate at Bundaberg Creek. The levee could be constructed to protect significant areas in Bundaberg East, South and Central against a major flood (2013 or greater).

Disclaimer:

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- East Levee (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA East Levee

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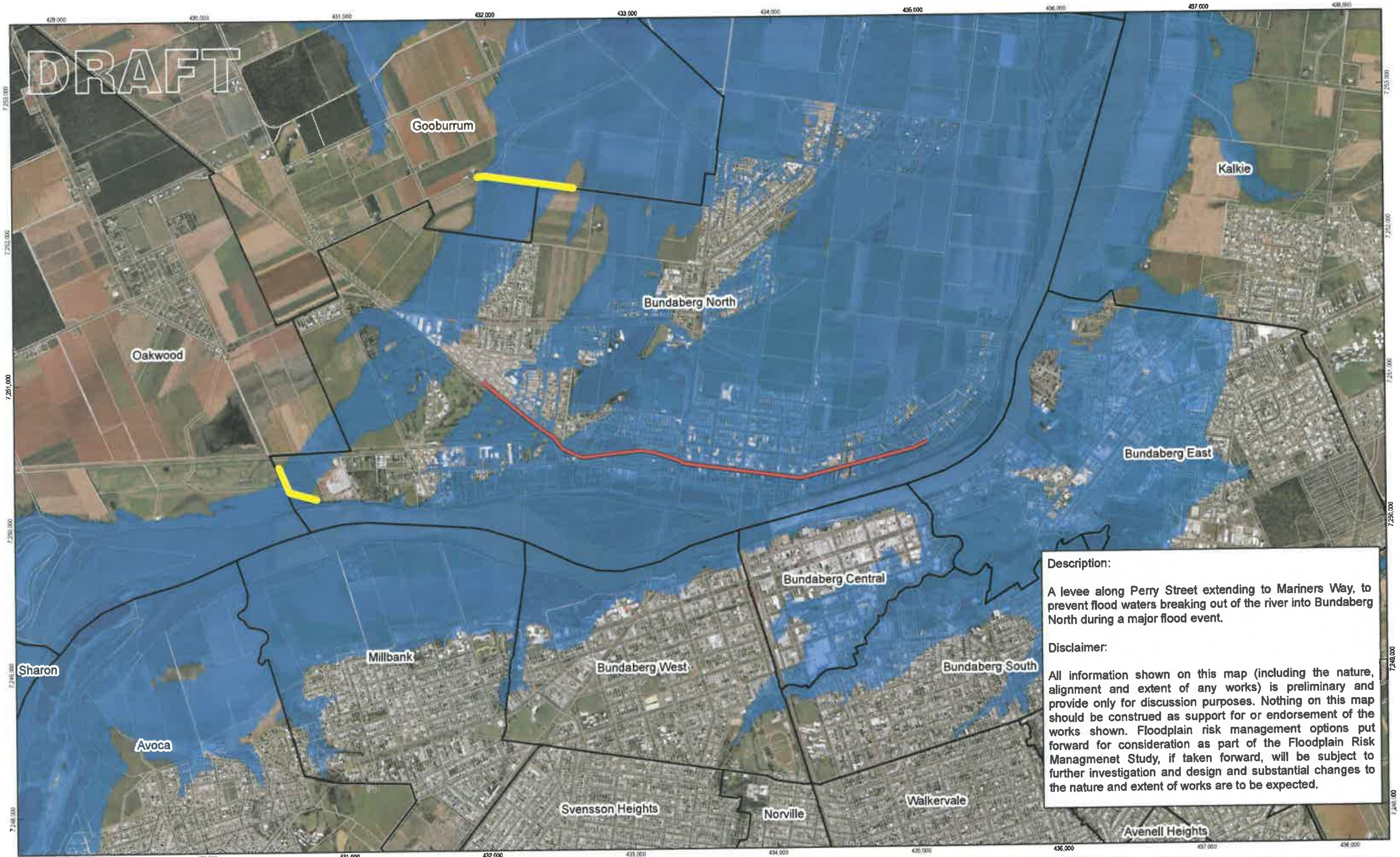

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Grid: GDA 1994 MGA Zone 56

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LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Perry St to Mariners Way Levee (Indicative Alignment)
- 2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Perry Street to Mariners Way Levee

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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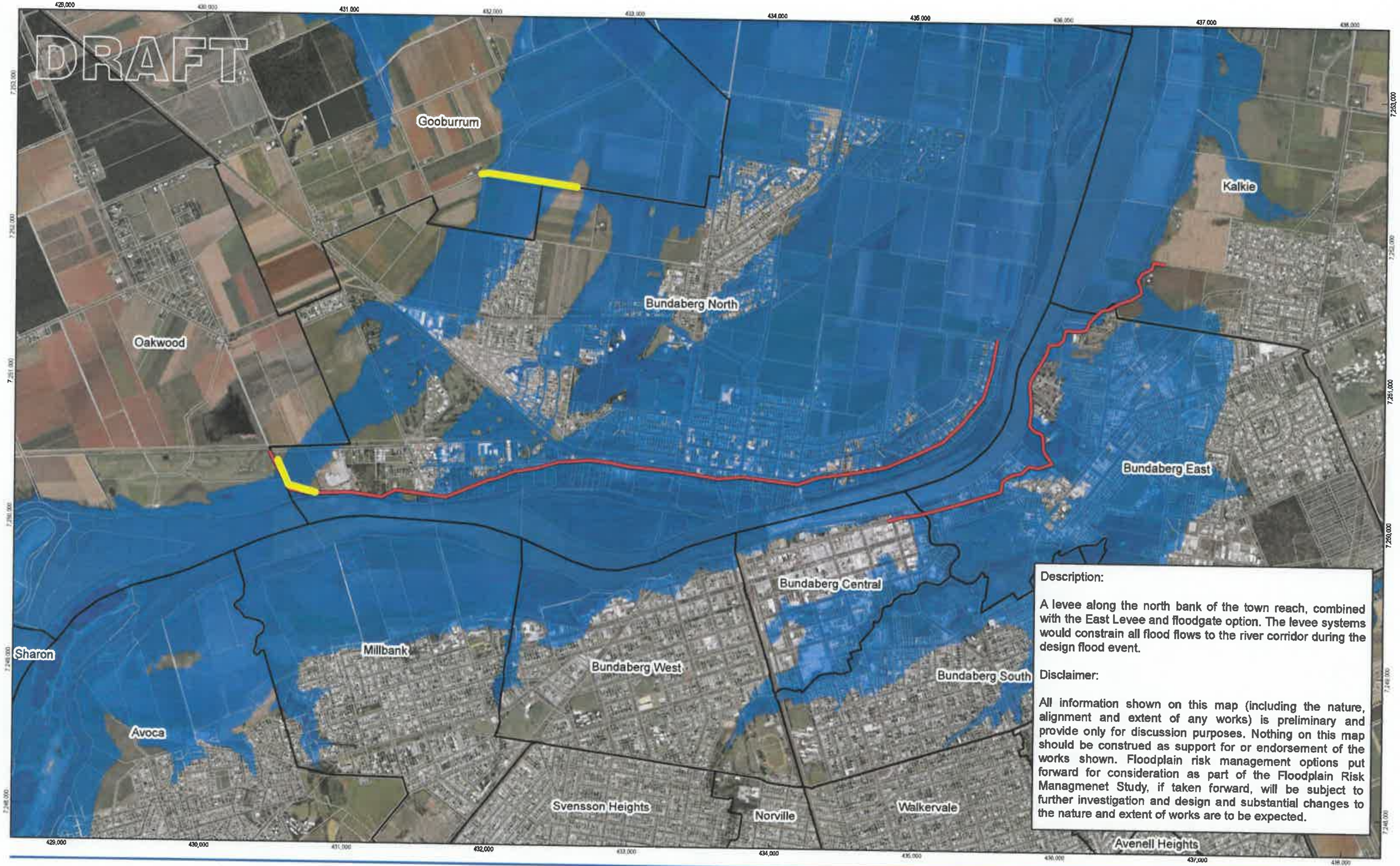

Description:

A levee along the north bank of the town reach, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor during the design flood event.

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LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- North Bank and East Levees (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
North Bank and East Levees

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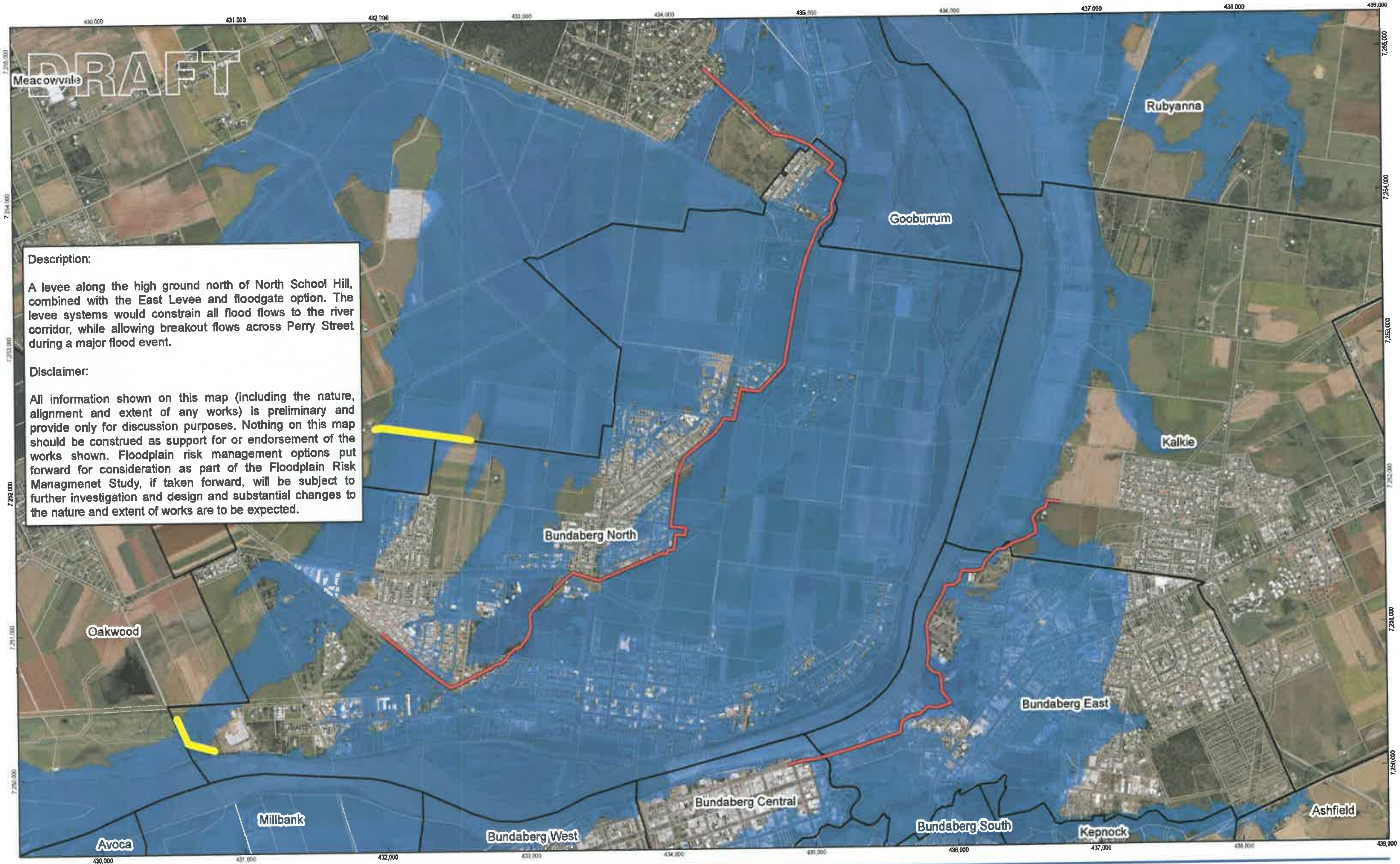


Description:

A levee along the high ground north of North School Hill, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor, while allowing breakout flows across Perry Street during a major flood event.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Technology Park and Batchlers Rd Levees (Seperate Project)

North and East Levees (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

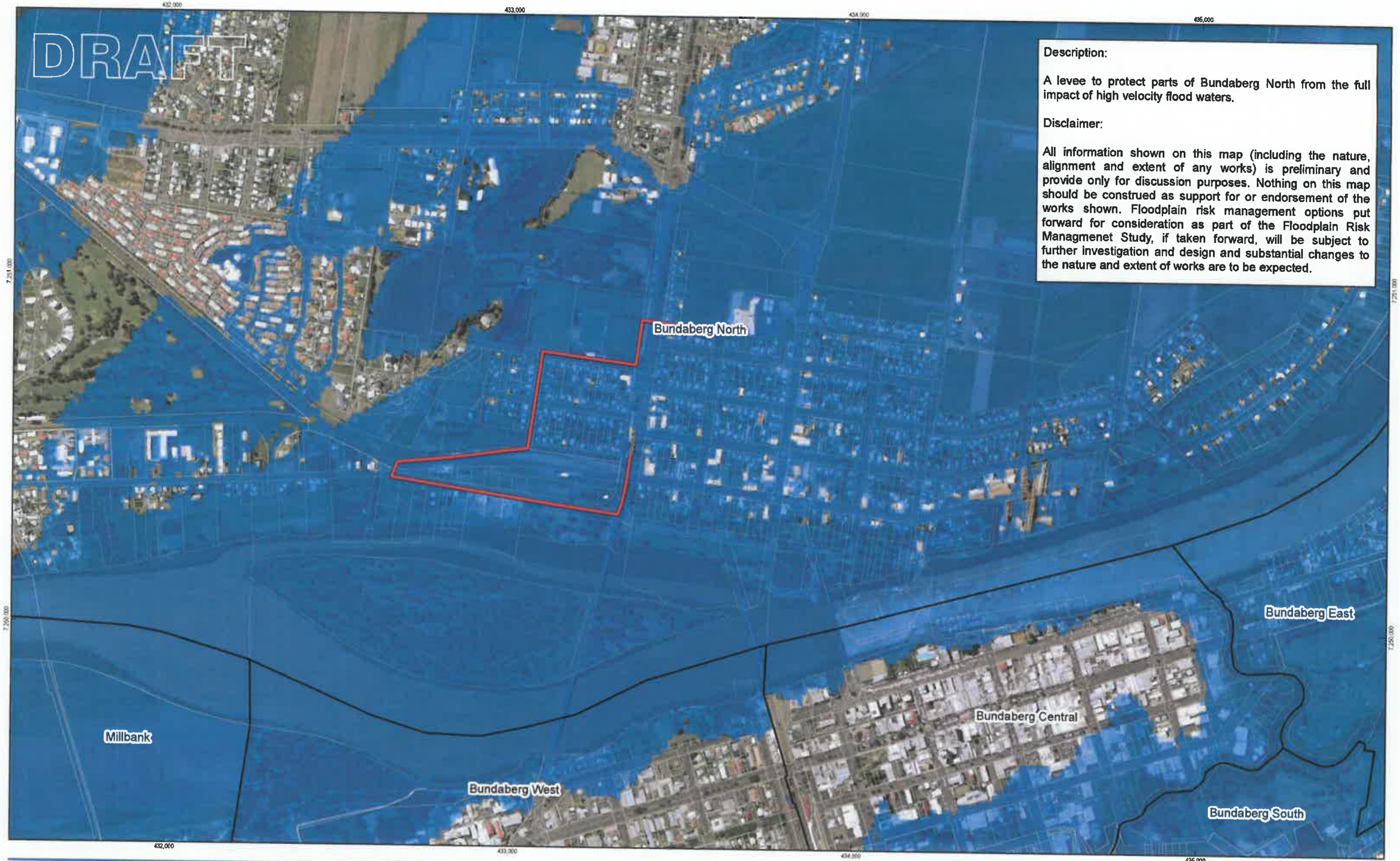
Job Number	41-26909
Revision	A
Date	28 Oct 2013

Preliminary Mitigation Options for MCA North and East Levees

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_005_MCA_NorthEastLevees.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

West Hinkler Avenue Levee (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

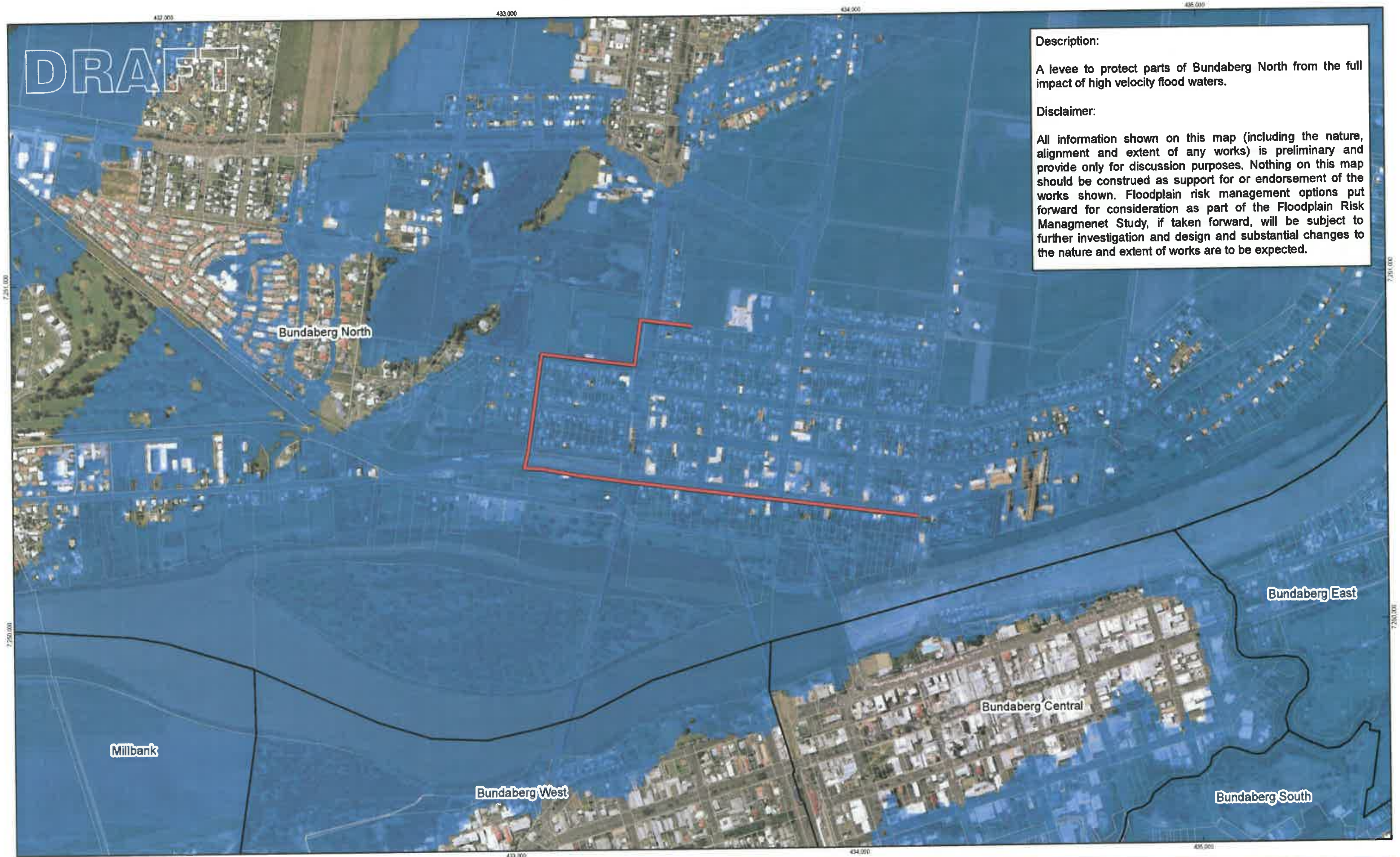
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
West Hinkler Avenue Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_006_MCA_WestHinklerAveLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Perry and Wilmot Street Levee (Indicative Alignment)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

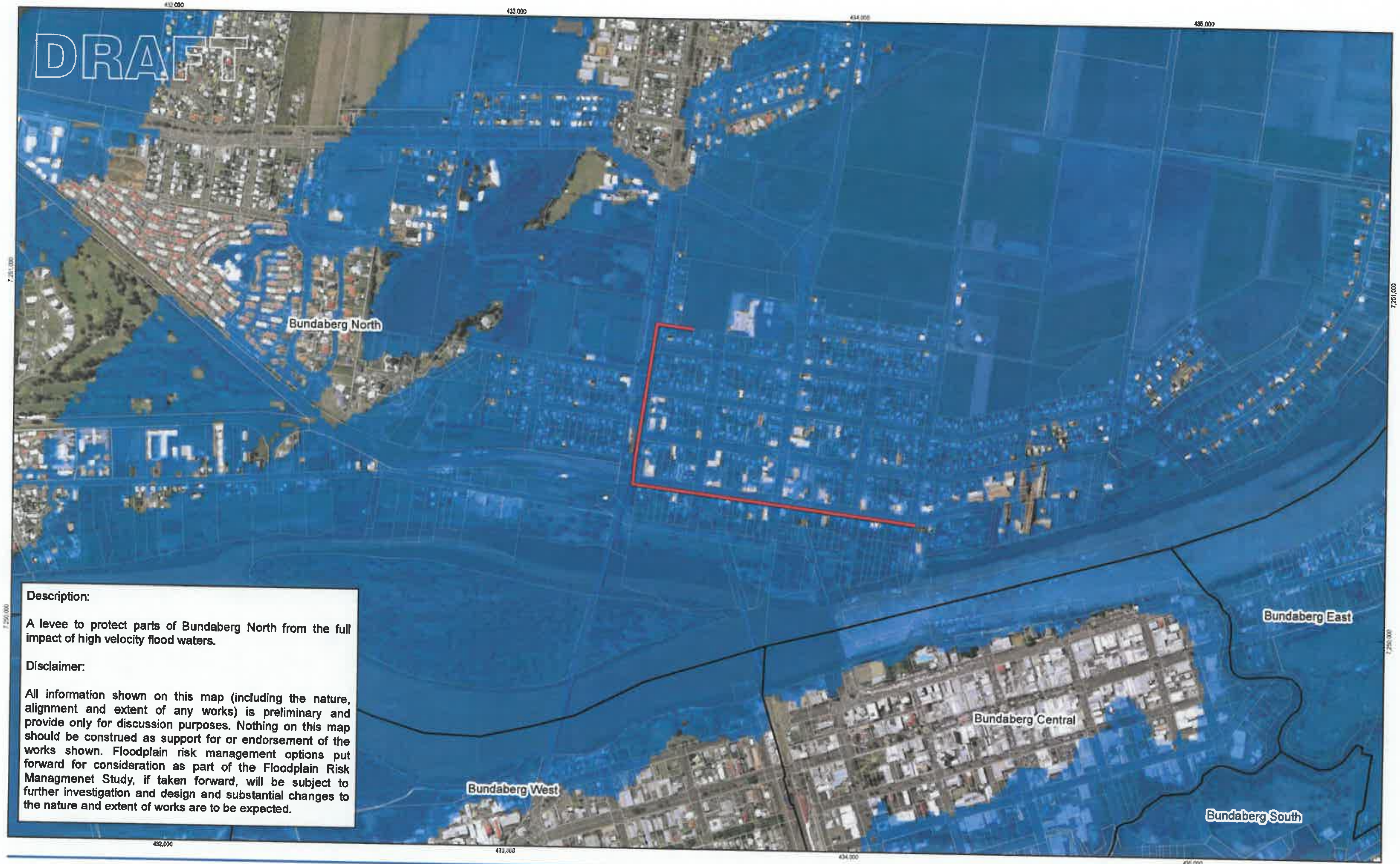
GHD BUNDABERG REGIONAL COUNCIL

Preliminary Mitigation Options for MCA
Perry and Wilmot Street Levee

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_007_MCA_PerryWilmotStLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Perry Street and Hinkler Avenue Levee (Indicative Alignment)
- 2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

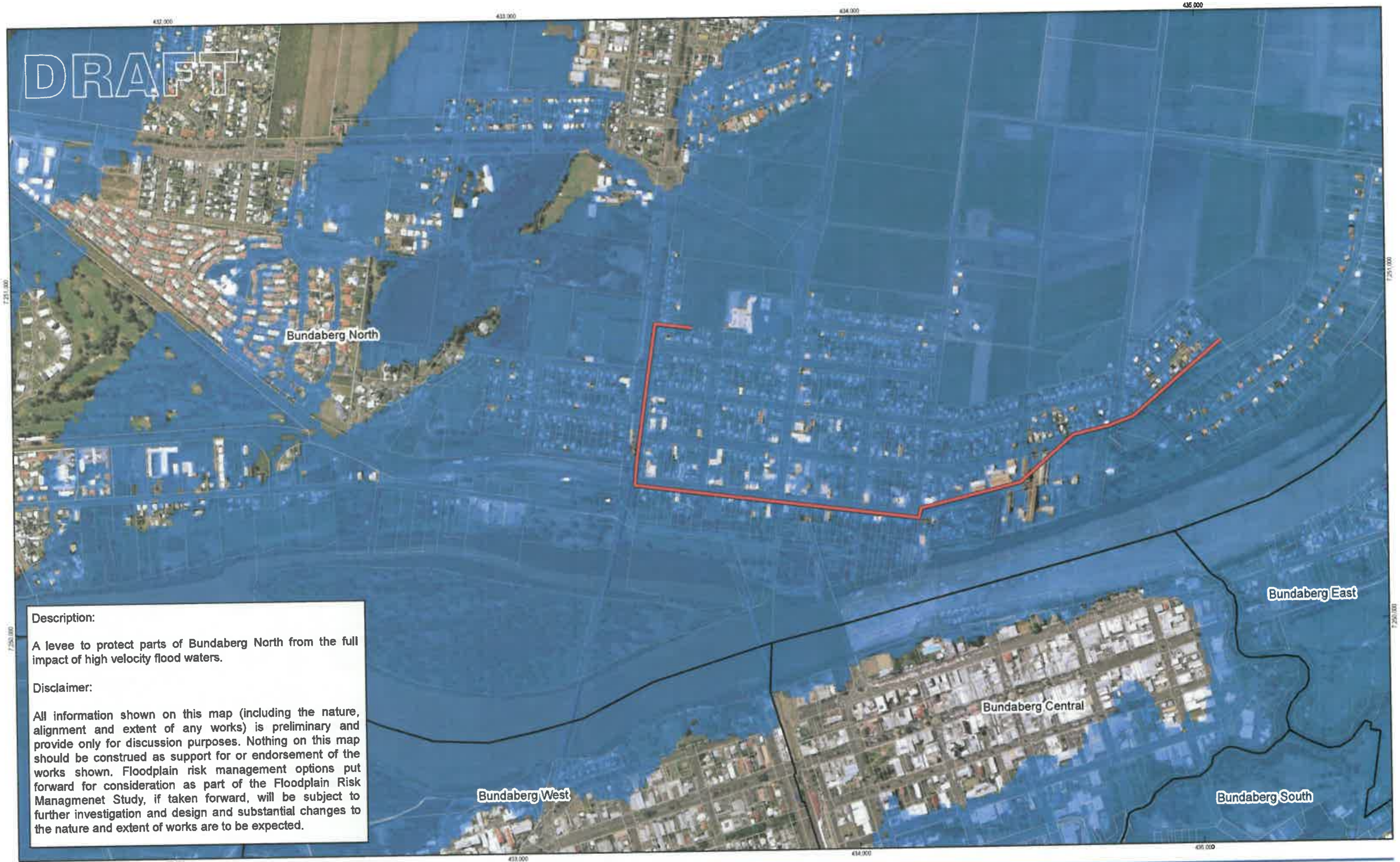
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Perry Street and Hinkler Avenue Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_008_MCA_PerryStHinklerAveLevee.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

A levee to protect parts of Bundaberg North from the full impact of high velocity flood waters.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Hinkler Avenue to Cameron Street Levee (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

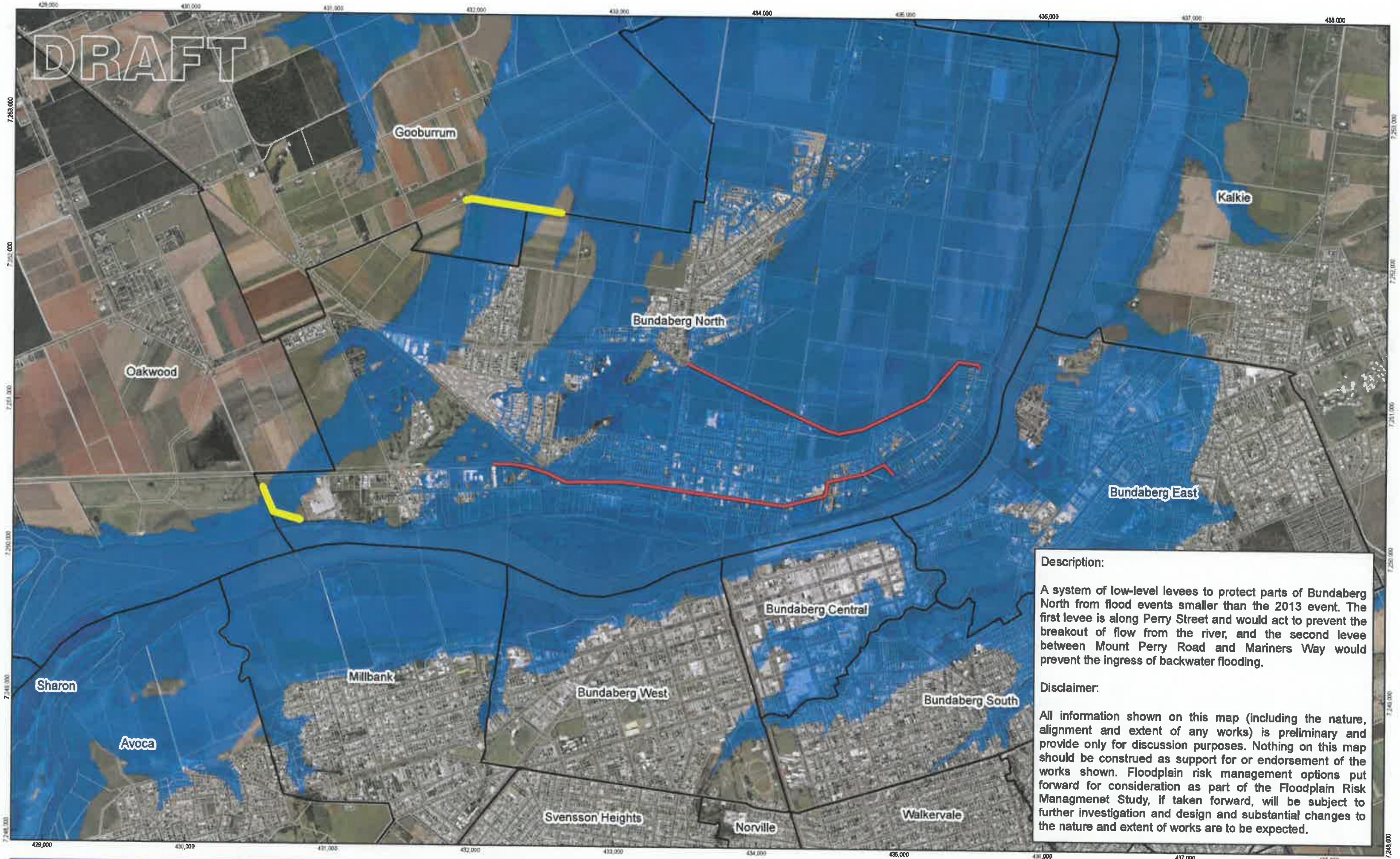
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Hinkler Avenue to Cameron Street Levee

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_009_MCA_HinkerAveCameronStLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

A system of low-level levees to protect parts of Bundaberg North from flood events smaller than the 2013 event. The first levee is along Perry Street and would act to prevent the breakout of flow from the river, and the second levee between Mount Perry Road and Mariners Way would prevent the ingress of backwater flooding.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Low Level North Bundaberg Levees (Indicative Alignment)
- 2013 Flood Extent

GHD

BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Low Level North Bundaberg Levees

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_010_MCA_LowLevelNorthLevees.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

Description:

A levee or sea wall along the river bank in the urban area at the Port of Bundaberg.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Port of Bundaberg Levee (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

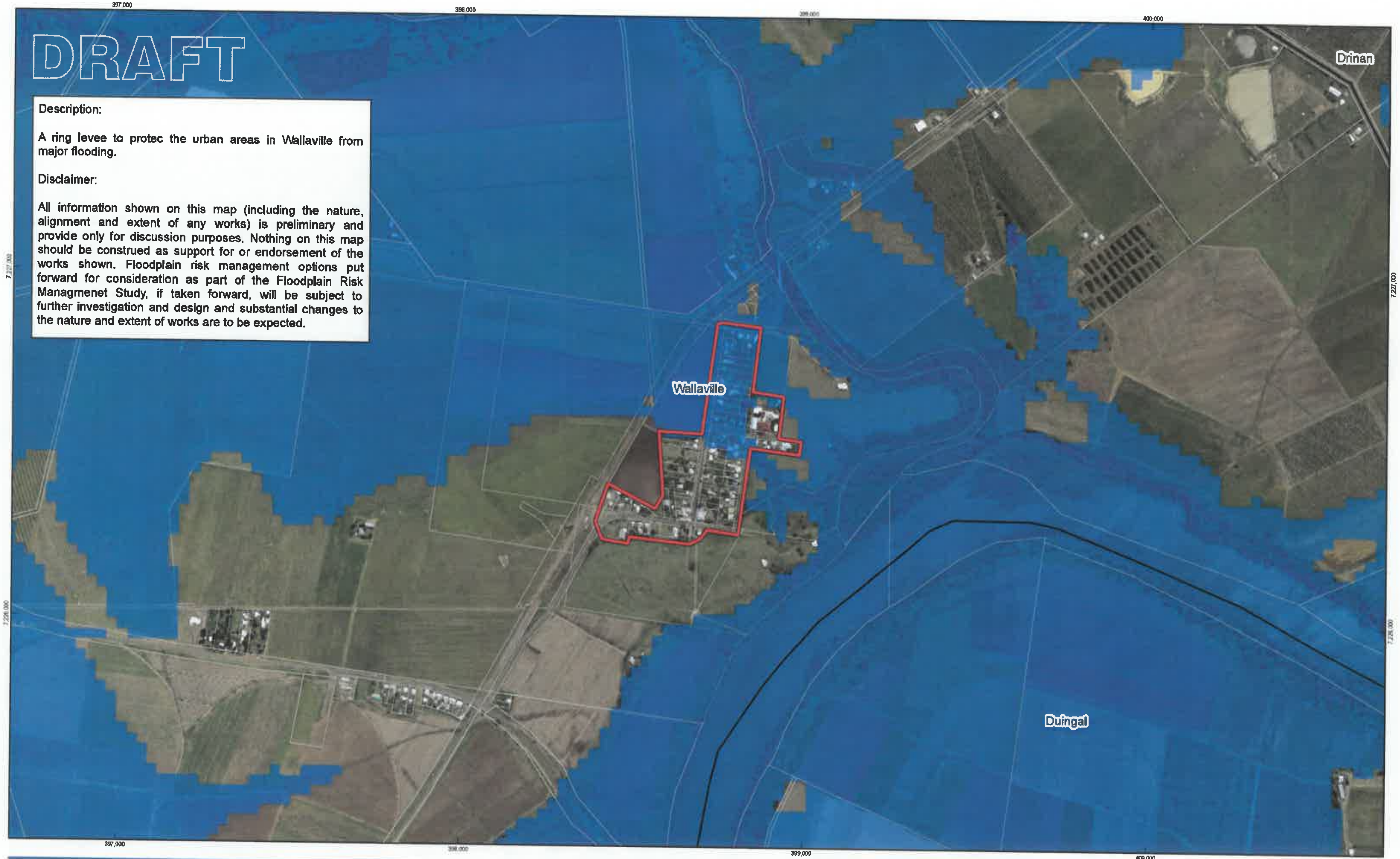
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Port of Bundaberg Levee

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_011_MCA_PortLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Wallaville Levee (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

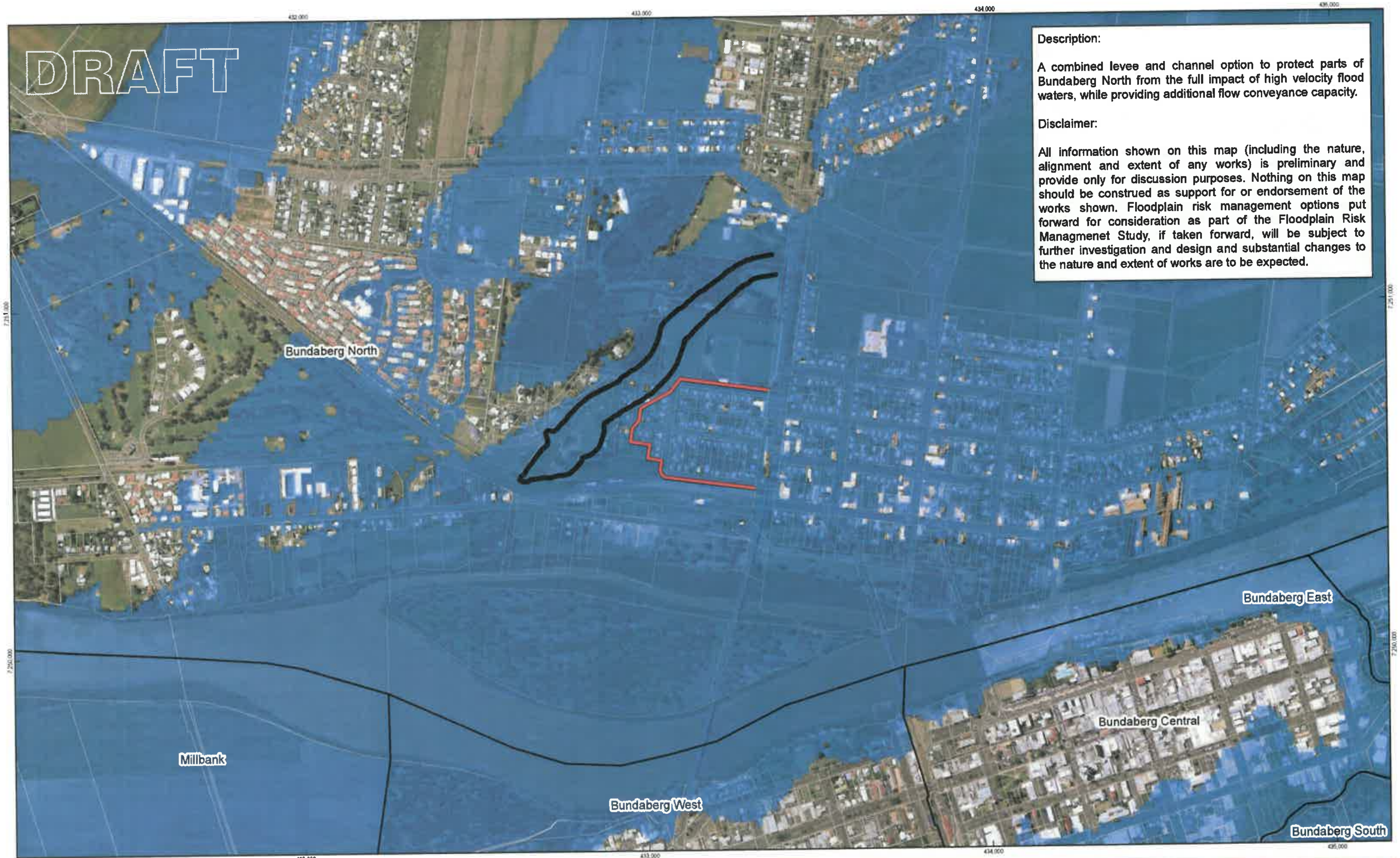
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Wallaville Levee

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_012_MCA_WallavilleLevee.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

West Hinkler Avenue Levee (Indicative Alignment)

Gardens Channel 1 Extents (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

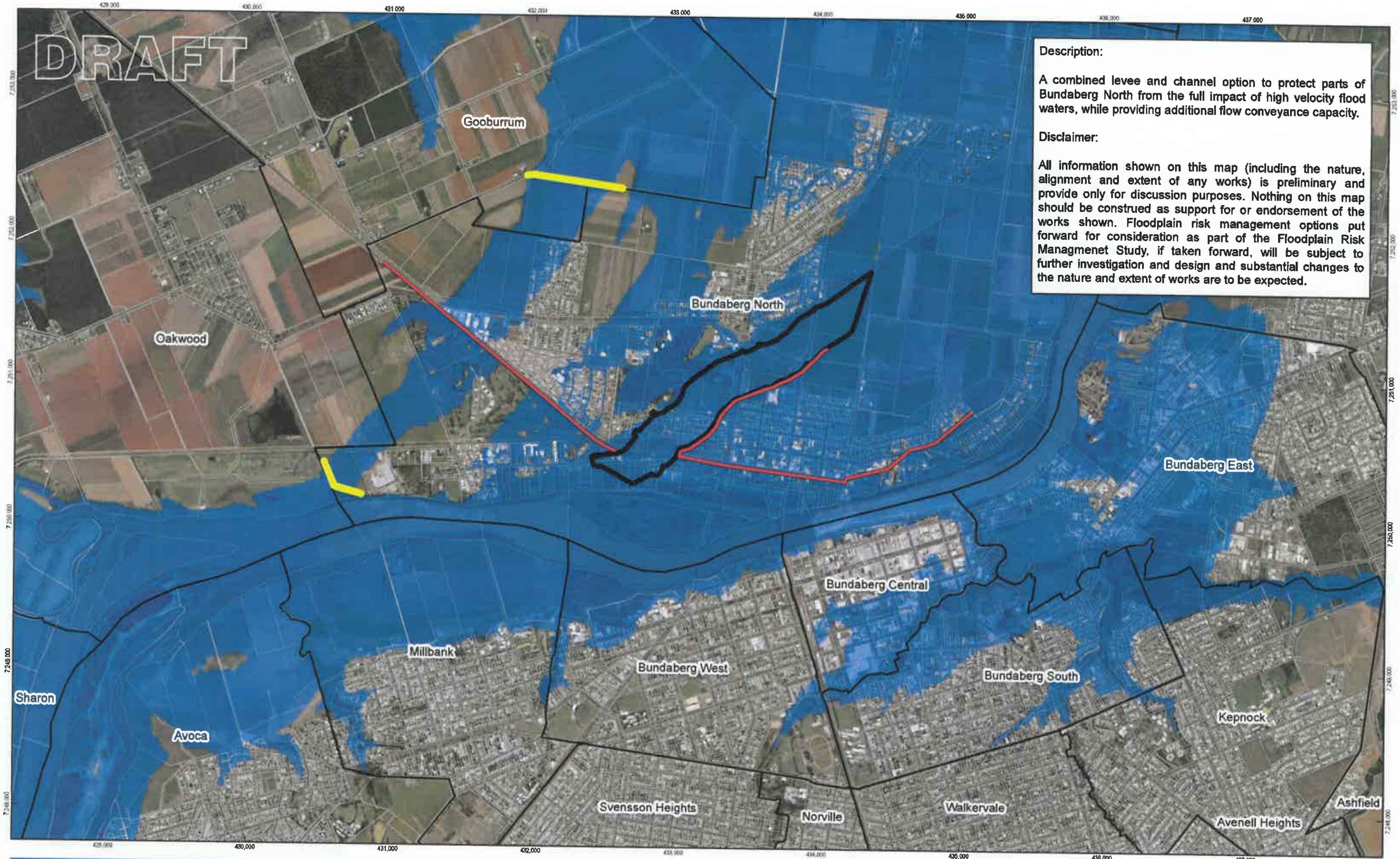
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
West Hinkler Avenue Levee & Gardens Channel 1

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_013_MCA_WestHinklerAveLeveeChnl.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Rail & Perry St to Cameron St Levees (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

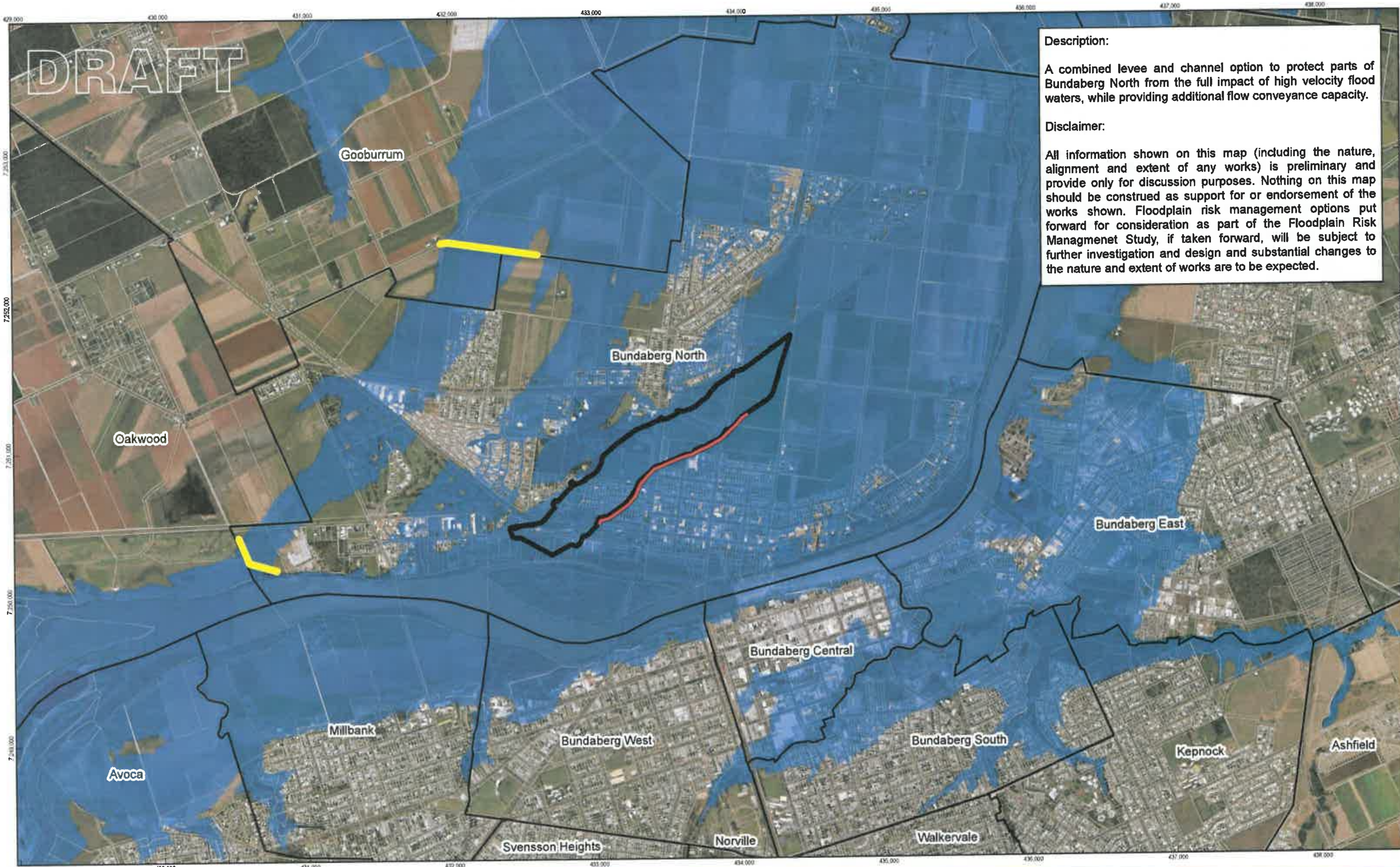
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Rail, Perry St to Cameron St Levees & Channel

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_014_MCA_RailPerryStCameronStLeveeChnl2.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A combined levee and channel option to protect parts of Bundaberg North from the full impact of high velocity flood waters, while providing additional flow conveyance capacity.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Adjacent Levee (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)

GHD BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Gardens Channel 2 with Adjacent Levee

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_015_MCA_Chnl2AdjacentLevee.mxd

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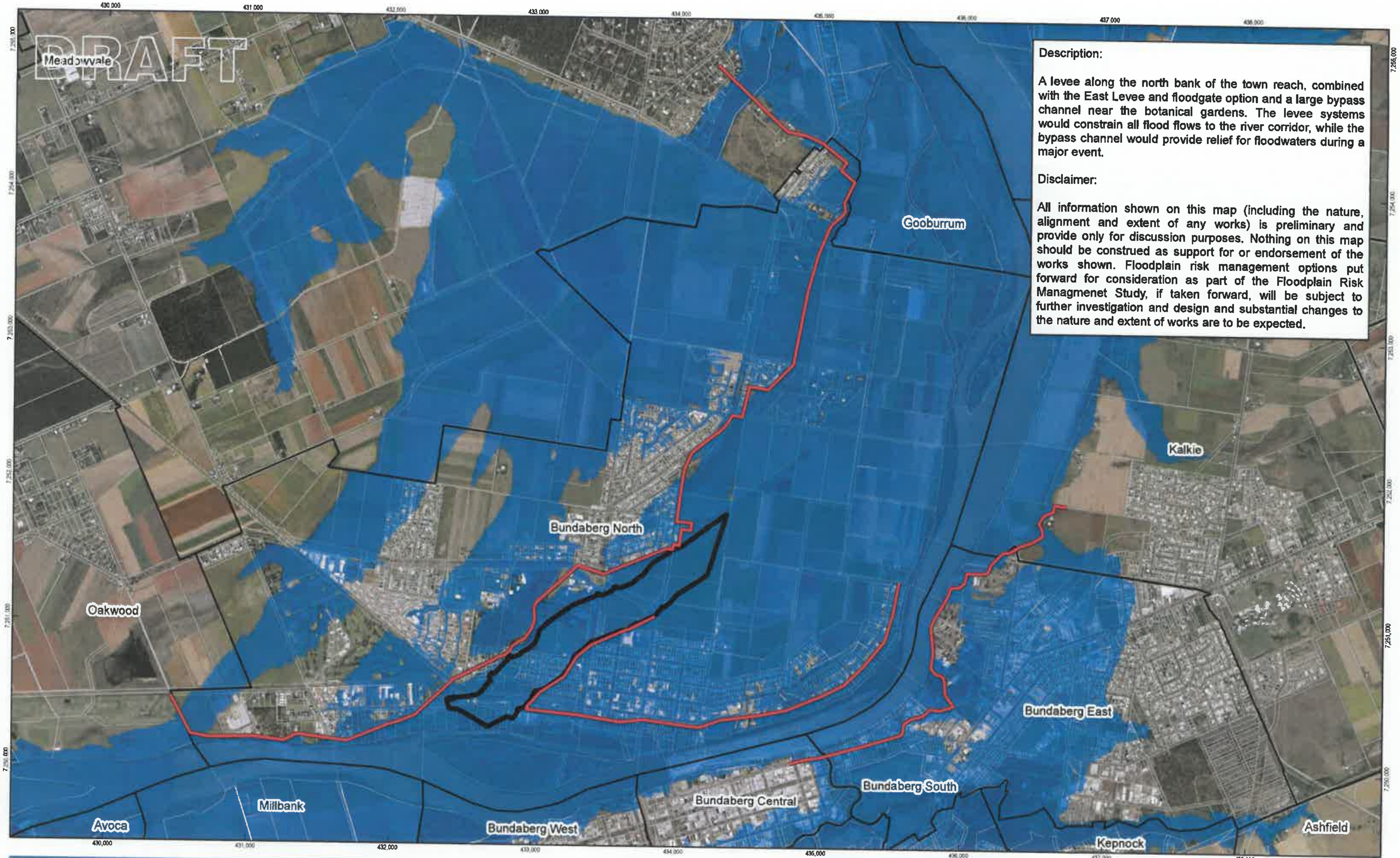

Description:

A levee along the north bank of the town reach, combined with the East Levee and floodgate option and a large bypass channel near the botanical gardens. The levee systems would constrain all flood flows to the river corridor, while the bypass channel would provide relief for floodwaters during a major event.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- North Bank and East Levees (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)
- 2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
North Bank & East Levees with Gardens Channel 2

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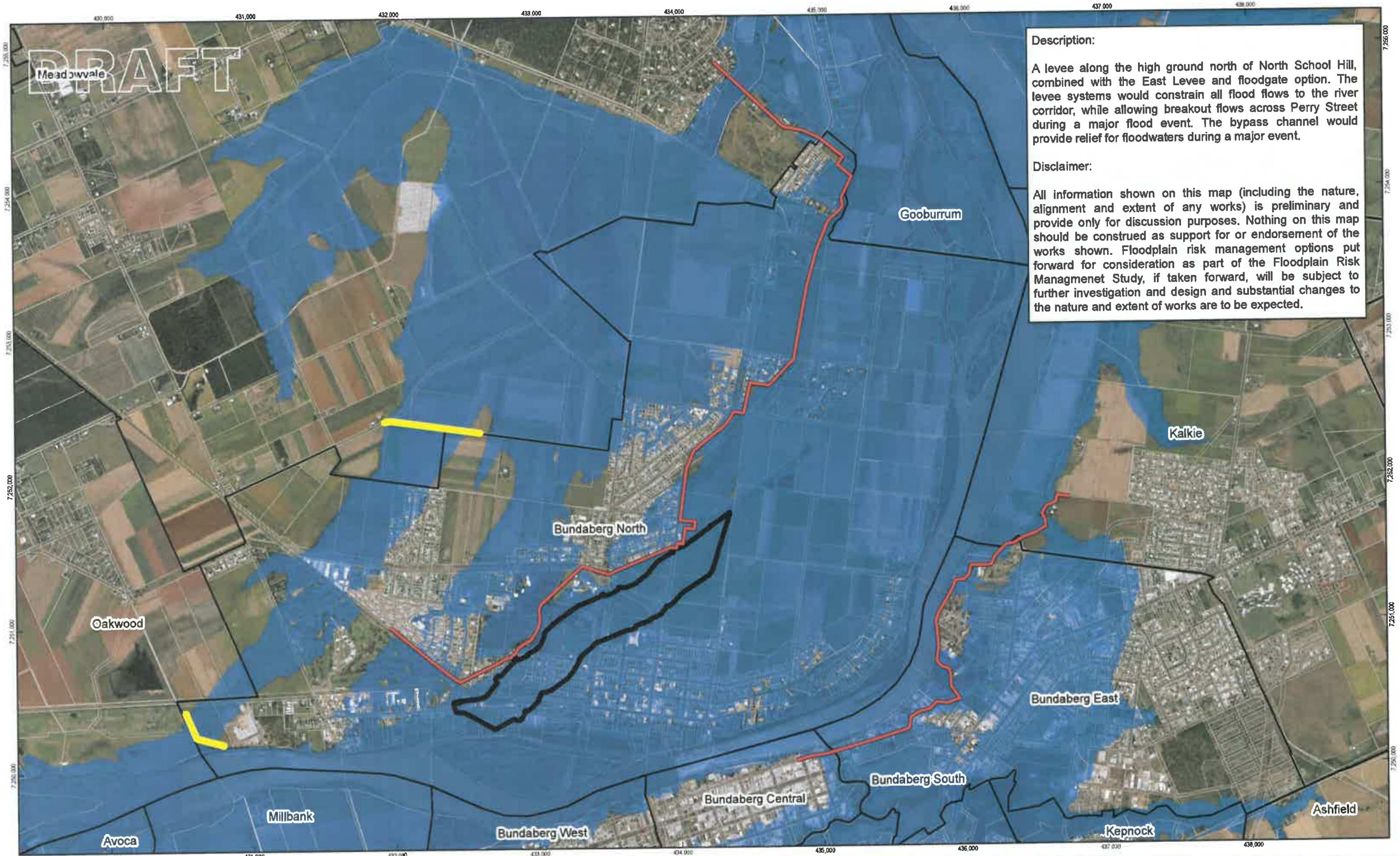
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A levee along the high ground north of North School Hill, combined with the East Levee and floodgate option. The levee systems would constrain all flood flows to the river corridor, while allowing breakout flows across Perry Street during a major flood event. The bypass channel would provide relief for floodwaters during a major event.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- North and East Levees (Indicative Alignment)
- Gardens Channel 2 Extents (Indicative Alignment)

GHD

BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
North & East Levees with Gardens Channel 2

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_017_MCA_NorthEastLeveesChnl2.mxd

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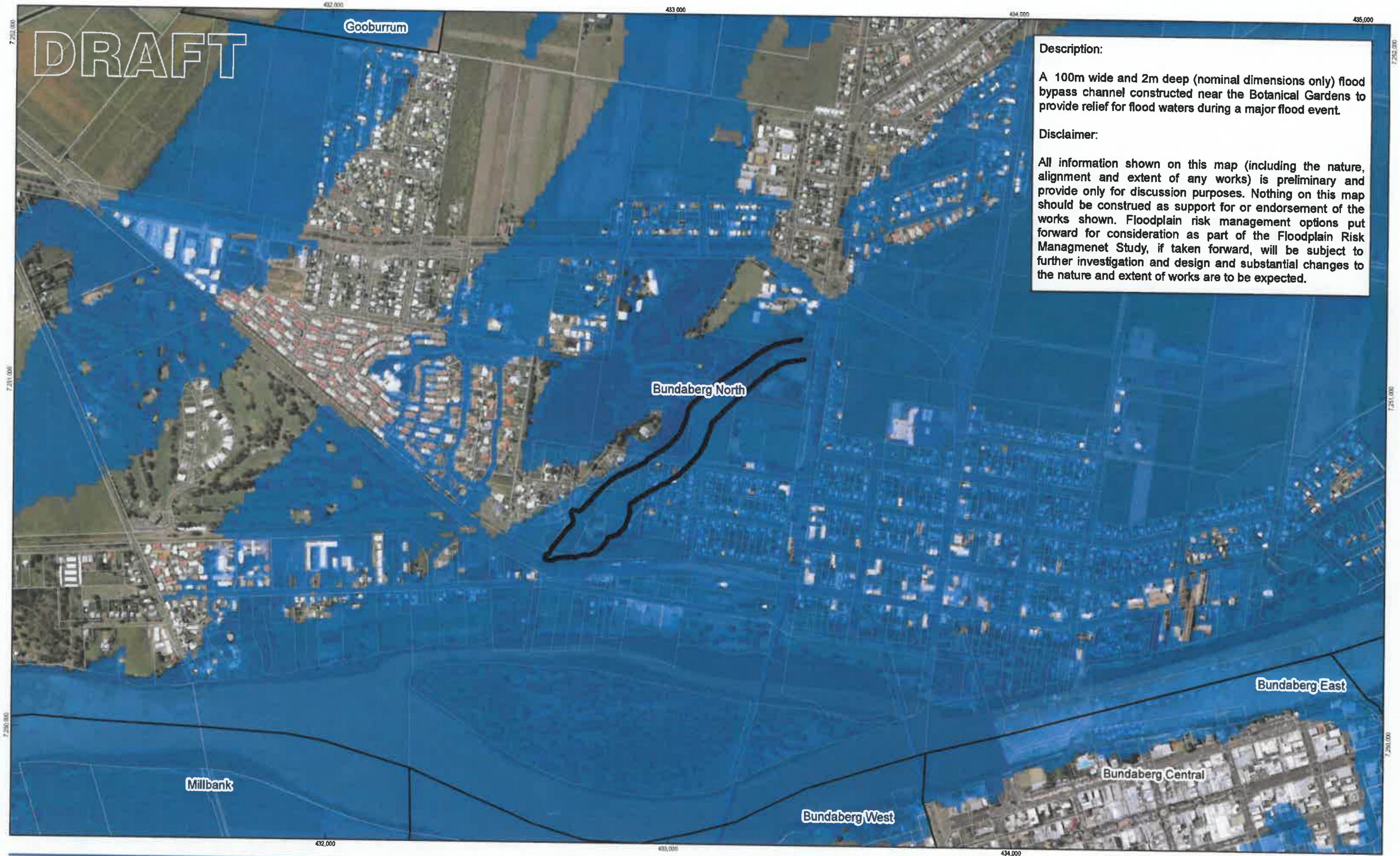

Description:

A 100m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:10,000 @A3

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Gardens Channel 1 Extents (Indicative Alignment)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Gardens Channel 1

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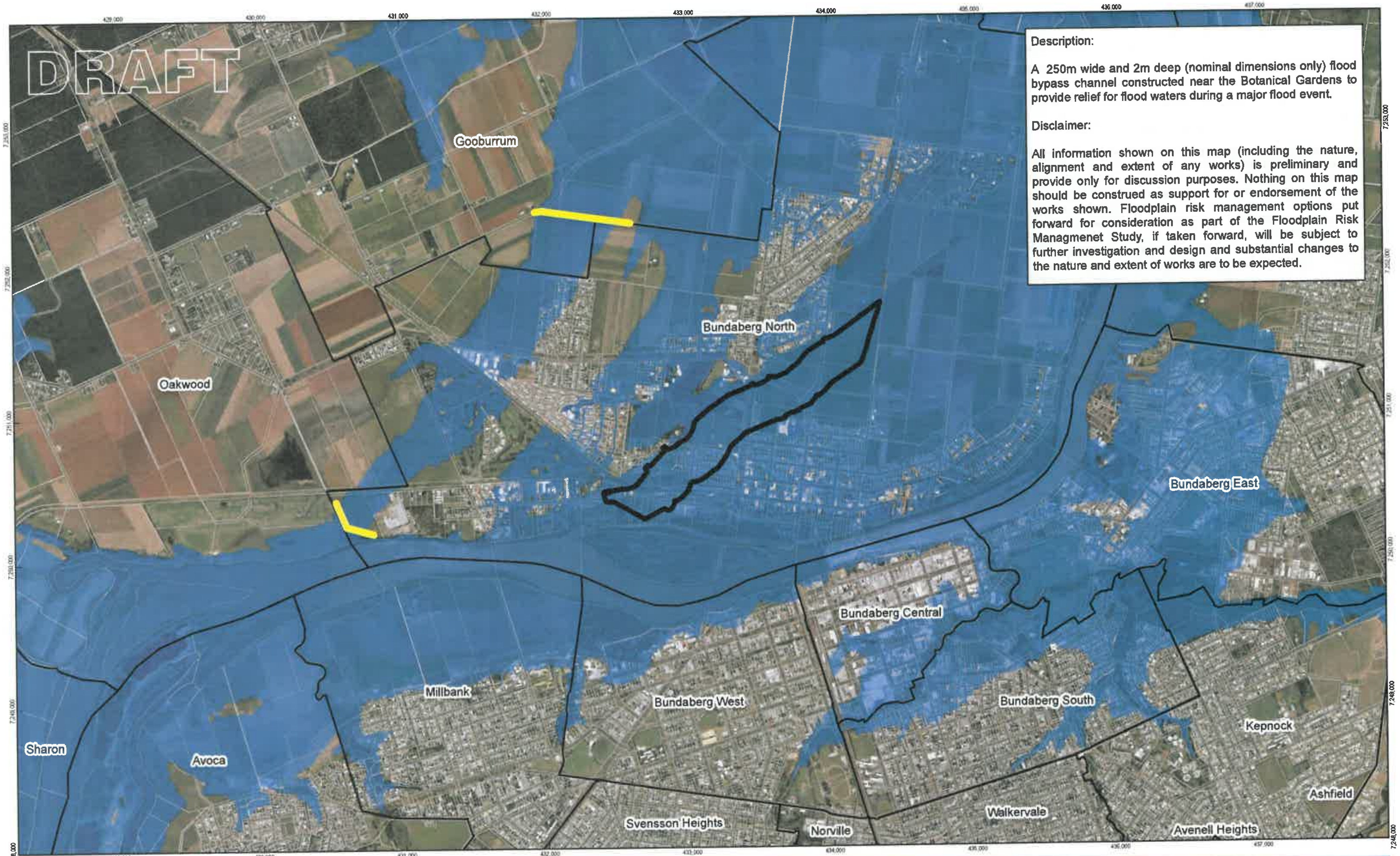
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A 250m wide and 2m deep (nominal dimensions only) flood bypass channel constructed near the Botanical Gardens to provide relief for flood waters during a major flood event.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- 2013 Flood Extent
- Technology Park and Batchlers Rd Levees (Seperate Project)
- Gardens Channel 2 Extents (Indicative Alignment)

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

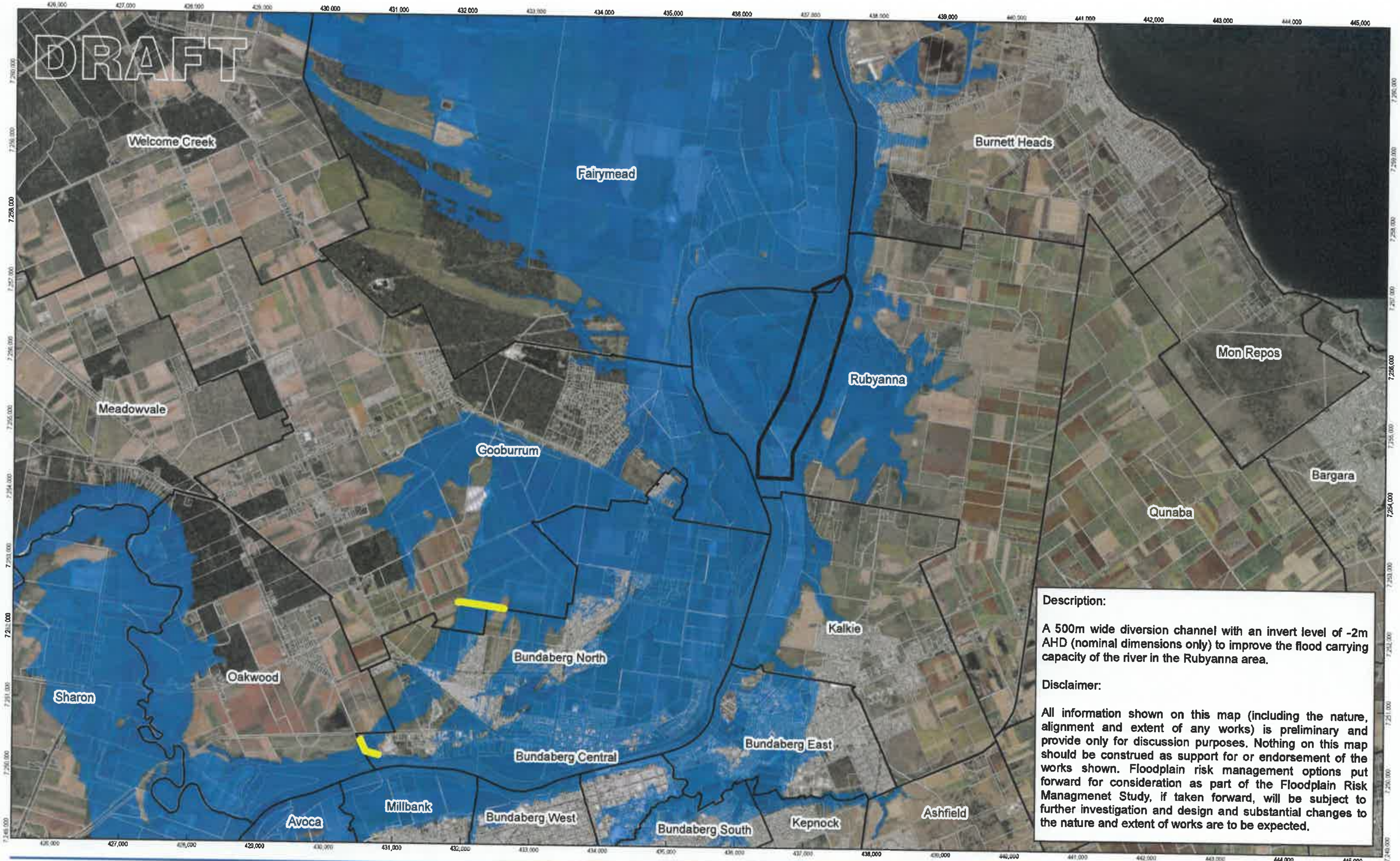
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Gardens Channel 2

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_019_MCA_GardensChnl2.mxd

Data source. Data Custodian, Data Set Name/Title, Version/Date.



Description:

A 500m wide diversion channel with an invert level of -2m AHD (nominal dimensions only) to improve the flood carrying capacity of the river in the Rubyanna area.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Rubyanna Bypass Channel (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

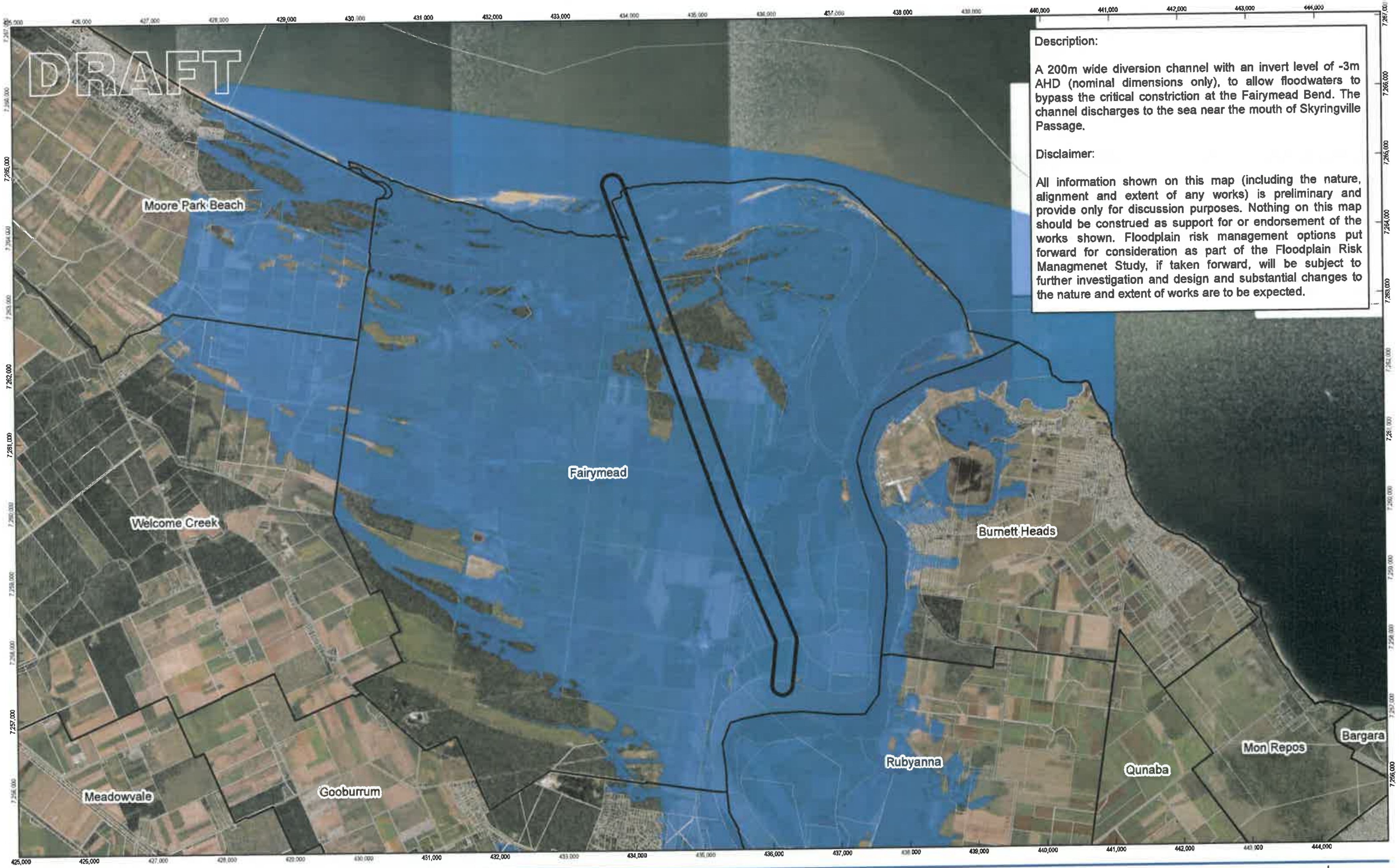
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Rubyanna Bypass Channel

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_020_MCA_RubyannaChnl.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel discharges to the sea near the mouth of Skyringville Passage.

Disclaimer:

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1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Fairymead Diversion Channel 1l (Indicative Alignment)
- 2013 Flood Extent

GHD

BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
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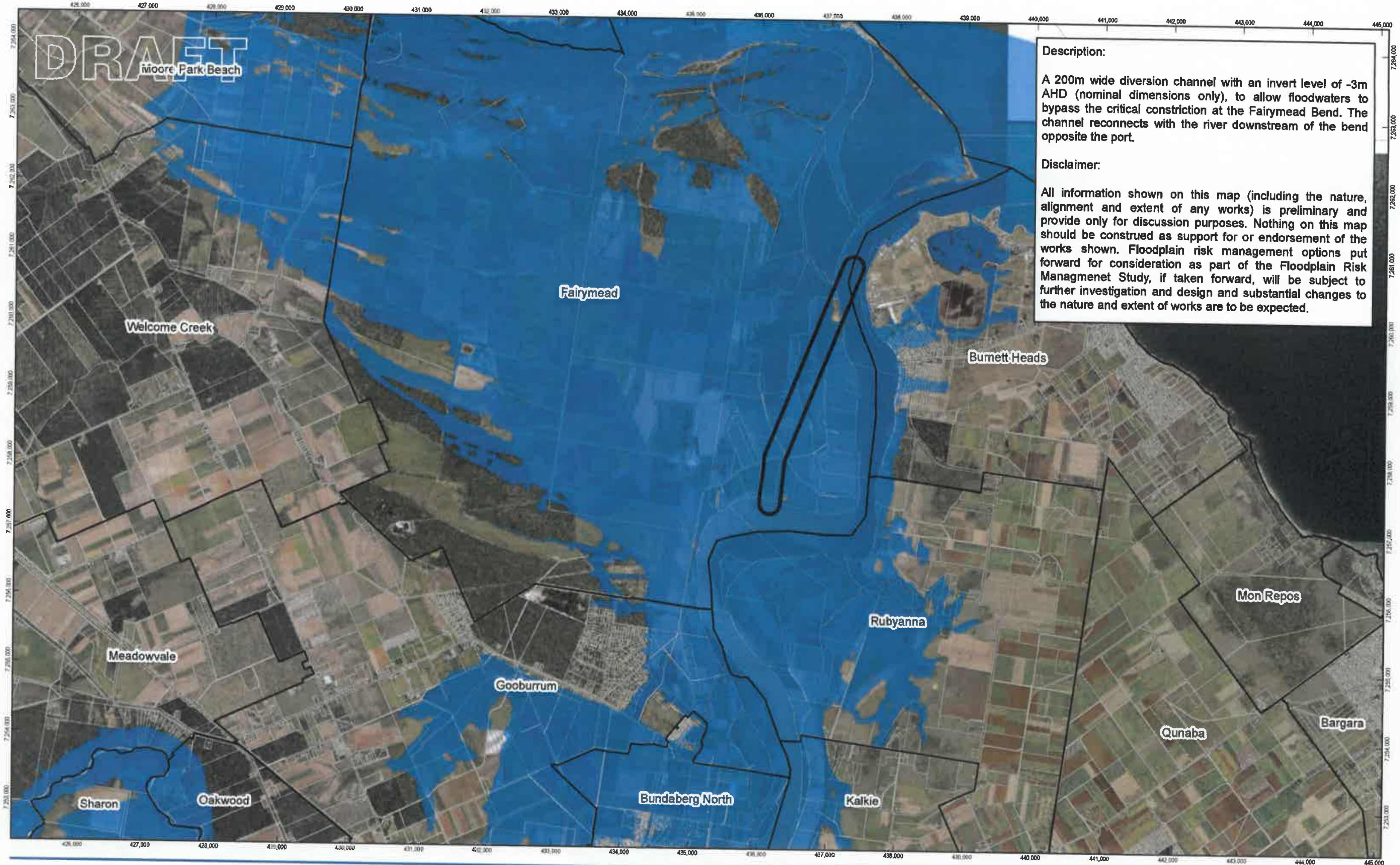
Preliminary Mitigation Options for MCA
Fairymead Diversion Channel 1

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_021_MCA_FairymeadChnl1.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

A 200m wide diversion channel with an invert level of -3m AHD (nominal dimensions only), to allow floodwaters to bypass the critical constriction at the Fairymead Bend. The channel reconnects with the river downstream of the bend opposite the port.

Disclaimer:

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1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Fairymead Diversion Channel 2 (Indicative Alignment)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

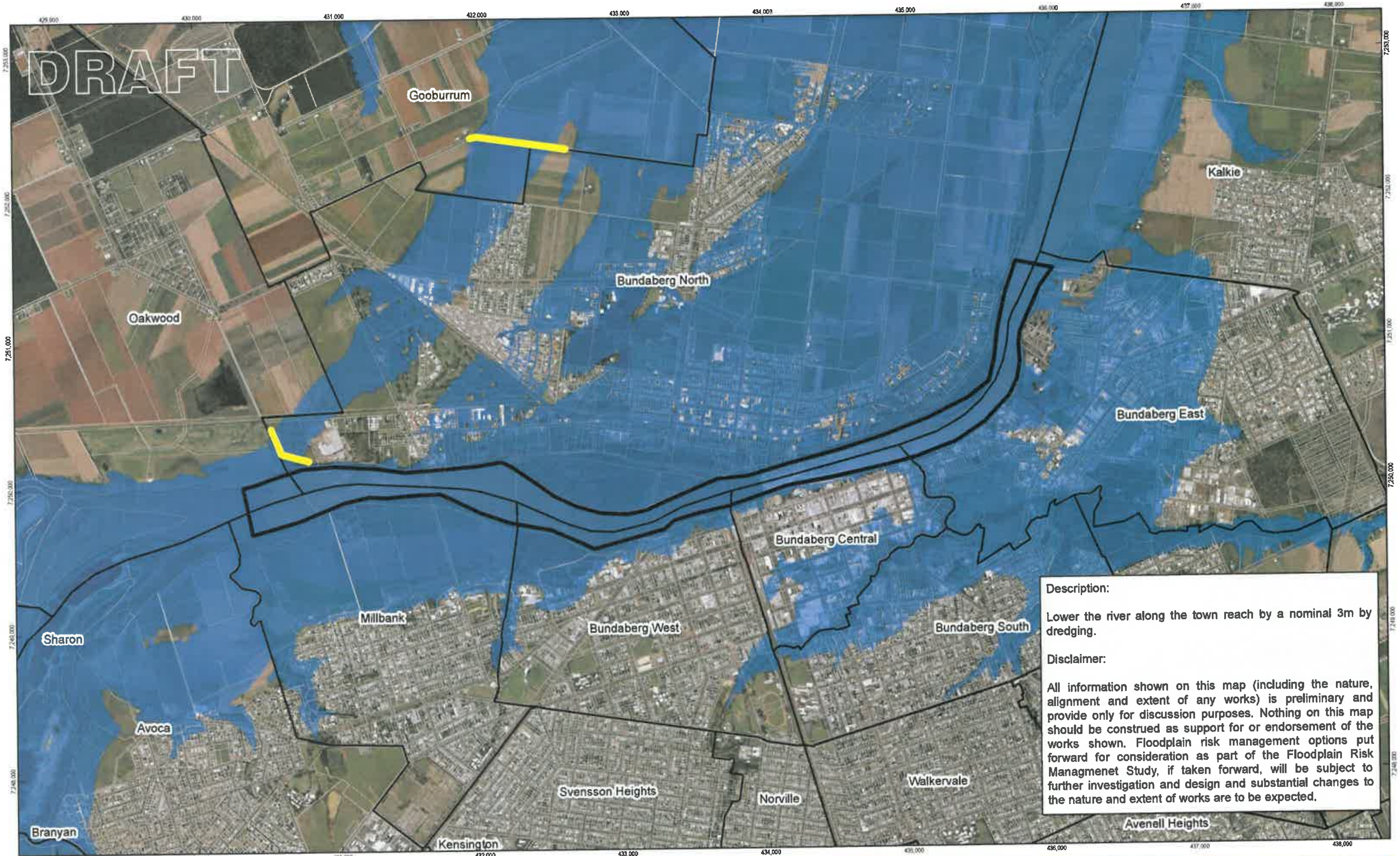
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Fairymead Diversion Channel 2

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_022_MCA_FairymeadChnl2.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Lower the river along the town reach by a nominal 3m by dredging.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Town Reach Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

GHD

BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
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Preliminary Mitigation Options for MCA
Town Reach Dredging

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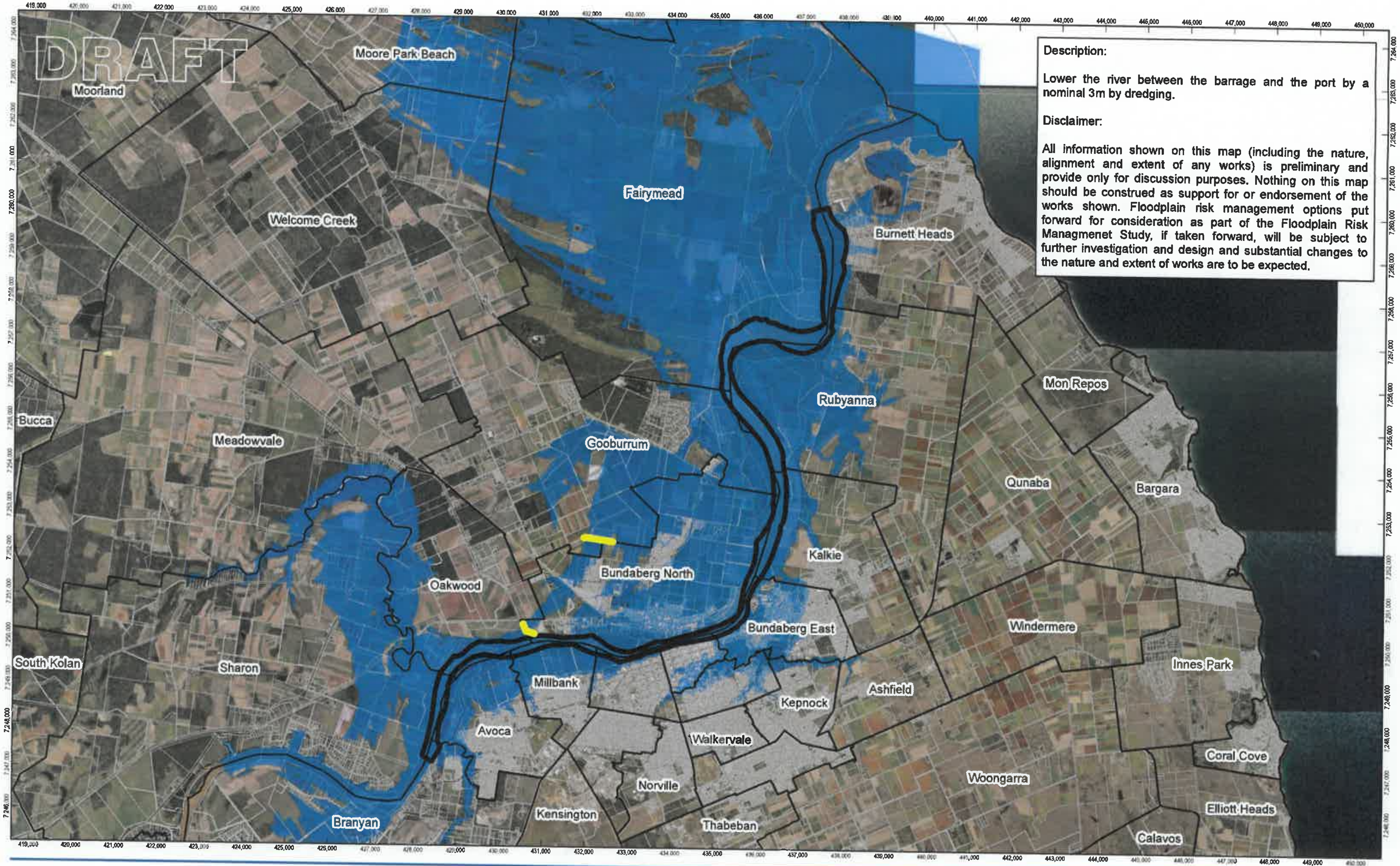
G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_023_MCA_TownReachDredge.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Lower the river between the barrage and the port by a nominal 3m by dredging.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:80,000 @A3

0 800 1,600 2,400 3,200 4,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Barrage to Port Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

GHD

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
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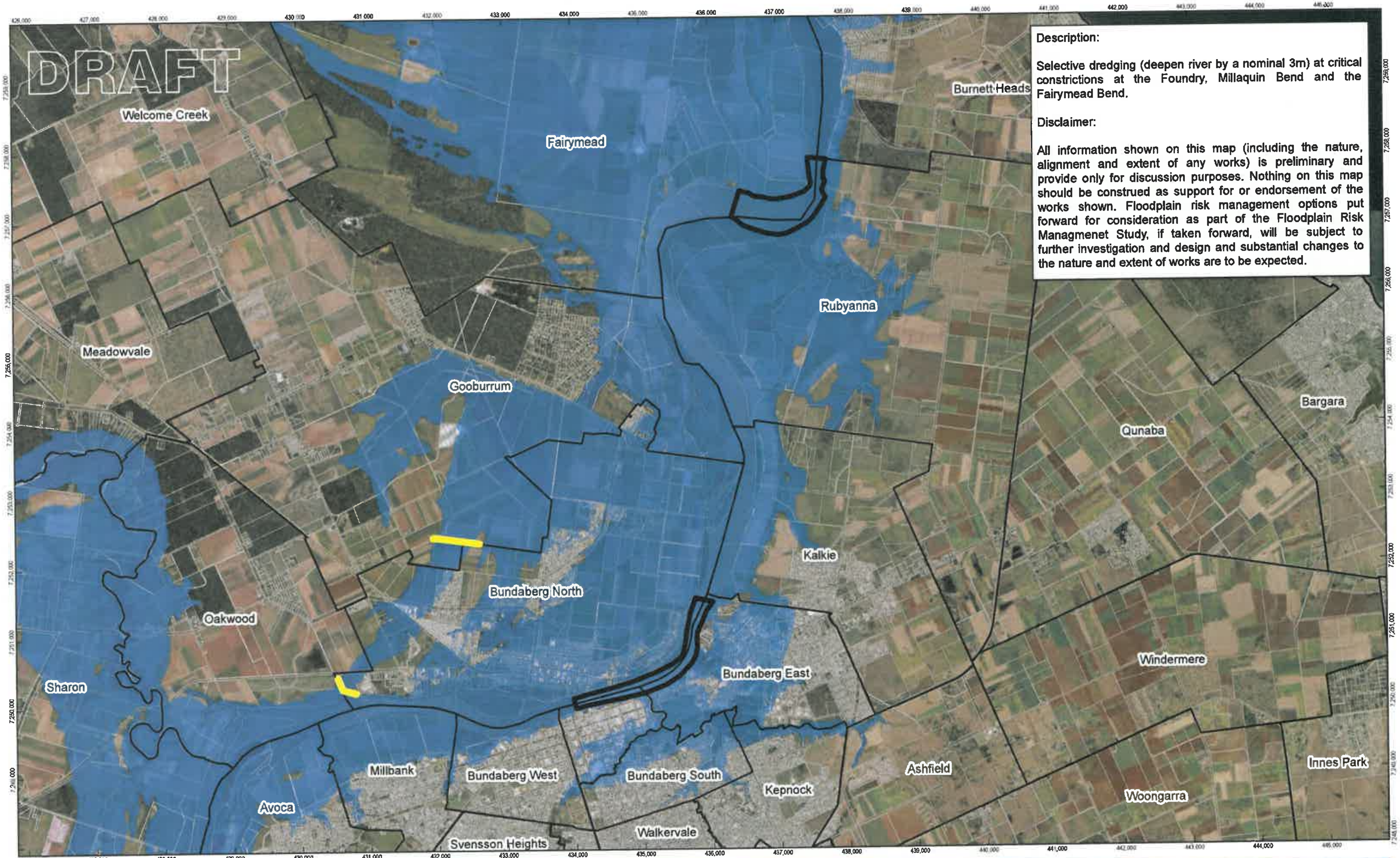
Preliminary Mitigation Options for MCA
Barrage to Port Dredging

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_024_MCA_BarragePortDredge.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Millaquin & Fairymead Bends Selective Dredging Extents (Indicative Alignment)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

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Preliminary Mitigation Options for MCA
Millaquin & Fairymead Bends Selective Dredging

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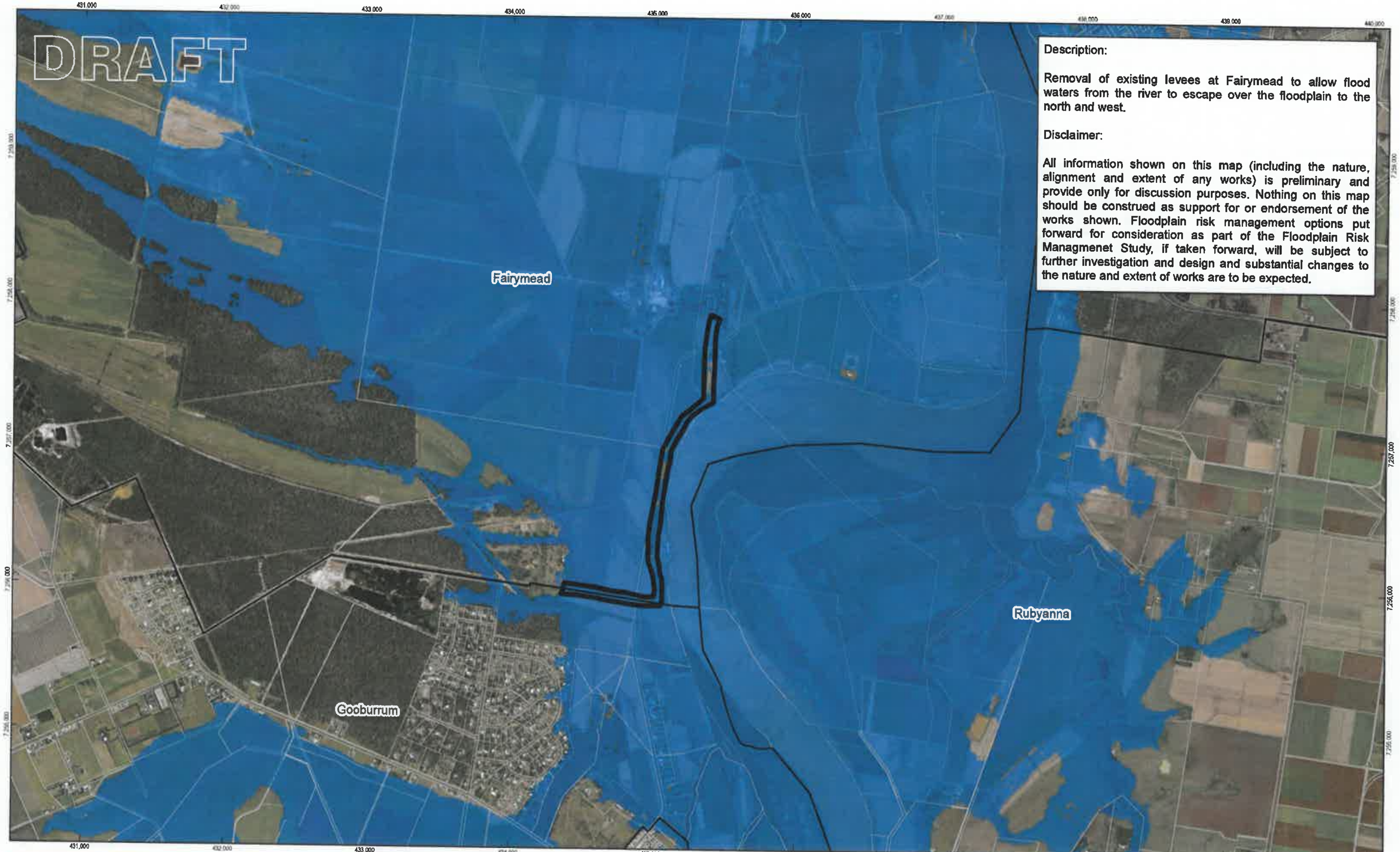
G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_025_MCA_FoundryMillFairymeadDredge.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Removal of existing levees at Fairymead to allow flood waters from the river to escape over the floodplain to the north and west.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Fairymead Levees (Indicative Alignment)

2013 Flood Extent

GHD

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

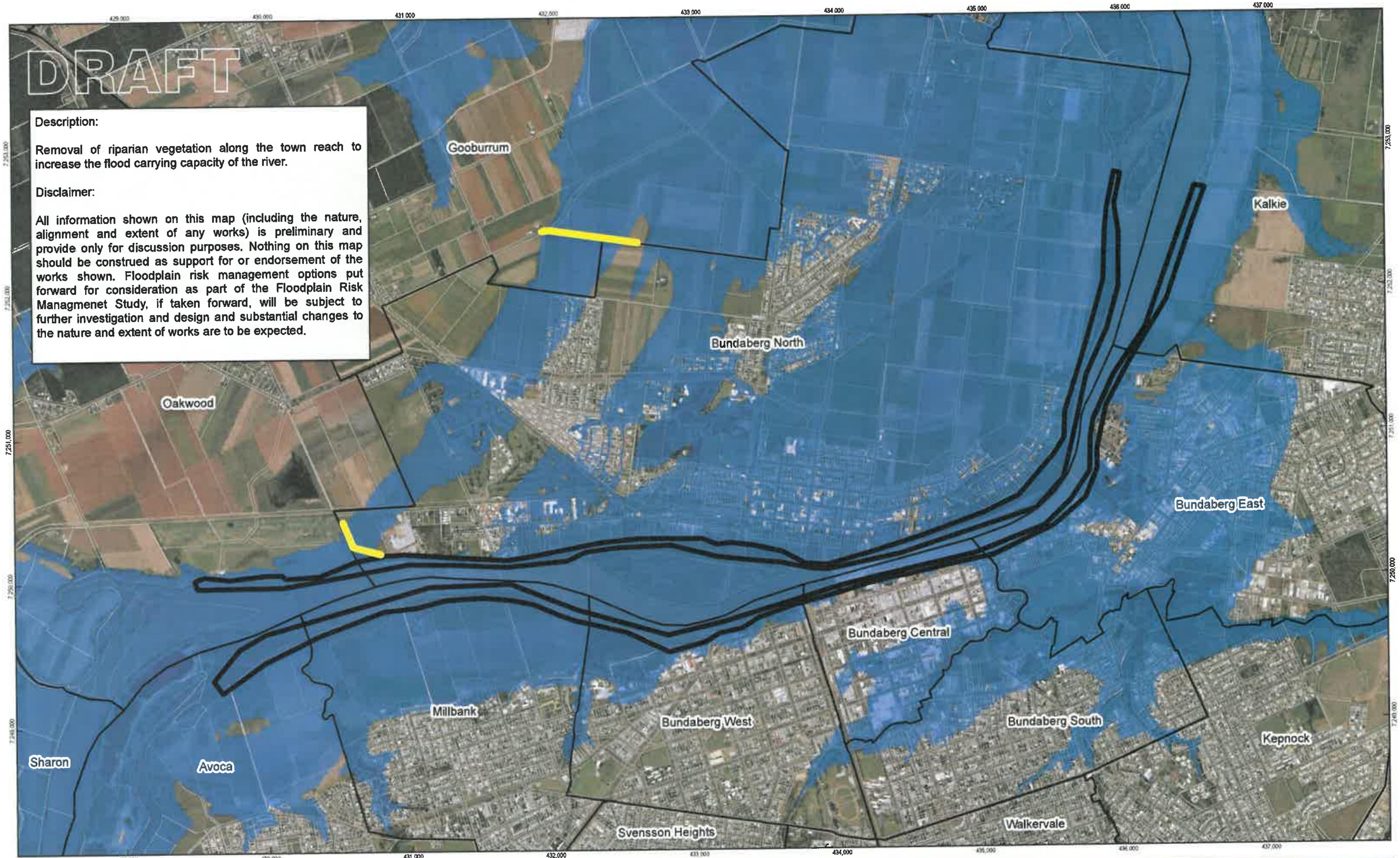
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Removal of Fairymead Levees

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_026_MCA_FairymeadLevees.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Removal of riparian vegetation along the town reach to increase the flood carrying capacity of the river.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND
- Cadastre
- Localities
- Extent of Mangrove Removal (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

GHD

BUNDABERG REGIONAL COUNCIL

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
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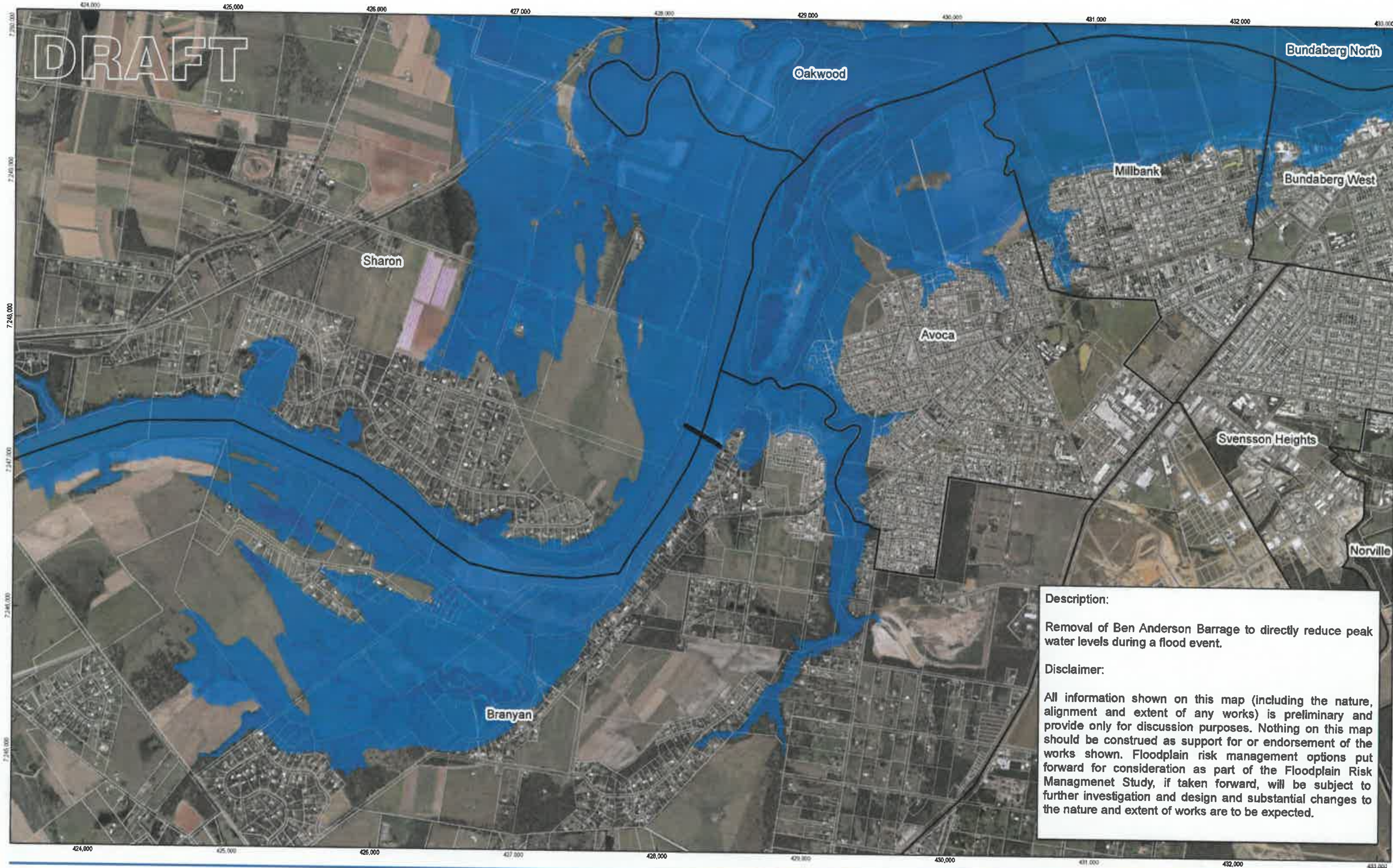
Date	25 Oct 2013

Preliminary Mitigation Options for MCA Removal of Mangroves from Town Reach

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_027_MCA_MangrovesTownReach.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Removal of Ben Anderson Barrage to directly reduce peak water levels during a flood event.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Location of Ben Anderson Barrage

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

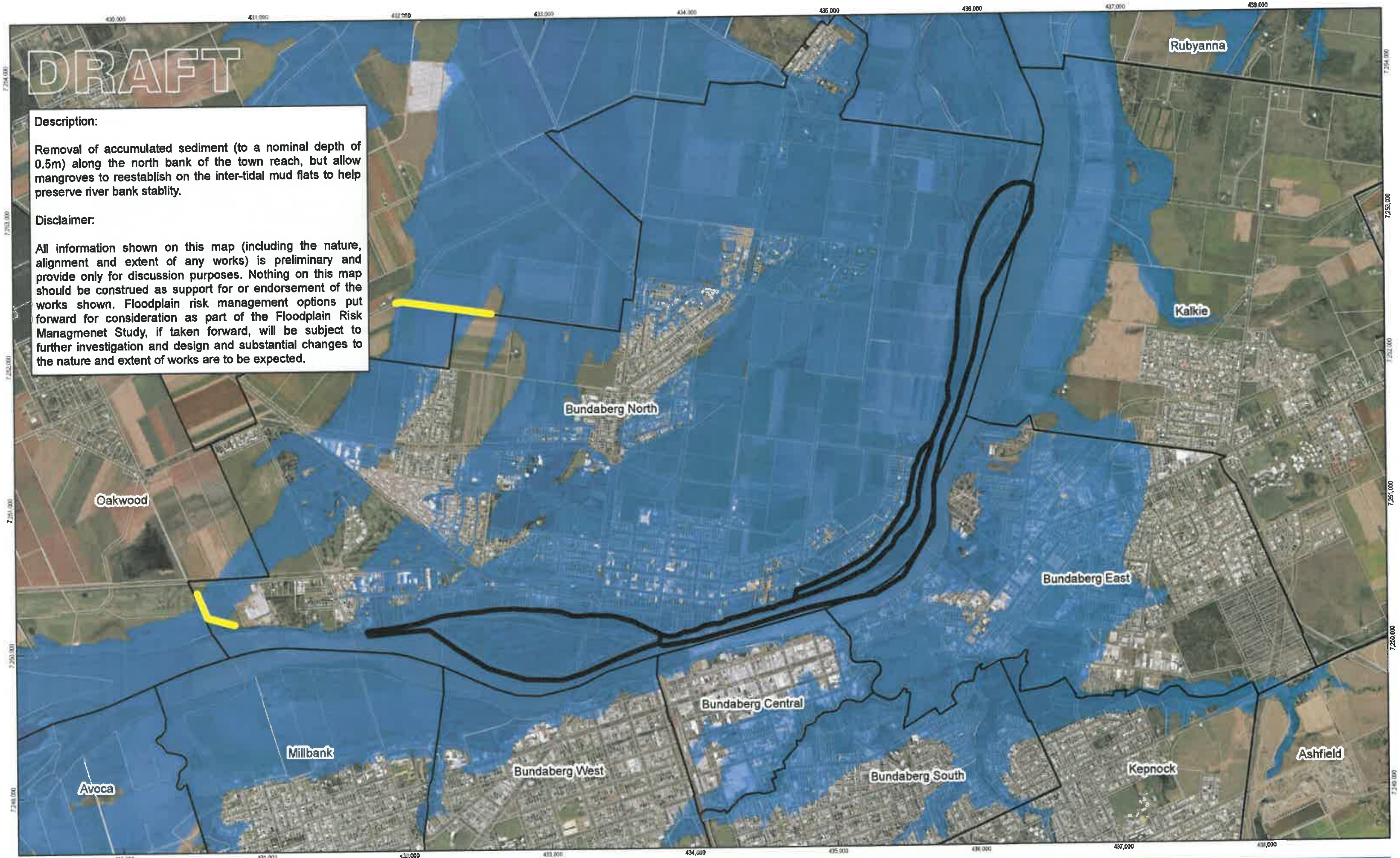
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Removal of Ben Anderson Barrage

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_028_MCA_BarrageRemoval.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Removal of accumulated sediment (to a nominal depth of 0.5m) along the north bank of the town reach, but allow mangroves to reestablish on the inter-tidal mud flats to help preserve river bank stablity.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Extents of Sediment Removal (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

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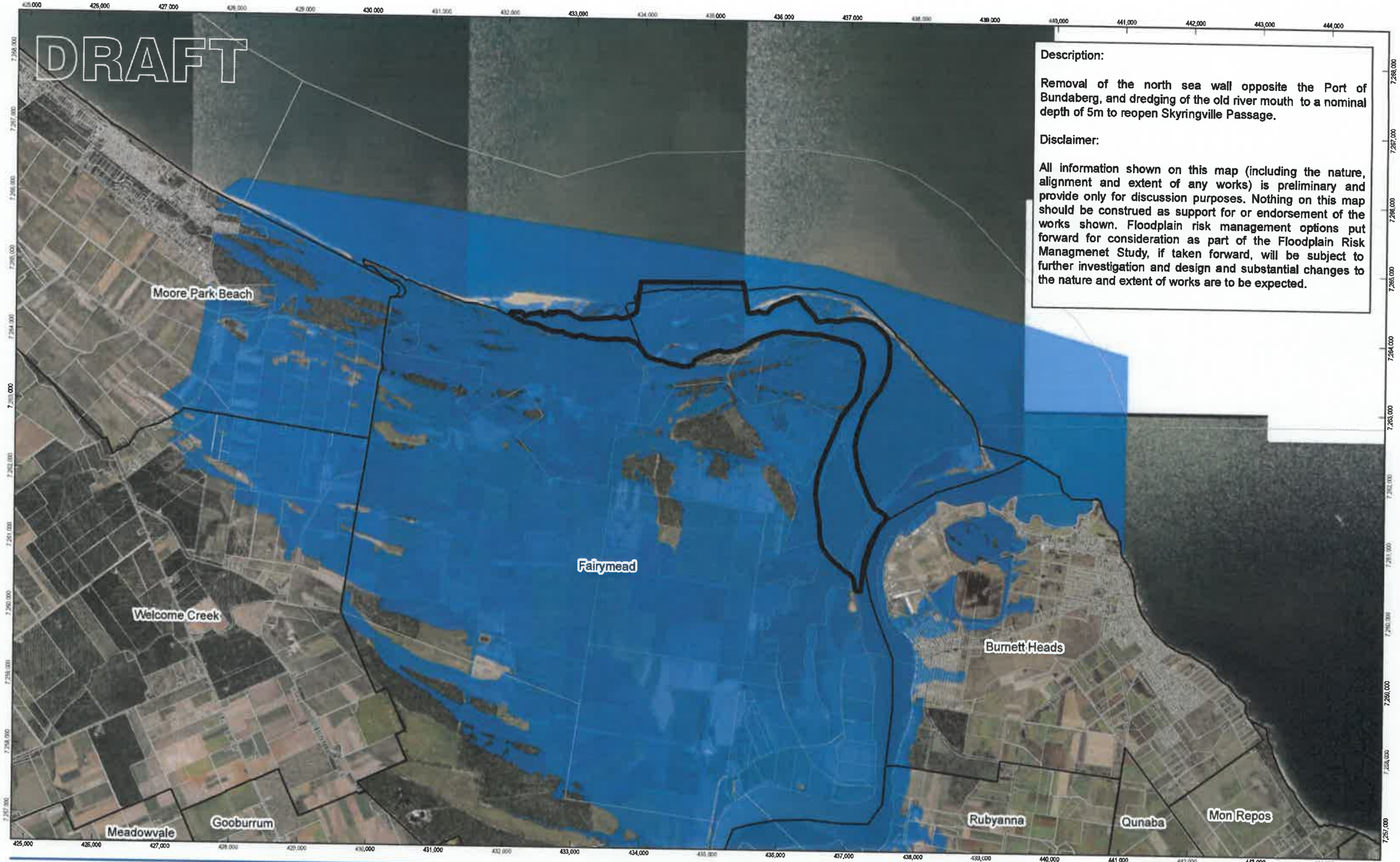
Preliminary Mitigation Options for MCA
Removal of Sediment from Town Reach

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_029_MCA_TownReachSedimentRemoval.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Removal of the north sea wall opposite the Port of Bundaberg, and dredging of the old river mouth to a nominal depth of 5m to reopen Skyringville Passage.

Disclaimer:

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1:50,000 @A3

0 500 1,000 1,500 2,000 2,500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Skyringville Passage Extent of Works (Indicative)

2013 Flood Extent

GHD

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

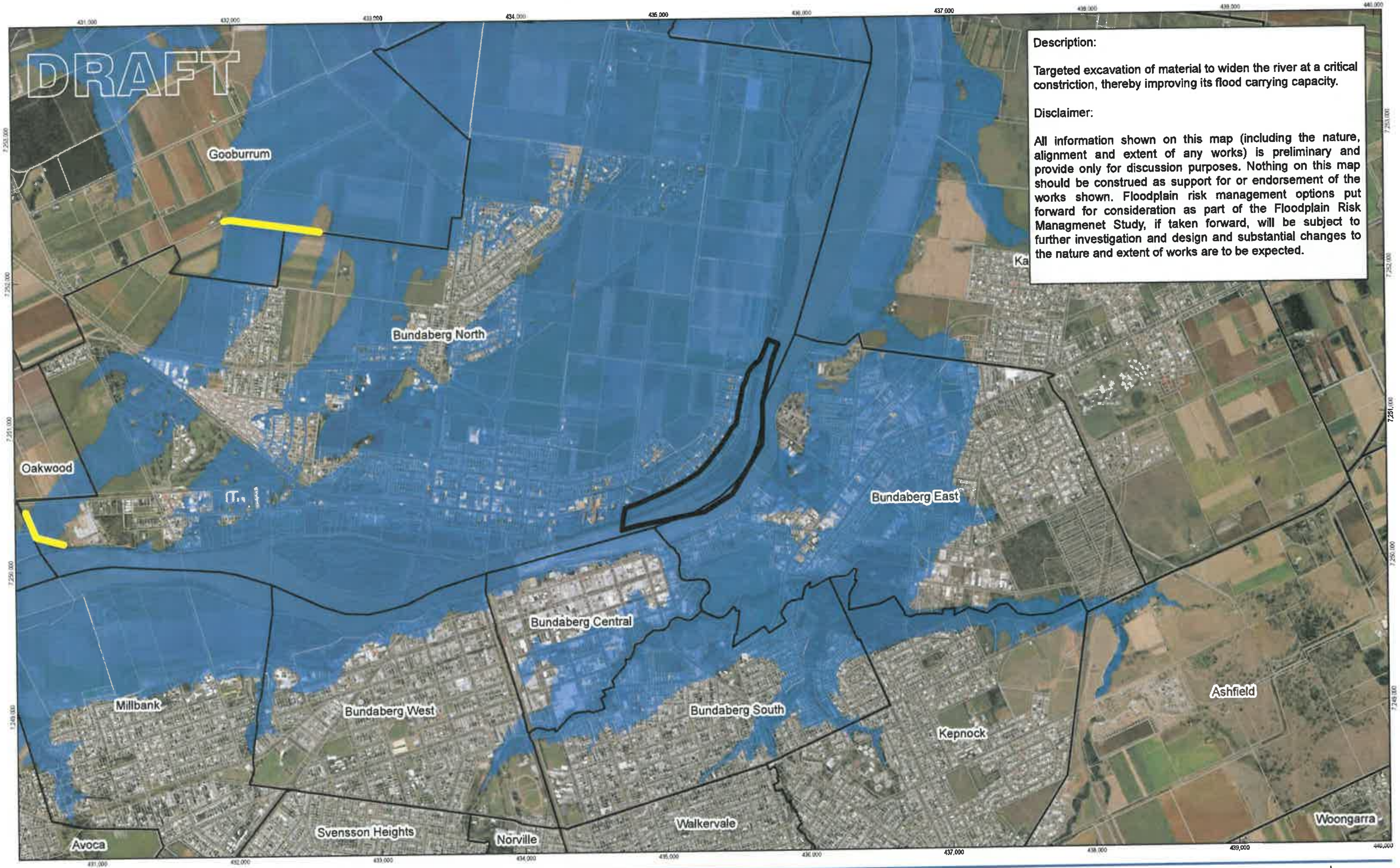
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Reopening of Skyringville Passage

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_030_MCA_SkyringvillePassage.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Milliquin Bend Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	28 Oct 2013

Preliminary Mitigation Options for MCA
Millaquin Bend Widening

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_031_MCA_MillaquinBendWidening.mxd

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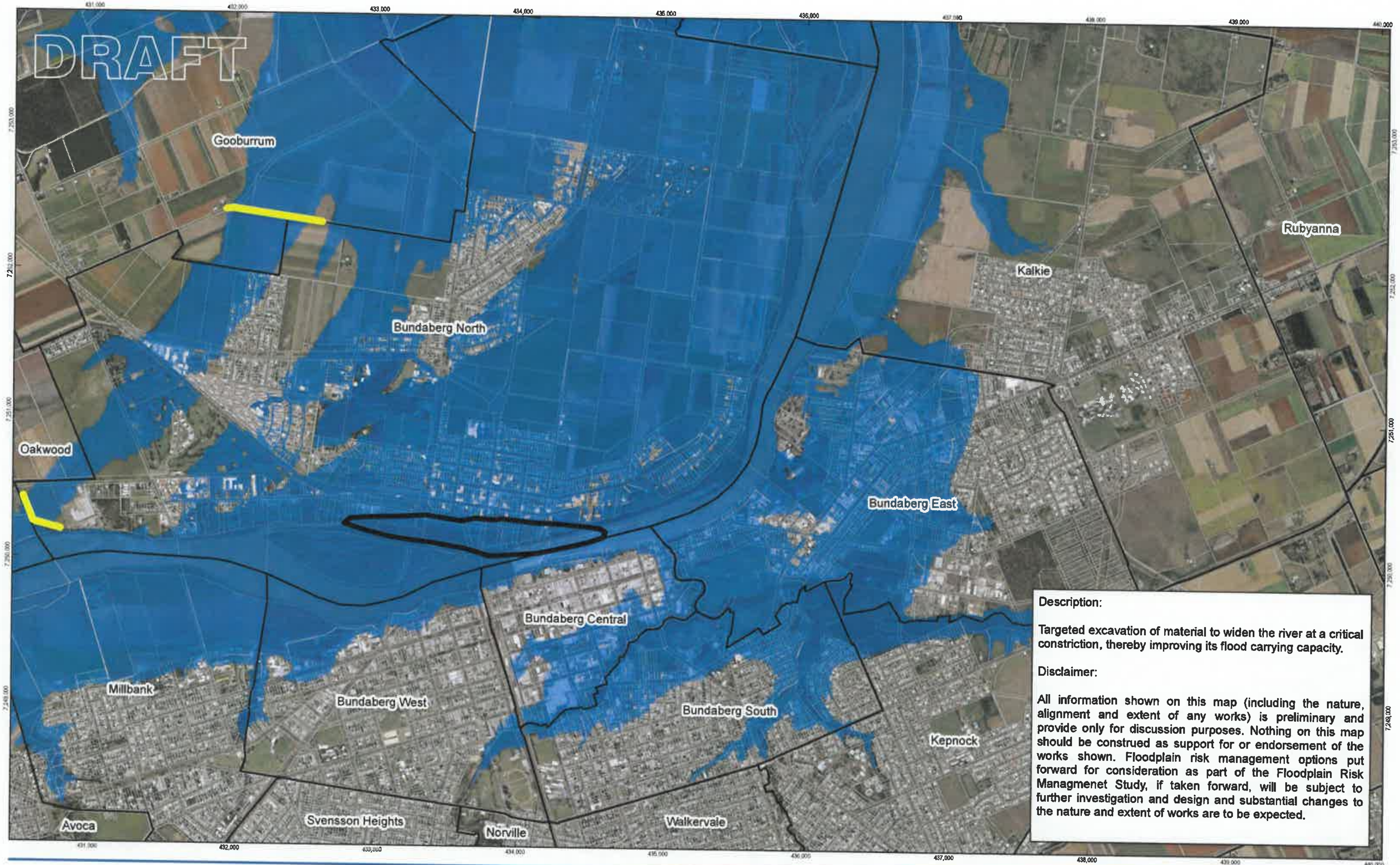

Description:

Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Edina St Park Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
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Date	28 Oct 2013

Preliminary Mitigation Options for MCA
Edina Street Park Widening

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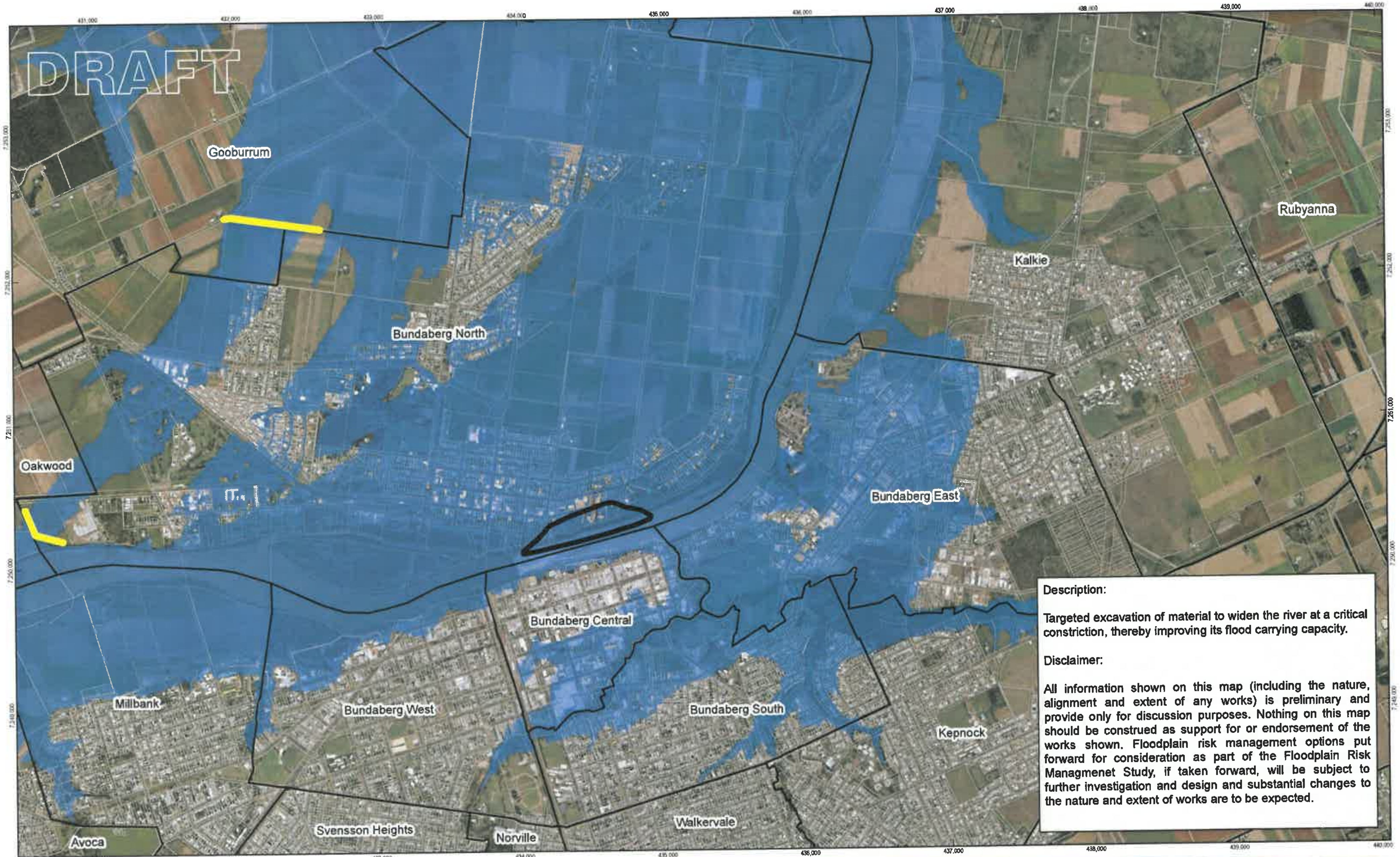
Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Foundry Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

GHD

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

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Preliminary Mitigation Options for MCA
Foundry Widening

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G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_033_MCA_FoundryWidening.mxd

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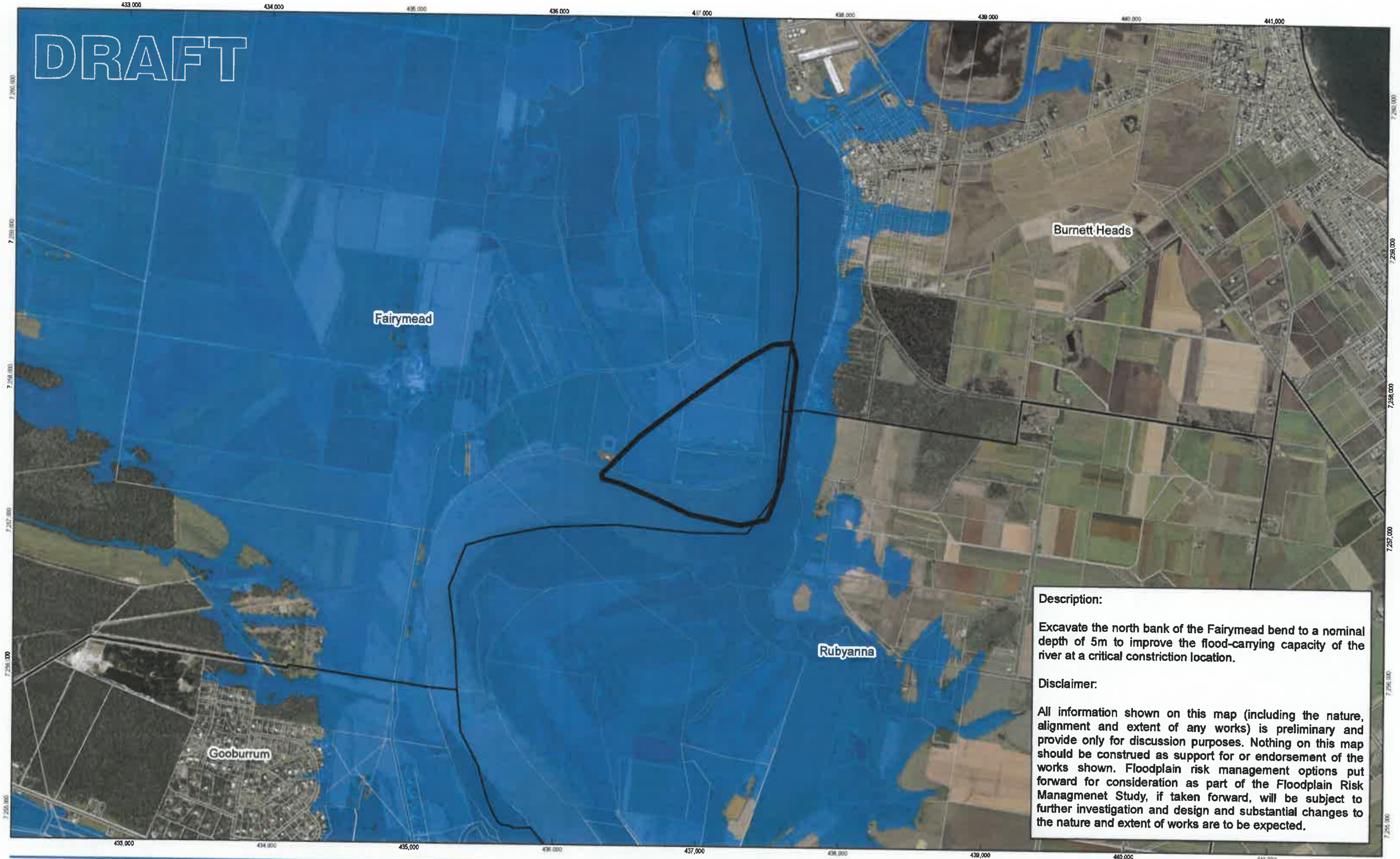

Description:

Excavate the north bank of the Fairymead bend to a nominal depth of 5m to improve the flood-carrying capacity of the river at a critical constriction location.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Fairymead Bend Widening Extent of Works (Indicative)
- 2013 Flood Extent

GHD

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
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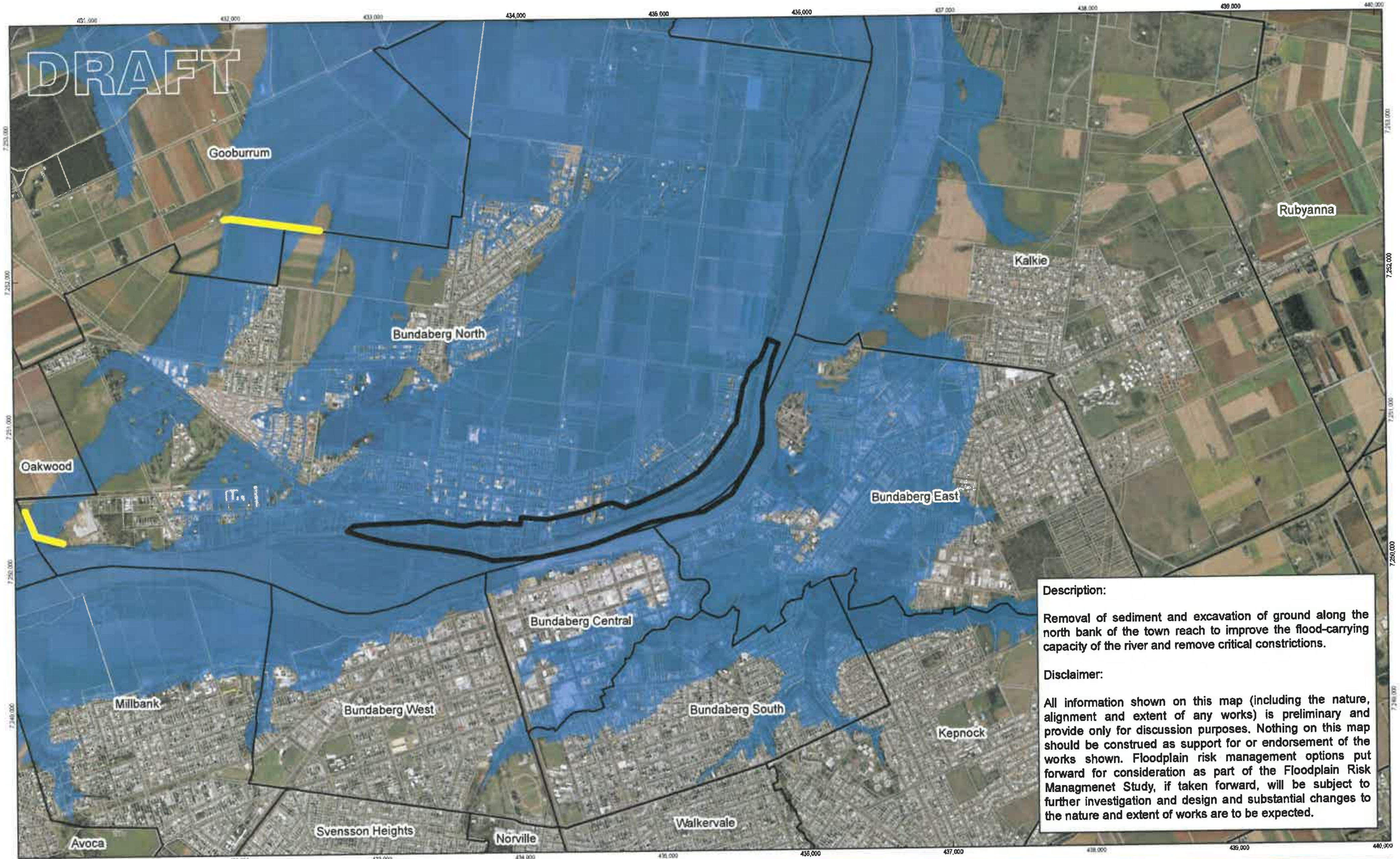
Preliminary Mitigation Options for MCA
Foundry Widening

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_034_MCA_FairymeadBendWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Removal of sediment and excavation of ground along the north bank of the town reach to improve the flood-carrying capacity of the river and remove critical constrictions.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Town Reach Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

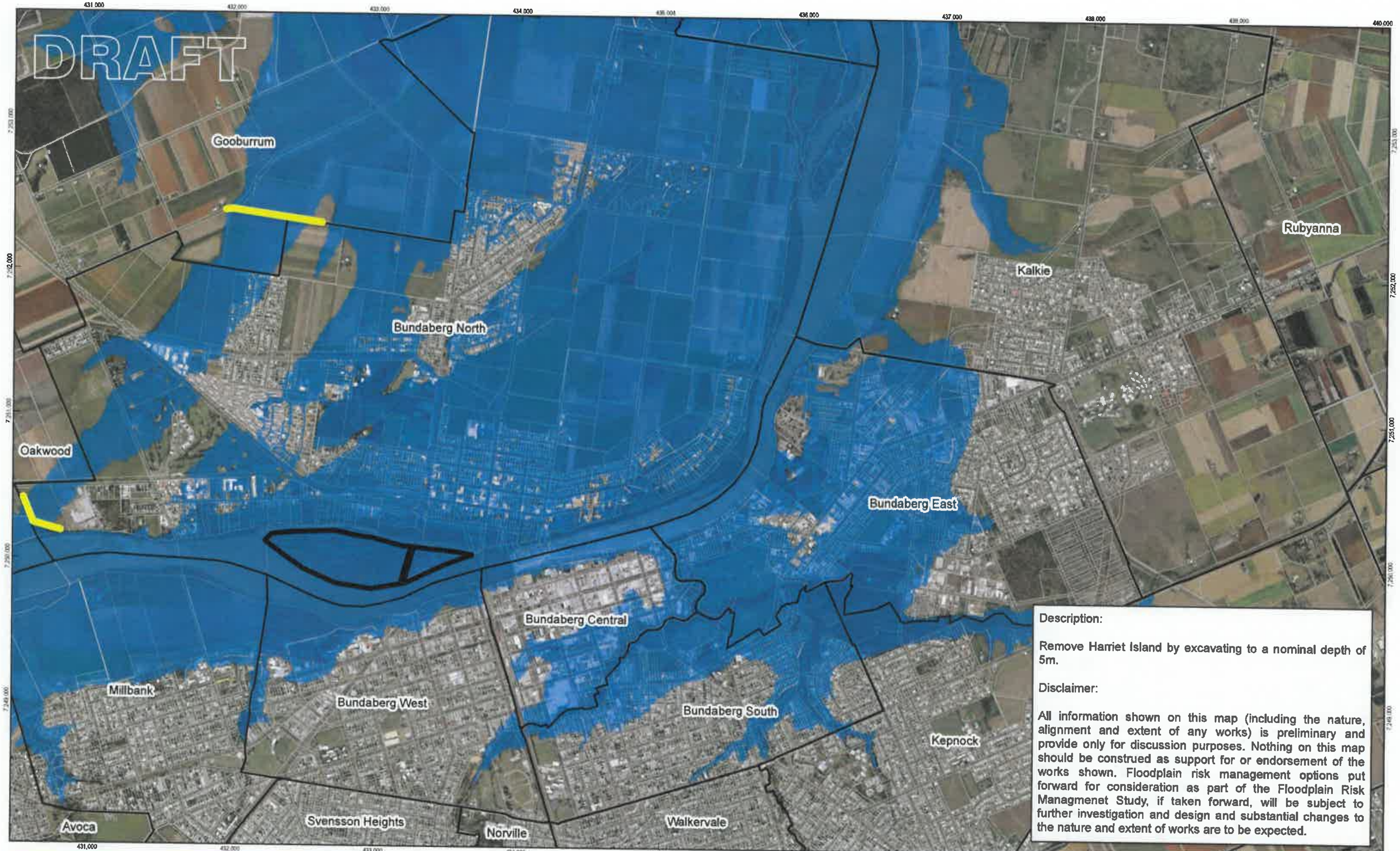
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Town Reach Widening

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_035_MCA_TownReachWidening.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.



Description:

Remove Harriet Island by excavating to a nominal depth of 5m.

Disclaimer:

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1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Harriet Island Removal Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)

2013 Flood Extent

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Harriet Island Removal

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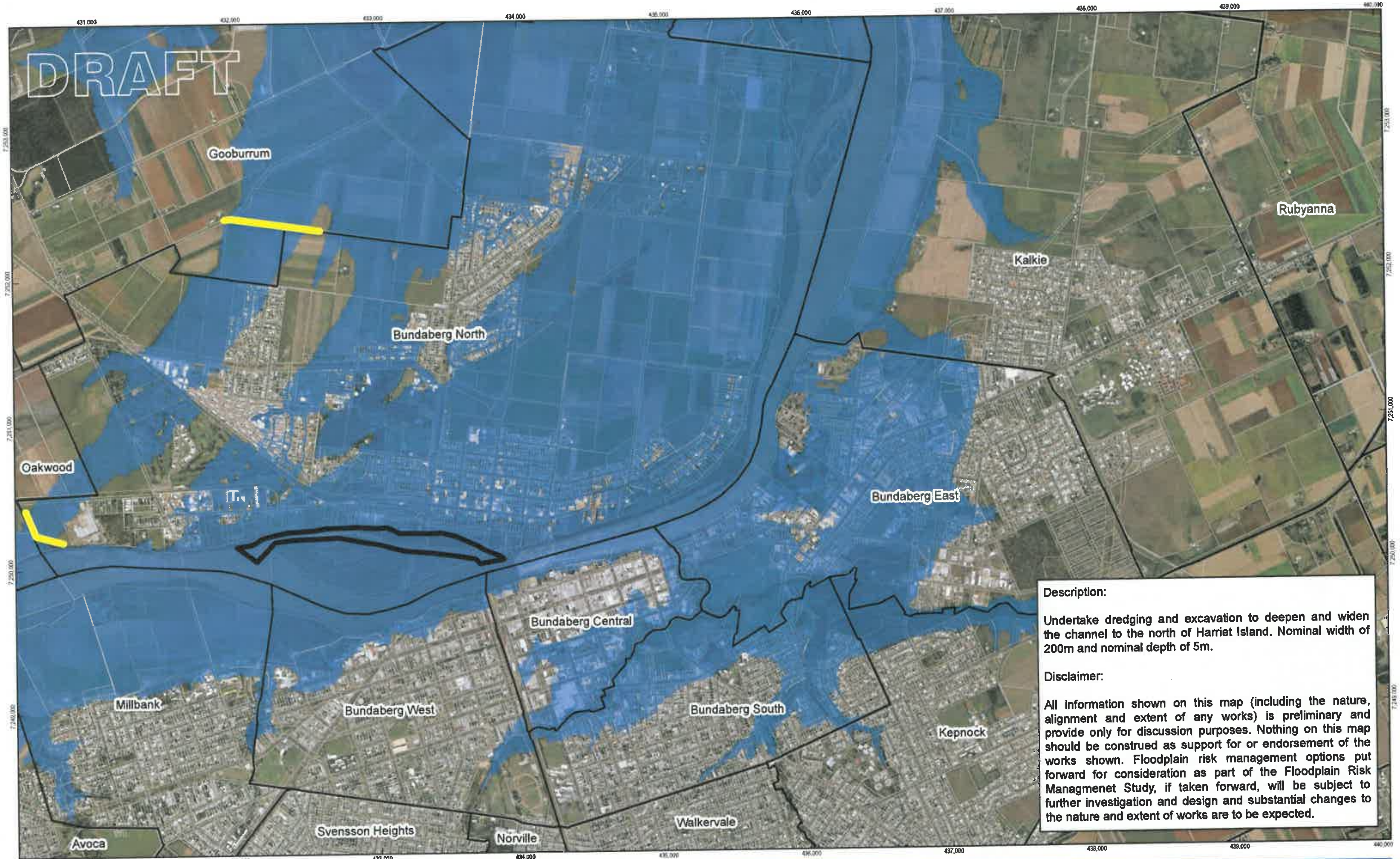
Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Undertake dredging and excavation to deepen and widen the channel to the north of Harriet Island. Nominal width of 200m and nominal depth of 5m.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to the nature and extent of works are to be expected.

1:24,000 @A3

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- North Channel Widening Extent of Works (Indicative)
- Technology Park and Batchlers Rd Levees (Seperate Project)
- 2013 Flood Extent

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Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

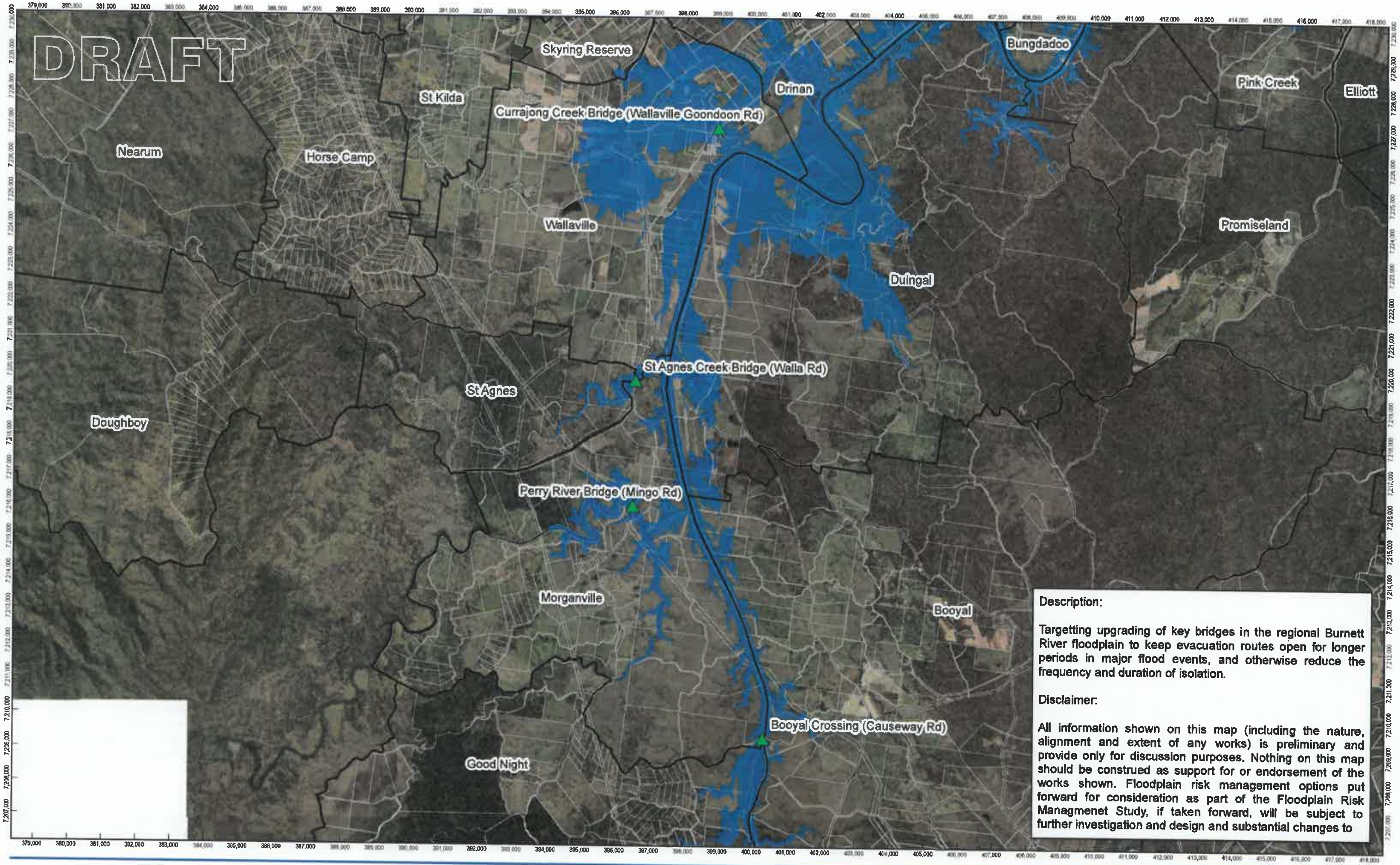
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
North Channel Widening Works

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_037_MCA_NorthChannelWorks.mxd

Data source. Data Custodian, Data Set Name/Title, Version/Date.



Description:

Targetting upgrading of key bridges in the regional Burnett River floodplain to keep evacuation routes open for longer periods in major flood events, and otherwise reduce the frequency and duration of isolation.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to

1:100,000@A3

0 1,000 2,000 3,000 4,000 5,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Cadastre
- Localities
- Regional Bridge Upgrades
- 2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

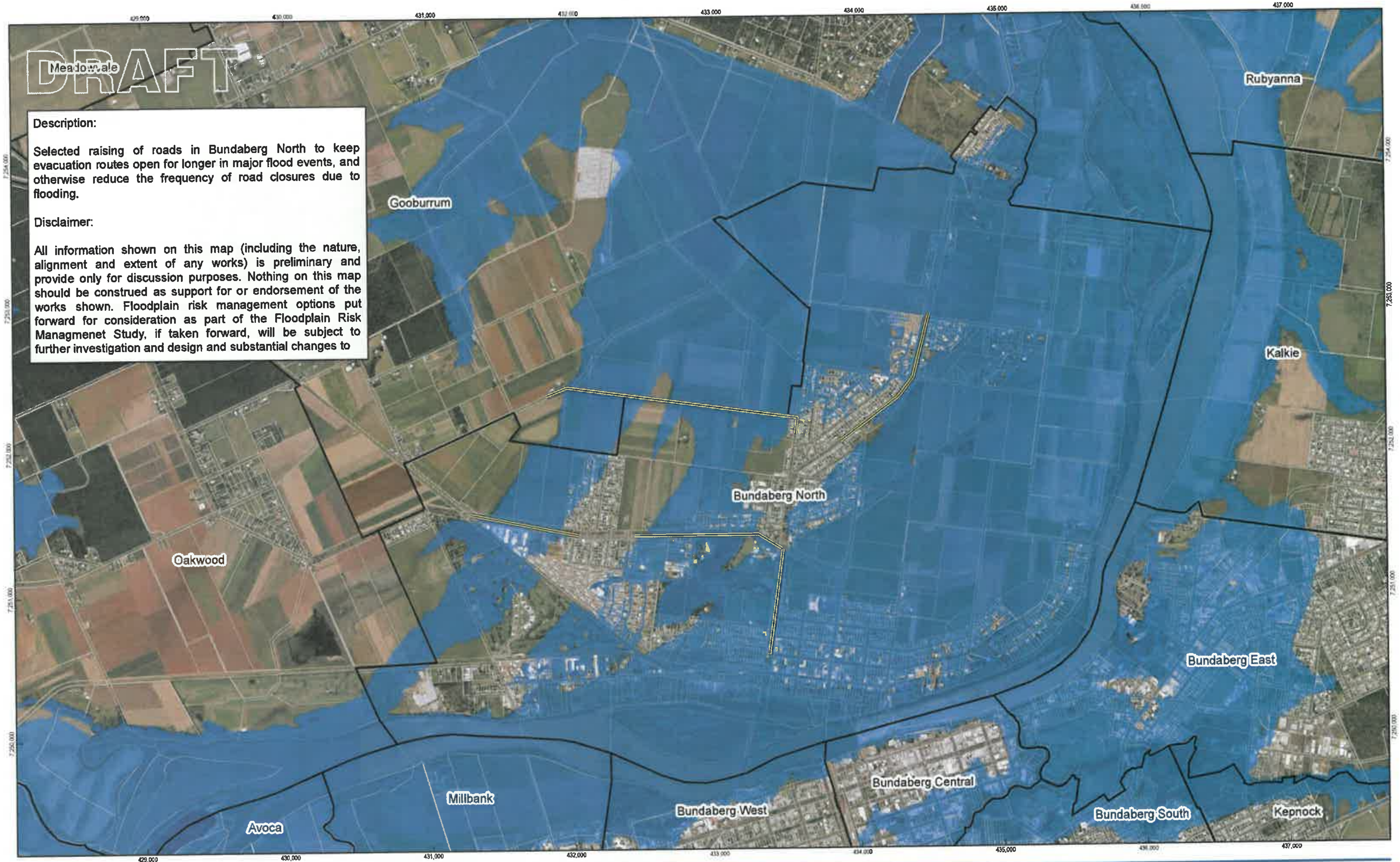
Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Regional Bridge Upgrades

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_036_MCA_RegionalBridgeUpgrades.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com



Description:

Selected raising of roads in Bundaberg North to keep evacuation routes open for longer in major flood events, and otherwise reduce the frequency of road closures due to flooding.

Disclaimer:

All information shown on this map (including the nature, alignment and extent of any works) is preliminary and provide only for discussion purposes. Nothing on this map should be construed as support for or endorsement of the works shown. Floodplain risk management options put forward for consideration as part of the Floodplain Risk Managmenet Study, if taken forward, will be subject to further investigation and design and substantial changes to

1:24,000 @A3

0 200 400 600 800 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Cadastre

Localities

Bundaberg North Evacuation Route Upgrades (Preliminary)

2013 Flood Extent

GHD

BUNDABERG

Bundaberg Regional Council
Burnett River Floodplain Risk Management Study

Job Number	41-26909
Revision	A
Date	25 Oct 2013

Preliminary Mitigation Options for MCA
Bundaberg North Evacuation Route Upgrades

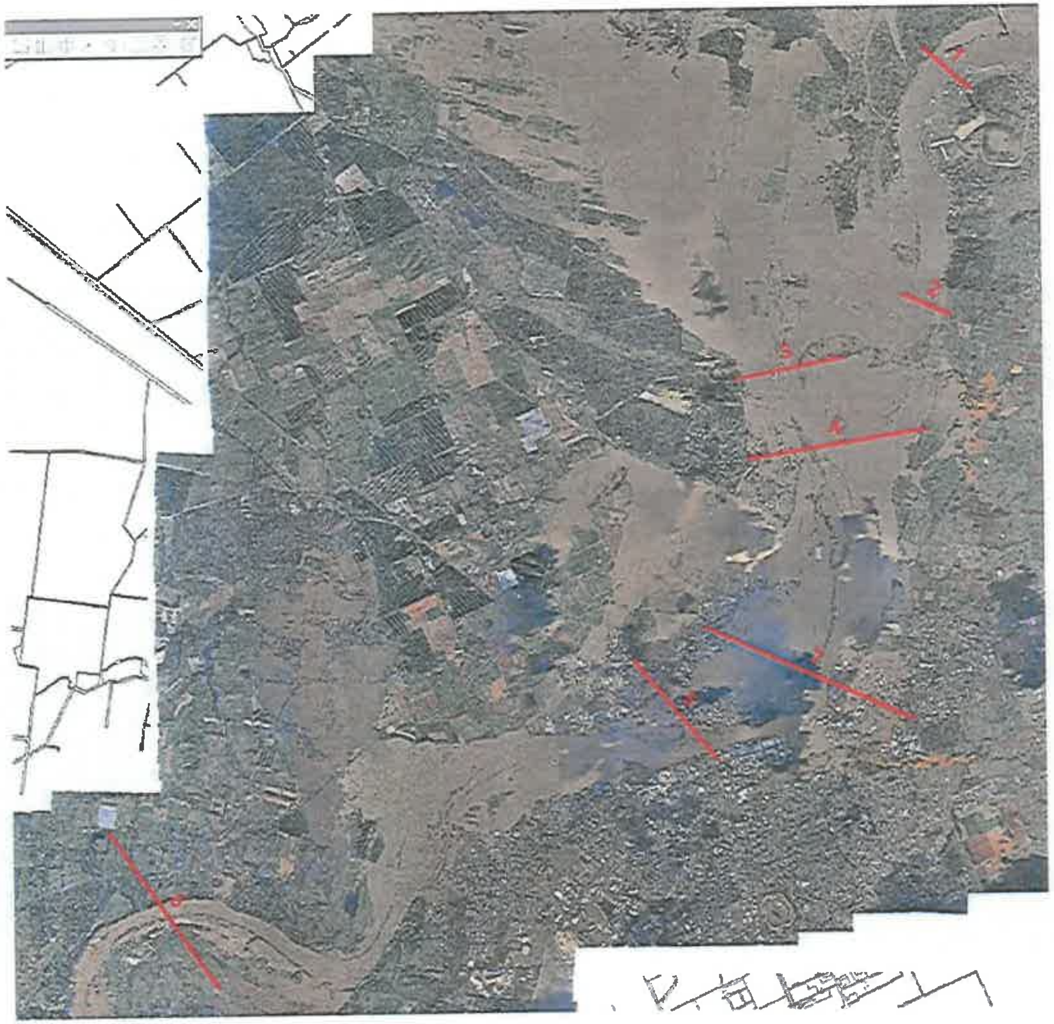
145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

G:\41\26909\GIS\Maps\MXD\00_MCA_Options\4126909_039_MCA_BundabergNorthRoadUpgrades.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date.

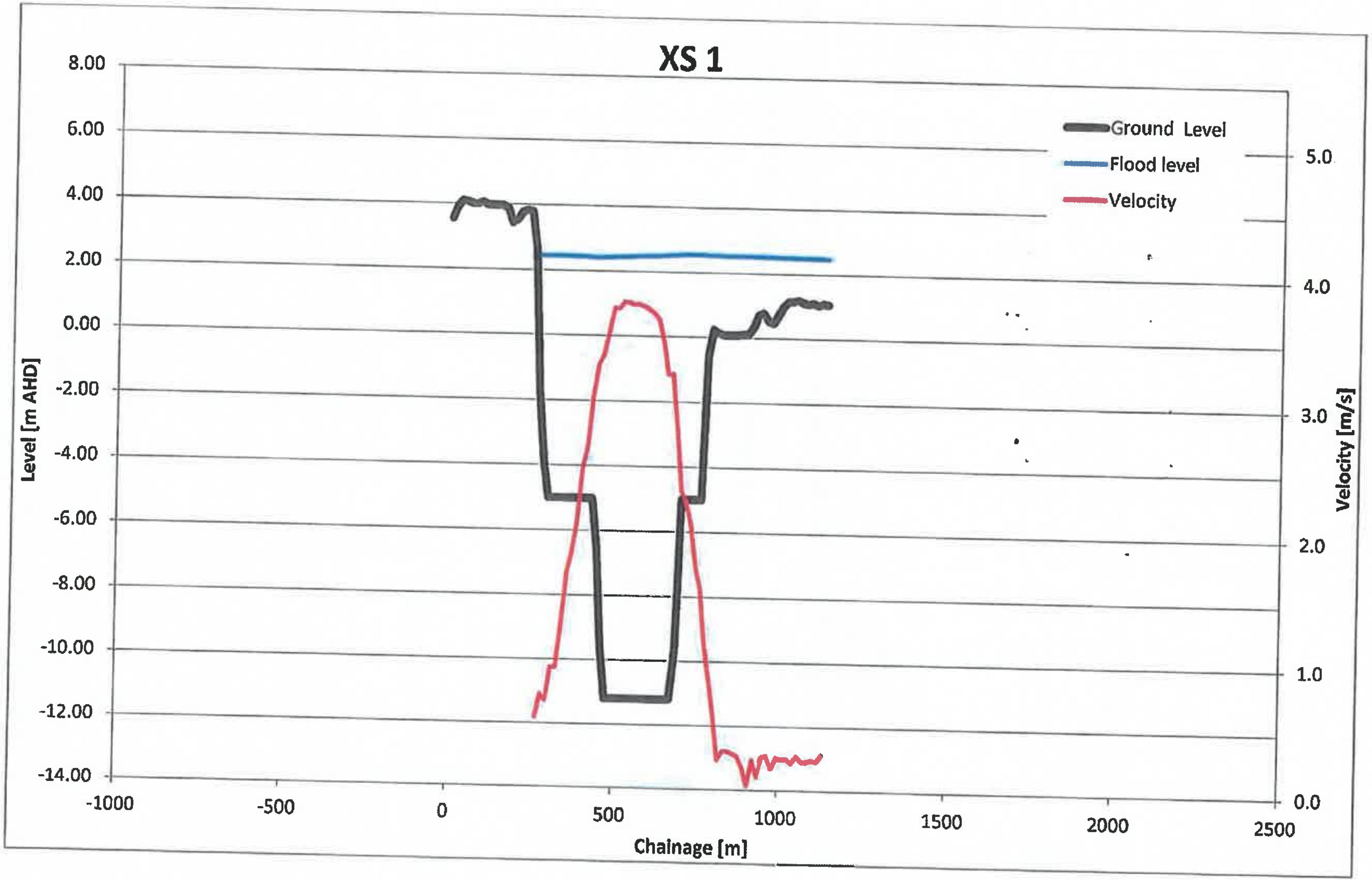
32	River works	Edina St widening (north bank)	Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.	No. Shifts problem downstream, needs to be combined with all town reach widening.
33	River works	Foundry widening (north bank)	Targeted excavation of material to widen the river at a critical constriction, thereby improving its flood carrying capacity.	No. Shifts problem downstream, needs to be combined with all town reach widening.
34	River works	Fairymead Bend widening	Excavate the north bank of the Fairymead bend to a nominal depth of 5m to improve the flood-carrying capacity of the river at a critical constriction location.	No. Diverts too much water towards Port, increasing flood levels.
35	River works	Town reach widening (north bank)	Removal of sediment and excavation of ground along the north bank of the town reach to improve the flood-carrying capacity of the river and remove critical constrictions.	Yes
36	River works	Remove Harriet Island	Remove Harriet Island by excavating to a nominal depth of 5m.	No. Limited hydraulic benefits, shifts problem downstream.
37	River works	Deepen and widen north channel at Harriet Island	Undertake dredging and excavation to deepen and widen the channel to the north of Harriet Island. Nominal width of 200m and nominal depth of 5m.	Limited hydraulic benefits, shifts problem downstream.
38	Road / bridge upgrade	Regional Bridge Upgrades	Targeted upgrading of key bridges in the regional Burnett River floodplain to keep evacuation routes open for longer periods in major flood events, and otherwise reduce the frequency and duration of isolation.	Yes
39	Road / bridge upgrade	Bundaberg North Evacuation Route Upgrades	Selected raising of roads in Bundaberg North to keep evacuation routes open for longer in major flood events, and otherwise reduce the frequency of road closures due to flooding.	Yes
40	Property	Funding for house raising / restumping	Provision of funding for residents to raise and restump homes in highly flood prone areas.	Yes

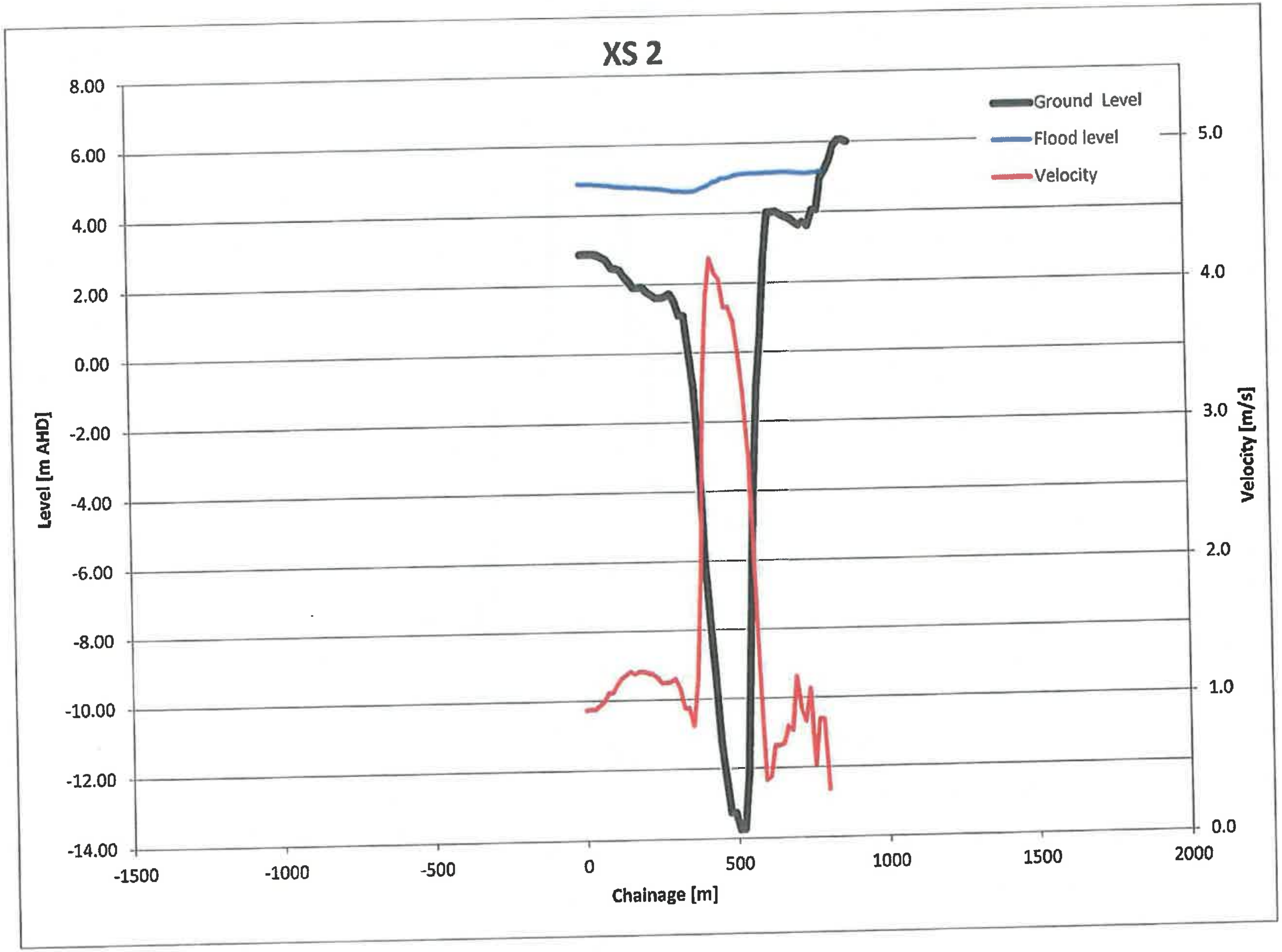
Level and velocity were extracted at the 7 XS shown on figure below:

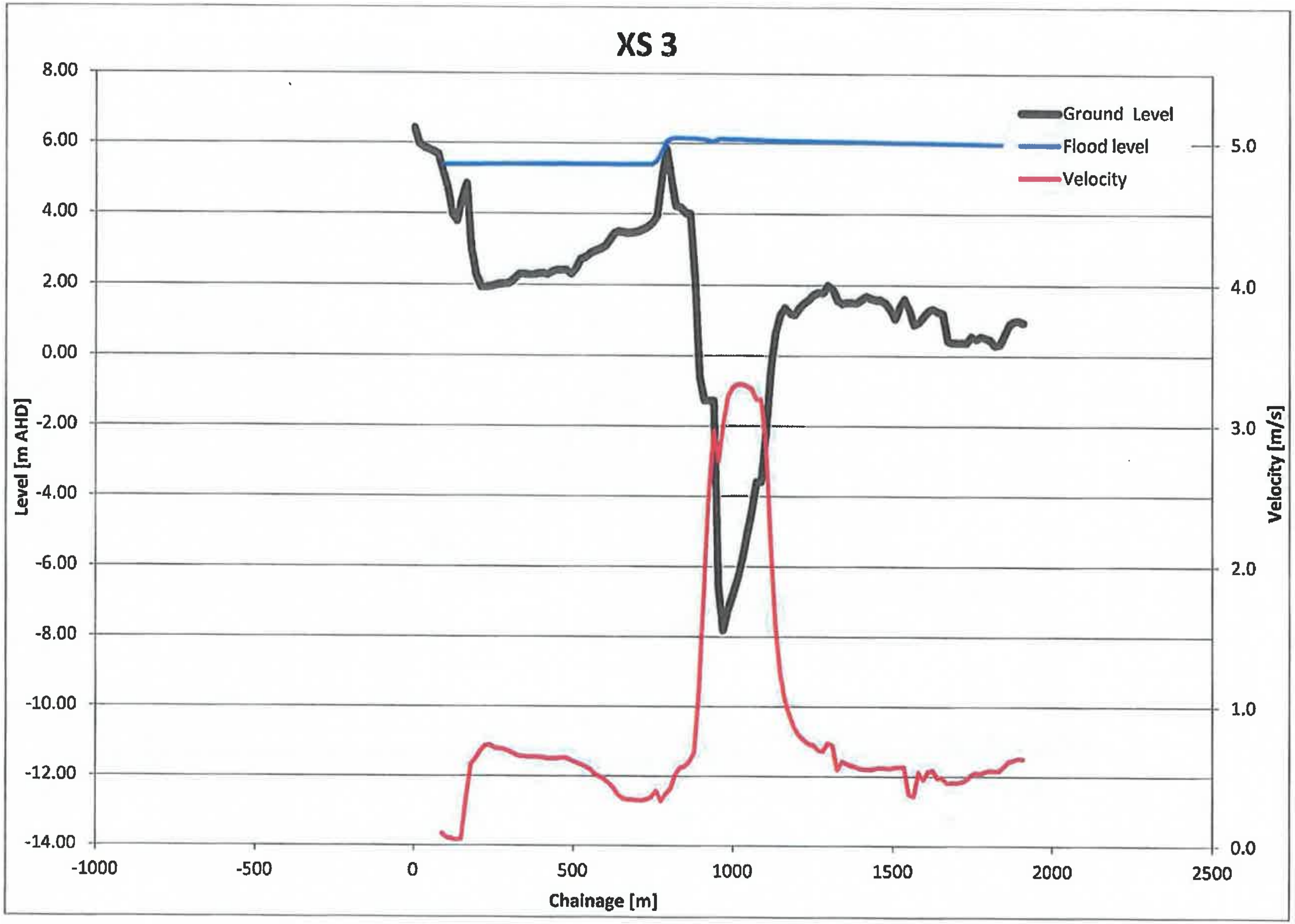


EMAILED INFORMATION
FROM GHD
(FLOW VELOCITIES)

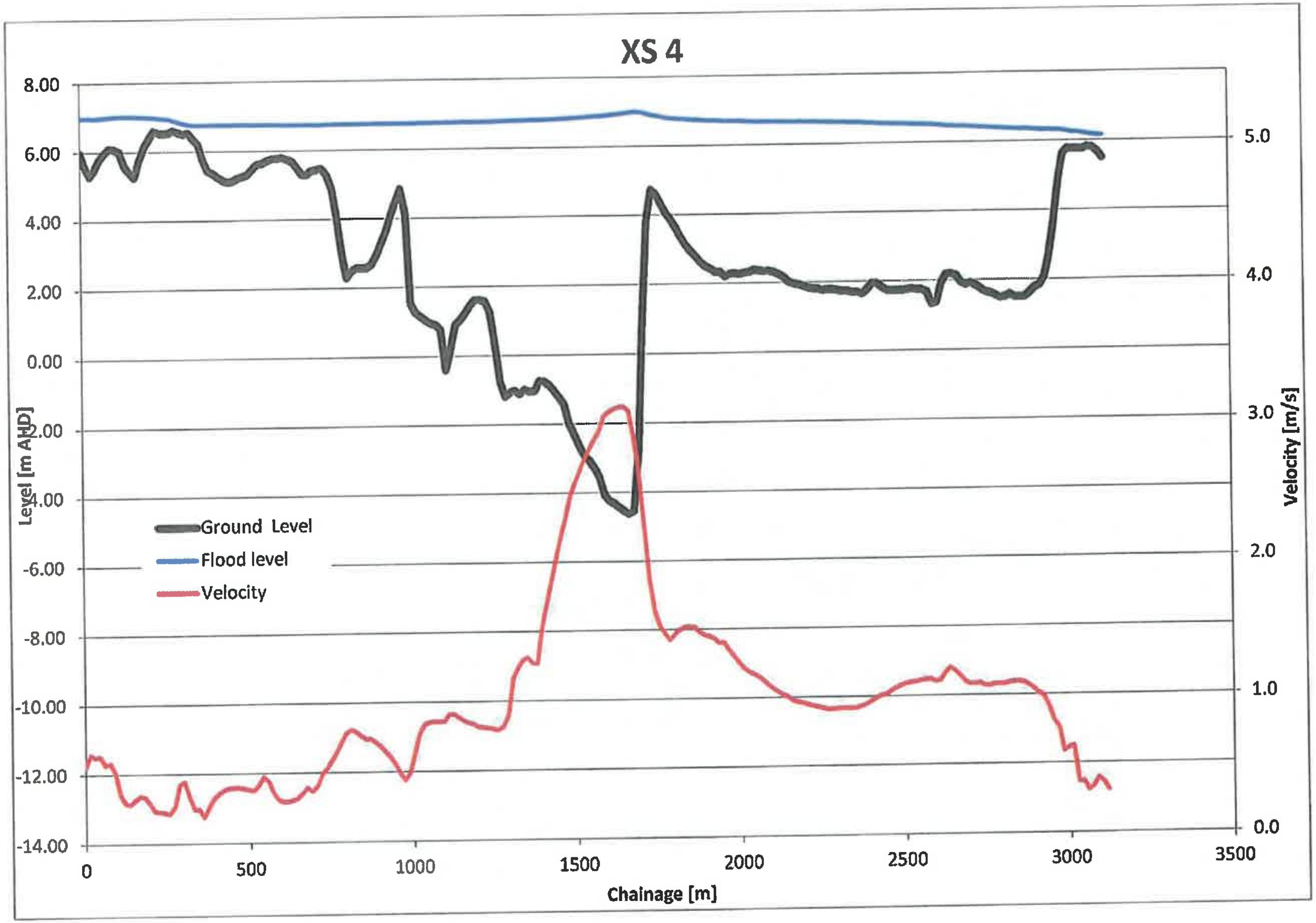
The Following results were obtained at each XS:

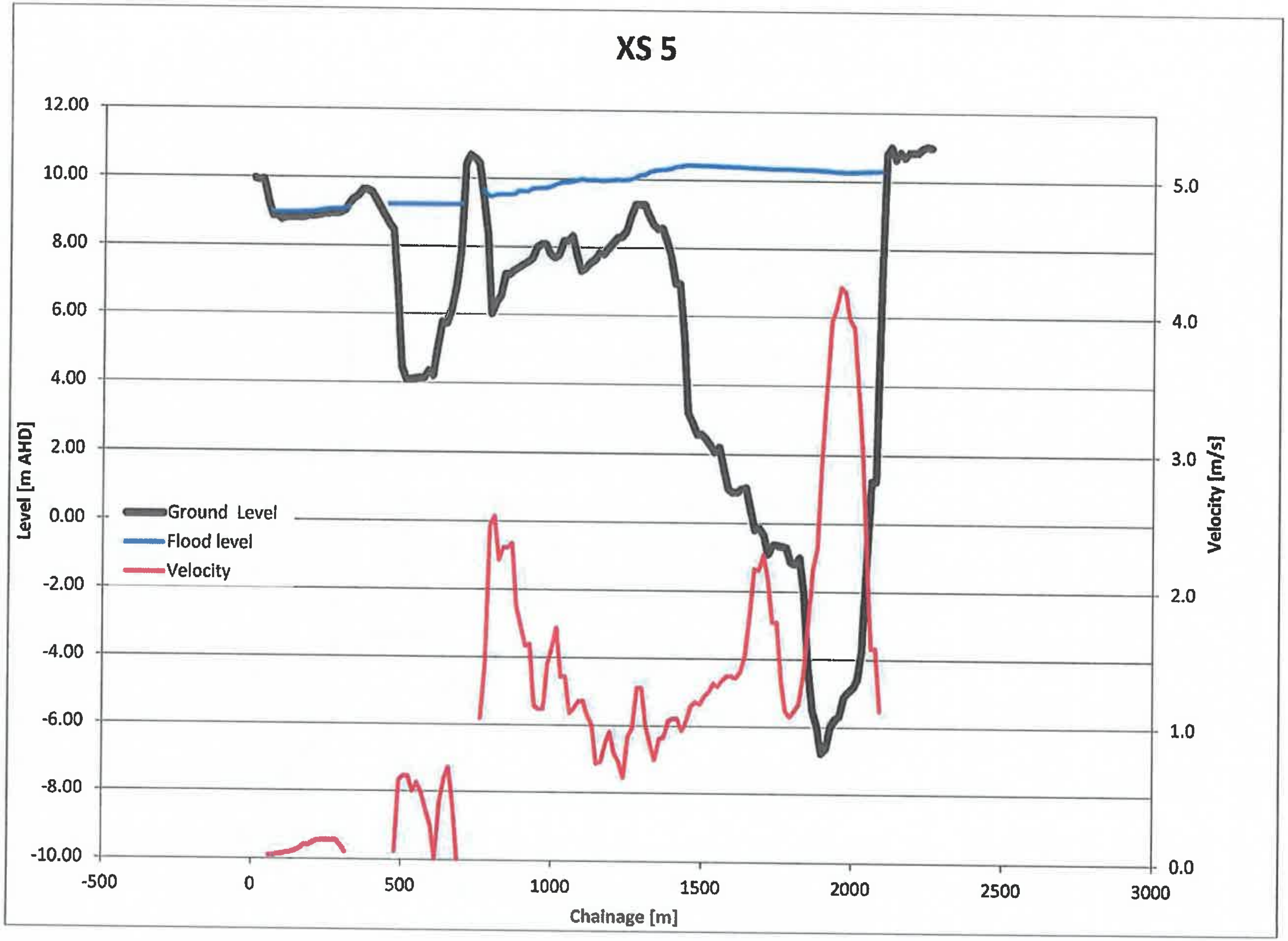


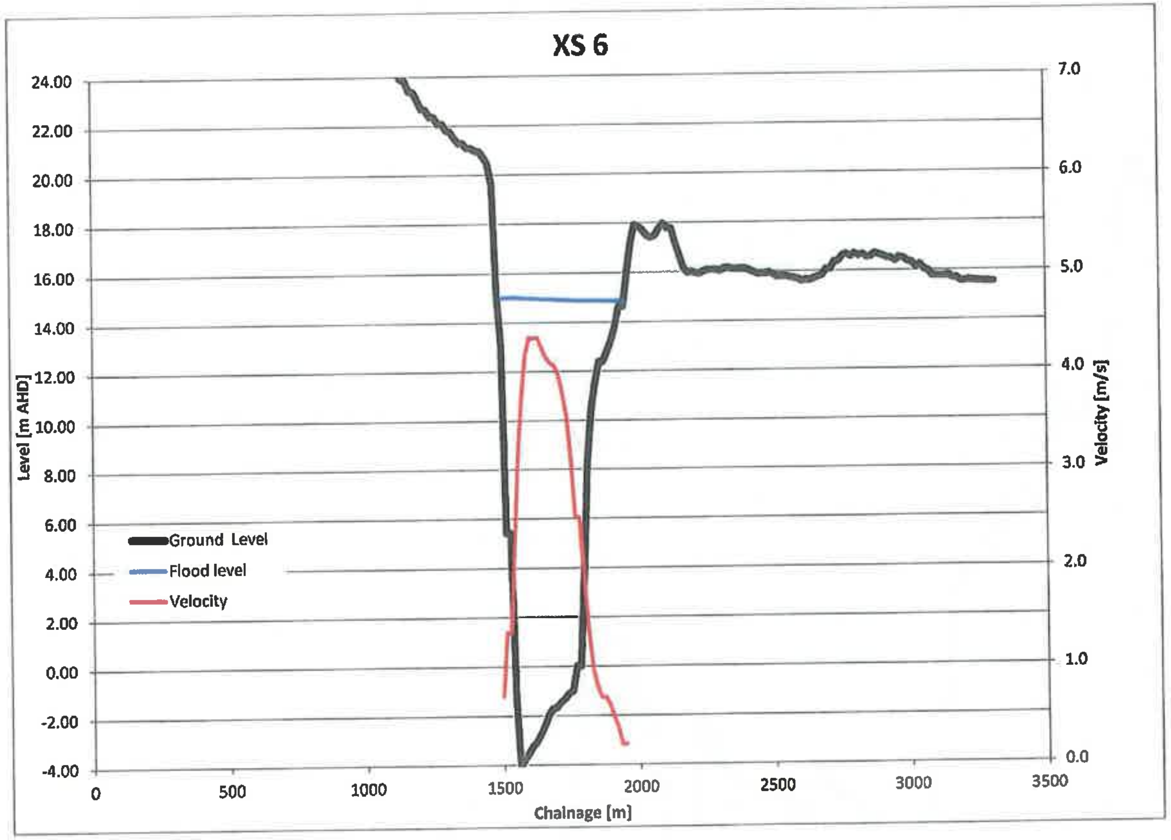

XS 2
Ground Level
Flood level
Velocity
Level [m AHD]
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
Velocity [m/s]
5.0
4.0
3.0
2.0
1.0
0.0
-1500
-1000
-500
0
500
1000
1500
2000
Chainage [m]



XS 3
Ground Level
Flood level
Velocity
Level [m AHD]
Velocity [m/s]
Chainage [m]
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-1000
-500
0
500
1000
1500
2000
2500
5.0
4.0
3.0
2.0
1.0
0.0


XS 4
Level [m AHD]
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
Velocity [m/s]
5.0
4.0
3.0
2.0
1.0
0.0
0
500
1000
1500
2000
2500
3000
3500
Chainage [m]
Ground Level
Flood level
Velocity


XS 5
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
Level [m AHD]
5.0
4.0
3.0
2.0
1.0
0.0
Velocity [m/s]
-500
0
500
1000
1500
2000
2500
3000
Chainage [m]
Ground Level
Flood level
Velocity



XS 6
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
Level [m AHD]
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Velocity [m/s]
0
500
1000
1500
2000
2500
3000
3500
Chainage [m]
Ground Level
Flood level
Velocity

Robyn Laing

From:	Dan Copelin [redacted]
Sent:	Thursday, 31 October 2013 2:38 PM
To:	Rob Marshman; Rowan Bond [redacted]
Cc:	~~Robyn Laing; Rob Calligaris; Dwayne Honor~~
Subject:	RE: FW: Volume and Velocity Records of Burnett River Flood
Attachments:	CRG_XS (2).docx
Follow Up Flag:	Follow up
Flag Status:	Completed

Rob,

Revised sections on a consistent x-axis scale, plus the new section through Millaquin Bend (XS 7) attached.

Regards,

Dan Copelin
Civil Engineer - Waterways & Water Resources

GHD
T: +61 7 3316 3608 | V: 413608 | E: daniel.copelin@ghd.com
Level 3 145 Ann Street Brisbane QLD 4000 Australia | www.ghd.com

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Please consider our environment before printing this email

From: MarsCEL [redacted]
Sent: Thursday, 31 October 2013 11:47 AM
To: Dan Copelin; Rowan Bond [redacted]
Cc: ~~Robyn Laing; Rob Calligaris (InTouch); Dwayne Honor (InTouch)~~
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood

Cheers mate, I'll have a look at this and take it to the meeting this afternoon.

Regards

Rob Marshman
B.Eng, RPEQ, MIEAust
MarsCEL *Civil / Structural*
Mob. 0408 729 742

As a company, we value customer satisfaction, and are continually seeking to improve our service delivery; therefore we request that you please provide feedback regarding our services?

From: Dan Copelin [redacted]
Sent: Wednesday, 30 October 2013 5:05 PM
To: MarsCEL; Rowan Bond ([redacted]om)
Cc: [redacted]
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood

Hi Rob,

As requested, we have extracted the cross-sections in those locations. We also have included the peak water level surface and peak velocities from our calibrated 2013 event model.

Regards,

Dan Copelin
Civil Engineer - Waterways & Water Resources

GHD
T: +61 7 3316 3608 | V: 413608 | E: daniel.copelin@ghd.com
Level 3 145 Ann Street Brisbane QLD 4000 Australia | www.ghd.com

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Please consider our environment before printing this email

From: MarsCEL [redacted]
Sent: Tuesday, 29 October 2013 12:16 PM
To: Dan Copelin
Subject: RE: FW: Volume and Velocity Records of Burnett River Flood

Dan

Could you provide this information.

Regards

Rob Marshman
B.Eng, RPEQ, MIEAust
MarsCEL *Civil / Structural*
Mob. 0408 729 742

As a company, we value customer satisfaction, and are continually seeking to improve our service delivery; therefore we request that you please provide feedback regarding our services?

From: MarsCEL
Sent: Tuesday, 29 October 2013 11:55 AM
To: [redacted]
Cc: Rowan Bond ([redacted])
Subject: FW: FW: Volume and Velocity Records of Burnett River Flood

Dwayne

During your presentations of the flood modelling investigations, you mentioned council had surveyed river cross-section at various locations of the river. Would it be possible to compare some of those cross-sections for a visual indication of the potential impacts various mitigation options may have.

There seems to be a lot of speculation amongst the group this may just help to gain a better understanding of the flood event and I am unable to get accurate cross-sections from Google Earth or the council interactive mapping (it appears as if all contours have been removed from the interactive mapping from below the flood waters in the areas of interest.

Regards

Rob Marshman
B.Eng, RPEQ, MIEAust
MarsCEL *Civil / Structural*
Mob. 0408 729 742

As a company, we value customer satisfaction, and are continually seeking to improve our service delivery; therefore we request that you please provide feedback regarding our services?

F[redacted]
Sent: Friday, 25 October 2013 9:08 PM
[redacted]

From: Dwayne Honor
Sent: Thursday, 24 October 2013 5:32 PM
To: ~~Robyn Laing~~
Subject: RE: Volume and Velocity Records of Burnett River Flood

Hi Robyn,

The flow rate for the northern breakout as per map below is about 2,725 m3/s (1% AEP) to 4,854 m3/s (0.5 % AEP). The January 2013 event is similar in magnitude to the 1% AEP.

Velocities are complex in North Bundaberg but in order to better understand the factors contributing to scour, local "nested' 2D hydraulic models were developed to simulate the impact of local features such as buildings and fences on local flow patterns and velocities. The below table is the statistical analysis from the nested model:

Property Maximum Velocity Mean	3.46 m/s
Property Maximum Velocity Std Dev	0.95 m/s
Lowest Property Maximum Velocity	1.82 m/s
Highest Property Maximum Velocity	5.77 m/s
1sigma	4.41 m/s
2sigma	5.35 m/s

Table 1 – Statistical Analysis of Flood Velocities, North Bundaberg, January 2013

The above information can be shared with the CRG.

Regards

DWAYNE HONOR
Manager Design
BET(Civil) BBA
Bundaberg Regional Council
PO Box 3130
Bundaberg QLD 4670
Tel: 1300 883 699
Fax: (07) 4150 5410
http://bundaberg.qld.gov.au/

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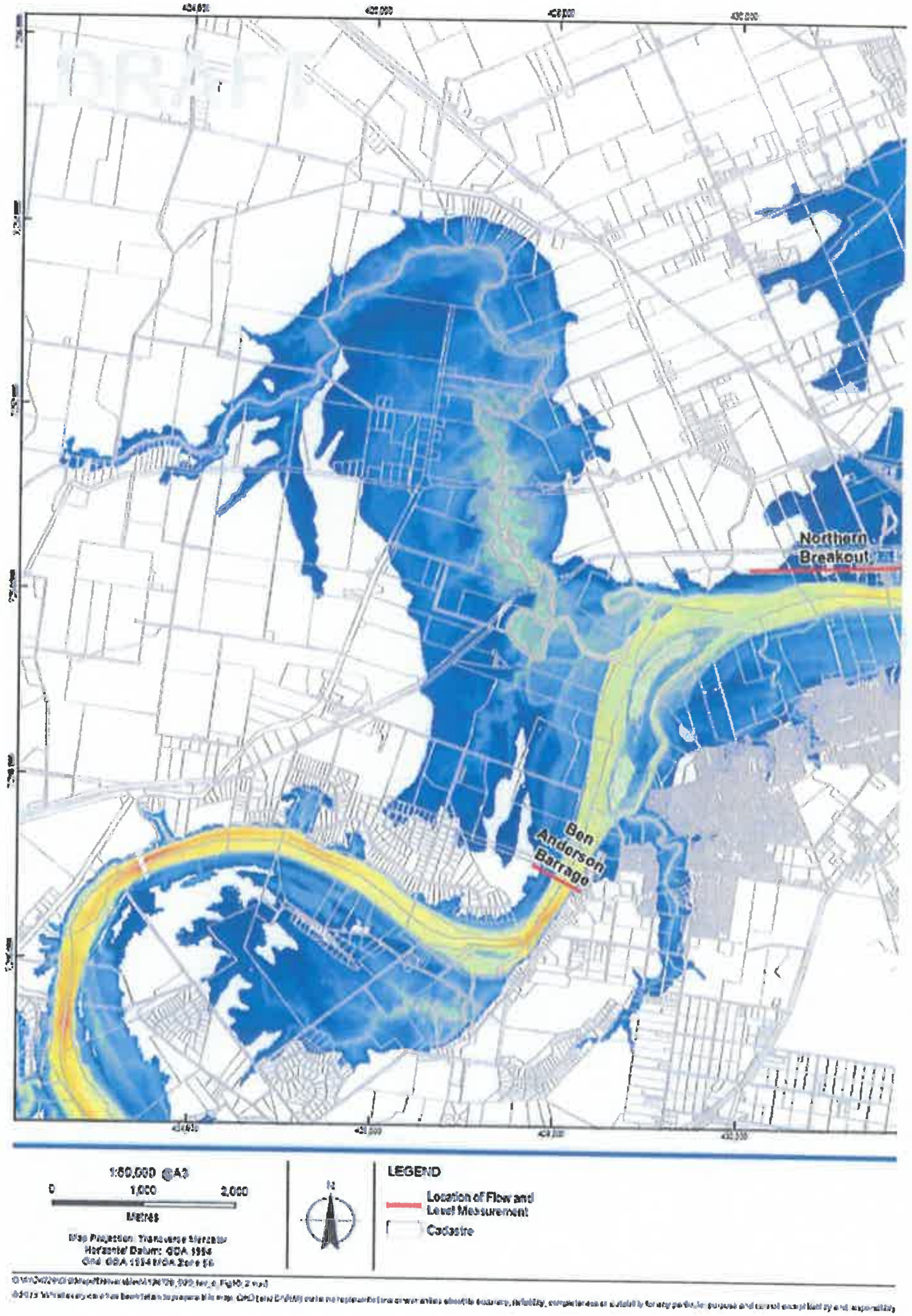
REGIONAL COUNCIL



Ben Anderson Barrage- Flood Elevation

To. Rowan Bond, CRG members, Robyn Laing.

Subject: Memorandum, Table 1. Subject No 28 "River Works", Ben Anderson Barrage.

(Dated 28 October 2013).

Sent to Rob Calligaris.

From GHD.

Issue of concern:

Subject 28. "Removal of Ben Anderson Barrage".

Rowan,

the GHD response to this subject matter, "The removal of Ben Anderson Barrage", does not really address the area of my concerns, which is elevated river heights during times of flooding.

GHD claim:

"No significant hydraulic benefit, major implications for water supply".

In terms of the second point first, there is adequate water supply in train through the Paradise Dam/Walla Weir impoundments.

The only obstacle is delivery of the water, (which is eminently achievable), and a long entrenched regional mind set focused on why we cannot do without the Barrage.

In terms of the first point, "no significant hydraulic benefit", I believe that the GHD modelling study is incomplete in that it primarily focusing its attention on the 2010-2013 periods.

The study does not model the river from the base line as a pristine river. This is fundamental to gauging whether or not the Ben Anderson Barrage elevates flood levels.

I contend that it DOES elevate flood levels.

Allow me to explain why.

Firstly, by their very nature, ALL dams and weirs elevate the water levels from one impoundment to the next as we progress upstream.

If not, then they cannot function as independent impoundments.

In the case of Ben Anderson Barrage, (as in the case of Bingera Weir before Ben Anderson was built), there is a salt water estuary on the downstream side, fresh water on the up river side.

It is absolutely vital under these conditions, that the tidal salt water cannot enter the fresh water impoundment, or the impoundment and its entire water capacity becomes undrinkable and unusable for most crop irrigation..

So the wall to wall cement structure must stand proud and above the spring tide level.

For the Burnett, the highest astrological tide, (summer), occurred on 12/1/2013, 8:57 at a 3.52m tide. During winter the highest tide was a 3.44m tide.

So Ben Anderson has to have been built above these levels or it cannot function in a useful way.

The height of the structure protruding from these spring tide levels, to the top of the barrage itself is the elevated level of fresh water upstream of the barrage.

Unfortunately, my computer is in the sick bay, so I am unable to research the levels just now.

A secondary example might be Walla Weir, which I believe is further elevated than Ben Anderson?

My rationale is that each impoundment in tidal waters, on the upstream side, has an artificially elevated water height above the high tide levels caused by the structure installation itself.

It cannot function were it to be otherwise.

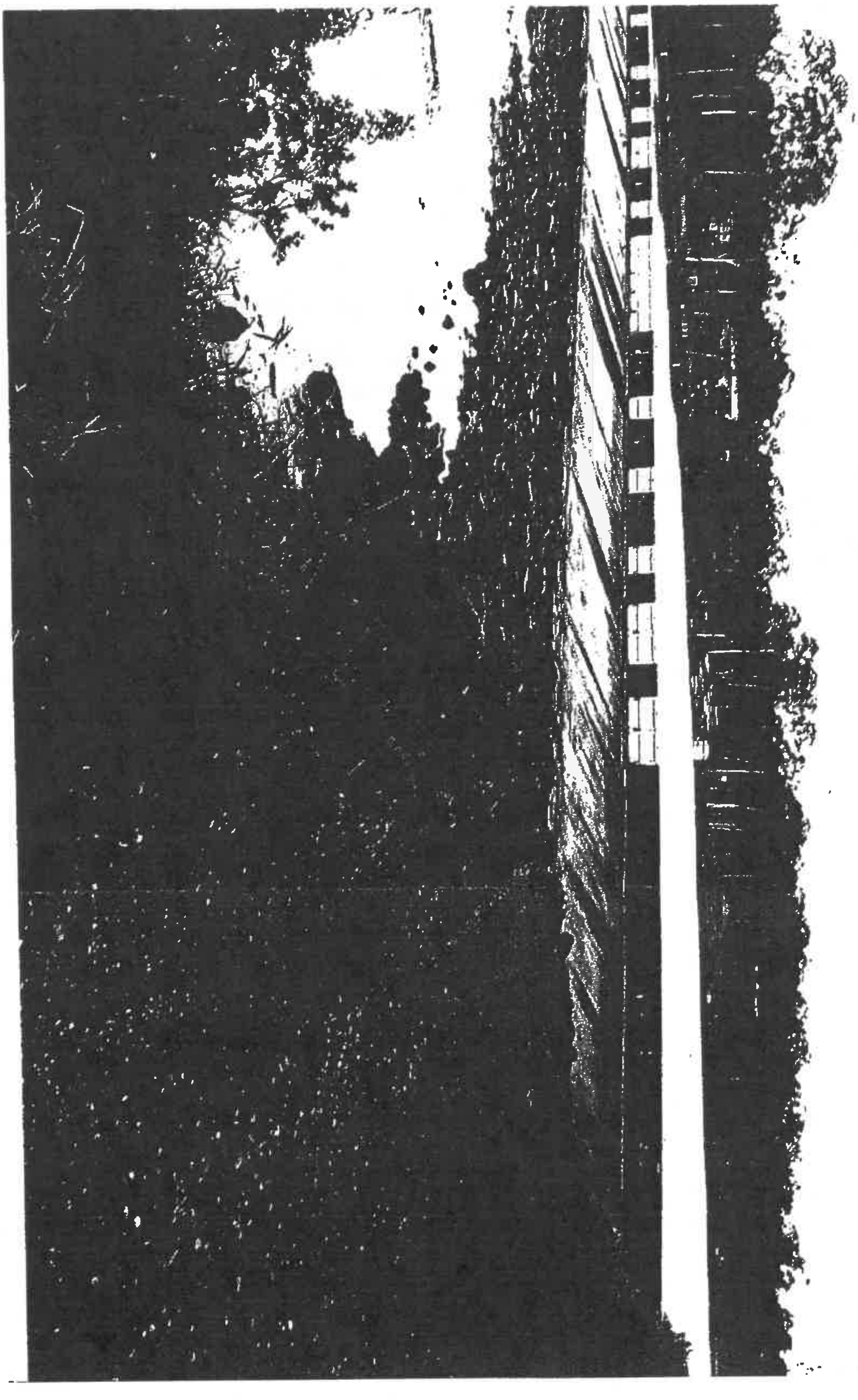
I contend this elevated river height cannot lessen during flood periods, and must in fact increase the water levels, compared to a pristine system.

This, and not basing the model on a pristine river system, is the component that I believe is missing from the GHD findings regarding Ben Anderson barrage.

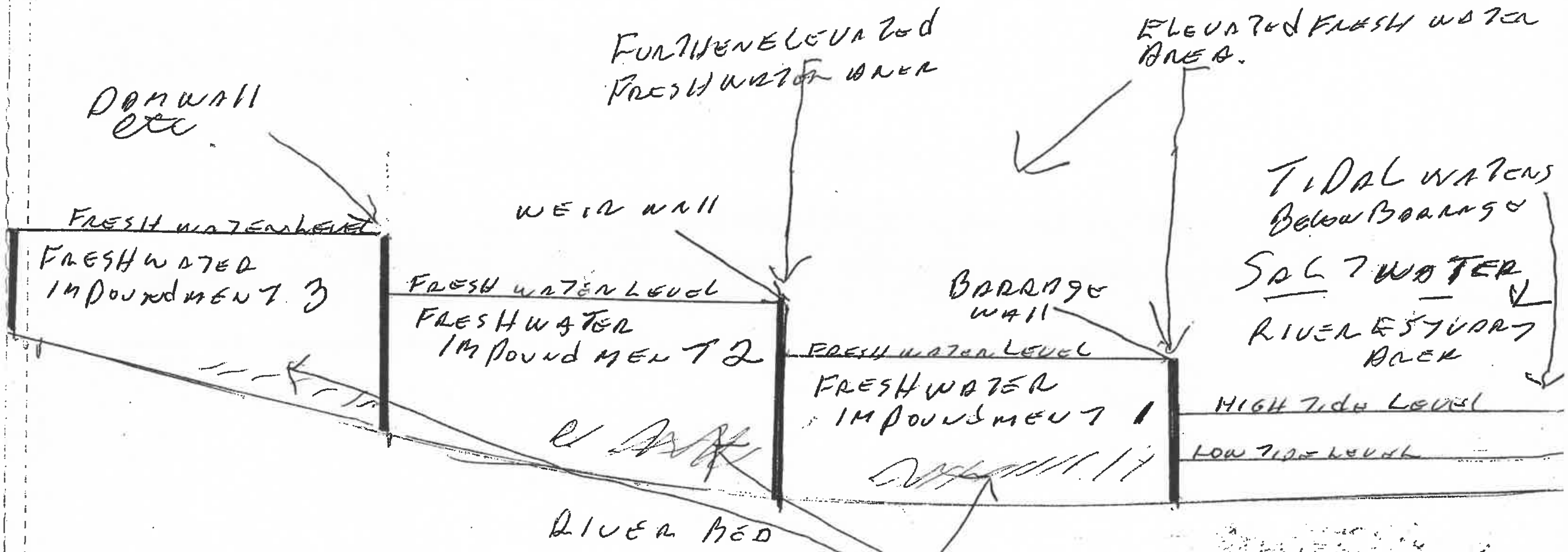
However there are a number of other salient points and ways that Ben Anderson Barrage contributes to flooding. I am happy to prepare a brief on these when my computer is fixed.

I am preparing a couple of very simple sketches to crystallise my point.

John Olsen



ROUGH SKETCH – RIVER SUCH AS BURNETT IN ADVANCED STAGES OF MODIFICATION. – EXAMPLE; SKETCH ONLY.

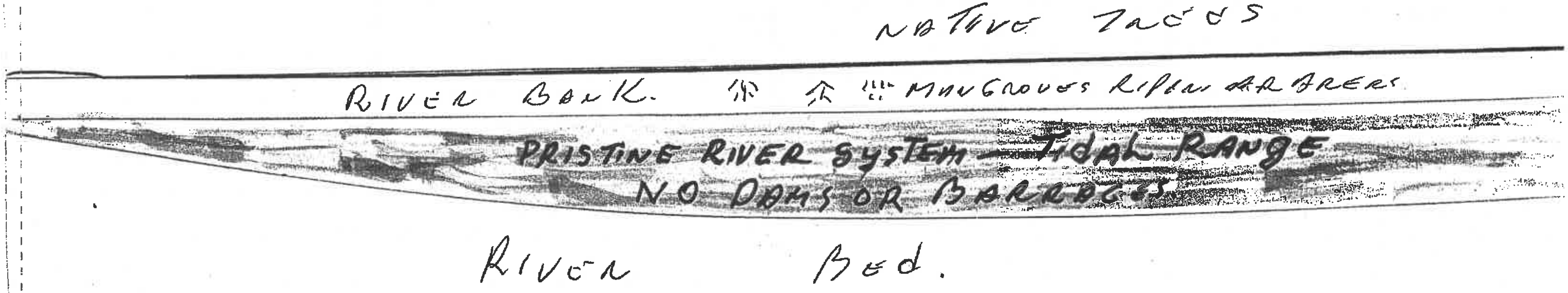


* OF ITSELF, THE MODIFIED SYSTEM CONTAINS DAM, WEIR AND BARRAGE WALLS WHICH ARE ELEVATED BY THEIR ENGINEERING DESIGNS. THIS MUST BE SO IN ORDER TO CATCH AND STORE INCREASED WATER LEVELS.

* IMPOUNDMENTS TRAP SEDIMENTS, DEBRIS, VEGETATION MATTER DURING DRY PERIODS. EXACERBATES SEDIMENT LOAD AND CAUSES HEAVY SILTATION.

SIMPLE SKETCH of A PRISTINE RIVER

NO SHAPING OR CONTOURS – PRINCIPLE OF ONLY.



* THERE ARE NO DAM WALLS ACROSS THE RIVER TO ELEVATE RIVER HEIGHT.

[redacted]

From:	[redacted]
Sent:	Thursday, 31 October 2013 1:42 PM
To:	[redacted]
Subject:	FW: Ben Anderson barrage
Follow Up Flag:	Follow up
Flag Status:	Completed

Rowan
Our Flood Consultants, GHD have supplied the following information in response to removal of Ben Anderson Barrage as a flood mitigation proposal.

Regards Robyn.

ROBYN LAING
Business Systems Facilitator
INFRASTRUCTURE & PLANNING
Bundaberg Regional Council
PO Box 3130
Bundaberg QLD 4670
Tel: 1300 883 699
Fax: (07) 4150 5410
http://bundaberg.qld.gov.au/

BUNDABERG
REGIONAL COUNCIL

From: Dan Copelin [redacted]
Sent: Thursday, 31 October 2013 12:07 PM
To: [redacted]
Cc: [redacted]
Subject: Ben Anderson barrage

Members of the CRG,

I wish to provide the following information to contribute to the discussion on the Ben Anderson barrage. You will note in my memo outlining the list of options for the MCA that the barrage removal option will not be taken forward as part of GHD's MCA. We made this decision primarily based on hydraulic modelling of the impact of the barrage. We will have the opportunity to discuss this information further during today's meeting. This information is provided for discussion purposes only and further detail and explanation will be provided in the final Floodplain Risk Management Study Report.

In terms of the barrage's direct impact on water levels during a significant flood event:

As part of the Burnett River Flood Study (refer to Section 11 once the report is available), GHD conducted a sensitivity test on the hydraulic model whereby the Ben Anderson barrage (as well as the bridges in the town reach) were removed from the model. The change in flood level for the 2013 event was calculated. The below is a screenshot of these results, where the points are labelled with the change in flood level in metres:

As seen, the removal of the barrage (and bridges) only reduces flood levels by 1 or 2 cm. This is not a significant effect, and is not an effective method for mitigating flooding. The primary reason for this very small effect is that the barrage is a relatively low structure (crest level 2.1m AHD) and the 2013 flood level at the barrage was about 12m higher than the top of the structure (flood level ~14m AHD at that location). The barrage was therefore completely drowned and exerted no significant impact on peak flood levels. This is true for all significant floods. The barrage would have a more pronounced impacted during minor river flows (where the water level downstream of the barrage is not much higher than the crest), however these flows are generally below the threshold of damaging floods and reducing water levels in these situations will not deliver benefit to the community. The below figure from the flood study shows this effect, where only a minor perturbation in the water surface is evident at the barrage. Far more significant are the locations circled in red, where constrictions in the river cause a significant increase in flood levels upstream.

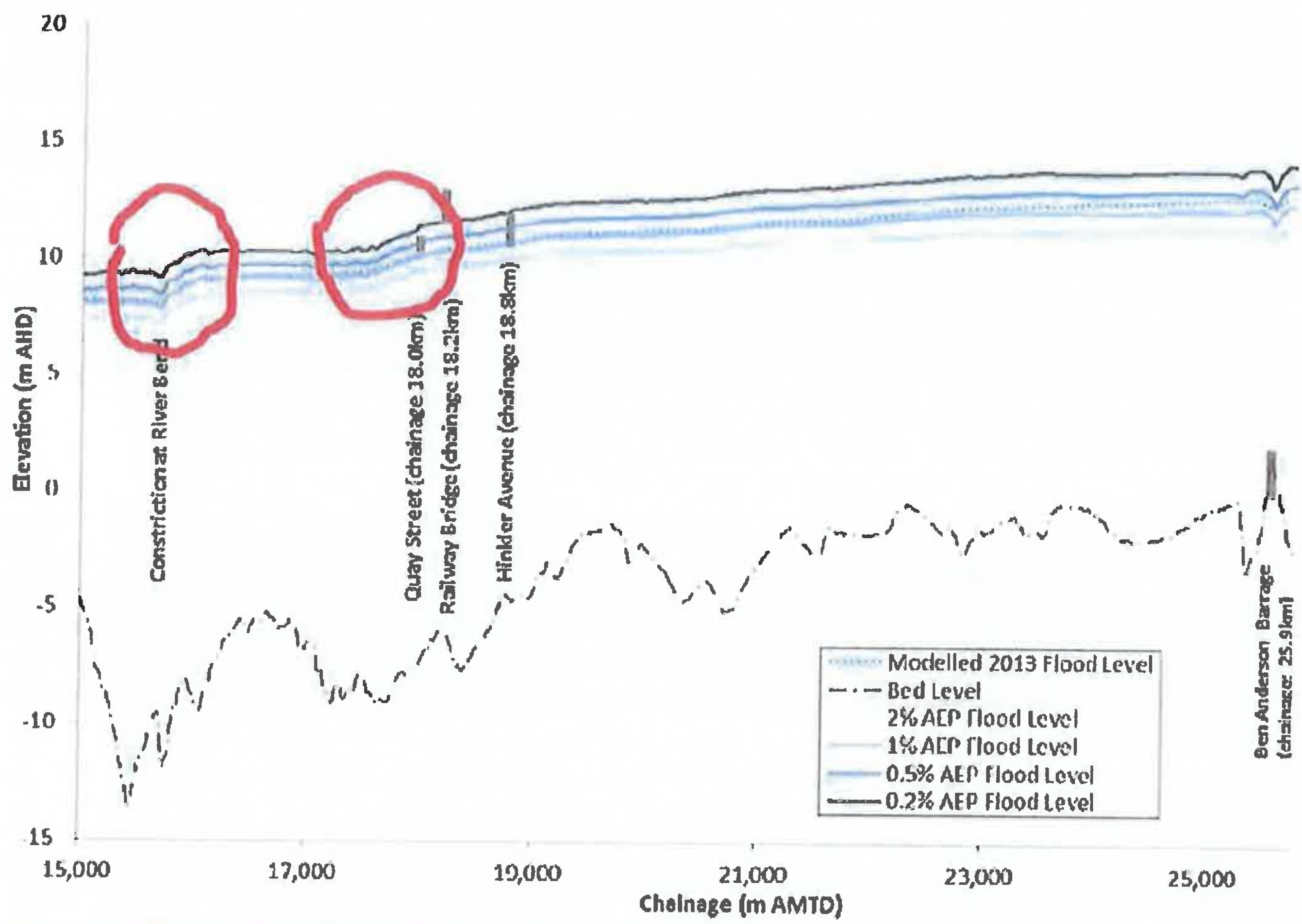


Figure 11-7 Design Event Flood Profiles along the Town Reach

In terms of the barrages impact on the accumulation of sediment in the town reach:

From very early records, it is known that the Burnett River is naturally very shallow in some locations and is heavily laden with sediment. It is also known that the river bed naturally changes over time due to the influence of tides and freshwater flooding, even without human interference. The Burnett River, as with other rivers in Queensland, has likely also been impacted by the clearing of land for agriculture. It is believed by some that man-made structures such as the Ben Anderson Barrage (built in 1974-75) have led to the accumulation of additional sediment and a reduction in river capacity through the town reach. There is certainly significant evidence (both anecdotal and from other sources such as aerial photograph) that intertidal mudflats (with accompanying mangrove growth) and sub tidal sediments have accumulated on the northern bank of the town reach over the period from 1942 to 2010. Whether this was due to the construction of the barrage or simply natural processes is a question that can be partially answered through engineering investigation.

In the past there have been two detailed hydraulic analyses (Queensland Government Hydraulics Laboratory, 1985 and 1994) of the impacts of the Ben Anderson Barrage on downstream sedimentation and channel depths. These studies were carried out in response to concerns that the barrage had caused a reduction in river depth in the town reach. While there were some limitations to these studies, the general finding was that the barrage had no significant impact on the accumulation of sediment downstream during both tidal and flood conditions. Based on these results, the observed accumulation of sediment in the town reach might be better explained by the lack of significant flood events between the time the barrage was constructed and 2010 or other natural or human-induced (i.e. soil loss due to agriculture) processes that have been occurring since before the barrage's construction.

Detailed surveys of the river bed from 2010, 2012 and 2013 show that recent flooding has removed significant quantities of sediment (up to 3m or more in places) from parts of the river bed, although some of the intertidal mudflats on the north bank remain. This supports the view that floods are the dominant factor contributing to the erosion and deposition of sediment in the Burnett River system. Further detailed investigations (geomorphological and sediment transport studies using modern computer simulations that model the flow of water in 2- or 3-dimensions and include fine silts and muds) would be necessary to conclusively determine whether removing the dam, weirs and barrages (or some combination thereof) would indirectly mitigate flooding in populated parts of the Burnett River floodplain by reducing the accumulation of sediment. This is because the processes that govern the mobilisation and deposition of sediments (gravels, sands, silts, muds, etc.) are complex, and a change in one part of the river might have both positive and negative impacts on the capacity of the river in other locations.

However, based on the currently available evidence described above it is not anticipated that the barrage has any significant impact on the accumulation of sediment through the town reach. Conventional wisdom and experience at many other river impoundments suggests that the most significant impact on sedimentation is actually upstream of the structure, where reduced flow velocities are likely to increase the rate of accumulation. Given this fact, the removal of the barrage may have detrimental effects on the town reach and below due to the release of this accumulated material.

Other Issues:

The other side of this issue, which isn't discussed here, is the potential cost of removing the barrage, which would have to be weighed against its benefits and the cost vs benefits of the other viable options under consideration. The substantial costs would include sourcing an alternate supply and constructing infrastructure to deliver water to Bundaberg, and sourcing additional supply to maintain the current level of water security during droughts. With the negligible benefits described above, we are confident that removal of the barrage is not a viable option for directly mitigating damaging floods.

Regards,

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