TECHNICAL REPORT

3

Flooding and hydrology assessment

PART 5 OF 13

Appendix E to F

NARROMINE TO NARRABRI ENVIRONMENTAL IMPACT STATEMENT

INLAND RAIL

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The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

TECHNICAL REPORT 3

Flooding and hydrology assessment

Appendix E River style descriptions

River style descriptions

The content of these River Style Descriptions has been sourced primarily from existing reports that document the River Styles Assessments completed for the Namoi, Castlereagh and Macquarie Catchment Areas (GHD, 2010; Lampert and Short, 2004). Where available photographs of specific watercourses have also been included, taken during site assessments by aquatic ecologists.

Confined Valley Setting, Confined valley, sand	
Characteristic	**Description**
Character	Single, low sinuosity, laterally stable sand bed system. Channel is symmetrical with variable width/depth ratio. Channel alignment and geometry is valley controlled. Occasional small floodplain pockets are observed along some reaches, in areas of locally wider valleys. The flat, featureless bed, which resembles a valley fill, is dominated by sand with some fines and organic materials. The bed is usually highly mobile but in undisturbed situations the surface is stabilised by a dense growth of grasses. Valley margins form the banks, except on the rare occasions where floodplain pockets occur.
Geomorphic Units	Within channel: • lumpy, featureless sand dominated bed • poorly defined low flow channel may be present • small scour features in bed associated with valley margins, large trees or Large Woody Debris (LWD). Floodplain: • generally absent, occasional small floodplain pockets may be present in areas of local valley widening • scour features on floodplain.
Controls	Occurs in middle to upper catchment positions of the *Pilliga* landscape unit, with a small presence in the *Liverpool plains*. Generally in low sinuosity, regular valleys between 5 m and 50 m wide at valley floor. Upstream catchment areas are up to 200 km^2 and on gradients of 0.01 m/m and steeper.
Behaviour	These intermittent systems do not typically retain surface water between flow events. With similarities to valley fills and gorges the whole valley floor acts as the channel during flow events. In nearly all cases, even the largest flow events are contained within the channel. Moderate to high flows transport both sand and suspended sediments that are deposited as a blanket on the bed via vertical accretion processes as flows wane. Benches and small floodplains pockets are formed through lateral accretion processes as a result of flow separation on bends. The stability of the bed is directly related to vegetation. If vegetation is disturbed, fines and organic materials are preferentially transported downstream, leaving a coarse mobile sand bed. Once disturbed the massive release of sediment will cause sediment slugs and the aggradation of downstream reaches. After disturbance the highly mobile bed and the lack of fines and organic matter may inhibit future revegetation. Relatively steep gradients and confinement can generate moderate to high stream powers. Hydraulic diversity is low due to homogeneous bed, however instream vegetation and LWD (if present) do create some scour features within the bed. Sediment transfer is generally in balance, unless bed vegetation has been disturbed and sand bed mobilised.

Confined Valley Setting, Confined valley, sand	
Characteristic	**Description**
Variability within River Style	Channel bed may be vegetated, dominated by sands with fines and organic matter (eg Molliera Creek) or comprised of mobile sand sheet (eg Rocky Creek).
Reaches	Coolangla Creek, Cumbil Forest Creek, Rocky Creek, Talluba Creek, Rocky Creek, Coghill Creek, Mollieroi Creek.

Mollieroi Creek Confined valley, sand, bed is partially stabilised by grasses

Rocky Creek Confined valley, sand. Sand bed is highly mobile

Partly Confined Valley Setting, Bedrock controlled, sand	
Characteristic	**Description**
Character	Single, low-moderate sinuosity, laterally stable channel within a partly confined valley. Changes in valley width and alignment largely dictate channel sinuosity and the longitudinal extent of floodplains. Discontinuous floodplains are formed as the channel crosses from valley margin to valley margin. Channel is generally compound with low-moderate width/depth ratio. Bed is composed of sands with occasional gravel deposits in higher energy locations. Banks are composed of bedrock or vertically accreted fines and sands.
Geomorphic Units	Within channel: • Long pools, often bedrock forced, separated by gravel riffles and bedrock steps • Sand and gravel bars (bank attached and point) • Vegetated islands • Benches with chute channels Floodplain: • Discontinuous floodplains traversed by flood channels • Levees on inside bends • Sand splays • Backswamps in protected, distal areas of the floodplains
Controls	Occurs in middle to upper catchment positions, predominantly within the *Sandstones* landscapes. Located in sinuous, spurred valleys, up to 1 km wide at valley floor. Gradients typically range from 0.002 to 0.02 m/m and catchment areas are up to several 10,000 km^2 (Macquarie River).
Behaviour	During low flows, fast flowing riffles/bedrock steps separate long slow flowing pools. Moderate flow events mobilise the sand bed, rework bars and scour pools. Flood events activate chute channels and form benches and levees. During floods the sand bed load is transported in suspension and sand splays are deposited on the floodplains by surges in flood height. Although moderate to high stream powers can be generated, the channel is relatively stable with little capacity for lateral adjustment. Concave banks are often pinned against the valley margin, limiting downstream migration of bends, and the floodplains usually form where bedrock spurs protect them. Channel may change course through avulsion in locally wider sections of valley. Channel is prone to enlargement through the erosion of benches and floodplains, especially when riparian vegetation is disturbed. LWD is often a significant bed control and, if removed, channel is prone to localised bed adjustments. Hydraulic diversity is high, with a range of flow conditions created by a diversity of bed materials, bed forms, bedrock outcrops and LWD. Sediments are generally throughput over the long term with temporal storage in floodplain deposits. Sediments may accumulate if upstream reaches are disturbed, resulting in pool infilling and a less diverse bed character.
Variability within River Style	Variations in valley width over short distances may create more confined gorge-like reaches or less confined more laterally active reaches.
Reaches	Macquarie River

Macquarie River Bedrock controlled, sand

Macquarie River Bedrock controlled, sand

Partly Confined Valley Setting, Planform controlled, low sinuosity, sand	
Characteristic	**Description**
Character	Single, low-moderate sinuosity, symmetrical channel set within a slightly irregular valley. Valley margins, which may be bedrock or terrace, limit lateral migration of channel. Discontinuous floodplains are formed as the channel crosses the valley floor from one valley margin to the other. Bed composed of fine to coarse sands. Banks and benches dominated by sands with fine-grained sediments and occasional gravel deposits in the form of riffles. Floodplains are composite of sand overlain by vertically accreted fine-grained sediments.
Geomorphic Units	Within channel: • Pools separated by sand riffles and/or log steps • Bank attached and mid-channel bars dissected by chute channels • Vegetated islands, up to 20 m long and 10 m wide Floodplain: • Discontinuous floodplains traversed by flood channels • Terraces • Linear backswamps abutting channel margins
Controls	Occurs in middle catchment positions across all landscapes with higher representation in the *Sandstone* landscapes. Valley width is regular and is generally less than 100 m wide, but can be up to 200 m wide. Valley margins may be terrace or bedrock. Gradients typically lie between 0.002 and 0.004 m/m and catchment area of up to 10,000 km^2 (Castlereagh River).
Behaviour	Between flows, stagnant pools are separated by dry riffles. During low flow events, the pools are connected by faster flowing riffles, transporting suspended sediments. Moderate stream energies generated during higher flows mobilise bed sediments, rework bars and scour pools. Overbank flows activate flood channels and deposit fine-grained sediment on the floodplains through vertical accretion processes. Hydraulic diversity is moderate to high, with variations in bed form and moderate LWD loading creating a variety of flow and habitat conditions. Sand transfer is in balance over the long term, with floodplains storing sediment over medium to long time frames. The channel is generally stable, however it is prone to expansion, incision and avulsion in wider valley settings. This will release stored sediments leading to the infilling of pools and reducing bed heterogeneity. The increased sediment supply will also impact on downstream reaches, again infilling pools and reducing bed diversity.
Variability within River Style	Valley margins may be bedrock or terrace. Can exhibit localised sections of higher sinuosity.
Reaches	Ewenmar Creek, Native Dog Creek, Kickabil Creek, Bundijoe Creek, Castlereagh River, Gulargambone Creek, Quanda Quanda Creek, Salty Springs Creek, Teridgerie Creek, Baradine Creek

Kickabil Creek, Planform controlled, low sinuosity, sand

Baradine Creek, Planform controlled, low sinuosity, sand

Partly Confined Valley Setting, Planform controlled, low sinuosity, fine grained	
Characteristic	**Description**
Character	Single, trench-like, symmetrical low sinuosity channel set within a partly confined valley. Low width to depth ratio channel flows through valleys up to 300 m wide at valley floor. The channel is moderately laterally stable with slow rates of lateral migration through concave bank erosion. Discontinuous floodplains are formed as channel moves from valley margin to valley margin. Cohesive fine-grained sediments dominate bed and alluvial banks. This style of creek is not commonly in poor condition.
Geomorphic Units	Within channel: • Occasional pools separated by short riffles or glides composed of small • Gravels • Benches and ledges • Undercut concave banks Floodplain: • Discontinuous fine grained floodplain • Flood channels • Relict features including paleochannels and cut offs • Terraces • Occasional levees on concave bends
Controls	Located in middle, upper and lower catchment positions across all landscapes, with higher representation in the *Alluvial* and *Sandstones* landscapes. Occurs in irregular valleys up to 300 m wide. Gradients lie between 0.002 and 0.009 m/m and upstream catchment areas are up to 15,000 km^2.
Behaviour	During low to moderate flows long, slow flowing pools are separated by short glides or riffles. These flows gradually undercut the outside banks of meander bends, resulting in slumping and the slow lateral migration of bends. Higher flows generate moderate stream energies, which are quickly dissipated across the floodplain. These flows activate flood channels and may result in a dramatic shift in channel position through avulsion. Fine-grained sediments are deposited via vertical accretion of suspended sediments on the floodplain and in palaeochannels during the waning stage of the flood. The limited range of in-channel geomorphic units means that hydraulic diversity is relatively low. Channel sinuosity and occasional LWD pieces provide some diversity in flow conditions. Fine-grained suspended sediments are throughput over all time frames, with floodplains being reworked over long time scales.
Variability within River Style	This style can be transitional between gravel and fine-grained. Often formed as a result of incision of valley fills or chain-of-ponds and is often terrace confined.
Reaches	Calga Creek

Laterally Unconfined Valley Setting, Low sinuosity, gravel	
Characteristic	**Description**
Character	Single, low-moderate sinuosity channel set within a wide continuous floodplain. Channels are compound to asymmetrical with low-moderate width/depth ratio (up to 60 m wide and 7 m deep). The channel is characterised by long pools separated by gravel riffles with gravel point bars on convex bends. Relatively laterally stable, due to fine grained vertically accreted floodplain, although prone to avulsion. Well armoured, often imbricated gravel bed.
Geomorphic Units	Within channel: • pools up to several 100 m long separated by gravel riffles • gravel bars (mid-channel, point and bank attached) dissected by chute channels • point and lateral benches • vegetated islands Floodplain: • multi-surfaced continuous floodplain bounded by terraces or bedrock • flood channels 5-10 m wide and several 100 m long • relict features including palaeochannels and backswamps.
Controls	Common in *Liverpool* plains landscape units, also found in *Lowland plains* and *Pillaga outwash*. Located in middle to lower catchment positions, in generally regular valleys ranging from 500 m to 15 km wide. Gradients lie typically between 0.0016 and 0.0065 m/m and catchment areas are up to 28,000 km^2.
Behaviour	During low flows, long pools are separated by faster flowing riffles, only fine-grained suspended sediments are transported and some infilling of pools occurs. Moderate stream energies generated by higher flow events, transport gravels, scour pools and rework bars and riffles. Channel is prone to lateral migration and avulsion especially if riparian vegetation is disturbed. Relic palaeochannels indicate a long history of channel avulsion and reworking of the floodplain deposits. Overbank flows activate flood channels and deposit suspended fine-grained sediments on the floodplain during the waning stage of flood. Generally flooded every 2-5 years unless incised. The high degree of channel incision and expansion along many reaches has disconnected the channel from the floodplain. Moderate to high hydraulic diversity is generated by an array of instream geomorphic units, moderate LWD loading and instream vegetation. Sediment transfer is in balance over the long term or gradually accumulating, unless the channel is expanding.
Variability within River Style	Anabranches are observed along some reaches. Channel may be disconnected from floodplain if it has incised and enlarged.
Reaches	Namoi River, Narrabri Creek

Namoi River, Low sinuosity, gravel

Namoi River, Low sinuosity, gravel

Laterally Unconfined Valley Setting, Low sinuosity, sand	
Characteristic	**Description**
Character	Single, laterally unconfined and relatively active channel set within a slightly undulating, wide and continuous floodplain. Channel is symmetrical to compound with a high width depth ratio (up to 60 m wide and 2 m deep). Bed is a relatively featureless, mobile sand sheet with scattered gravels, up to 10 mm b-axis. Banks are fine sands with some silt and organic matter. The wide floodplains are bounded by terraces and are traversed by a series of flood channels and palaeochannels.
Geomorphic Units	Within channel: • Planar mobile sand sheet with scattered gravels • Small bars with chute channels • Benches up to 50 m long and 10 m wide with chute channels • Scroll bars • Point bar/bench complex at confluence with tributaries Floodplain: • Broad, gently undulating, continuous floodplain • Levees and sand splays • Valley margins are dominantly terraces • Paleochannels and flood channels
Controls	Occurs in the *Pilliga outwash*, *Pilliga* and *Liverpool plains* landscape units, most commonly in middle catchment positions of the *Pilliga outwash*. Located in regular valleys between 250 and 5,000 m wide. Typically on gradients between 0.0018 and 0.0065 m/m and with catchment area of up to 1,350 km^2.
Behaviour	These intermittent systems do not retain surface water between flows. Low to moderate stream energies generated by higher flows will mobilise the un-vegetated sand bed and rework bars and benches. The channel will go through phases of incision, expansion and lateral migration, and then recover through bench formation. Over bank flows, which occur at intervals of between 1 and 2 years, activate flood channels, dissipating flow energy onto the floodplains. Levees and splays are formed when sediment charged floodwater loses energy as it breaks out of the channel, depositing sediment along the channel margin. The presence of numerous palaeochannels on the floodplains suggests that the channel is prone to avulsion and reflects a history of reworking the floodplain and outwash deposits. Hydraulic diversity is low due to the generally featureless, mobile sand bed, low levels of LWD and only scattered instream vegetation. Sediment throughput is generally in balance, however sand will accumulate rapidly when there is upstream incision or erosion.
Variability within River Style	Some systems draining the Pilliga area are thought to be recently infilled or incised *Lowlands chain of ponds* River Style. Some of these reaches exhibit relic ponds on the floodplains, while others show evidence of recent pond formation.
Reaches	Emogandy Creek, Marthaguy Creek, Caleriwi Creek, Etoo Creek, Goona Creek

Goona Creek, Low sinuosity, sand

Goona Creek, Low sinuosity, sand

Laterally Unconfined Valley Setting, Low sinuosity, fine-grained	
Characteristic	**Description**
Character	Single, low-moderate sinuosity channel with wide continuous floodplains. Symmetrical or compound channel with a low width/depth ratio. Relatively laterally stable channel, due to fine-grained cohesive banks and floodplains. Relict features on floodplain show prior position of channel. Bed composed of fine-grained sediments. Some reaches have small gravel deposits usually in the form of bars or riffles.
Geomorphic Units	Within channel: • Pool/riffle sequences • Occasional point bars • Log steps up to 1 metre high • Benches up to 30 m long and 10 m wide • Inset features Floodplain: • Gently undulating continuous floodplain with subtle multi-surfacing • Flood channels • Tributaries often flood out across the floodplain • Relict features including palaeochannels
Controls	Typically occurs in lower catchment positions across all landscape units, but predominantly in the Alluvial landscape. The channel generally flows through regular valleys, ranging from 500 to 30,000 m wide, with gently sloping valley sides. Gradients are typically low ranging from 0.001 and 0.003 m/m but up to 0.007 m/m. Upstream catchment areas are up to several 10,000 km^2.
Behaviour	The channel generally holds water in isolated pools between flows. Moderate to high flows transport gravels (if present), slowly erode concave banks and scour pools below log steps. The channel is prone to incision followed by expansion, reducing the frequency of overbank flows and increasing within channel flow energy. When in good condition, the channel has a low capacity and overbank flows are readily dissipated across the floodplain surface, activating flood channels and depositing fine grained sediments on the floodplain. The presence of benches along poorer condition reaches may reflect river recovery following expansion after disturbance. Moderate hydraulic diversity is created by variations in bed form, log steps and bank vegetation. LWD loading is moderate to low, relying on recruitment from adjacent and upstream riparian vegetation. Low energy systems due to gentle gradients and broad continuous floodplains. Fine-grained sediments slowly accumulate over the long term.
Variability within River Style	Short sections may be anabranching or may represent an arm of a large anabranching system that displays low-sinuosity fine-grained style features. These systems often act as distributary channels in some anabranching systems. May have occasional gravel deposits in the form of bars and riffles.
Reaches	Baronne Creek, Bucklanbah Creek

Laterally Unconfined Valley Setting, Channelised fill	
Characteristic	**Description**
Character	Continuous channel that has incised, probably since European settlement, into valley fill or chain of ponds through head-cut retreat and channel expansion. Forms a laterally stable, low sinuosity, trench-like, symmetrical or compound channel. Valley confinement varies from partly-confined to laterally unconfined. The floodplains represent former valley fill surfaces and are generally flat and featureless. Bed and banks are dominated by mud, sand and small, angular gravel. A low flow channel may meander within the larger, incised macro-channel.
Geomorphic Units	Within channel: • Trench-like channel with inset features (benches) • Bank attached bars • Occasional pools • Sand/gravel sheets • Bedrock steps Floodplain: • Floodplains are generally flat and featureless and can be continuous or discontinuous (depending on degree of valley confinement) • May have relict ponds if incised chain of ponds
Controls	Occurs in any catchment position in regular or irregular valleys across all landscape types. Gradients are typically greater than 0.002 m/m and catchment areas are generally less than 50 km^2.
Behaviour	These systems generally have an intermittent flow regime and do not usually retain surface water between flow events. Low flows are often contained within the low flow channel and transport fine grained suspended sediment. Moderate stream energies generated during higher flow events can re-activate erosional processes. Head-cuts will progress upstream and unprotected banks will erode, releasing large amounts of sediment. Most channels have incised to a point where all flows are contained within the channel such that the former fill surfaces are rarely inundated. This concentrates flow energy within the channel resulting in increased rates and occurrences of channel erosion. Terraces at valley margins indicate a history of phases of incision and infilling. Hydraulic diversity is low due to limited variability in bed form and only scattered LWD. During the incision phase these systems are a sediment source and become a sediment sink when recovering (infilling). Indications of recovery include improved bed stability and channel narrowing through the deposition of stable benches. The release of sediment during the incision phase has significant downstream impacts including bed aggradation and homogenisation.
Variability within River Style	Degree of valley confinement varies from partly-confined to laterally unconfined.
Reaches	Wallaby Creek, Goulburn Creek, Pint Pot Gully, Milpulling Creek

Discontinuous, Valley fill, sand	
Characteristic	**Description**
Character	Featureless swampy valley floor surface with no defined, continuous channel. Whole valley floor acts as a channel with valley margins as the banks. Valley floor is either flat or slightly higher in the centre than at the valley margins and up to 2000 m wide. Swampy bed surface is composed of organic rich mud and/or sand especially in the granitic areas of the catchment.
Geomorphic Units	Within channel: • Alluvial fan confined by valley walls with no discrete geomorphic units • Swampy fill surface is typically flat and featureless Floodplain: There is no floodplain within this River Style.
Controls	Occurs in any catchment position in regular or irregular valleys across all landscape types but predominantly in upper catchment positions. Rare in the *Alluvial* landscape. The width at valley floor is highly variable, ranging from 5 to 2000 m. Gradients range between 0.002 and 0.04 m/m and upstream catchment areas are generally less than 50 km^2.
Behaviour	The swampy fill deposits retain water between flow events, generally flowing slowly and continuously below the surface. During high intensity rain events water flows across the surface in a sheet. Flow energy is dissipated across the valley floor, resulting in the deposition of fine-grained suspended sediments. Low energies associated with flow dissipation lead to long-term accumulation of fine-grained sediments. The vegetation cover on these systems is very important because once disturbed, finer grained sediments and organic material are easily flushed away leaving a continuous, homogeneous coarse mobile sand bed. If valley floor is disturbed a head-cut may be also be initiated. This will form a continuous channel that will incise, enlarge and progress up stream with each subsequent flow event. This significantly alters the behaviour of the system (refer to *Channelised fill*). When intact, hydraulic diversity is low, flow is either sub-surface or across the valley floor at uniform depth and velocity.
Variability within River Style	n/a
Reaches	Tenandra Creek, Mungery Creek, Black Gutter, Small Creek

Tenandra Creek, Valley fill, sand. Vegetation has been cleared from banks from valley floor and shows signs of active incision and head cut development

Discontinuous, Valley fill, fine-grained	
Characteristic	**Description**
Character	Featureless swampy valley floor surface with no defined, continuous channel. Whole valley floor acts as a channel with valley margins as the banks. Valley floor is either flat or slightly higher in the centre than at the valley margins and up to 2000 m wide. Swampy bed surface is generally composed of organic rich mud and silt.
Geomorphic Units	Within channel: • Alluvial fan confined by valley walls with no discrete geomorphic units • Swampy fill surface is typically flat and featureless Floodplain: There is no floodplain within this River Style.
Controls	Predominately located on the Alluvial plains as "Cowals", abandoned channels and low flow fills, however occurs within all landscapes and catchment positions. Located in upper catchment positions at points of valley widening. The width at valley floor is highly variable, ranging from 5 to 2000 m. Gradients range between 0.002 and 0.04 m/m and upstream catchment areas can be up to several 10,000 km^2.
Behaviour	The swampy fill deposits retain water between flow events, generally flowing slowly and continuously below the surface. During high intensity rain events water flows across the surface in a sheet. Flow energy is dissipated across the valley floor, resulting in the deposition of fine-grained suspended sediments. Low energies associated with flow dissipation lead to long-term accumulation of fine-grained sediments. The vegetation cover on these systems is very important because once disturbed, a head-cut may be initiated. This will form a form a continuous channel that will incise, enlarge and progress up stream with each subsequent flow event. This significantly alters the behaviour of the system (refer to Channelised fill) and releases excess sediment downstream. Lateral stability in these reaches is generally high due to the cohesive nature of the fine grained sediments and the lack of channel definition, which prevents flow confinement. Therefore there is generally no thalweg visible in these reaches, and the flows simply flood out over the valley floor, occasionally to the outer margins of this floor, giving rise to the slight dome-shape to the centre of the valley. Lateral stability in these reaches is determined by the degree of channel incision.
Variability within River Style	n/a
Reaches	Judes Creek

Discontinuous, Valley fill, Lowland chain of ponds	
Characteristic	**Description**
Character	Symmetrical, discontinuous ponds separated by poorly defined channel depressions, swampy fills and/or sand splay deposits. The ponds are surrounded by fill deposits set within partly confined to unconfined valleys with margins varying between bedrock and terraces. Ponds are round to linear (up to 200 m long) in shape and are often located against the valley margin. Usually a single channel exists characterised by a line of discontinuous ponds. However, in some unconfined reaches two or more channel depressions can be observed, separated laterally by low relief ridges. In more confined reaches discontinuous floodplain surfaces are present, inset within a bedrock margin or higher relief terrace plain. These floodplains often exhibit backswamps and flood channels on their surfaces. The bed and banks of the channel are composed of fine sands with mud and organic material.
Geomorphic Units	Within channel: • Pools/ponds up to 200 m long, 30 m wide and 2 m deep • Ponds can be connected by a poorly defined channel depression or separated by swampy, featureless fills and/ sandy splay-like deposits Floodplain: • Floodplains may be continuous or discontinuous and are often multi-surfaced • Flood channels traverse floodplain and terrace surfaces • Backswamps on distal floodplain margins
Controls	Located in middle to lower catchment positions of regular valleys, predominantly within the Alluvial and Sandstone landscape units. Valley floor width is variable, typically greater than 50 m. Valley floor gradients lie between 0.001 and 0.002 m/m and catchment areas are up to 200 km^2.
Behaviour	Ponds tend to retain water throughout the year. During moderate to high flow events sand, fine-grain and suspended sediment is transported. These events also redistribute LWD, scour pools and rework splay deposits downstream of the ponds. Overbank flows activate flood channels and deposit sand and debris on floodplain. Sandy bank attached bars are formed at the top and bottom end of pools as flows subside. The often well-vegetated nature of the fill deposits surrounding and separating the pools restricts the formation of a continuous channel. Vegetation disturbance can lead to the initiation of a head-cut and the development of a continuous, mobile channel (See *Channelised Fill*). Re-colonisation of the channel bed by vegetation will lock up sediments and allow pools to reform within the recently created channel zone. Increased sediment supply from incising reaches upstream can drown out pools downstream, also creating a flat mobile sand sheet (refer to Low sinuosity, sand). Sand sheet may be re-scoured during high flows once sediment supply is blocked.
Variability within River Style	Channel may be set within a partly-confined, terrace controlled valley or an unconfined alluvial setting. Unconfined reaches are more laterally active and may have multiple, ill-defined channel depressions linking ponds. Some pond systems are also bedrock forced, where pools form at bedrock margins but have a discontinuous form.
Reaches	Tinegie Creek, Bundock Creek, Bohena Creek

Tinegie Creek, Lowland chain of ponds

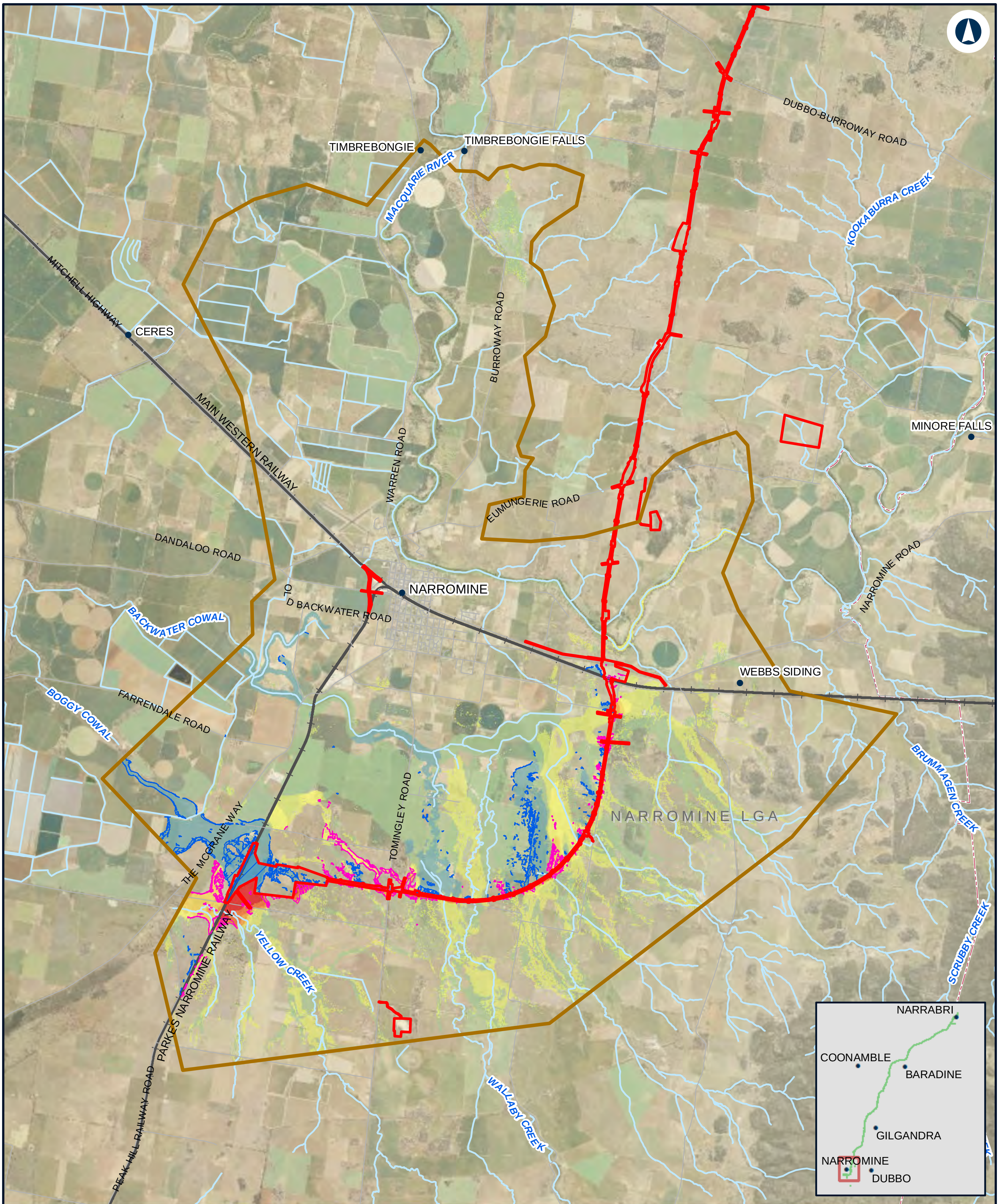
Bundook Creek, Lowland chain of ponds

TECHNICAL REPORT 3

Flooding and hydrology assessment

Appendix F Construction flood impact mapping

NARROMINE TO NARRABRI ENVIRONMENTAL IMPACT STATEMENT



NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - NFM Appendix F - Figure 1a

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:140,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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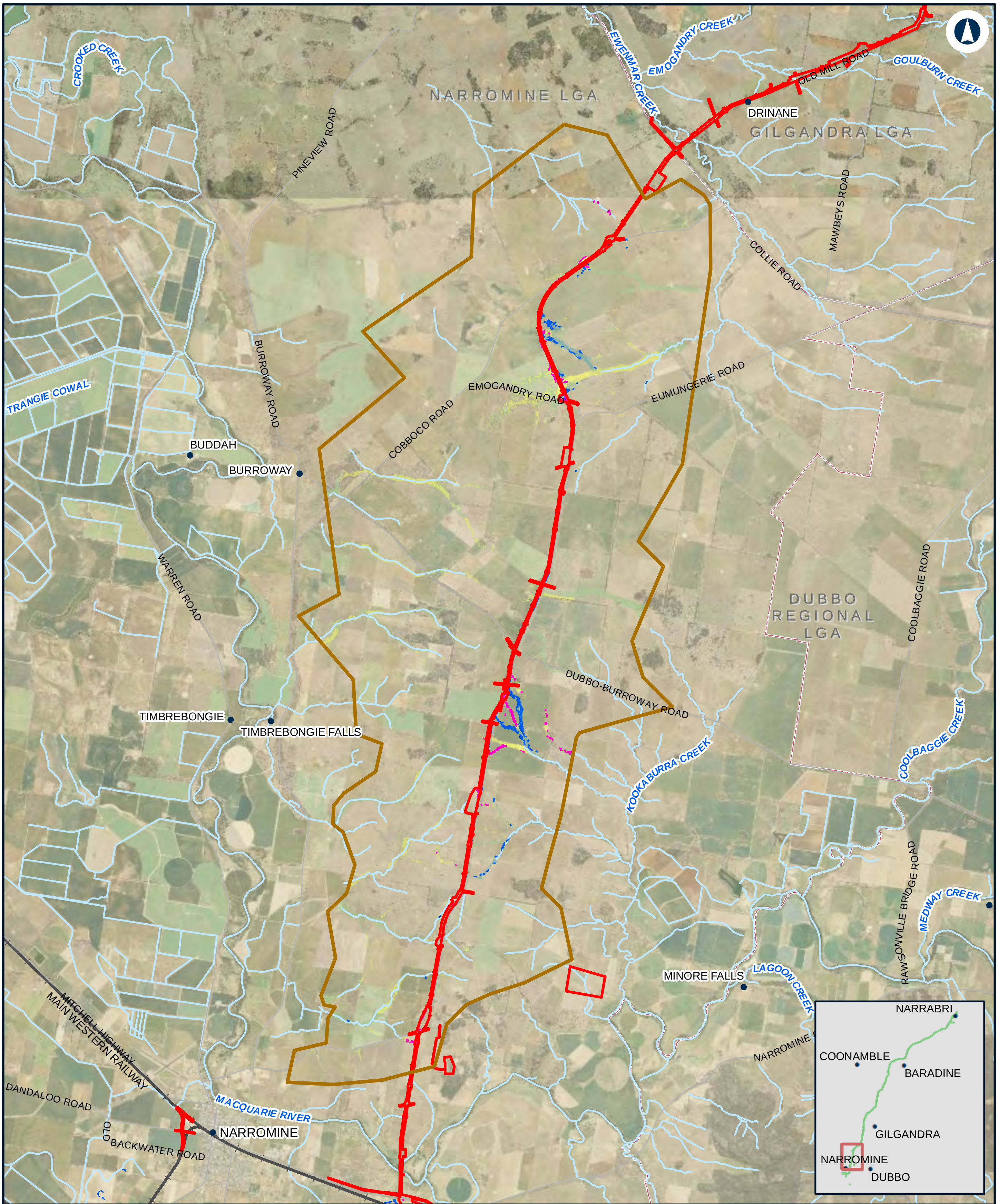

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N14 Appendix F - Figure 1b

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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G:\22\19593\GIS\GIS_2500_N2N_v2\Maps\Deliverables_EISFinal\EIS\FloodingHydrologyAssessment\Apendix\2500_EISFWPAPP040_FloodImpactAfflux__Construction_20pc.mxd

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N13 Appendix F - Figure 1c

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:180,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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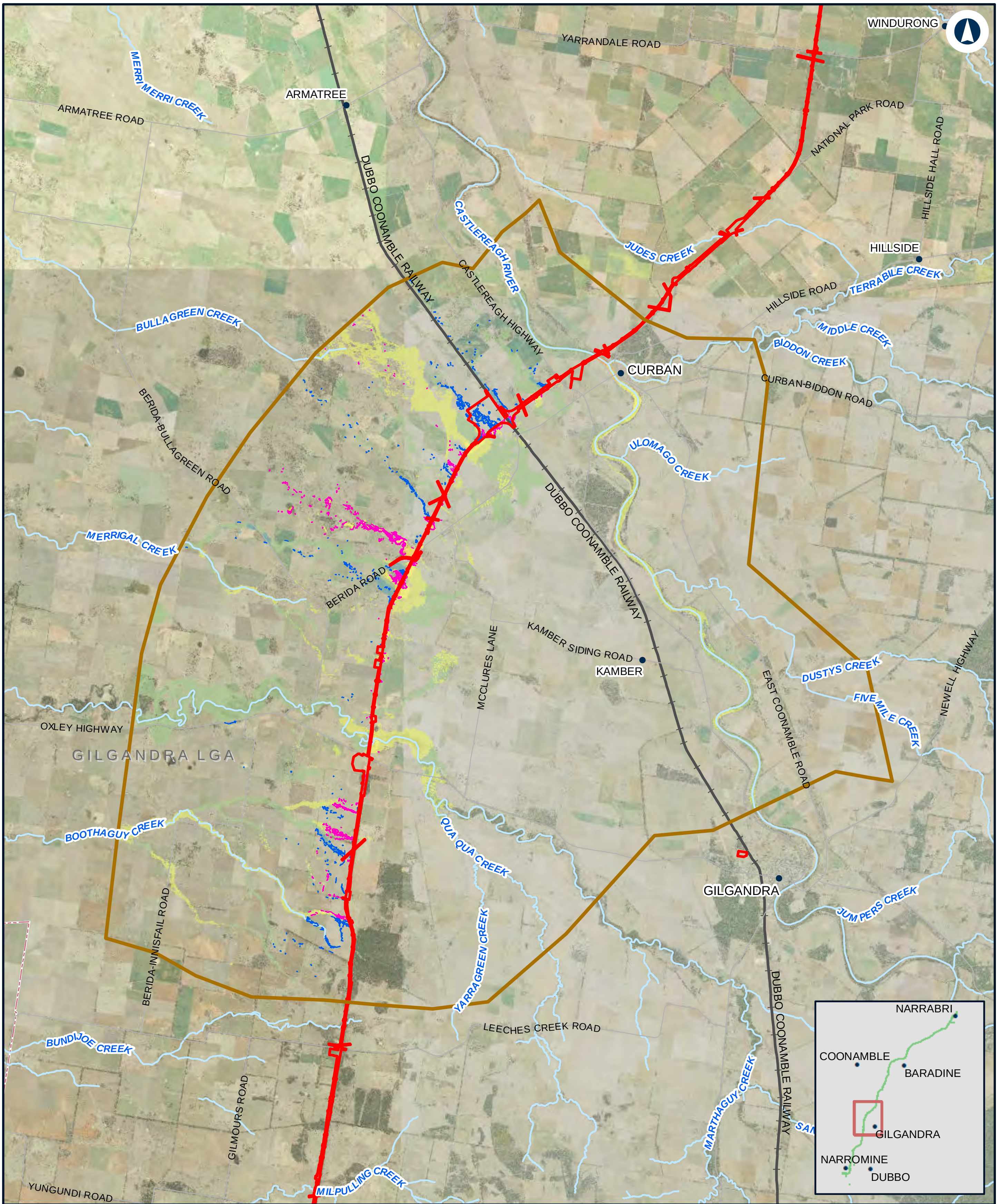

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 20% AEP - N2N11N12

Appendix F - Figure 1d

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:200,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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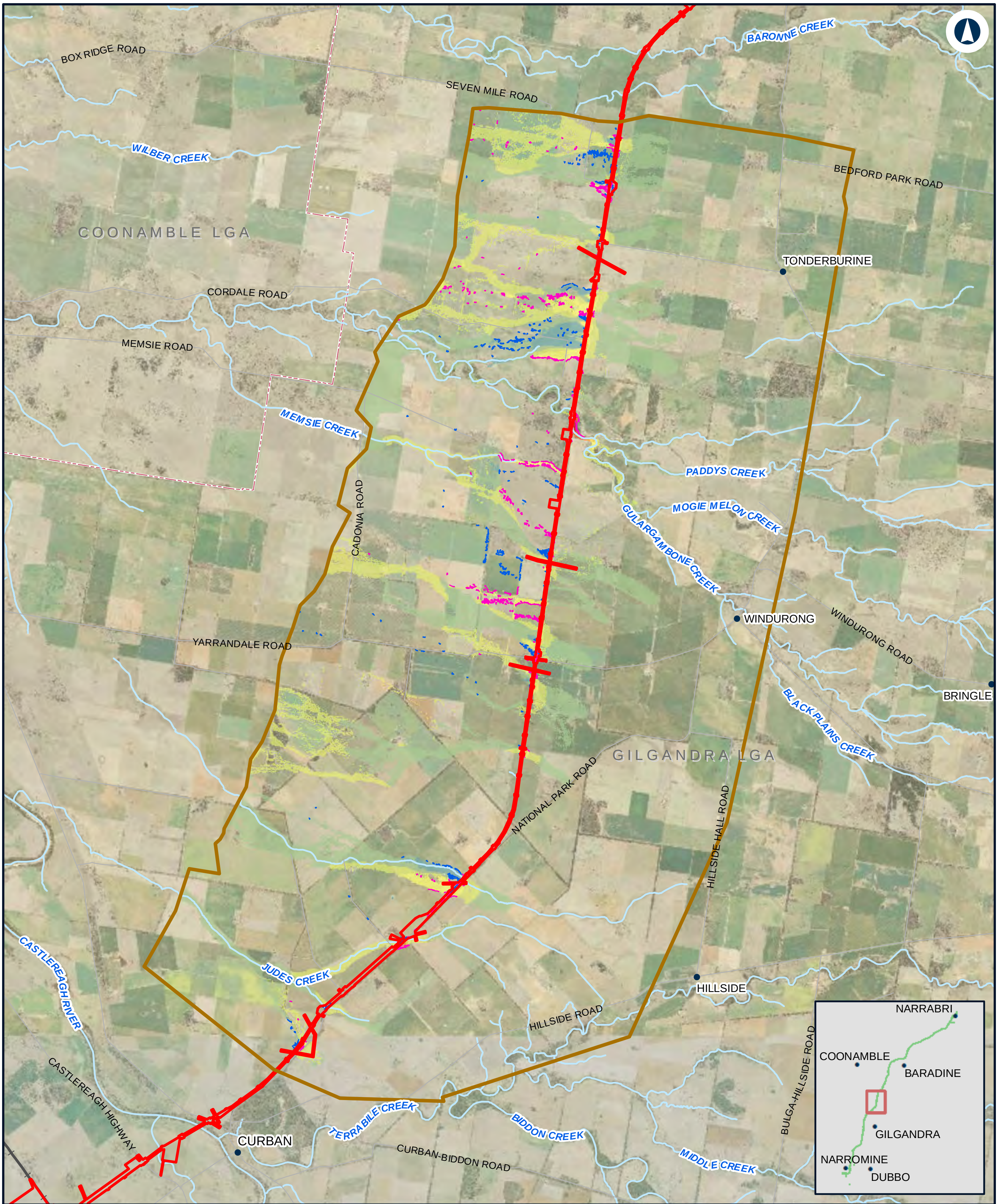

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N10 Appendix F - Figure 1e

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:130,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N9 Appendix F - Figure 1f

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:110,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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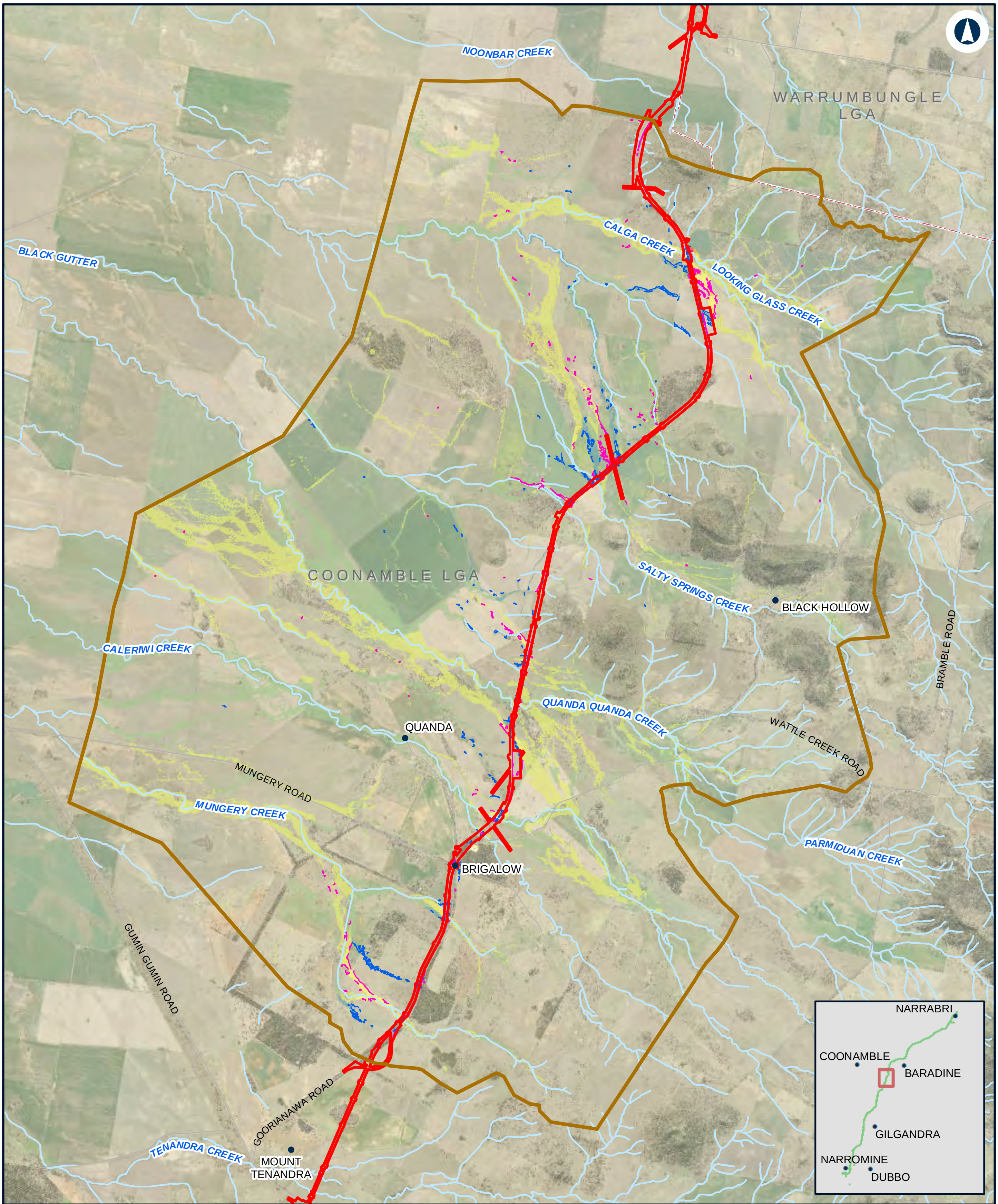

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N8 Appendix F - Figure 1g

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:100,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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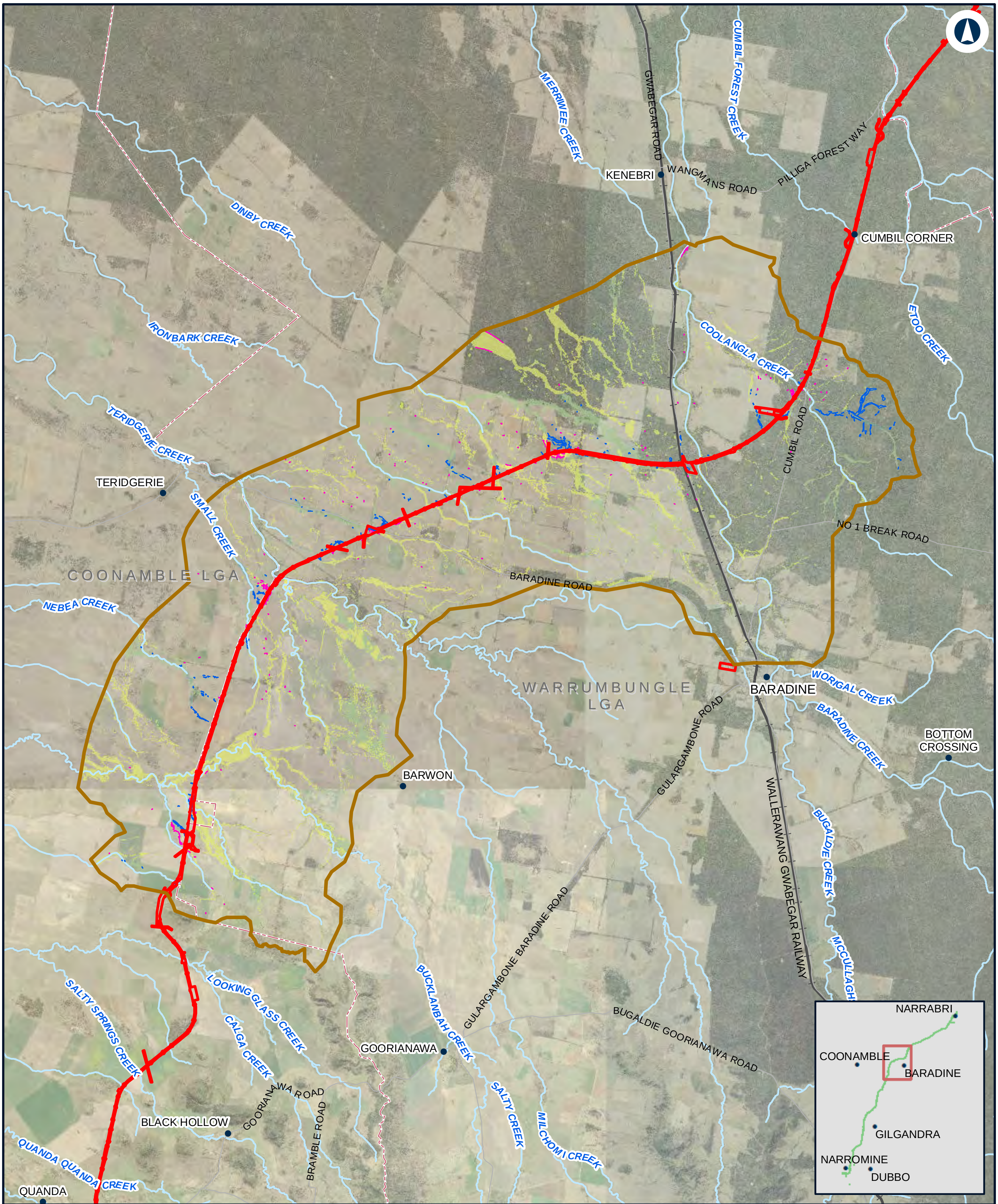

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N7 Appendix F - Figure 1h

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:200,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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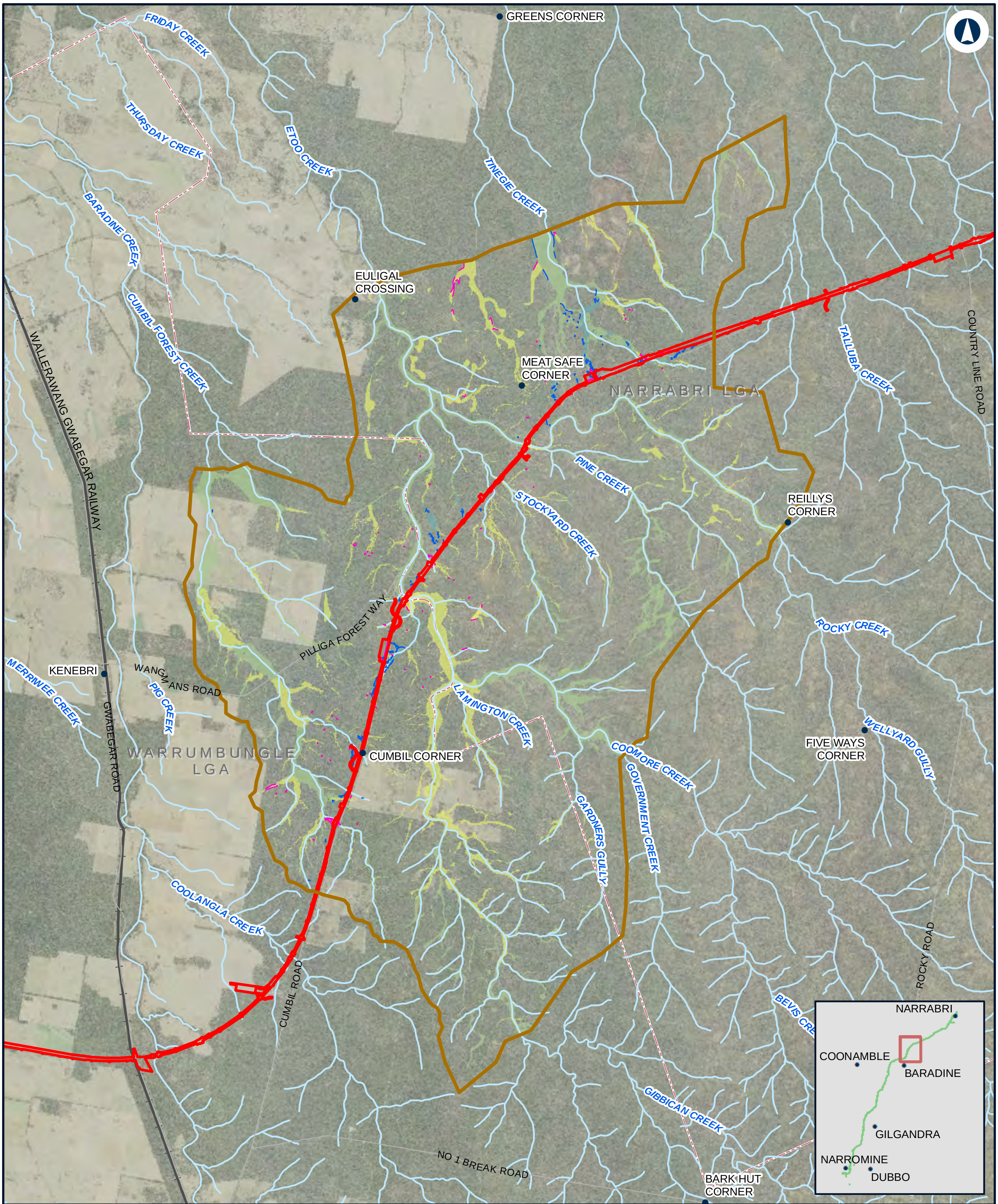

NARROMINE TO NARRABRI | Change in peak flood level (afflux) construction - 20% AEP - N2N6 | Appendix F - Figure 1i

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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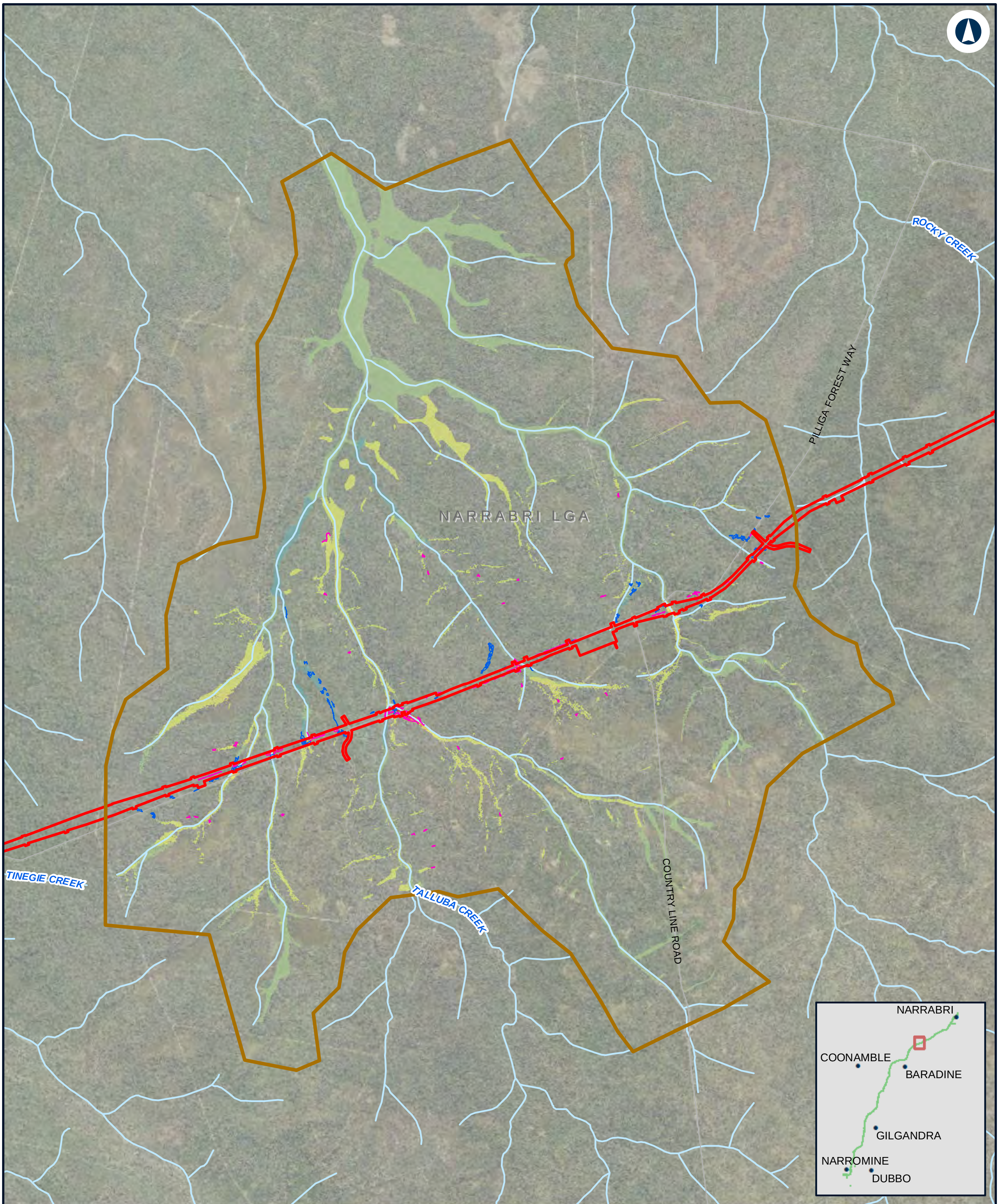

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N5 Appendix F - Figure 1j

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:70,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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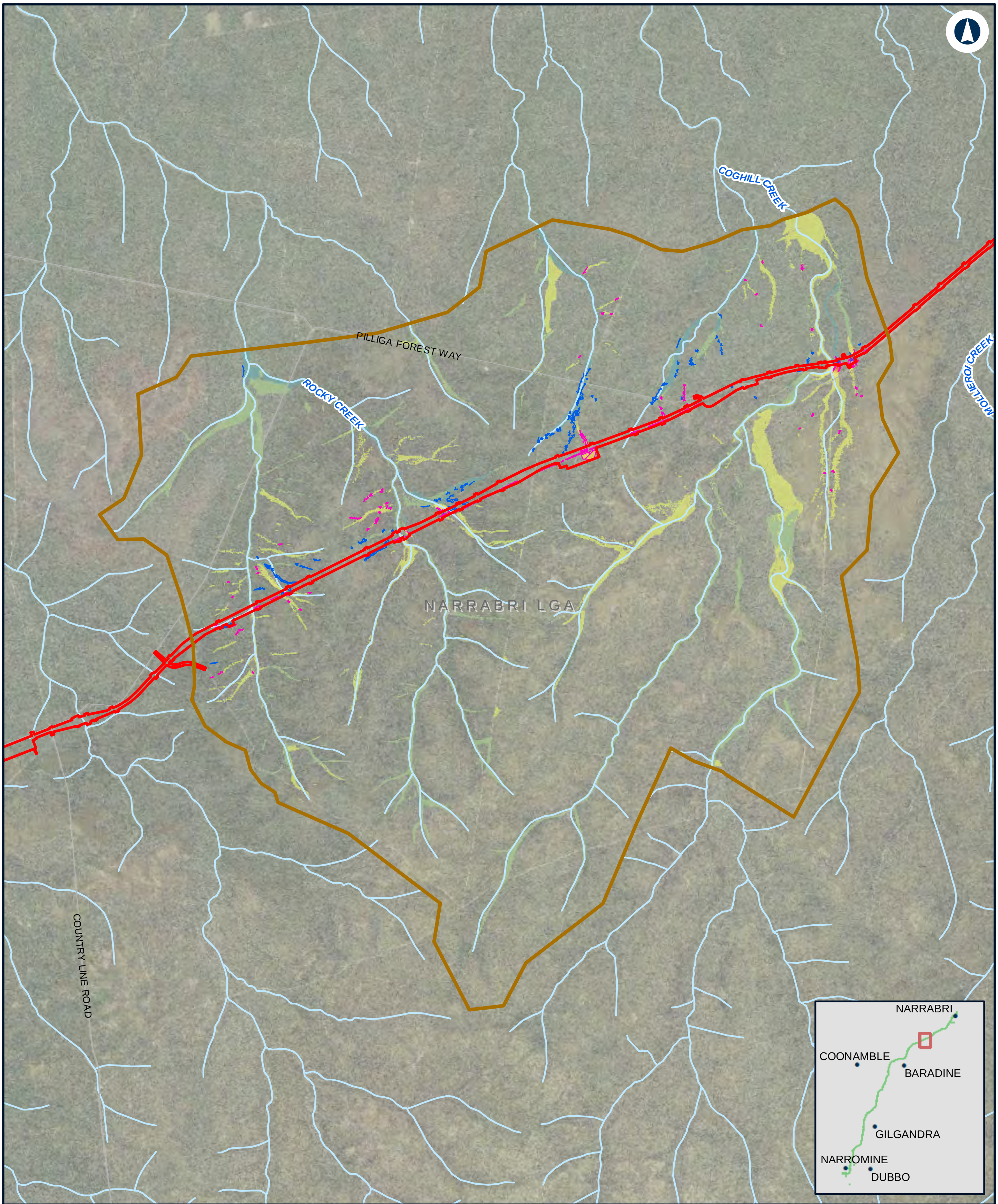

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 20% AEP - N2N4 Appendix F - Figure 1k

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:80,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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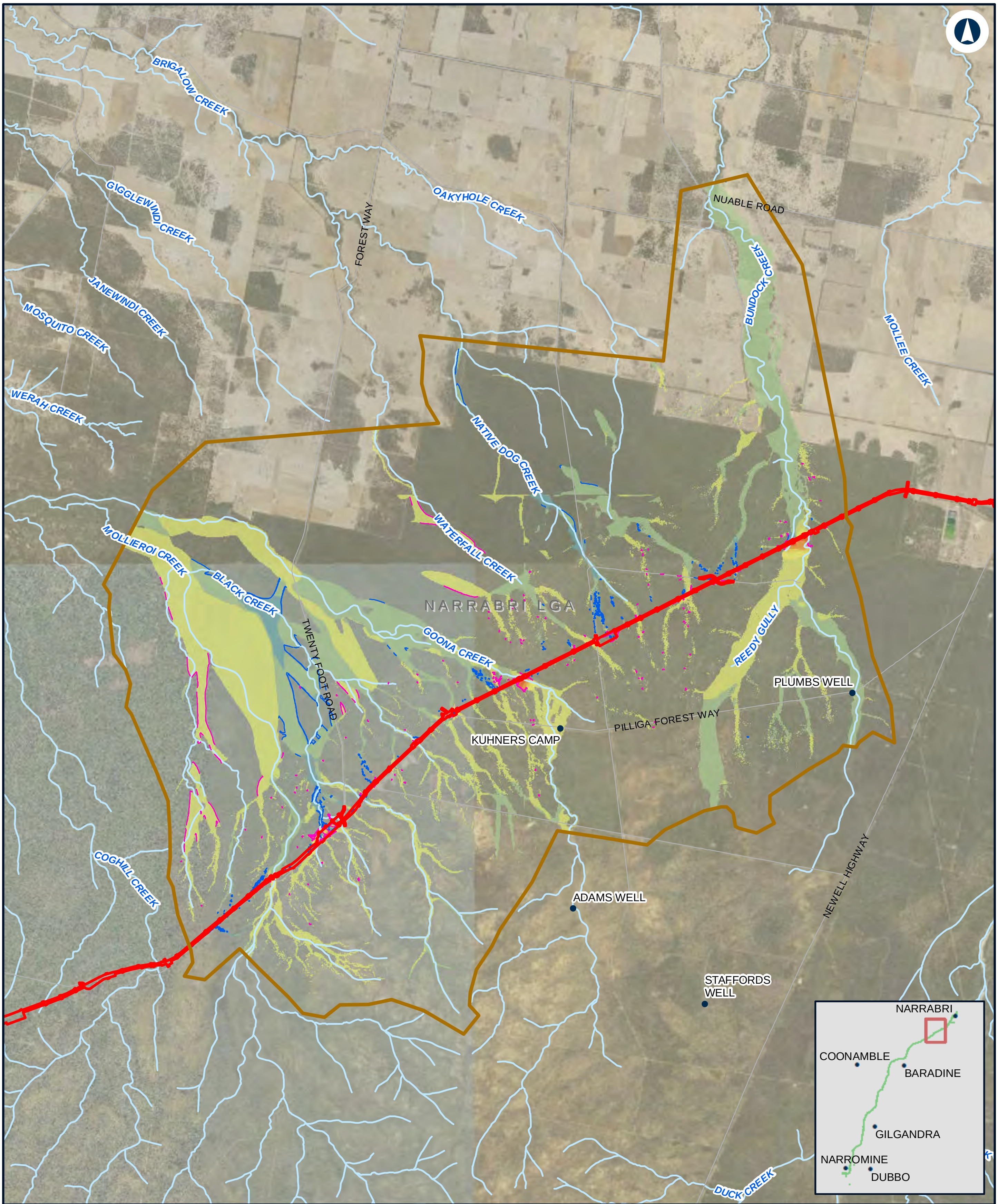

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 20% AEP - N2N23

Appendix F - Figure 1l

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:140,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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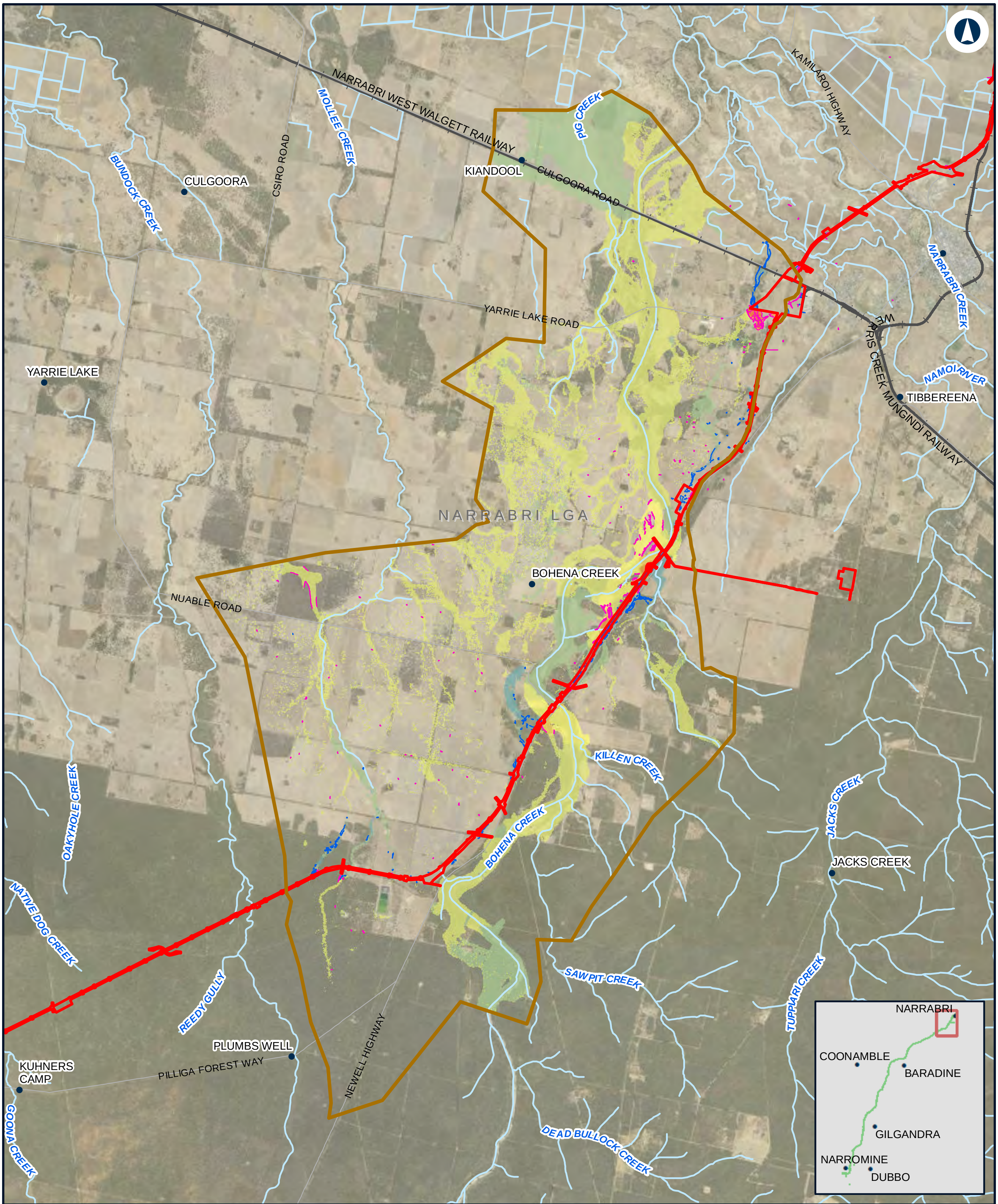

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 20% AEP - N2N1

Appendix F - Figure 1m

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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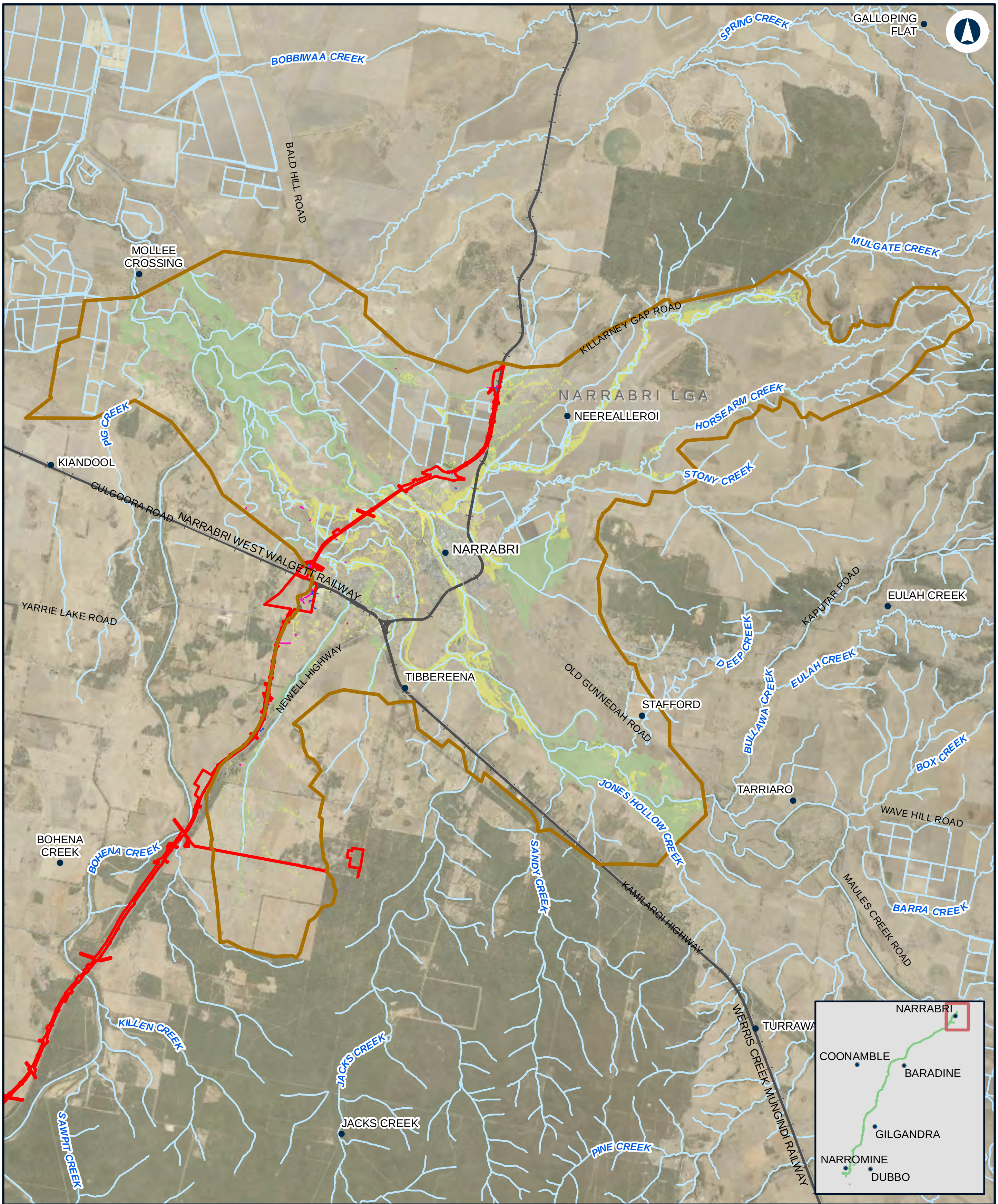

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 20% AEP - Narrabri

Appendix F - Figure 1n

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:160,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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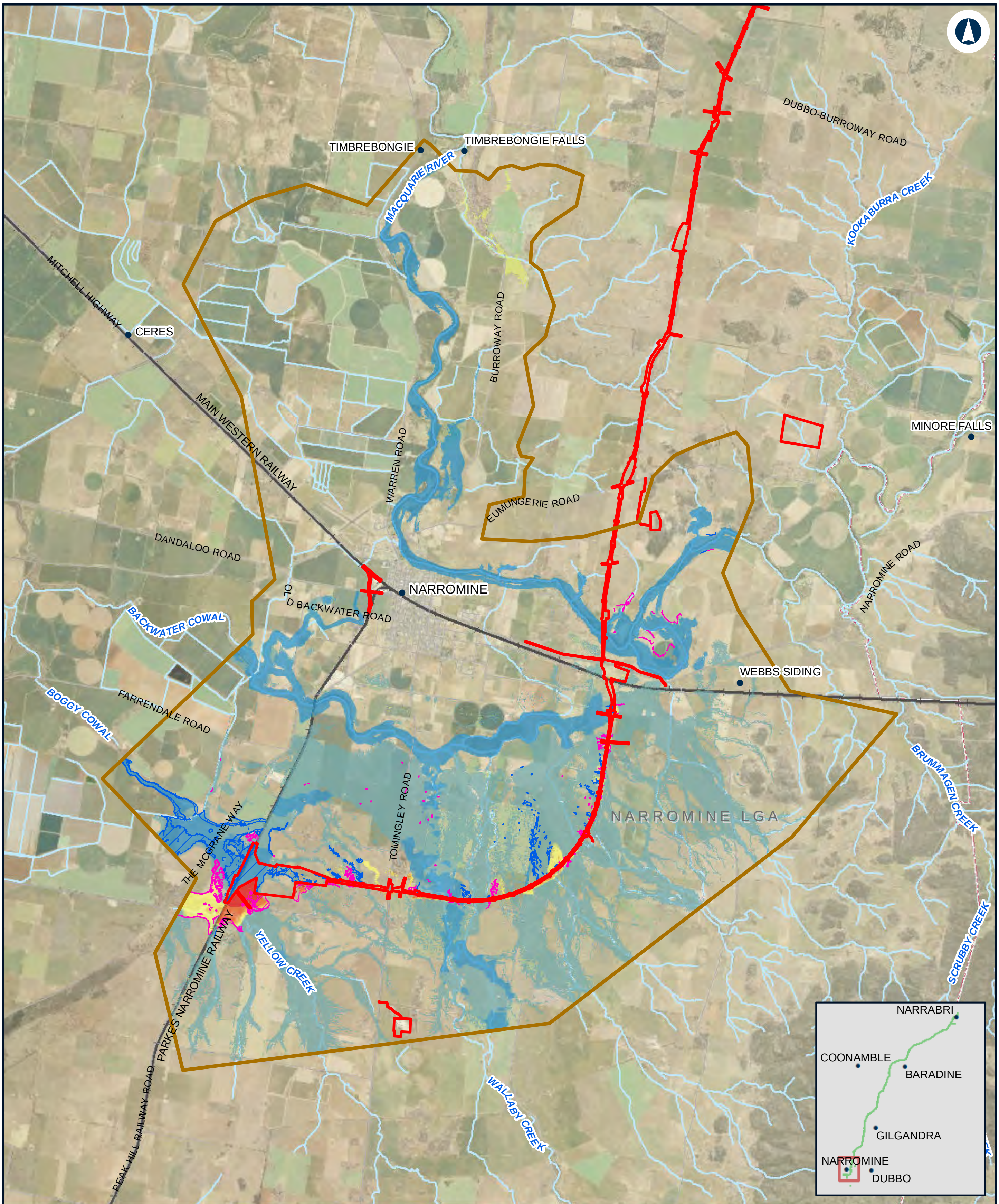

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 5% AEP - NFM

Appendix F Figure 2a

0 1.5 3 Km

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:140,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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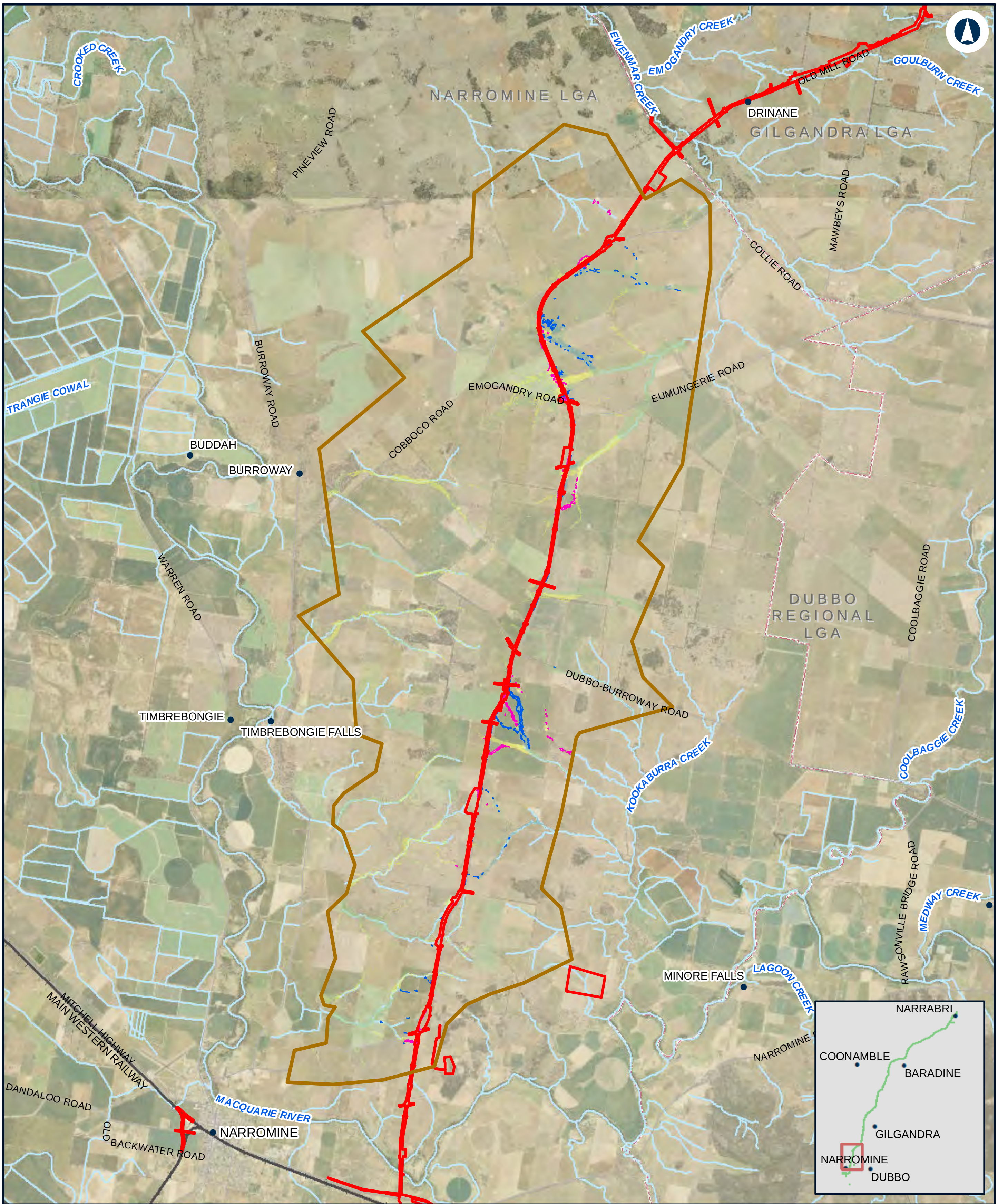

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N14 Appendix F Figure 2b

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N13 Appendix F Figure 2c

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:180,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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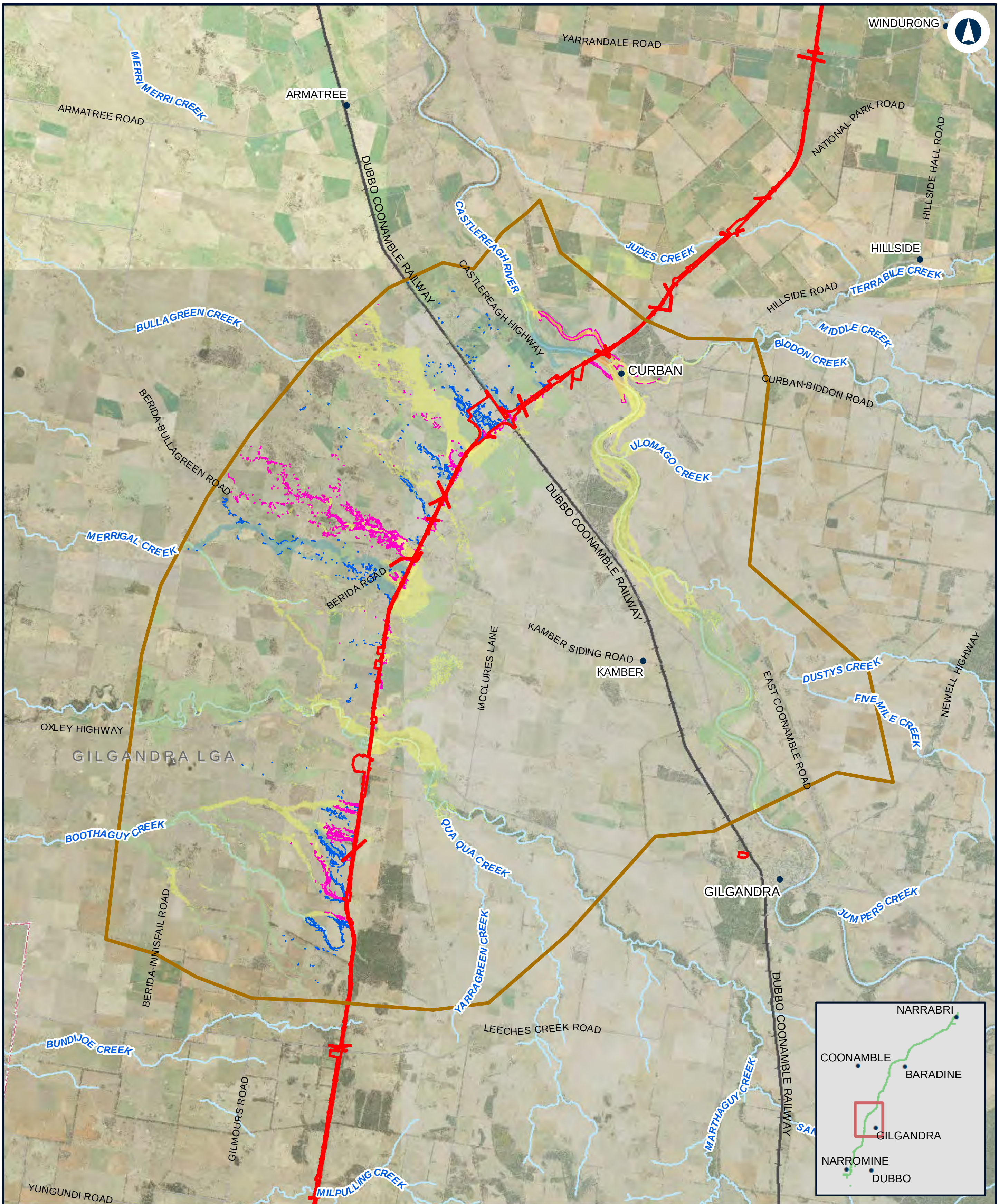

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 5% AEP - N2N11N12

Appendix F Figure 2d

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:200,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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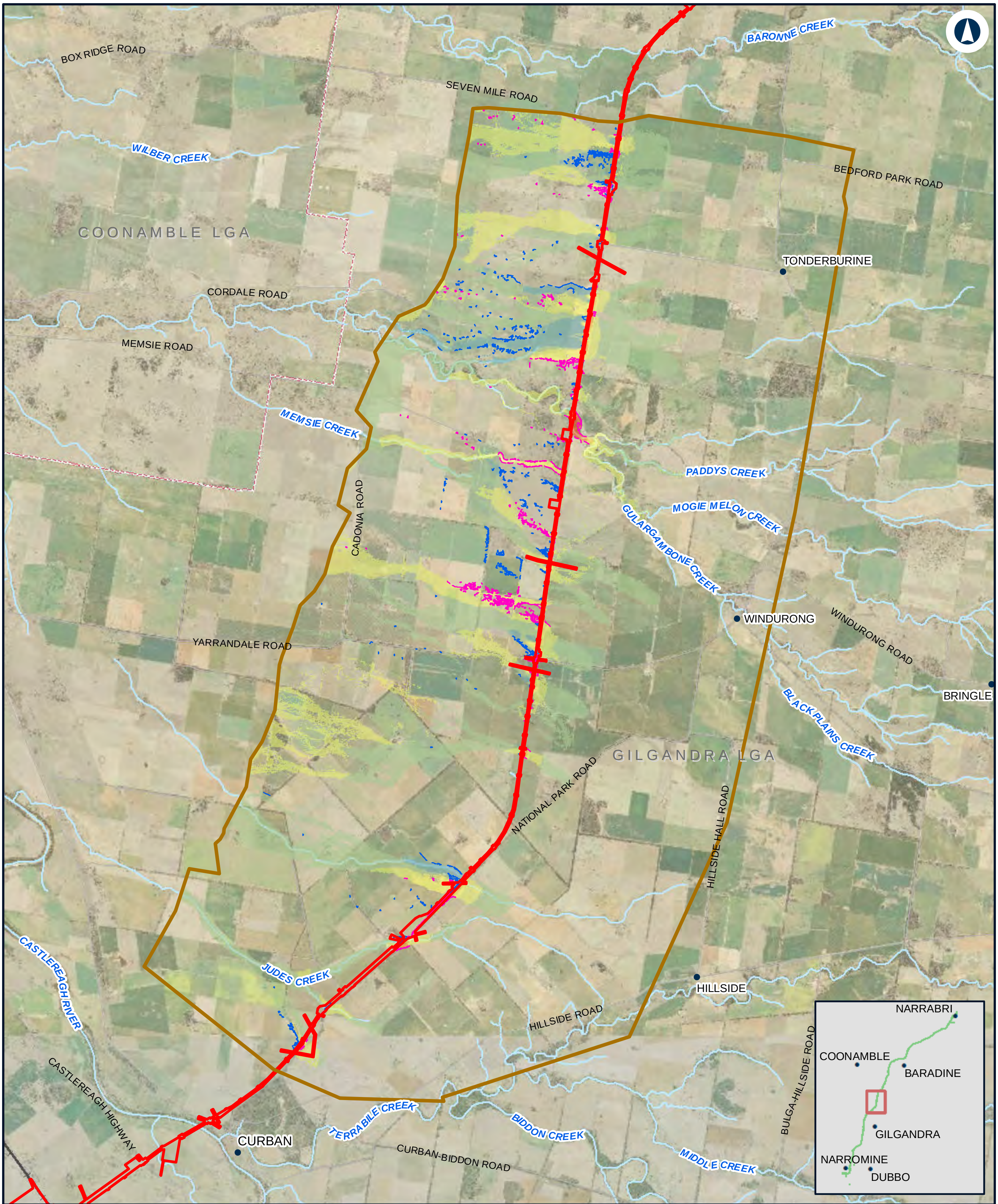

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N10 Appendix F Figure 2e

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:130,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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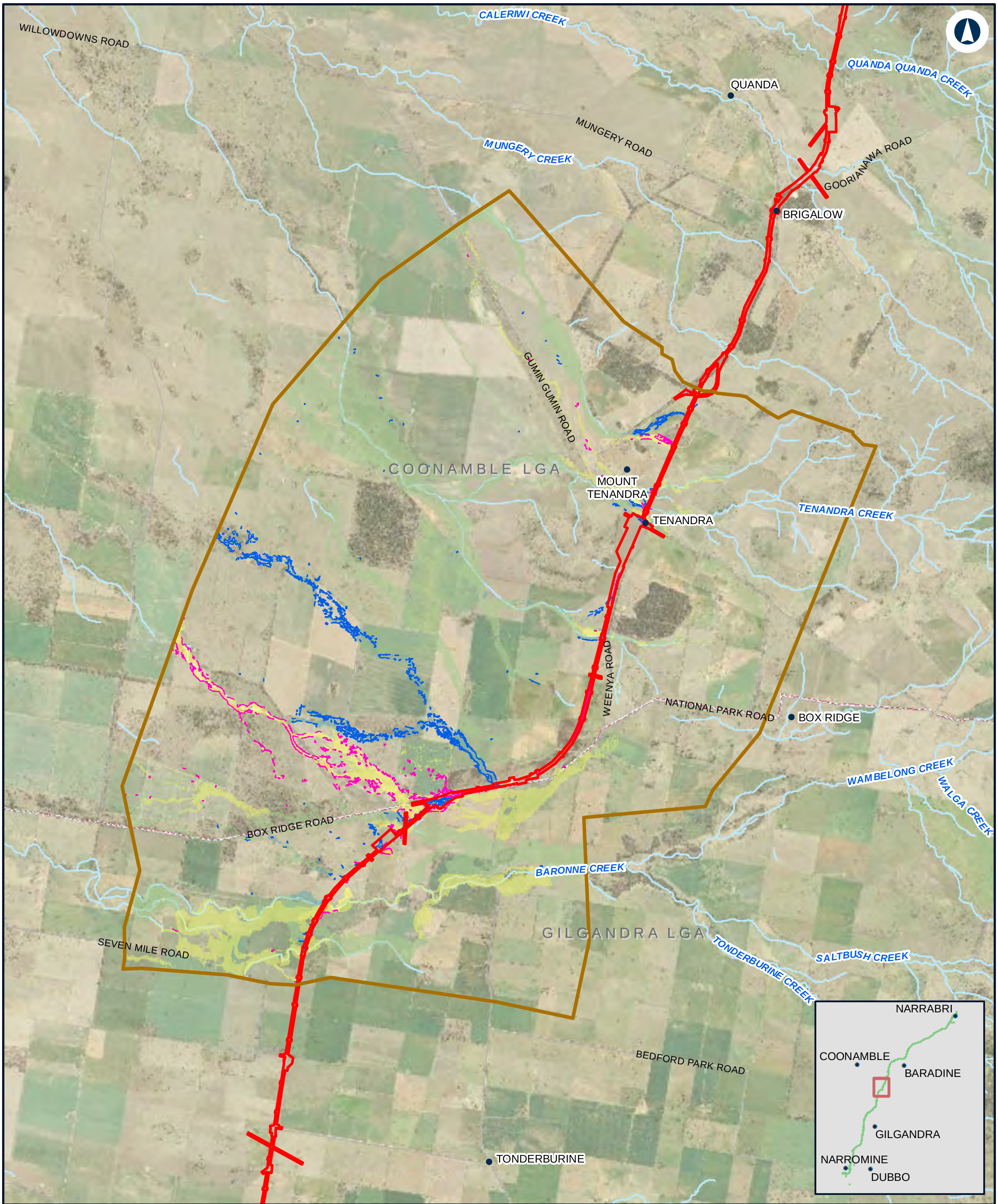

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N9

Appendix F Figure 2f

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:110,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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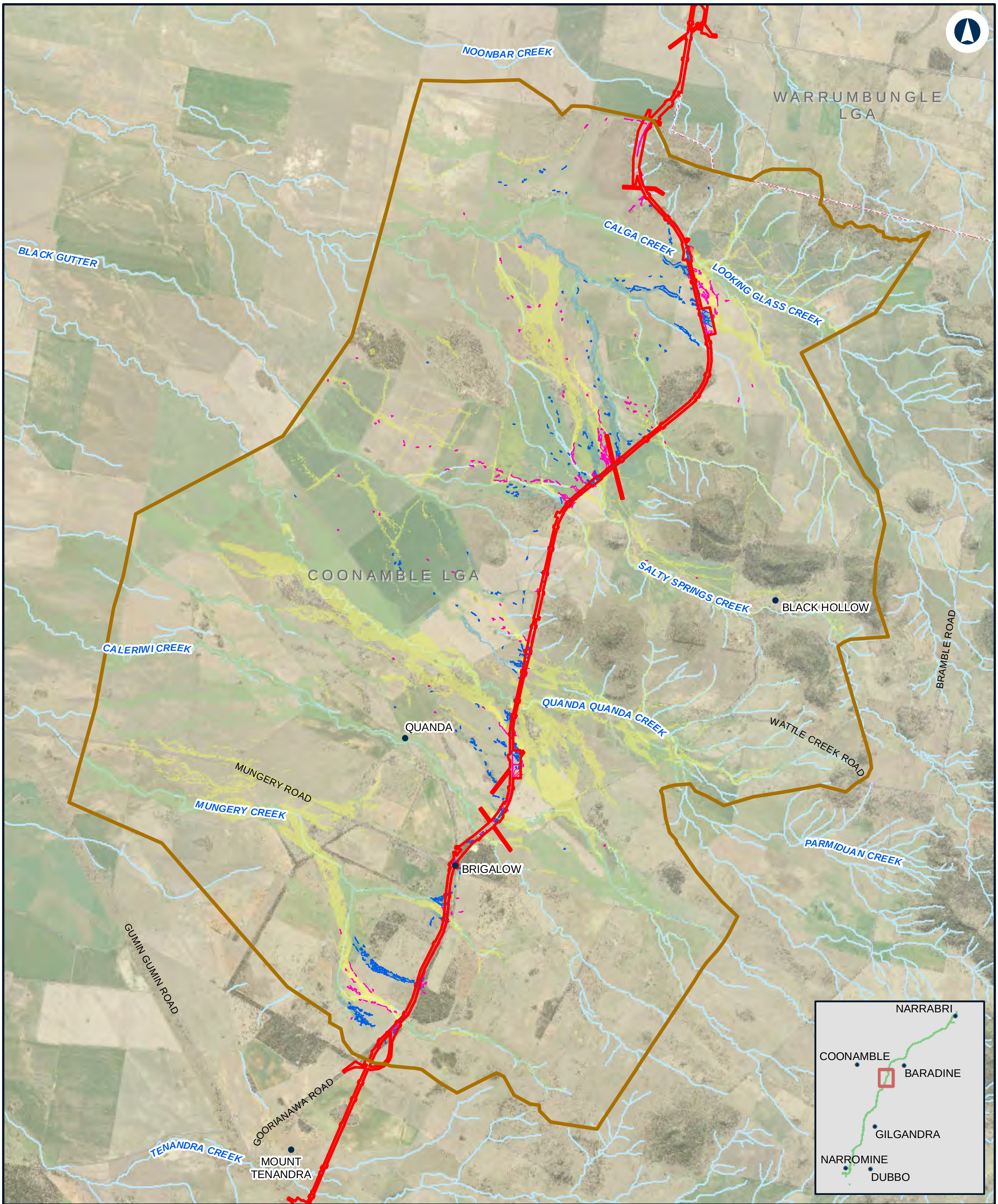

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 5% AEP - N2N8

Appendix F Figure 2g

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:100,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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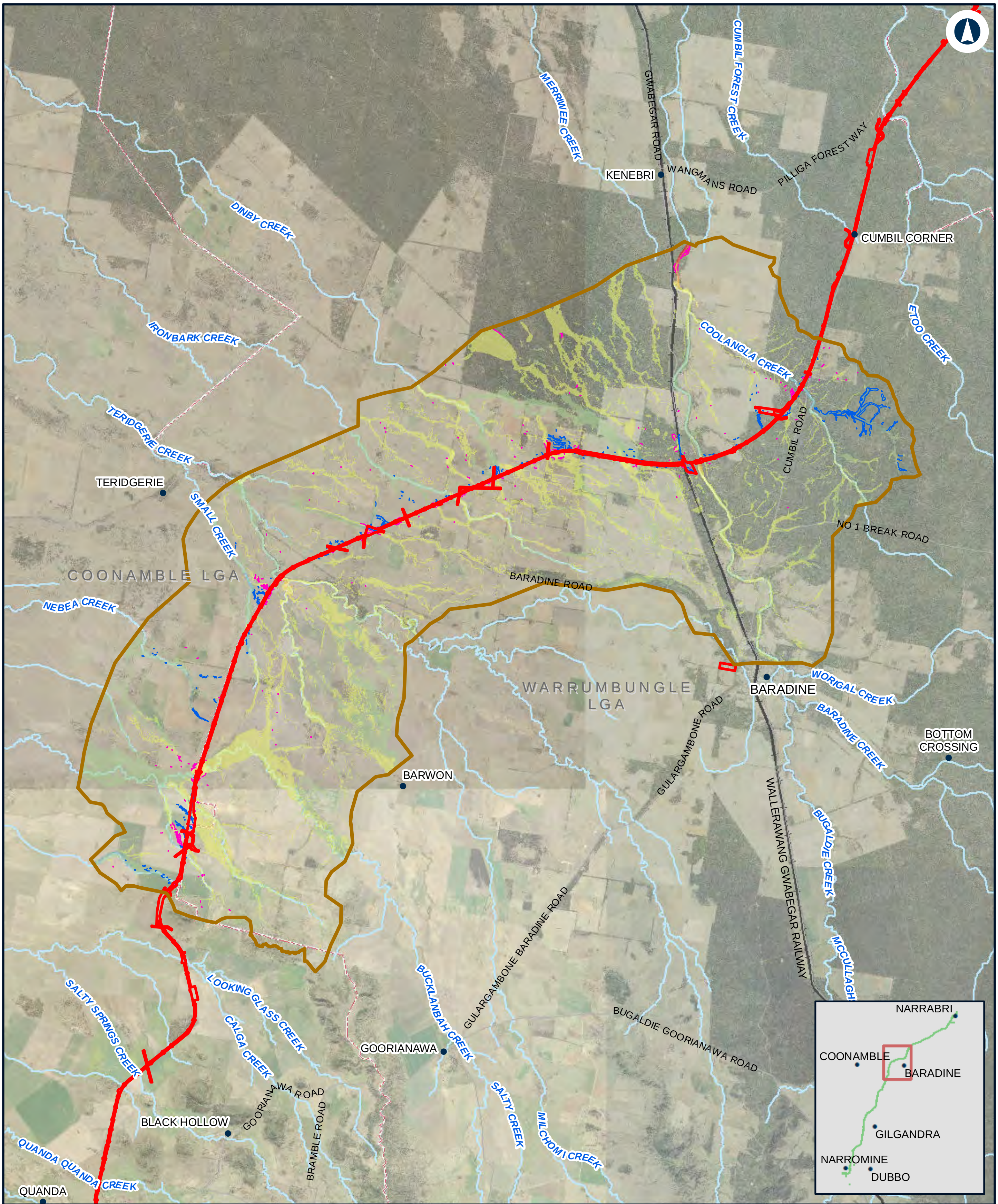

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N7

Appendix F Figure 2h

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:200,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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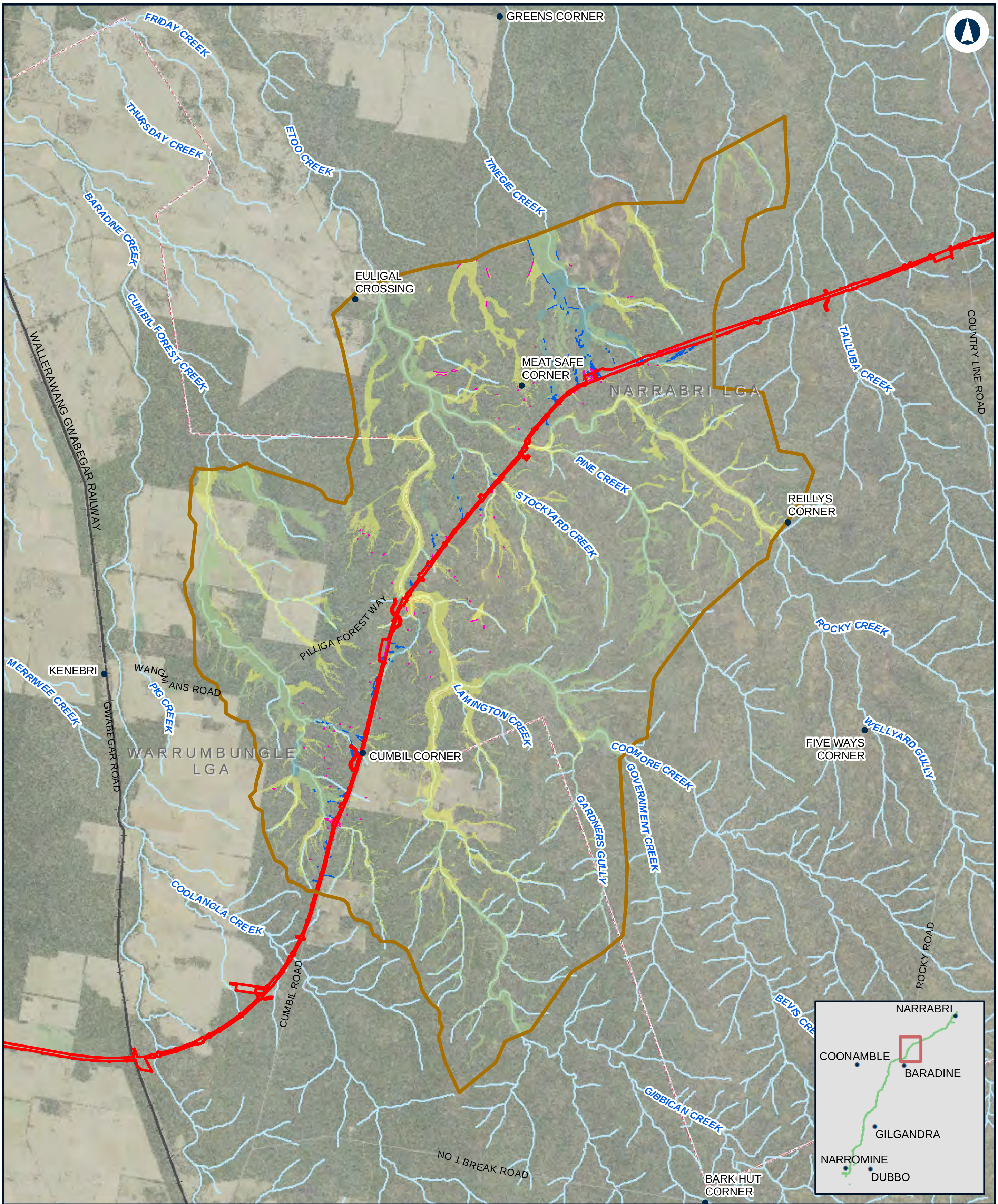

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N6

Appendix F Figure 2i

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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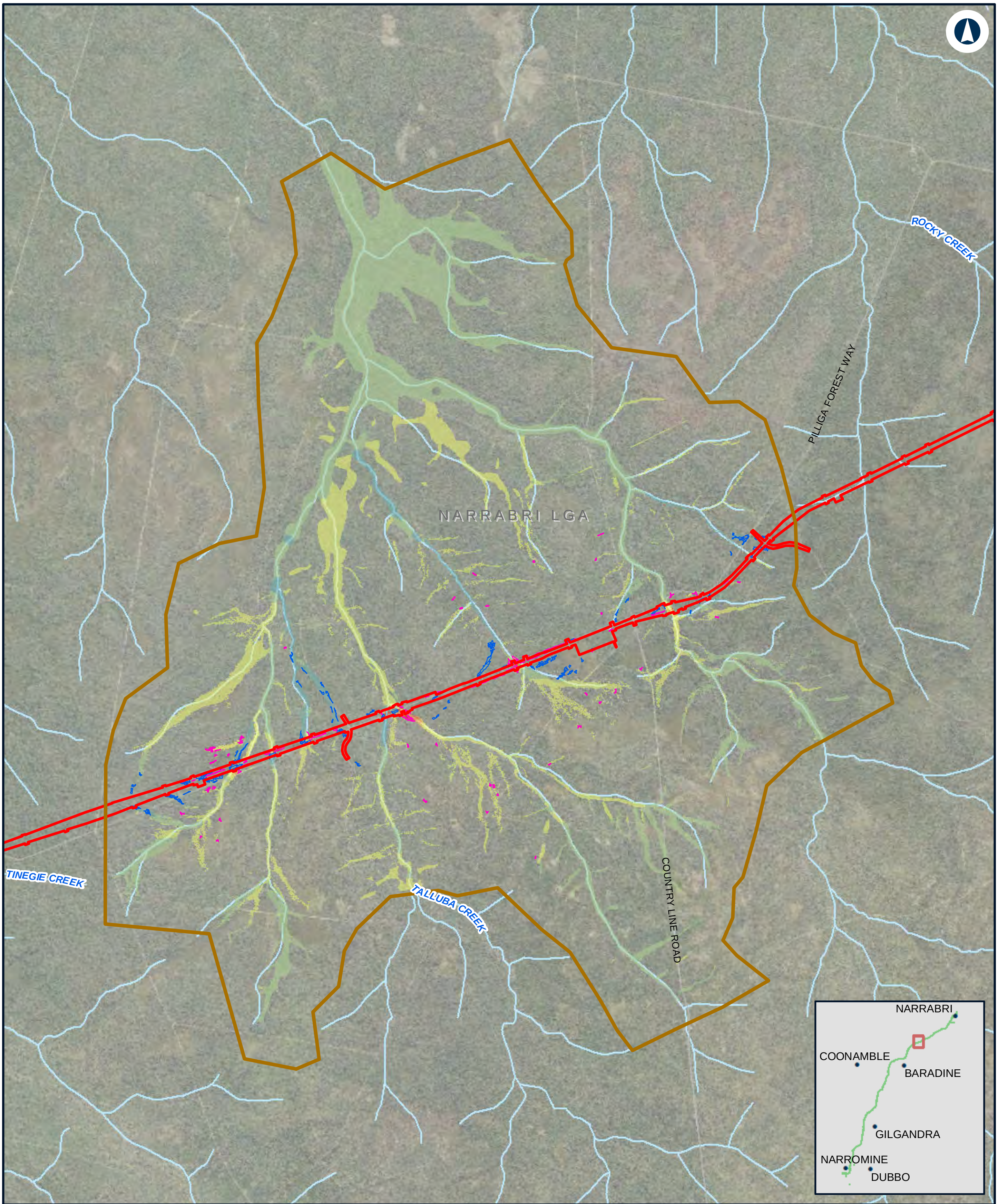

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N5

Appendix F Figure 2j

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:70,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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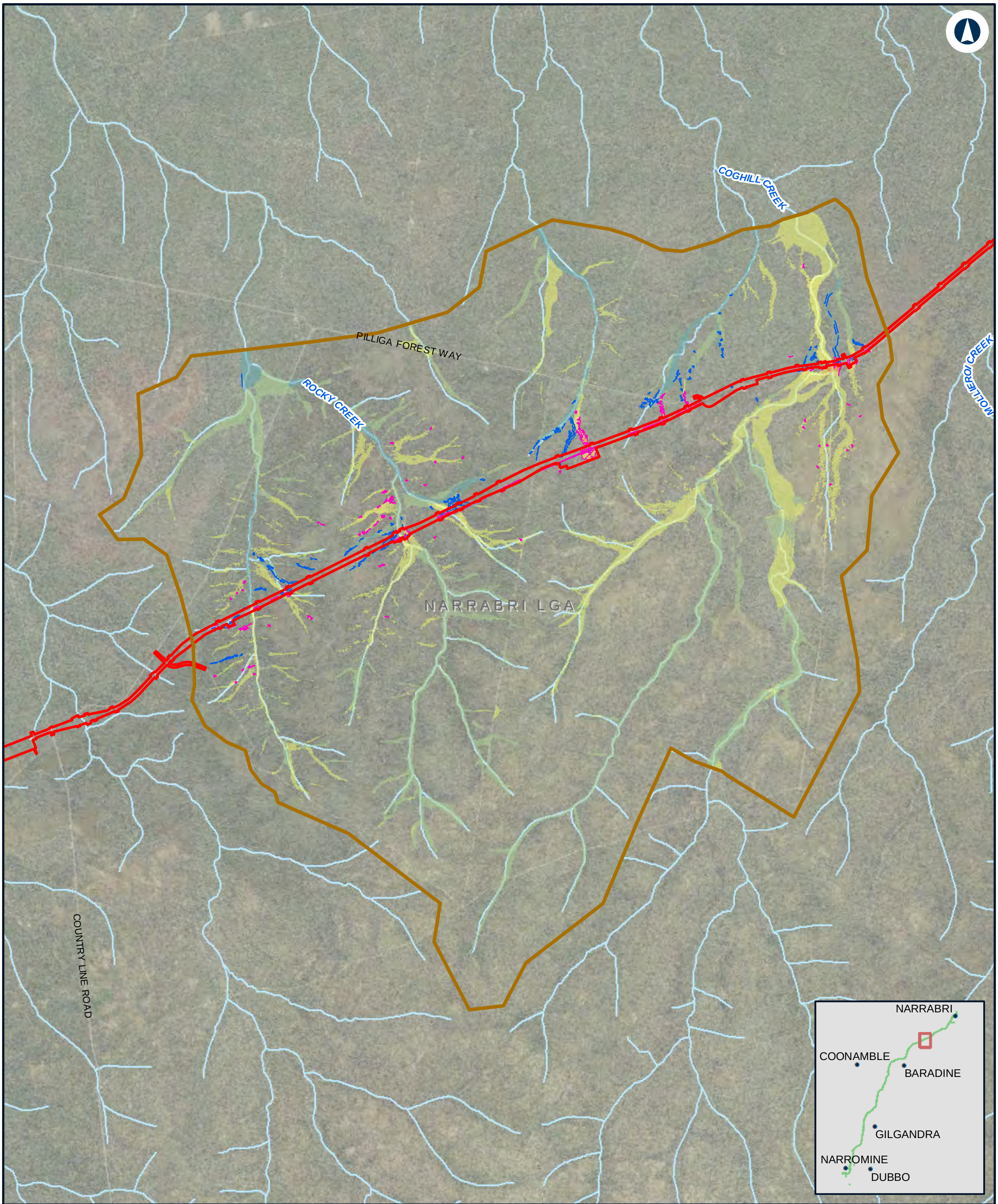

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 5% AEP - N2N4 Appendix F Figure 2k

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:80,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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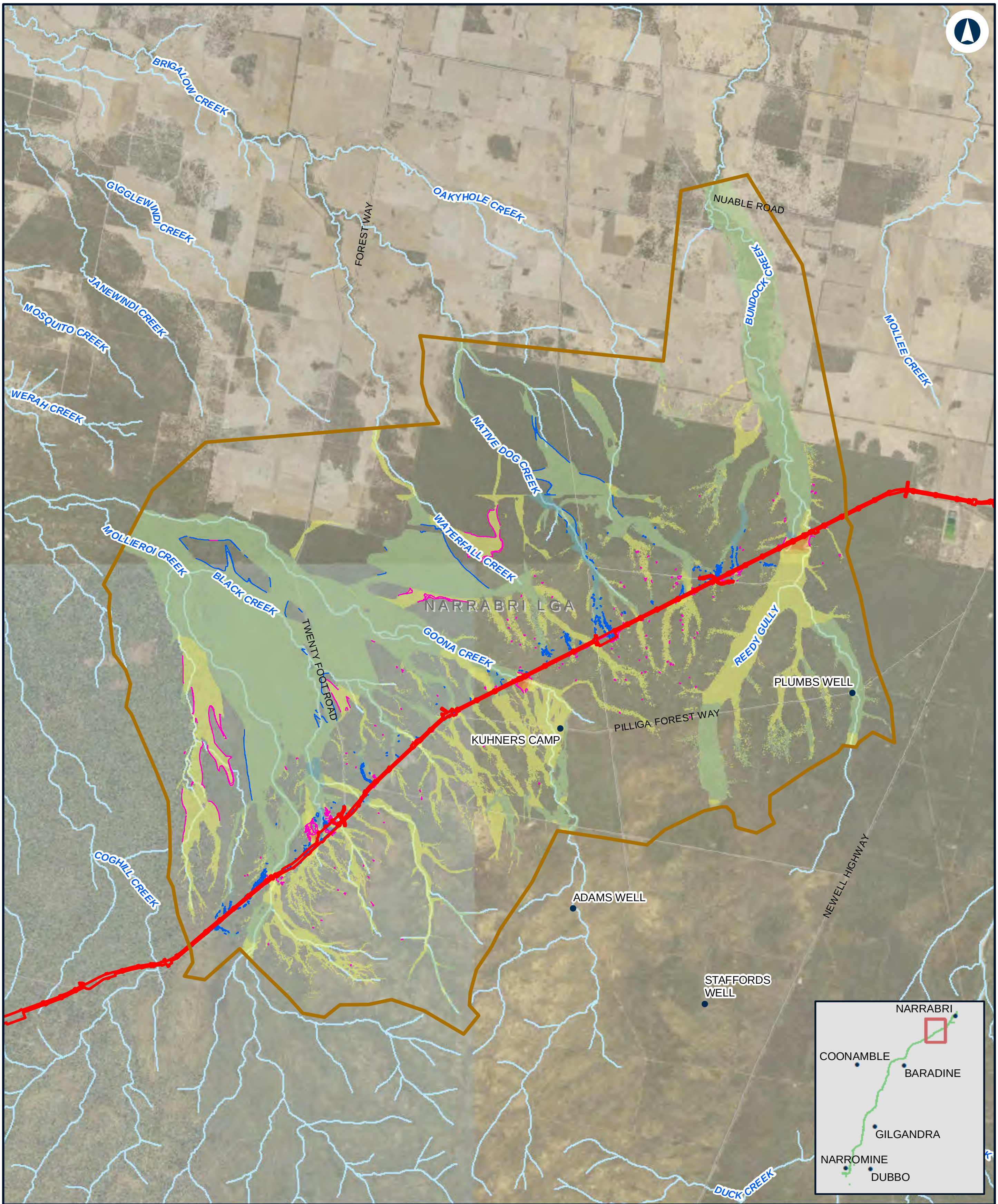

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 5% AEP - N2N23

Appendix F Figure 2l

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:140,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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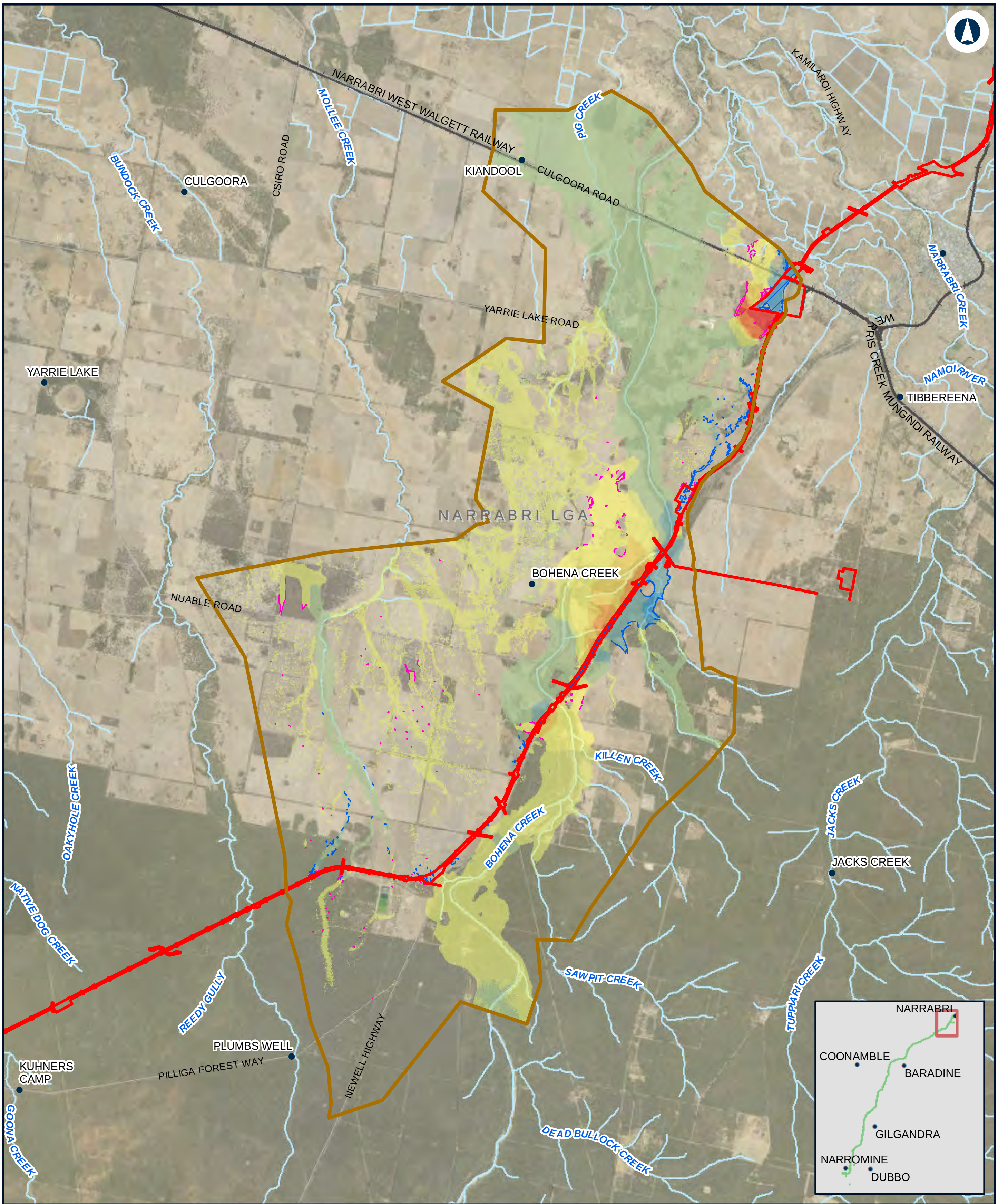

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 5% AEP - N2N1

Appendix F Figure 2m

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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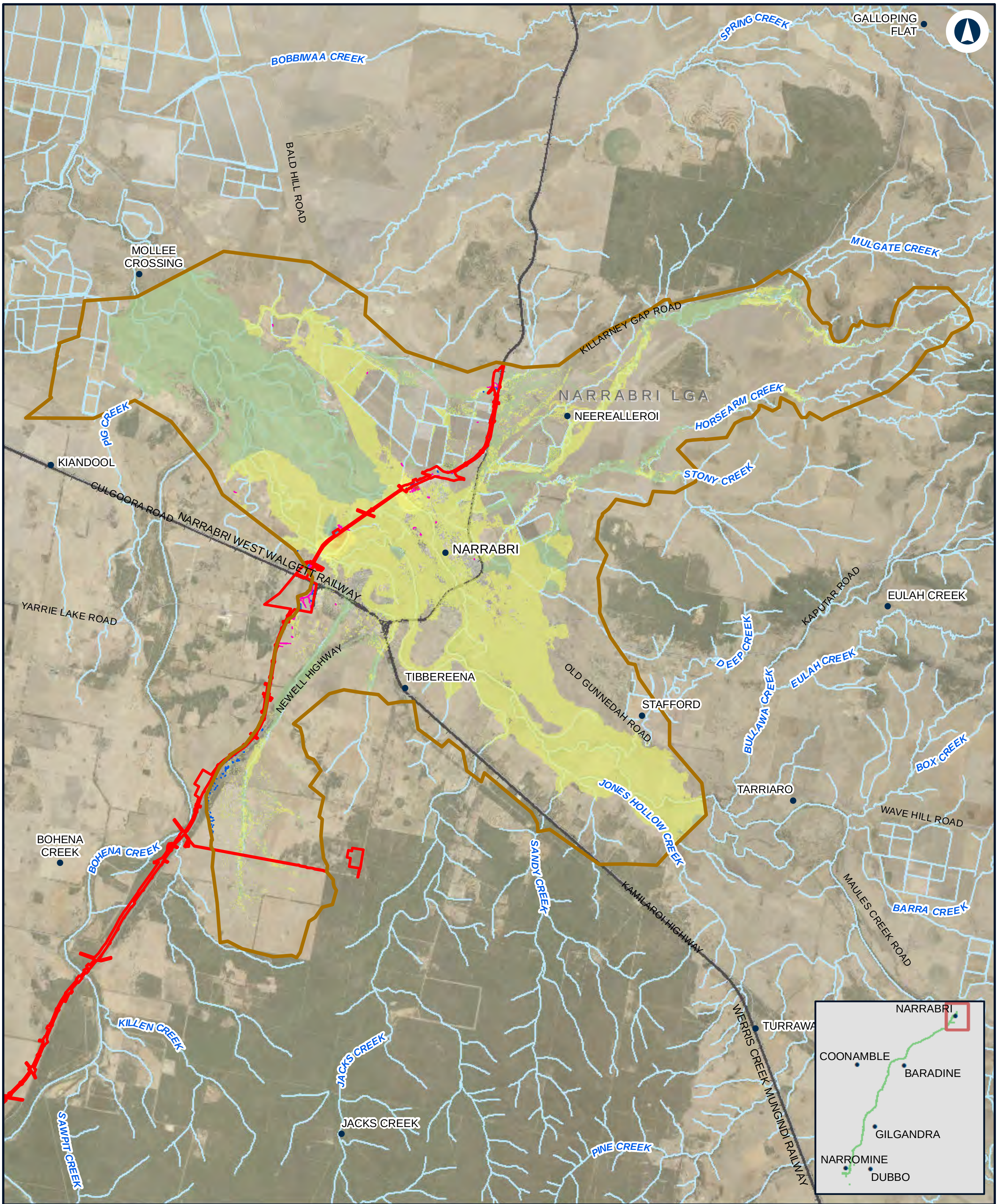

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 5% AEP - Narrabri

Appendix F Figure 2n

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4

Author: JacobsGHD Scale: 1:160,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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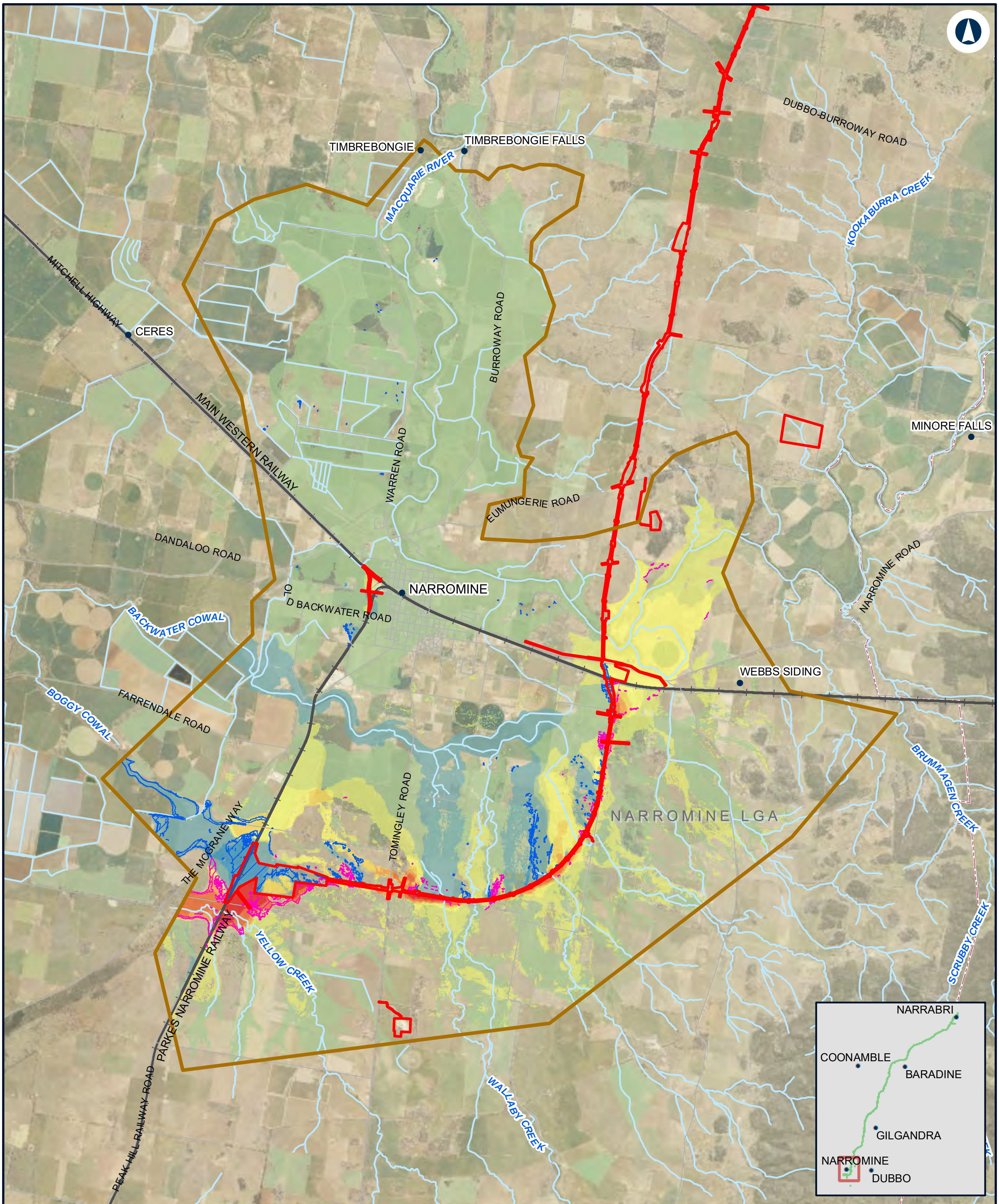

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - NFM Appendix F – Figure 3a

0 1.5 3
Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:140,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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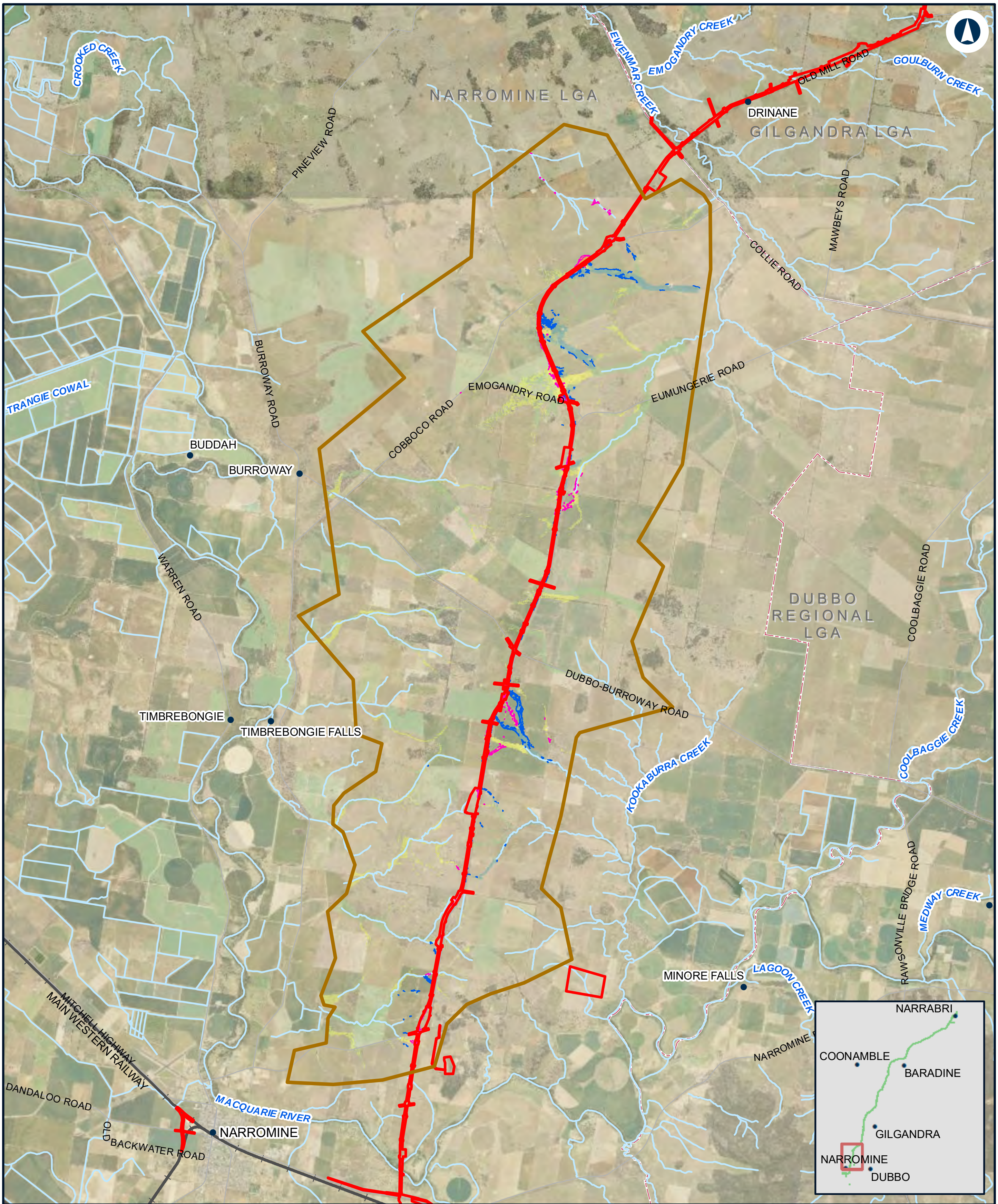

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 1% AEP - N2N14

Appendix F – Figure 3b

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N13 Appendix F – Figure 3c

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:180,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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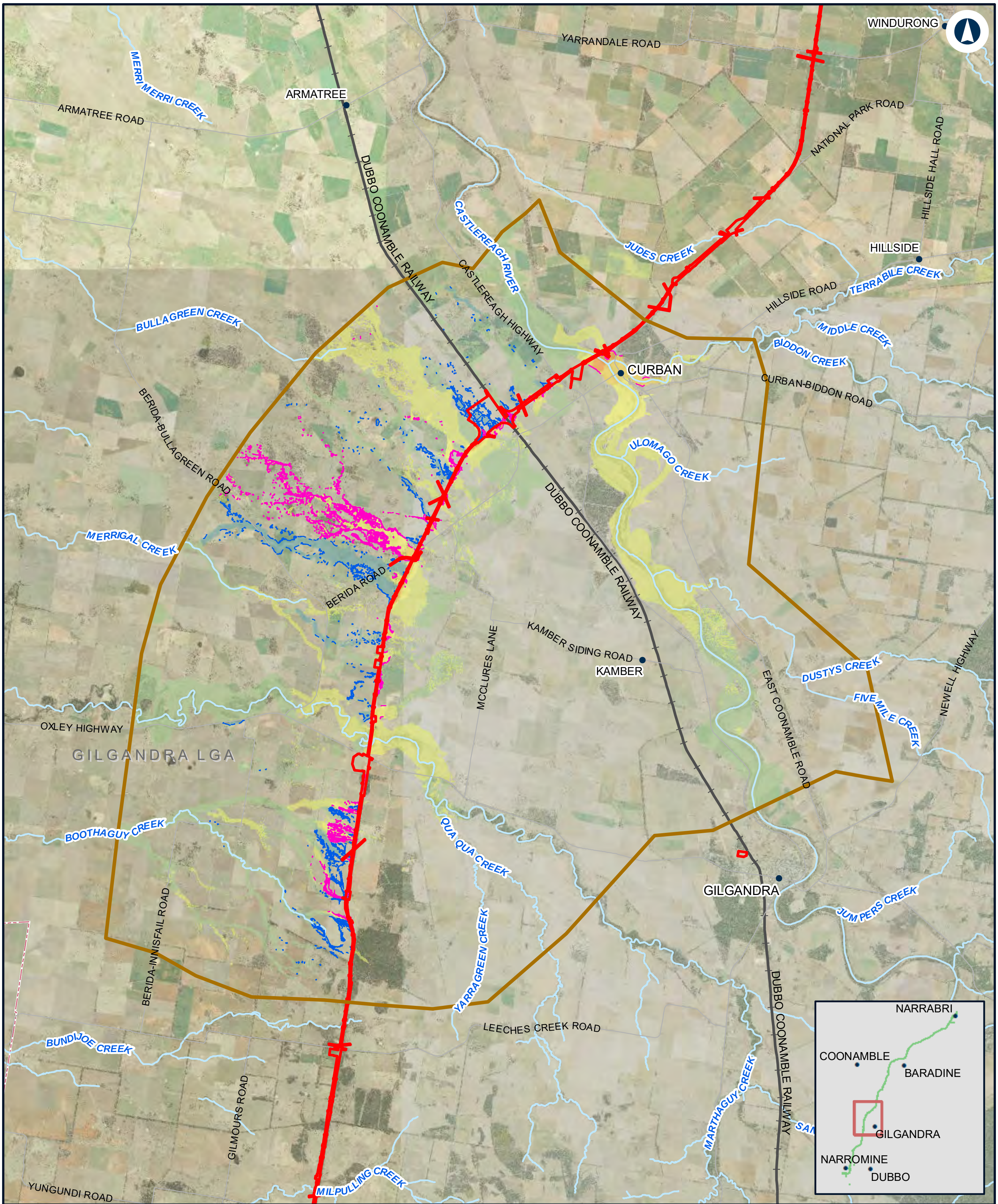

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N11N12 Appendix F – Figure 3d

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:200,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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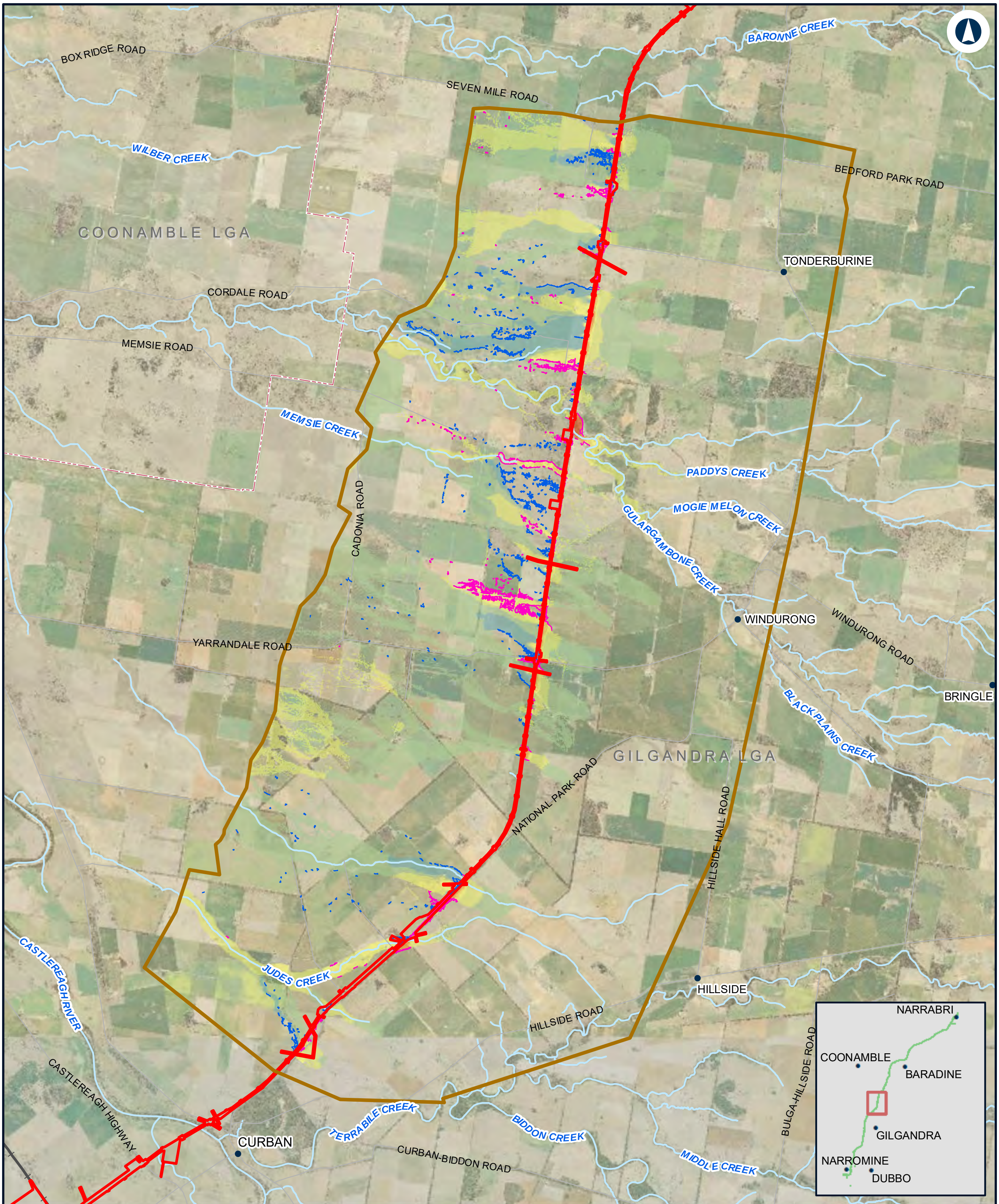

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N10 Appendix F – Figure 3e

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:130,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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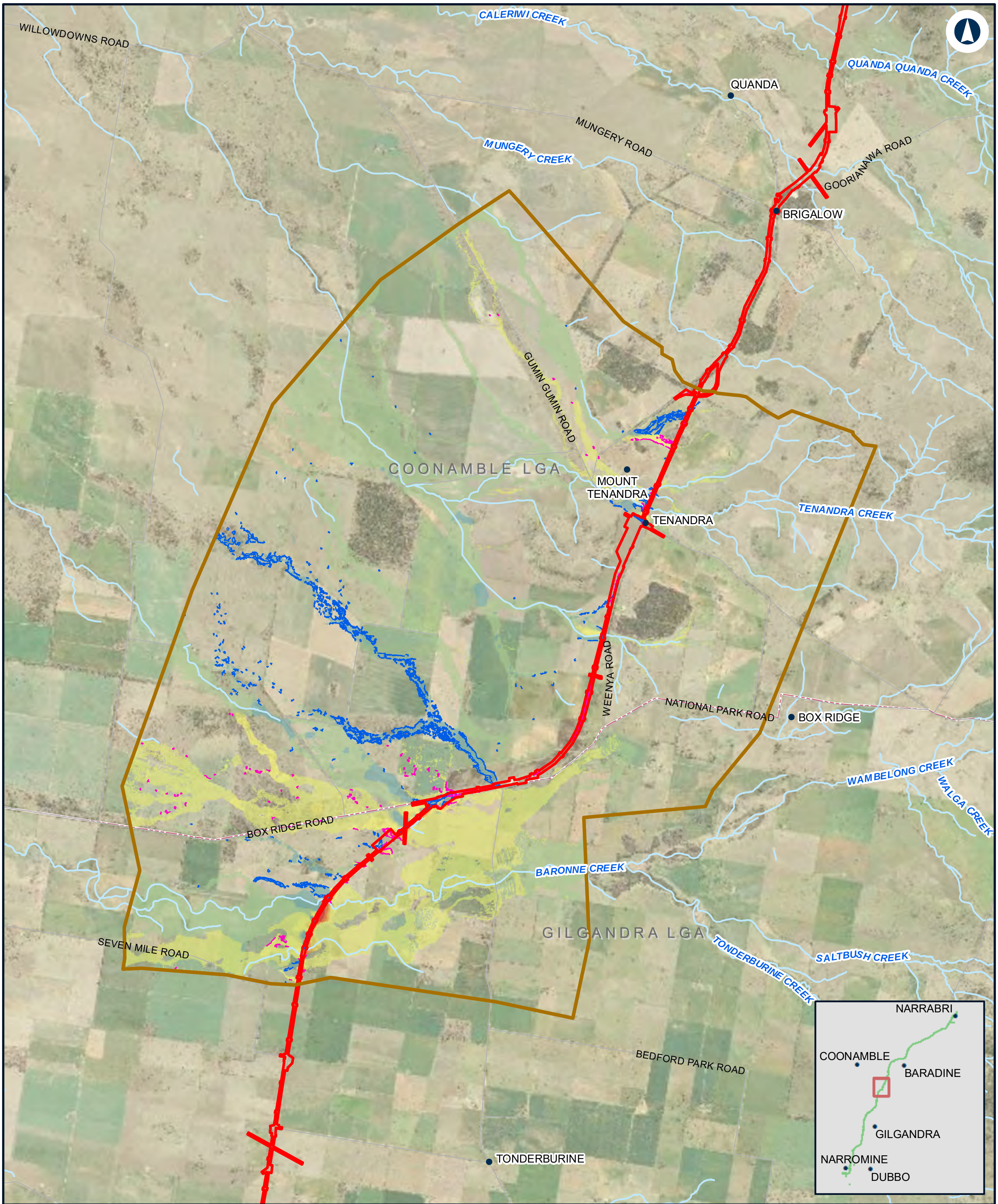

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N9 Appendix F – Figure 3f

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:110,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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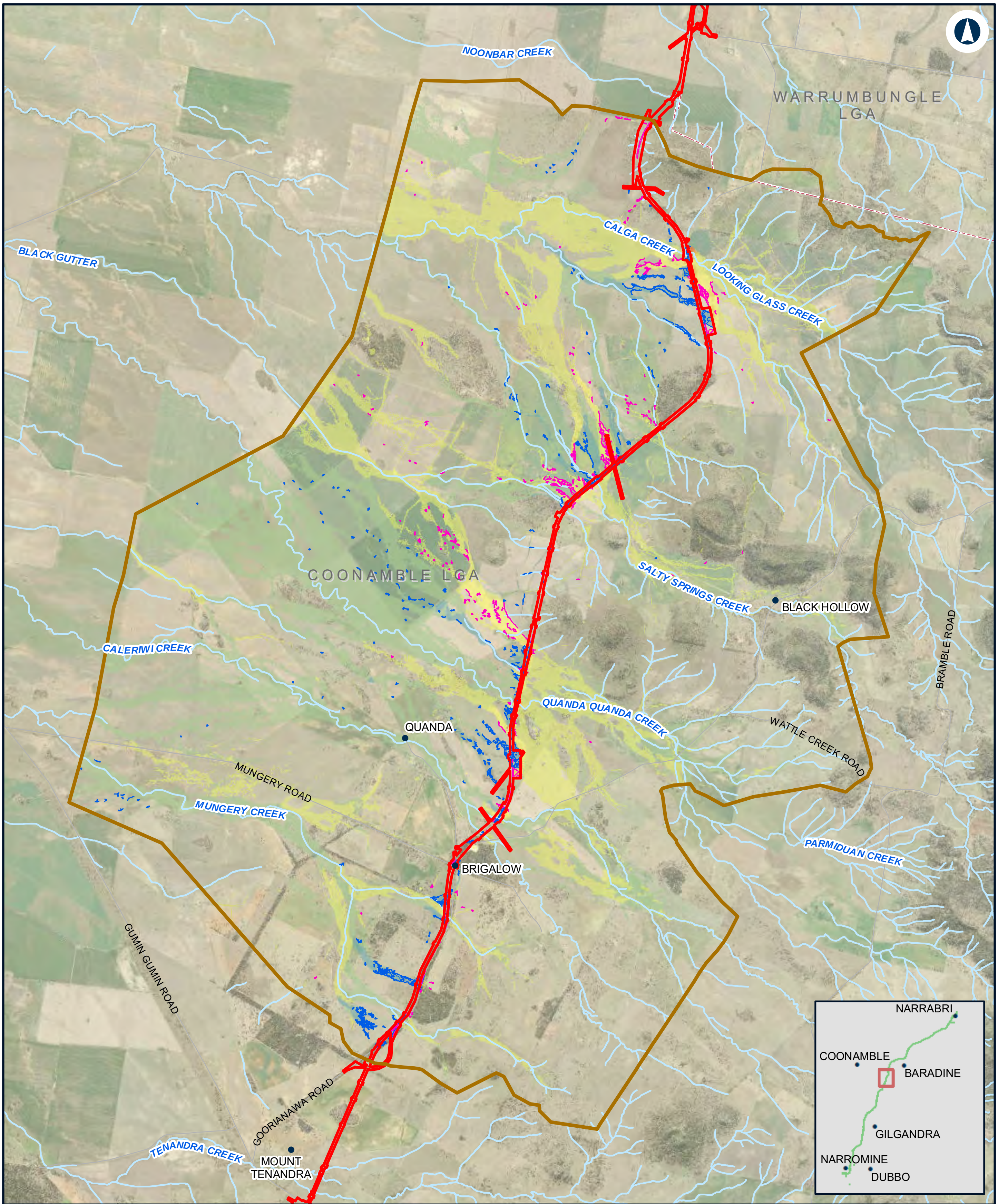

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N8 Appendix F – Figure 3g

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:100,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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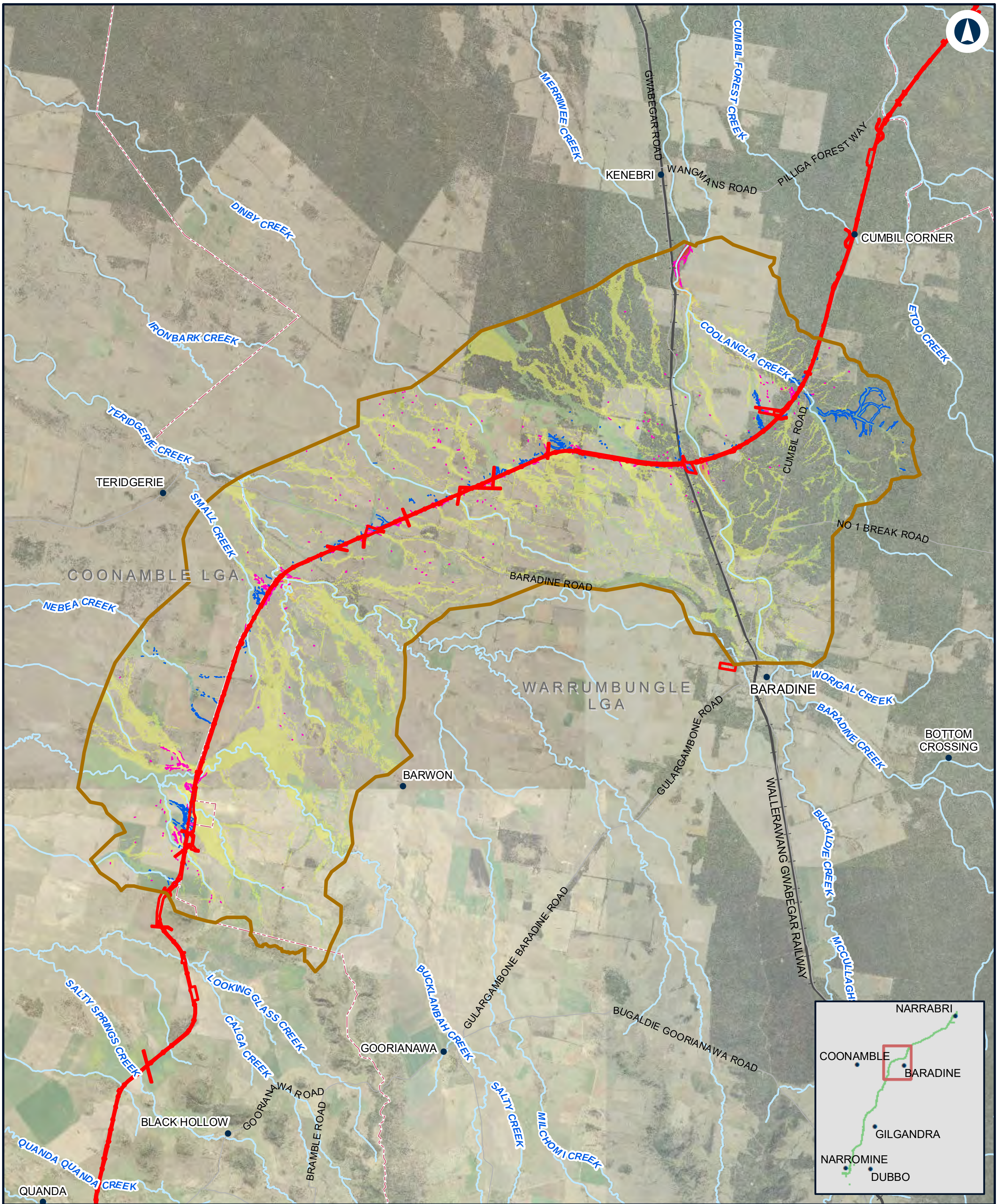

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N7 Appendix F – Figure 3h

0 2.5 5 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:200,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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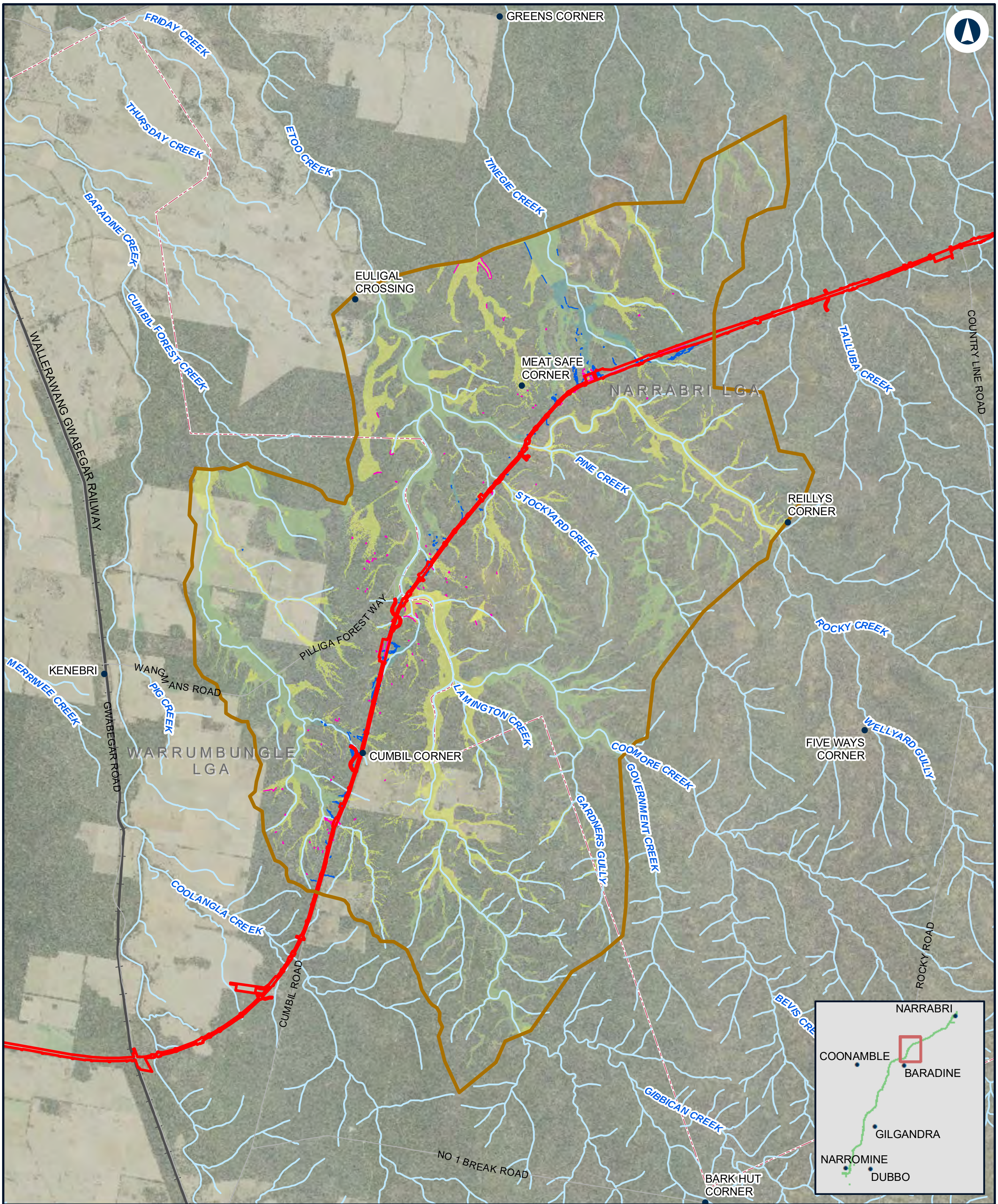

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N6 Appendix F – Figure 3i

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

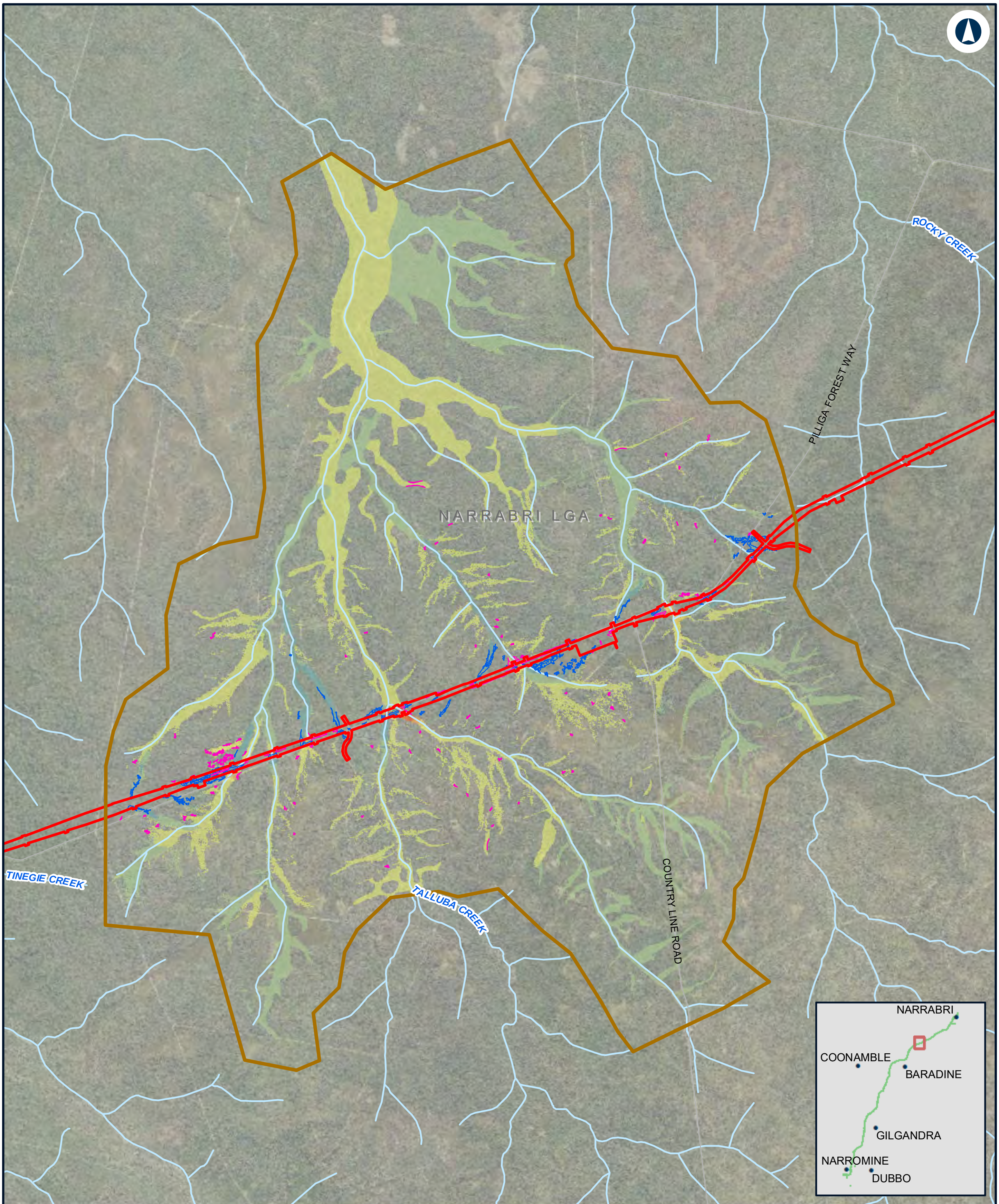
- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.



NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N5 Appendix F – Figure 3j

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:70,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

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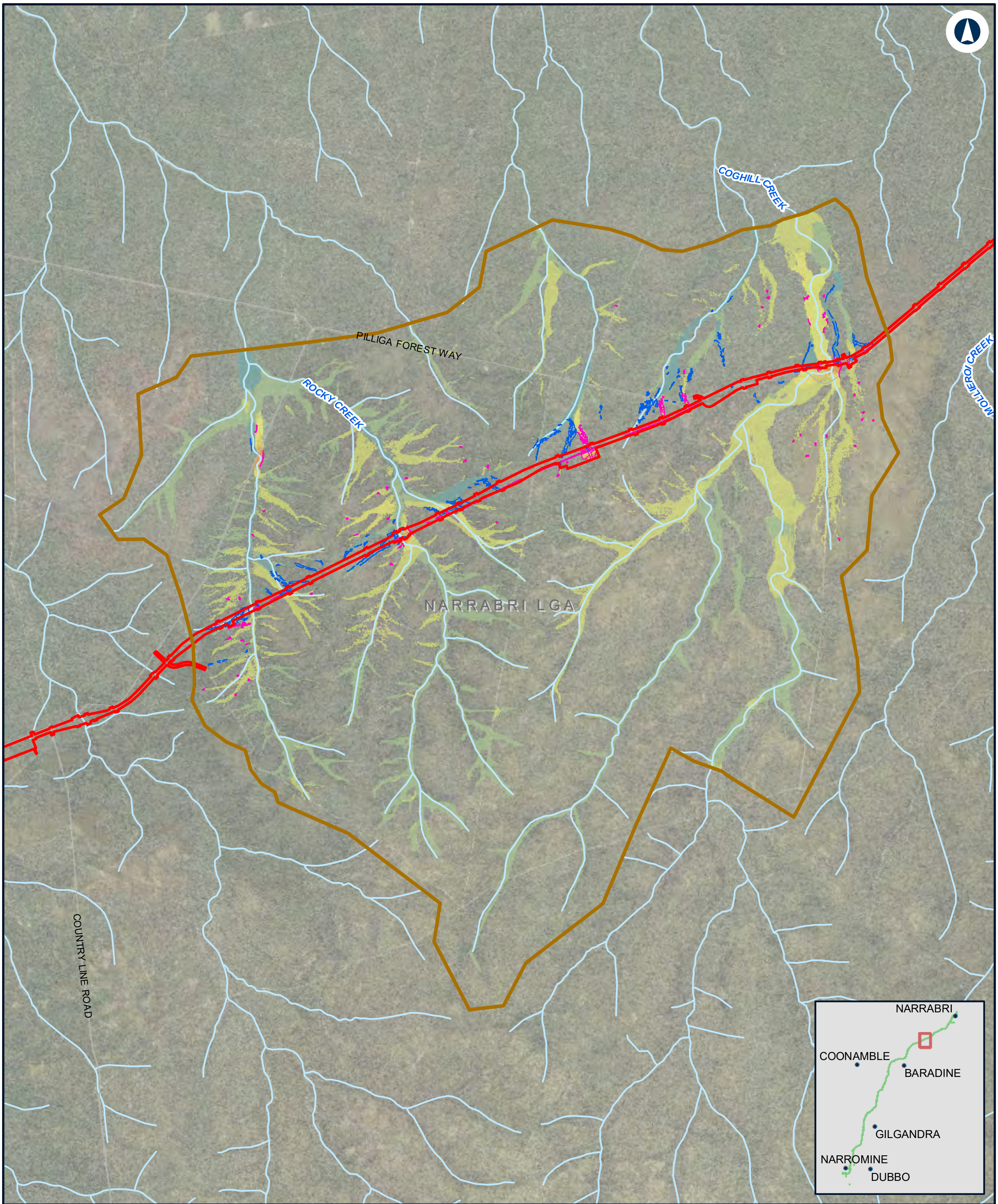

NARROMINE TO NARRABRI | Change in peak flood level (afflux) construction - 1% AEP - N2N4 | Appendix F – Figure 3k

0 1 2 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:80,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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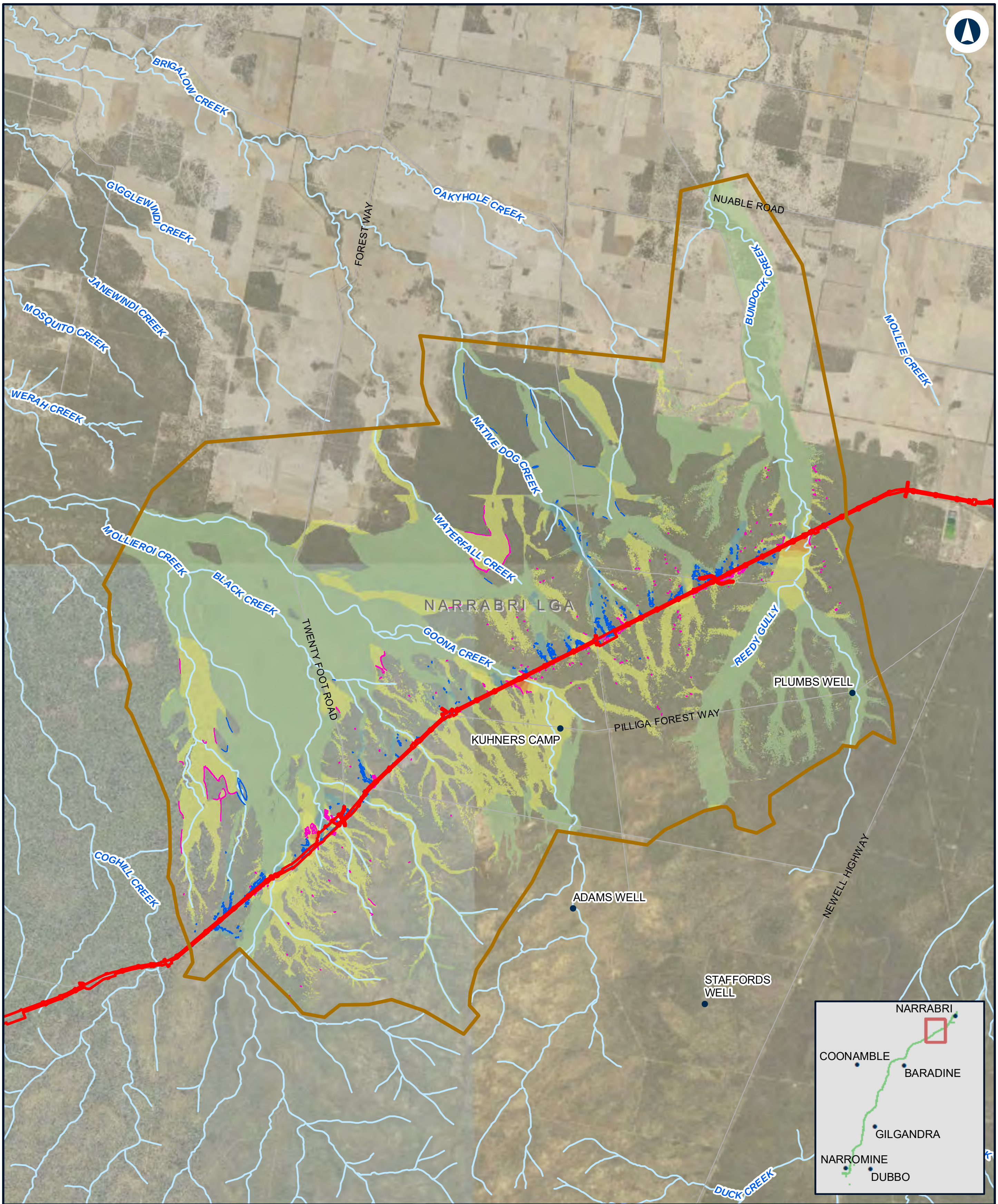

NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - N2N23 Appendix F – Figure 3l

0 1.5 3 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:140,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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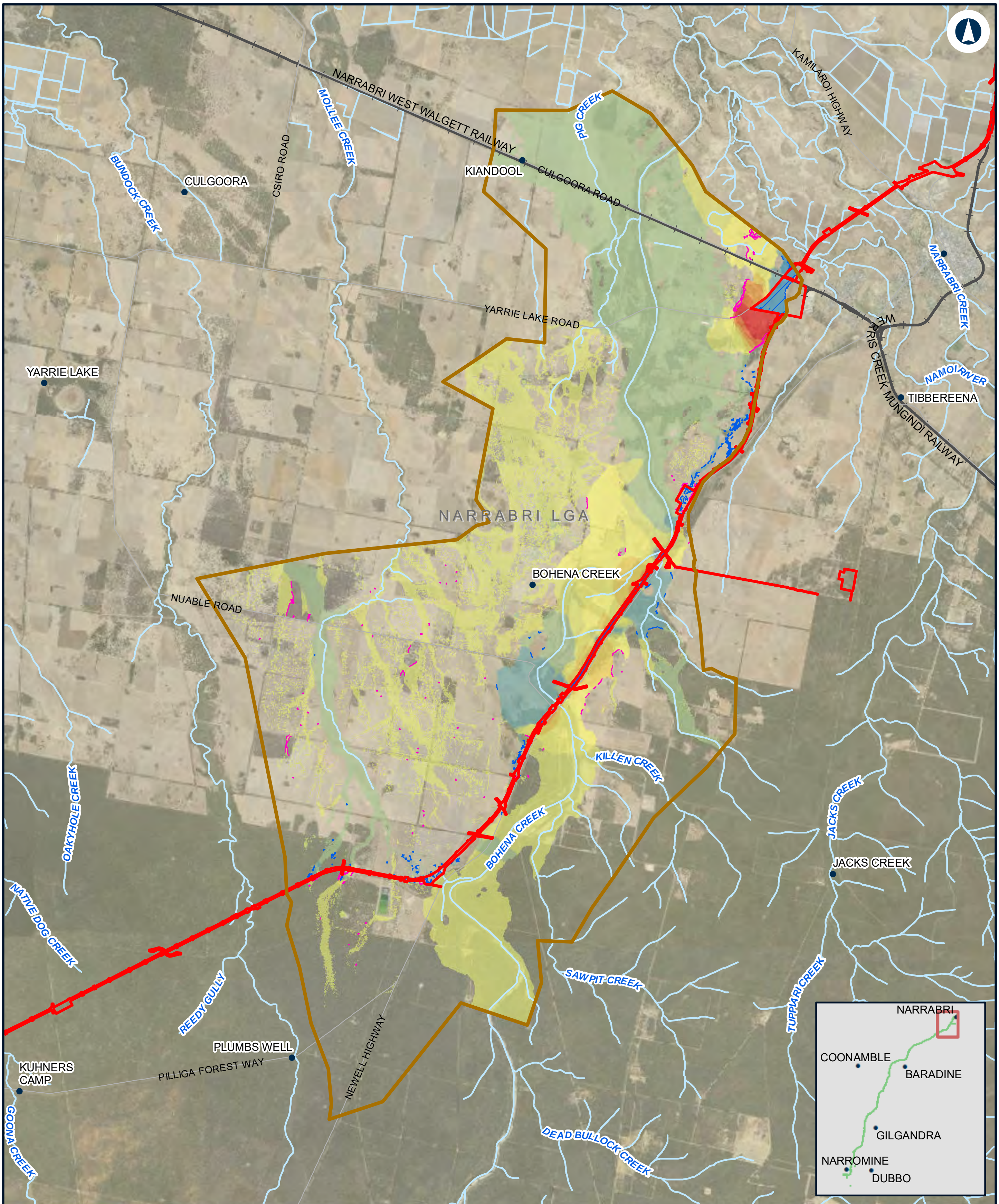

NARROMINE TO NARRABRI

Change in peak flood level (afflux) construction - 1% AEP - N2N1

Appendix F – Figure 3m

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:150,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

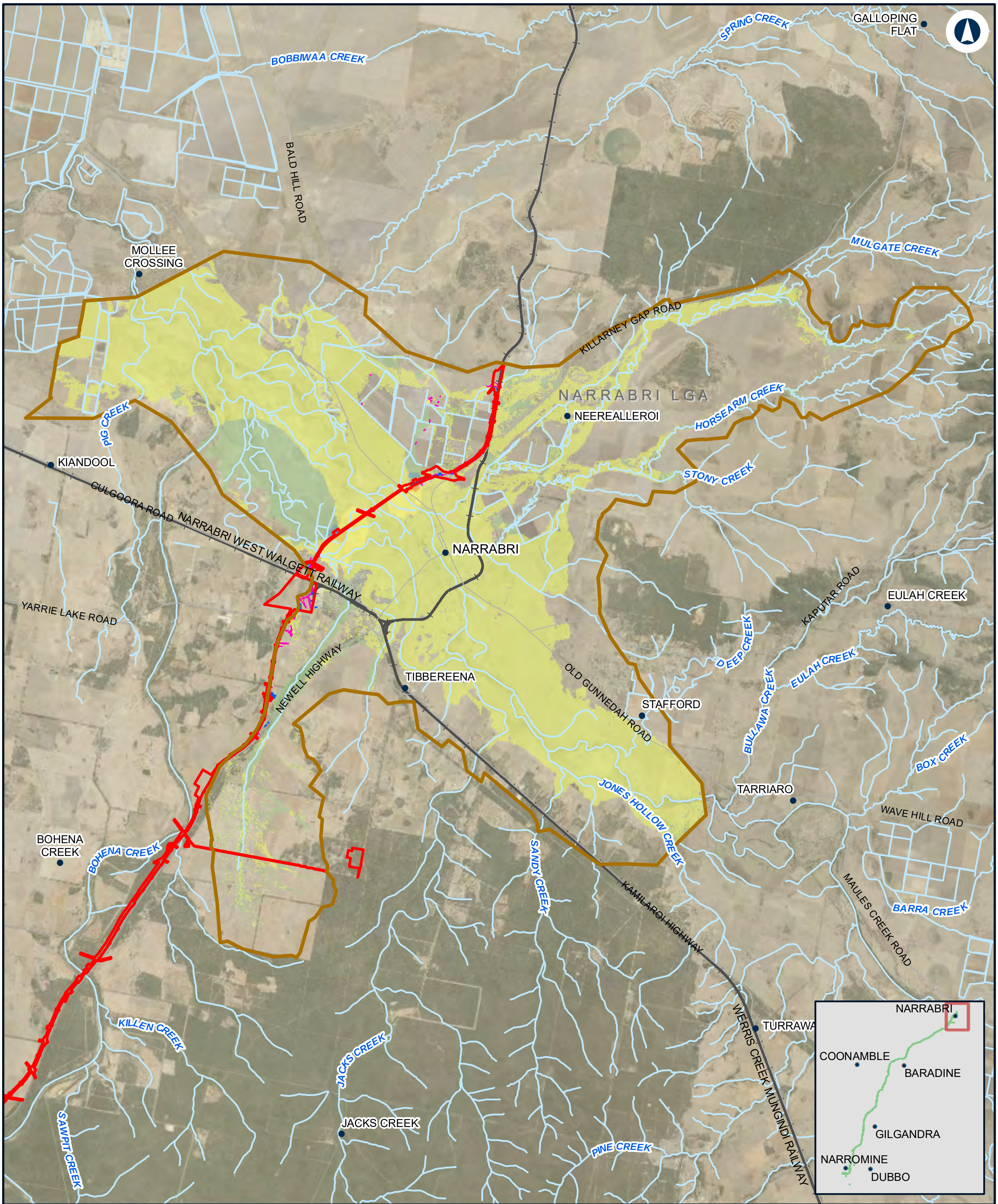
- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

INLAND RAIL ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.



NARROMINE TO NARRABRI Change in peak flood level (afflux) construction - 1% AEP - Narrabri Appendix F – Figure 3n

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 55

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Date: 4/11/2020 Paper: A4
Author: JacobsGHD Scale: 1:160,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

LEGEND

- The proposal site
- Model boundary
- Was dry now wet
- Was wet now dry

Afflux band

- > 0.2m decrease
- 0.01 m - 0.2 m decrease
- 0 m - 0.01 m decrease
- 0 m - 0.01 m increase
- 0.01 m - 0.05 m increase
- 0.05 m - 0.1 m increase
- 0.1 m - 0.2 m increase
- 0.2 m - 0.5 m increase
- > 0.5 m increase

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