APPENDIX 8

Flooding Assessment

SURVEYING THE BAY
HAWKE'S BAY | NEW ZEALAND

TKKM TE WANANGA WHARE TAPERE O TAKITIMU : NEW SCHOOL

BENNETT ROAD, HASTINGS

FLOODING ASSESSMENT

Prepared for :	**RDT PACIFIC LTD on behalf of the MINISTRY OF EDUCATION**
Prepared by :	**Surveying The Bay Ltd**
Date Prepared :	**June 2017 (Revised August 2017)**
Project:	**4337**

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1.0 Introduction and Background

The Ministry of Education proposes to build a new school in Hastings and has purchased the subject site, shown as Area 1A in Appendix B. The Ministry is now proceeding with a Notice of Requirement application.

On behalf of the Ministry, Surveying The Bay Ltd has been engaged by RDT Pacific Ltd to provide a preliminary flooding assessment of the site including identifying any particular issues around disposal of stormwater.

2.0 Site Location

The site is located at Bennett Rd, on the north-east side of Hastings and is shown in Figure 1 below, outlined in red.

Figure 1 : General locality

The site is in a flat area of production land of generally mixed use - primarily pip fruit, market gardens and cropping. To the west is the Heinz Wattie's industrial site, and there is also a recreation area (rugby and polo grounds) to the south-west.

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Below is an extract from the Council GIS showing an aerial photograph and site features. The site is approximately 1,100m (as the crow flies) north-east of the Kenilworth Rd suburban residential area. There is also a rural residential cluster of housing approximately 600m to the south of the site.

Figure 2 : Aerial Photo

3.0 Legal Description

The land is contained in Computer Freehold Register HBB3/462, and is described as Lot 2 Deeds Plan 566 and Lot 2 DP 11280. The total land area is 9.2471 ha. The title is owned by Aorangi Maori Trust Board, and has no memorials noted apart from a mortgage, and being subject to Section 36(4) of the Counties Amendment Act 1961.

The Ministry of Education is proceeding with the purchase of part of HBB3/462, shown as Area 1A in Appendix B.

4.0 District Plan Zoning

The current underlying zoning is *Plains Production* as shown on Map 27 and 35 of the Proposed Hastings District Plan 2015, an extract of which is shown below in Figure 3.

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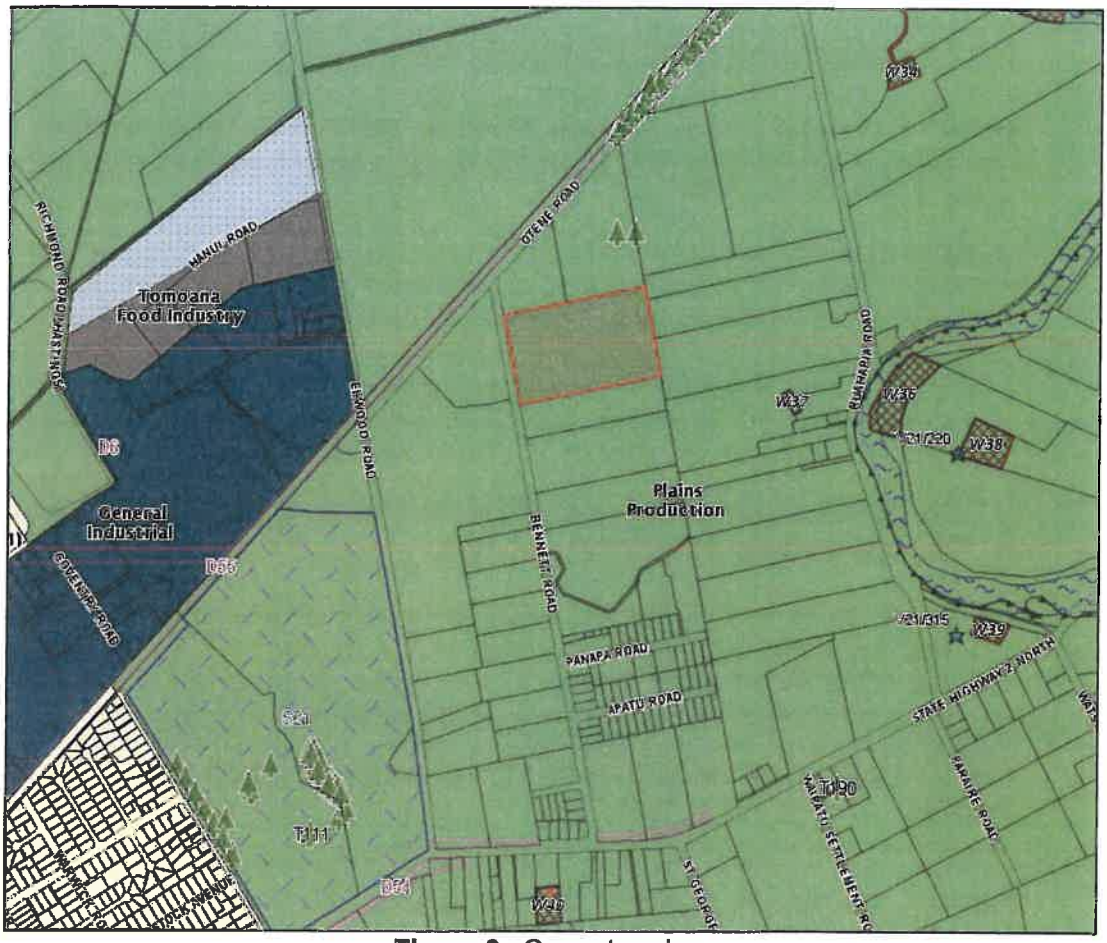

Figure 3 : Current zoning

5.0 Site Characteristics

The site of interest is in the north-west corner of the block and labelled Area 1A on the project plan titled "Proposed Required Land" (dated 28-11-2016 prepared by The Property Group).

It was not possible to perform a walkover of the site as access was restricted. However, it appears the entire area of interest is in pasture and fenced into several paddocks. The area is flat and appears to contain a dirt horse training track.

There are no significant buildings on the site in the area of interest, and we could not observe any drains or other drainage features.

Appendix D contains various site photos.

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6.0 Hastings District Plan Stormwater Provisions

Section 4.1.5.1 (g) of the Proposed Hastings District Plan 2015 describes certain information requirements relating to stormwater that should be provided when applying for resource consents as follows:

(g) Stormwater

> *(i) The amount of stormwater runoff likely to occur from activities on the site.*
>
> *(ii) Availability of a public reticulated stormwater disposal system for the site to connect to, and the available capacity of that system to carry stormwater from the site.*
>
> *(iii) Where a public reticulated stormwater disposal system is not available, how stormwater may be disposed of on the site.*
>
> *(iv) An explanation of how low impact stormwater design techniques and solutions can be incorporated into the design of the development in order to manage stormwater runoff. Refer Section D5 (Stormwater Management) of the Subdivision and Infrastructure Development in Hastings: Best Practice Design Guide.*

These aspects should be considered for the stormwater design of any development proposal.

7.0 Hastings Engineering Code of Practice 2011 Provisions

In terms of performance criteria, the Engineering Code of Practice 2011 (ECoP) states in Section 4.1 that:

Any stormwater system shall:

> *(a) Provide protection from storms of at least a 50 year return period (2% annual exceedance probability, AEP) using a system of primary and secondary flow paths, appropriate to the intended land use over its design life. The primary system shall have a minimum capacity of at least a 5 year return period storm (20% AEP)*
>
> *(b) Provide flood management to avoid serious inundation or hazard*
>
> *(c) Provide rural lots with an area suitable for effluent pipes, tank and treatment system which is free from inundation in a 50 year event, and an area suitable for effluent disposal that is free from inundation in a 10 year return period storm (10% AEP) and not likely to cause a health hazard during any 50 year event inundation*
>
> *(d) Adequately service the catchments and accommodate the design flows, for both the level of development at the time of design and that which can reasonably be expected to exist once the catchments are fully developed*
>
> *(e) Adequately service each lot, road area or land area discharging to the point of entry through to an approved outlet.*

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In terms of stormwater system design, Schedule D of the Hastings ECoP (See ***Appendix A***) has adopted Section 4 of NZS 4404 with some additions and/or alterations.

Below are selected extracts from Schedule D relating to the control of stormwater and design of stormwater systems:

Clause 4.3 Design

In general, the design principles outlined in Section 4.3 of Part 4 of NZS 4404 are to be followed. The following text provides additional comments and some specific changes that will take precedent over Part 4 in NZS 4404.

The Stormwater System

Stormwater drainage encompasses a total system providing amenity, land drainage and protecting land and infrastructure against flooding.

The public stormwater system comprises a primary drainage system (usually consisting of pipes and open channels); while overland flow paths and controlled flood plains provide additional protection (a secondary system).

Catchments

All stormwater systems shall provide for the collection and controlled disposal of stormwater from within the developed area, together with any runoff from upstream catchments including roads and driveways, etc. When designing downstream facilities the upstream catchments should be considered as being fully developed, and provision made to extend the system to the upstream boundary.

For larger developments or where constraints exist in the downstream stormwater system, a developer may be required to ensure that the development creates no increase in either downstream peak flow or total volume or both. To satisfy this requirement stormwater attenuation or re-use may be required within the proposed development area. Specific attenuation methods and design criteria shall be submitted to Council for approval.

Comment : The Karamu Stream represents a constraint in the downstream stormwater system, that may require specific on-site attenuation methods.

System Design

The primary stormwater drainage system of pipes and/or open watercourses shall have sufficient capacity to convey a 5 year rain storm without surcharging onto roads (i.e., not within 400mm of kerb tops). If a detailed runoff calculation method is applied, a hydraulic grade line 250mm below kerb level may be acceptable. This requires designers to consider 5 & 50 year storm scenarios in the design process. This requirement is currently under review and other scenarios may also be required.

It will be necessary to refer to Table D2 for the Roading Network Expected Level of Service when considering the ability of the road corridor to assist with Stormwater Management.

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Hierarchy Classification	Storm Water Return Period (yrs)			
	5	10	20	50
Arterial Road	All designed movement lanes	All designed movement lanes	2 x Full traffic lanes	2 x Full traffic lanes
Collector Road	All designed movement lanes	2 x Full traffic lanes	2 x Full traffic lanes	1 x Full traffic lane
Local Road	1 x Full traffic lane	1 x Full traffic lane	0mm depth on Carriageway Center line	100mm depth on Carriageway Center line
Lane	1 x Full traffic lane	0mm depth on Carriageway Center line	100mm depth on Carriageway Center line	200mm depth on Carriageway Center line

Table D2: Required Road Corridor Level of Service for Stormwater Management

Comment: For the purposes of stormwater management, Bennett Rd is considered a Local Road. From Table D2, the stormwater system can tolerate some flooding of the road carriageway, up to 100mm in a 50yr return storm.

8.0 Ground Levels from LIDAR Data

LIDAR data (raw points, dated July 2003) was obtained from the Hawkes Bay Regional Council (HBRC) and contours were generated within roughly 500m of the subject land using proprietary survey software. The 2003 LIDAR data is the latest available from HBRC. See the below Figure 4, which is also attached as ***Appendix B***.

The contours indicate Site 1A is higher in the south-western portion, and the ground levels are lower towards the north-east.

The contours clearly indicate the remnants of an old stream bed to the east of the subject site, and the general alignment of the watercourse which meandered its way across the plains.

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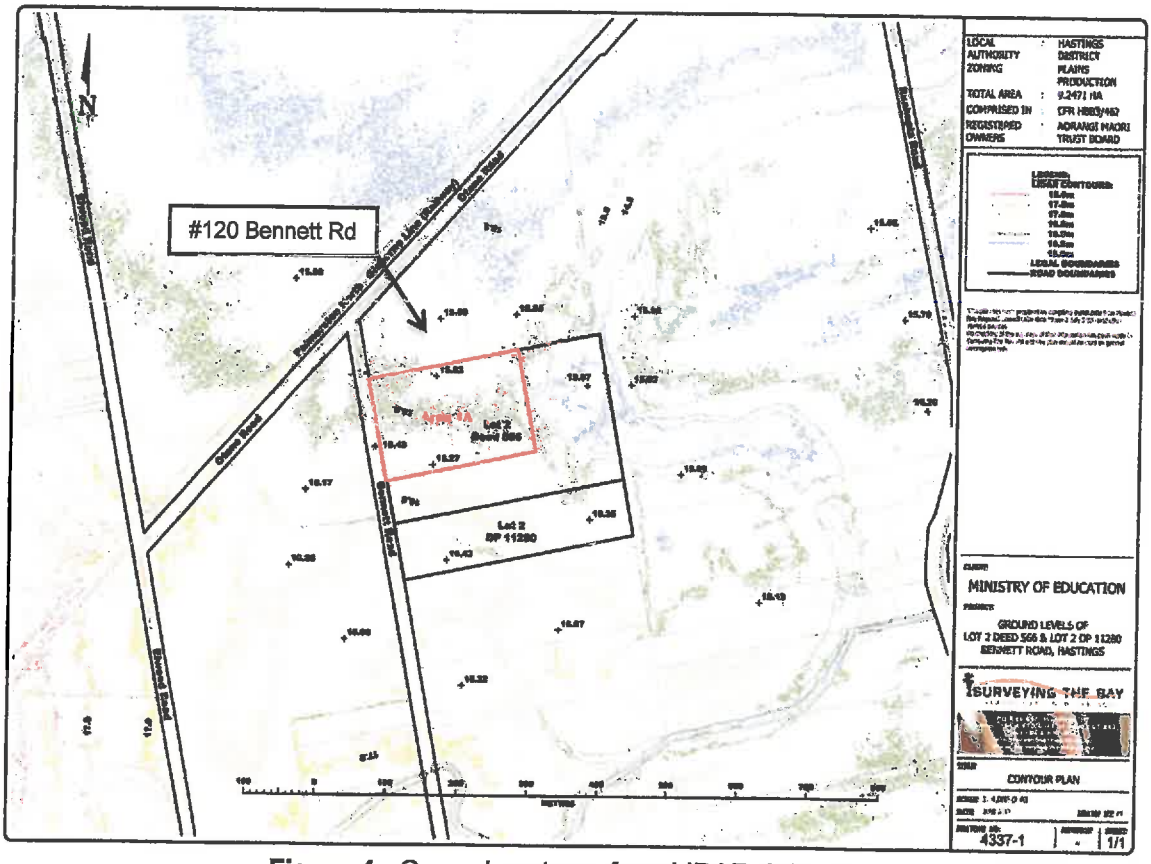

Figure 4 : Ground contours from LIDAR data

9.0 Local Drainage Network

The road frontage to the site has no formalised drainage, and presently takes the form of a shallow grassed swale drain.

There is an open drain on the roadside along part of the frontage of the adjoining property (to the north of the subject site) at #120 Bennett Rd. This connects with an open drain in Otene Rd that in turn drains to the Karamu Stream where Otene Rd intersects Ruahapia Rd.

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Photo 1 : Bennett Rd looking north, showing existing road swale drains.

Photo 2 : Open drain along frontage of #120 Bennett Rd, looking south.

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Photo 3 : Open drain along Otene Rd looking east towards Karamu Stream (from Bennett Rd intersection).

10.0 Hawkes's Bay Regional Council Consultation

The HBRC Hazard Portal identifies the north-east portion of the site as being a flood risk area per the below Figure 5 (also attached as ***Appendix C***). This area corresponds well with the LIDAR data contours shown previously.

The flood risk area has been modelled by the Regional Council for a 50yr event affecting the Karamu Stream (with no climate change allowance).

We have consulted with Craig Goodier (Manager Engineering – HBRC), who has advised that the 50 yr flood level is RL16.1m.

He also advises "*An aspect of this flooding is that it is exacerbated by blockages caused by the sewer pipe crossing the Karamu. The blockages may not happen every time it floods, however, if there is a weed build-up, the upstream water level can increase substantially.*" (Refer to Figures 6 and 7 below)

Mr Goodier states that in terms of this project "*There may be a bit of overland flow to take into account during heavy rain, but this can probably be dealt with using site drainage.*"

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Figure 5 : Flood risk area from HBRC hazard portal.

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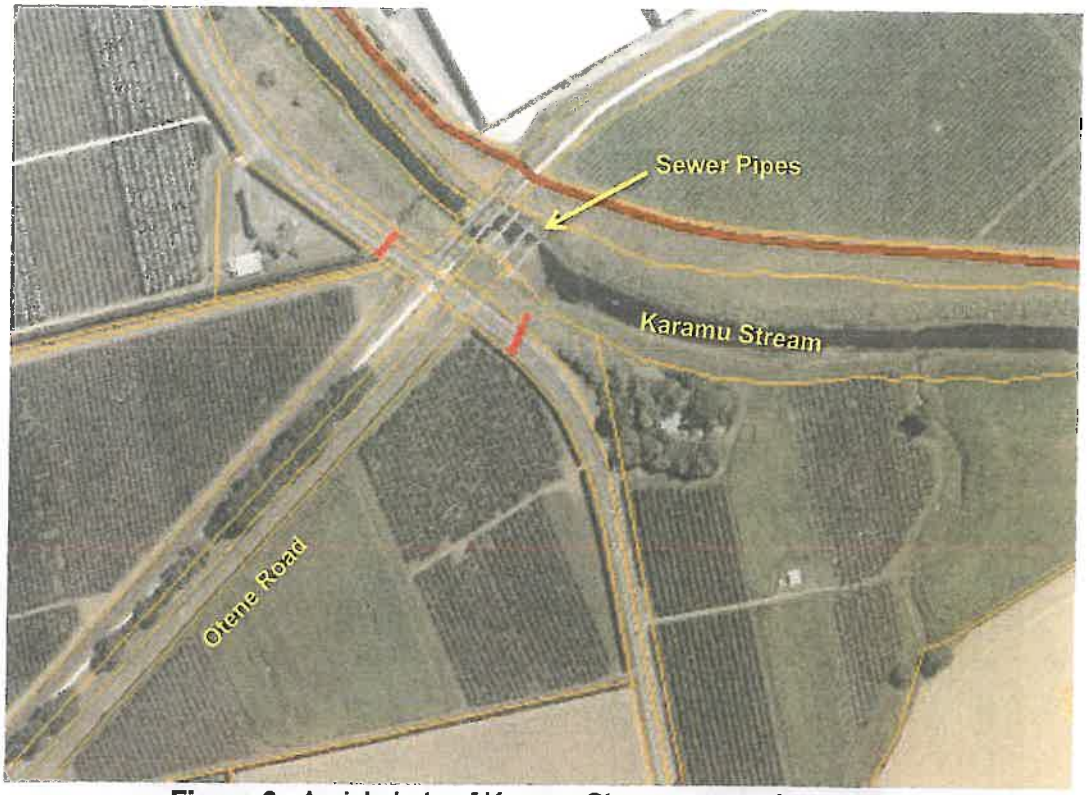

Figure 6 : Aerial photo of Karamu Stream sewer pipe crossing.

Figure 7 : Hastings District Council sewer pipes crossing the Karamu Stream

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A further comment from Mr Goodier is as follows:

"One thing we're finding now is that this modelling was done in 2003 using a 1D model, and we're slowly doing more areas using 2D models with a direct rain on grid approach. This area hasn't been looked at yet using this approach, but it may warrant it, if there is substantial call for a more accurate representation of the flood risk depending on the scale of development."

Below is a further extract from the HRBC modelling software showing elevation detail and the flood risk area over the subject site:

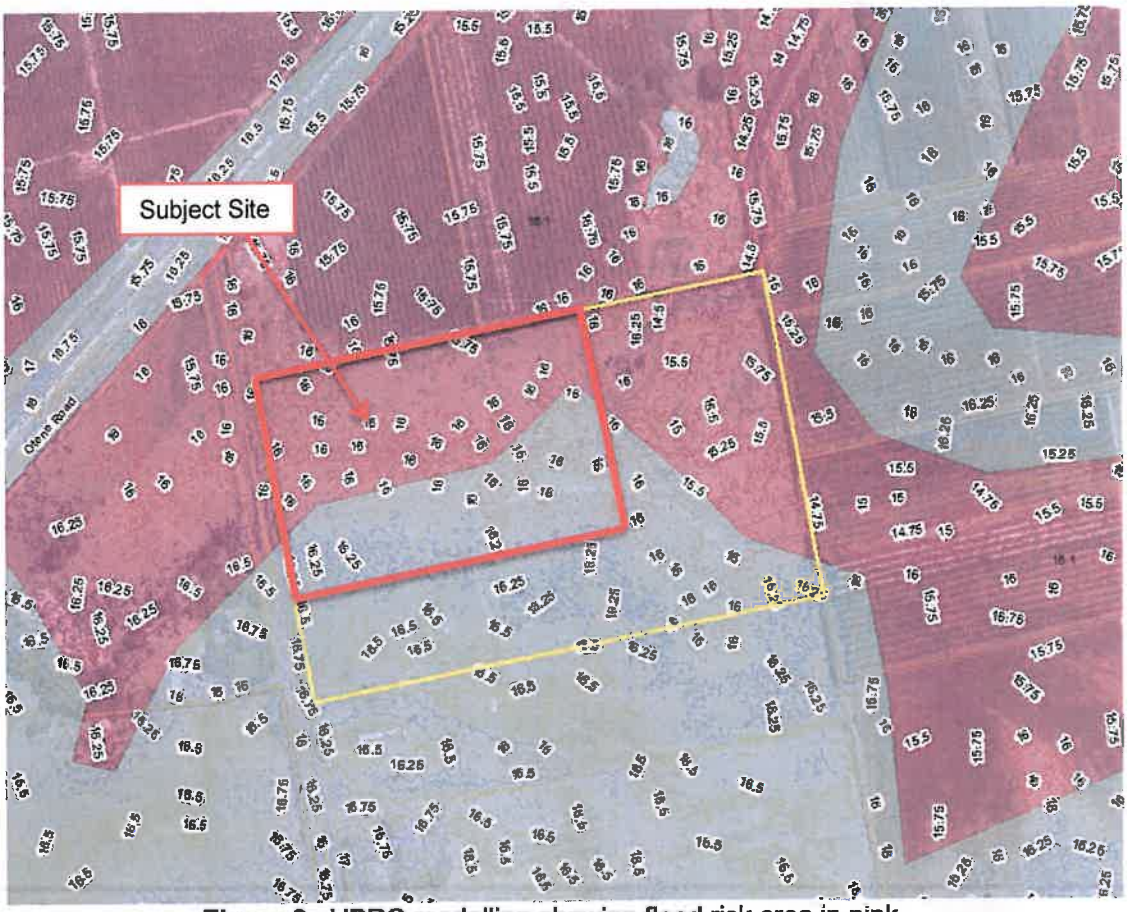

Figure 8 : HBRC modelling showing flood risk area in pink

We note that the current modelling of HBRC has determined that the 50 yr flood risk level is RL 16.1m. Current ground levels of the subject Site 1A range from approximately RL 15.8-16.3m, and average approximately RL 16.0m.

With the current information, it would appear feasible to develop the site to minimise the risk of inundation of buildings by either raising the site level, or constructing buildings on foundations higher than the flood risk level.

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11.0 Hastings District Council Consultation

We have contacted the Water Services Manager from Hastings District Council (HDC), Brett Chapman. Mr Chapman advises this area is outside the HDC urban stormwater network, and will most likely require approval from HDC and HBRC if considering discharging stormwater to the roadside.

Other considerations in terms of stormwater design for site development are:

- Council will need assurance there will be no nuisance caused to neighbours in terms of flooding or ponding effects as a result of site development.
- The basic premise per the engineering code is that post-development overland flow is no greater than pre-development.
- Floor levels will need to be set so that they are at a height no less than 0.3m above the 1:50 year flood level.

12.0 Conclusion

Site 1A is subject to an area of 50 yr flood risk in the northern portion that will need to be accounted for in the earthworks and stormwater designs. Mitigation of potential effects on neighbours will be required.

General overland flow is in a north-easterly direction towards the Karamu Stream, which has a large urban catchment. Flood levels can be exacerbated when sewer pipes crossing the stream at Otene Rd have detritus buildup which block flows. This can cause upstream flooding, potentially including the subject site.

HBRC recommends being commissioned to perform further site specific flooding analysis. The current modelling is based on generalised 1D analysis, and a 2D direct rain on grid approach will potentially provide more accurate flooding analysis specific to Site 1A.

The Hastings District Council ECoP states that in areas where there are downstream drainage constraints, a developer is required to ensure there is no increase in either downstream peak flow, total volume, or both. Some form of on-site attenuation may be required within the development.

The existing roadside drainage network may be able to accept flows, providing this can be modelled to the satisfaction of the Hawke's Bay Regional Council.

Prepared by: **Date: June 2017**
(Revised August 2017)

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APPENDIX A : HDC ECoP SCHEDULE D

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Schedule D – Altered Requirements to Section 4 NZS 4404 Stormwater Drainage

The Hastings District Council has adopted Section 4 of NZS 4404 with the following additions and/or alterations to be used in conjunction with NZS 4404.

Drawings

NZS 4404 includes Standard Drawings in Appendix A. Council has opted in this document to make reference back to these drawings, and also the drawings produced for WSA 02, and has amended these drawings for inclusion in this document. Within the following text specific reference is made where appropriate to the attached Drawings, referenced as *SEW - *****. Document users are also encouraged to be familiar with and where appropriate utilise the Drawings in Appendix A in NZS 4404.

Standards

The Standards and Codes of Practice which are listed below are referred to in this section. The design, materials and methods of construction shall comply with these standards and codes as applicable. The standards shall incorporate the latest amendments. Standards superseding those listed shall automatically apply.

AS/NZS 1260 : 2002	*PVC – U pipes and fittings for drain, water and vent applications*
AS/NZS 2566.1:2002	*Buried Flexible Pipes, Part 1 Structural Design*
AS/NZS 2566.2:2002	*Buried Flexible Pipes, Part 2 Installation*
NZS 3109 : 1997	*Specification for Concrete Construction*
AS/NZS 3725 : 2007	*Design for Installation of Buried Concrete Pipes*
AS/NZS 4058:2007	*Precast Concrete Pipes (Pressure and Non-Pressure)*
AS/NZS 4130 : 2003	*Polyethylene (PE) Pipes for Pressure Applications*
NZS 4405 : 1986	*Helical lock-seam corrugated steel pipes*
NZS 4442 : 1988	*Welded Steel Pipes and Fittings for Water, Sewage and Medium Pressure Gas*
AS/NZS 4058 :	*Manufacturing, Handling and Storage*
Concrete Pipe Association of Australia	*Manual on the Selection and Installation of Concrete Pipes and Associated products*

Clause 4.3 Design

In general, the design principles outlined in Section 4.3 of Part 4 of NZS 4404 are to be followed. The following text provides additional comments and some specific changes that will take precedent over Part 4 in NZS 4404.

The Stormwater System

Stormwater drainage encompasses a total system providing amenity, land drainage and protecting land and infrastructure against flooding.

The on-site system comprises guttering, down pipes, storage tanks, infiltration tanks, and pipe and overland flow systems to the property boundary which are usually installed in accordance with the Building Act.

The public stormwater system comprises a primary drainage system (usually consisting of pipes and open channels); while overland flow paths and controlled flood plains provide additional protection (a secondary system).

Design for Integration, Efficiency and Compatibility

Council seeks to promote the utilisation and enhancement of natural systems for stormwater treatment and integration into the environment through subdivision and land development design. When assessing proposals the Council will look to:

- Encourage development styles and stormwater management methods that maximize infiltration, control frequent flood flows and direct flows in large storms through secure overland flow paths
- Promote protection and enhancement of riparian vegetation
- Minimise vegetation loss in riparian areas associated with development
- Ensure water flows are maintained to support healthy aquatic life by maximising infiltration
- Promote the restoration of degraded streams
- Promote on site disposal
- Encourage the fencing off of stock from water bodies and their margins
- Promote the use of bioengineering solutions where practicable
- Preserve stable meander pattern in streams, and for streams already in a forced alignment encourage the realignment into a stable meander pattern

Council will encourage the efficient use of water resources within subdivision and land development projects. When assessing proposals the Council will look to:

- Promote the use of stormwater methods that minimise, retain, treat and reuse stormwater runoff within the development for non-potable uses such as irrigation, and fire fighting in areas where water resources are limited
- Ensure that treated stormwater water quality is of a standard suitable for the proposed use, where it will be used in contact with people

- Ensure that specifications for stormwater treatment devices take into account habitat requirements in the receiving water

Council will also seek to ensure that new subdivision and land development projects are compatible with existing receiving waters. When assessing proposals the Council will look to:

- Minimise the adverse effects of activities on habitat quality and promote sustainable solutions
- When addressing flooding issues, give priority to solutions that also address water quality and habitat values by ensuring a practical balance is achieved to address both flooding and ecological considerations
- Ensure secondary flow paths are located in public land in areas where they will not be obstructed by fences or planting
- In areas subject to flooding ensure the type of planting does not obstruct stormwater flows
- Consider effects on groundwater quality, levels and flows.

Council will also seek to ensure any stormwater treatment and disposal/use systems proposed in a subdivision or land development project are able to maintain and enhance the natural and human environment. When assessing proposals the Council will look to:

- Promote the use of stormwater management devices that are designed to increase habitat opportunities
- Preserve natural watercourses as public open space and ensure these become landscaped features of the urban environment. Piped waterways are preferred where the land being developed is to become private property
- Require the treatment of road runoff within a development, prior to discharge to natural systems, where expected traffic volumes constitute a significant source of contaminants
- Ensure stormwater infrastructure (including manmade natural systems) is designed to minimise whole of life costs, including maintenance costs
- Ensure stormwater systems do not conflict with the operation of other utilities
- Ensure safety of the general public in terms of the management of stormwater.

Catchments

All stormwater systems shall provide for the collection and controlled disposal of stormwater from within the developed area, together with any runoff from upstream catchments including roads and driveways, etc. When designing downstream facilities the upstream catchments should be considered as being fully developed, and provision made to extend the system to the upstream boundary.

For larger developments or where constraints exist in the downstream stormwater system, a developer may be required to ensure that the development creates no increase in either downstream peak flow or total volume or both. To satisfy this requirement stormwater

attenuation or re-use may be required within the proposed development area. Specific attenuation methods and design criteria shall be submitted to Council for approval.

Where existing or future land-use in a catchment gives rise to the possibility of stormwater contamination, or where sensitive receiving environments exist, stormwater treatment will be necessary.

Stormwater Runoff

Pre and post development stormwater peak runoff from a catchment or watershed may be calculated in accordance with the Rational Method or Modified Rational Method. These methods are described in the New Zealand Building Code, Approved Document E1 - Surface Water. However, care is to be taken in application of time of concentration formulae to flat catchments (Section 2.3.2 b i) of Approved Document E1) Alternative methods will be accepted subject to appropriate certification by a suitably qualified person.

Table D1 below provides typical values for an average runoff coefficient, C, for use on catchments in this District where impervious surfaces dominate the runoff coefficients. These can be used for the design of public stormwater infrastructure where there is no other downstream constraint. If a developer does not wish to restrict runoff to this capacity and to undertake a development that utilises the maximum site coverage permitted in the District Plan, this may require on site attenuation, storage or infiltration. Such conditions may need to be protected by Restrictive Covenant on the Title.

Table D1 Stormwater Runoff Coefficients

Type of surface or land use	Return Period	
	5 Year	50 Year
Sealed Surfaces, Roofs	0.9	0.9
Central Business District	0.8	0.8
Industrial Heavy	0.5	0.6
Industrial Light	0.7	0.75
Residential	0.5	0.6
Parks (not residential)	0.3	0.5

When working in catchments where the percentage of impervious surface is lower, alterative design approaches using a 'soil profile method' for calculation of the average runoff coefficient can be used. This method uses District soil characteristics to match site soil profiles to select the pervious surface part of the average runoff coefficients.

Council has commissioned studies to determine soil data for Hastings, Havelock North and Heretaunga Plains. Data can be obtained from Council. If free draining soils exist in these catchments the average runoff coefficient may be lower than the typical District values. However, reductions below typical District values will not be accepted unless soil profile data has been provided from an IANZ accredited soils laboratory.

Rainfall intensities and durations for 2, 5, 10 and 50 year return periods (i.e. 50%, 20%, 10% and 2% AEP) for the Hastings urban areas can be obtained from Council's Engineering Division. The rainfall intensity data provided in this code relate / is extracted from NIWA's HIRDS programme. Version 3 is about to be issued and will become the required reference source for design data. This data includes standard tables and tables incorporating an allowance for probable climate change effects over the next 50 years. NZS4404 requires designers to "consider" climate change. This code requires designers to "take climate change into account", as part of a whole of life approach to the asset design, including managing the risk of climate change over the intended life of the asset.The advice of Council staff should be sought if variations to the low-medium-high range of intensity values are being considered to suit specific developments.

Data for other areas can be obtained from Council. Specific charts are available for Havelock North, Ocean Beach, Poukawa and Waimarama.

System Design

The primary stormwater system shall usually comprise pipes except where Council approves an alternative solution. In general, existing natural perennial watercourses (i.e. streams, rivers) shall not be piped and shall be incorporated in public open space.

The primary stormwater drainage system of pipes and/or open watercourses shall have sufficient capacity to convey a 5 year rain storm without surcharging onto roads (i.e., not within 400mm of kerb tops). If a detailed runoff calculation method is applied, a hydraulic grade line 250mm below kerb level may be acceptable. This requires designers to consider 5 & 50 year storm scenarios in the design process. This requirement is currently under review and other scenarios may also be required.

It will be necessary to refer to Table D2 for the Roading Network Expected Level of Service when considering the ability of the road corridor to assist with Stormwater Management.

Storm surge, tsunami hazards, and sea level rise should also be considered when designing any stormwater system, particularly on low lying land.

For rainfall in excess of a 5 year storm up to a 50 year rainstorm, the secondary stormwater system shall have sufficient capacity to discharge runoff and protect buildings and household gully traps from inundation.

If the run-off calculated for a 5 year event using coefficients in Table D1 is above the level of service provided by the downstream stormwater system, run-off must be controlled by an approved system of on-site stormwater management.

The flowchart approach to stormwater system design shown in Diagram D1 below is encouraged:

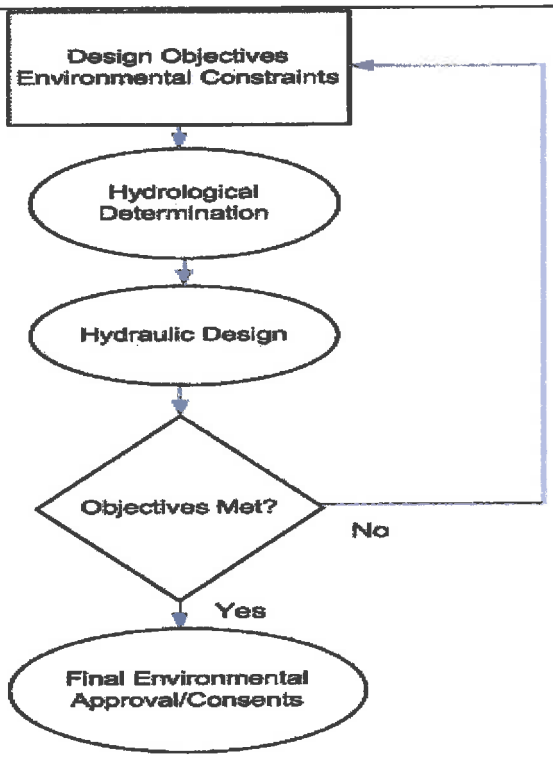

Diagram D1: Flowchart showing Stormwater Design Methodology

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Expected Road Corridor LOS for Stormwater Management

Hierarchy Classification	Storm Water Return Period (yrs)			
	5	10	20	50
Arterial Road	All designed movement lanes	All designed movement lanes	2 x Full traffic lanes	2 x Full traffic lanes
Collector Road	All designed movement lanes	2 x Full traffic lanes	2 x Full traffic lanes	1 x Full traffic lane
Local Road	1 x Full traffic lane	1 x Full traffic lane	0mm depth on Carriageway Center line	100mm depth on Carriageway Center line
Lane	1 x Full traffic lane	0mm depth on Carriageway Center line	100mm depth on Carriageway Center line	200mm depth on Carriageway Center line

Table D2: Required Road Corridor Level of Service for Stormwater Management

Pipeline Design

Pipes shall be sized according to Colbrook-White, or Manning's formula. Alternative methods will be accepted subject to appropriate certification by a suitably qualified person.

Acceptable pipeline designs may incorporate the use of the following software:

- HEC – HMS
- MIKE URBAN (DHI)
- XP – SWMM
- AULOS (Hydra Software)
- MIKEII (DHI)
- PURRS
- ILSAX
- XP - CULVERT

Council will require supporting calculations with the submission. Appropriate allowance shall be made for head losses at changes of direction in manholes.

The minimum flow velocity for pipes flowing just full shall be 0.7 m/s. The choice of a larger diameter pipe than is necessary for the peak discharge is not a satisfactory means of achieving compliance with the minimum velocity requirements.

No stormwater pipe, except for a connection to a lot shall be less than 200mm internal diameter. Stormwater connections to manholes and other Council infrastructure must be made using proprietary systems, and not cause unnecessary damage to the existing infrastructure, including breaking holes through manhole riser pipes.

All stormwater pipes shall then be laid in accordance with the manufacturers published recommendations.

Design plans shall show long-sections, identifying other service crossings (except water supply laterals) and other drains with pipe diameters and invert levels.

The maximum length of a connection from the boundary to the main shall be 20m in a straight line, with an inspection point installed on the boundary.

Pipe wall strength shall be sufficient to withstand anticipated soil pressures, surface and traffic loads, (crushing load imposed on a water service to exceed that which would arise from the soil overburden plus a HN-HO-72 wheel or axle load as defined by the New Zealand Transport Agency Bridge Manual 2004) and any other loads to be anticipated both during construction and when in service. These factors shall be taken into account during design, and appropriately documented in the design report.

Open Watercourses

Open drains are discouraged as permanent features within urban lots without specific Council approval. Early consultation with Council staff is encouraged if open drains are being considered.

Existing watercourses within a development or subdivision and those associated with Council project work, shall be protected by a drainage reserve. Easements may be considered in exceptional circumstances. The reserve/easement shall include clear land sufficient to allow access for maintenance purposes. Council's Bylaws and the Regional and District Plans provide rules for the set back distances from drains and other water courses. The Building Act set rules for the set back of foundations.

The extent of any stream or open watercourse improvement work shall be agreed with both the Regional and District Council. Factors that should be considered in the design process are:

- the retention of natural topography and vegetation
- land stability
- hydraulics
- ongoing maintenance requirements.

Where open watercourses are retained through a new development, channel upgrading/enhancement and/or land-raising may be required.

The design of open channels and secondary flow paths, e.g. parks, roads, paths and drainage reserves, shall ensure that flow velocities will not cause erosion or scour. Where potential for scour or erosion exists, preventative measures such as silt and debris traps, bank and bed protection, shall be considered in the design.

All overland flow paths shall be identified and protected from conflicting uses and restrictions or obstruction. The discharge of stormwater into ephemeral watercourses will

not cause an extra nuisance to downstream owners, or increase the potential for erosion or land instability.

Inlet and Outlet Structures

Permanent control structures shall be constructed at the inlets and outlets of pipelines. Provision shall be made for energy dissipation unless it is demonstrated that outlet velocities and in-situ bed and bank materials are such as to make this unnecessary. The design shall provide non-scouring velocities at the point of discharge and into the receiving channel, or alternatively provide scour/erosion mitigation in the solution design. Inlet structures shall be designed to develop sufficient head to overcome entry losses.

To control debris and ensure safe access, all pipelines < 600mm in diameter, or with a length > 20m, with an inlet from an open watercourse, shall have specially designed inlet structures.

Sumps

Sumps shall be located as necessary to ensure the design flow can enter the primary stormwater system without overtopping the kerb top or encroaching on the carriageway at intersections. (Refer Section Four: Schedule C)

All new sumps shall be Type II sumps as detailed in the Building Code E/1.

The design of a grate or back entry road sump shall include a calculation of its capacity based on acceptable levels of ponding, the risk of debris blockage and orifice flow.

Discharge from sumps shall be via pipe leads with a minimum diameter of 225mm, either

- directly into manholes, or
- soffit to soffit into a stormwater main of at least 900mm diameter, provided that the receiving pipe has a manhole within 40m of the sump lead connection. Where the hydraulic gradient of a sump lead is affected by pipe full conditions in the main, specific design calculations to determine size will be required.

The materials used for and the location of sump leads must be able to carry all superimposed loads from backfill and traffic, particularly during construction and when in service.

Where large capacity sumps are required, specific design of the sump and lead pipe work is required.

Design consideration shall also be given to the effects of road cross fall, and longitudinal grade (particularly on steep grades and at intersections), to ensure that the full design flow enters the sump.

During road works or construction a suitable means of preventing silt, detritus and contaminants entering sumps must be used. Any gravel or debris entering sumps or the stormwater system shall be removed from the system at the end of construction.

Appropriate filters shall also be installed in sumps during construction to remove any oils, cement or other contaminants that may have come from construction machinery or activities.

Stormwater Pumping

Stormwater pumping will only be approved where gravity disposal is not technically feasible because stormwater pump stations are often only used intermittently and under extreme conditions when mains power supply cannot be guaranteed.

Pumping systems shall be specifically designed so that the performance matches the inflow hydraulics of the upstream system without backwater effects. Council recommends that the design philosophy and technical details shall be discussed with Council staff before detailed design is commenced. All electrical equipment shall be designed for a maximum of 15 starts per hour.

Depending on the consequences of flooding during a pump station power outage, Council may require that on-site emergency power generation be provided.

The pumps shall be capable of limited dry running during routine maintenance. Pumps shall also be able to accommodate transient loads and cycling loading over their expected service life.

Pressure pipes of 100mm diameter or larger shall be ABS, API Schedule 40 line pipe, concrete lined steel, ductile iron, or PVC material (of appropriate Class); with all bends and valves adequately protected against movement. Flanged or welded fittings shall be provided throughout, with a proprietary dismantling joint or similar in the system to facilitate dismantling.

Stormwater pump stations shall incorporate control, monitoring, alarm and telemetry communication systems to Council standards at the time of the design.

All pump stations are to be located on public land with suitable all weather vehicle access.

Siphons

Siphons are not permitted except by the specific Council approval. If the designer believes siphons are an option, this should be discussed with Council at a very early stage.

Stormwater Treatment

Where a stormwater discharge is from land areas where there is a high risk of contamination, then design consideration shall be given to the treatment of the stormwater. Examples of high contamination risks include roads with traffic volumes greater than 5000 vehicles per day and industrial land uses.

Preference shall always be given for the treatment to be done at source of the contaminated flow before it is discharged into the reticulated network.

The Hawke's Bay Regional Plan controls discharges of contaminants to land, particularly those that may reach natural water bodies. Council's Water Services and Trade Waste Bylaw list requirements for the discharge of stormwater.

Subsoil Drains

The control of groundwater levels may be required.

In all cases subsoil drains shall be specifically designed, and shall allow for future maintenance. The final construction shall be such that no ingress of fines is allowed into the subsoil drain.

In areas where subsoil drains are required, the stormwater pipelines may also be required to act as a subsoil drainage system.

Soakage

Ground soakage for stormwater is not to be used in the following circumstances:

- for disposal of contaminated road runoff
- for disposal of runoff in areas not approved for soakage, for example Havelock North
- for disposal of runoff, where the method below shows that soakage is not permitted
- in areas where on-site stormwater management involving detention is utilised.

On site stormwater management and detention can be provided by a range of alternative methods such as rain gardens, rain tanks, ponds, depression storage, underground detention tanks, etc, as appropriate for the particular site and situation.

Designers should refer to the NZWERF publication "On-Site Stormwater Management Guideline" (NZWERF/Ministry for the Environment, 2004). This publication provides methods to assist in the selection and design of the appropriate system(s) for any site. It includes references to other available published information dealing with this topic. Refer http//www.nzwwa.org.nz , keyword "on-site"

Council has commissioned studies to determine soil data for Hastings, Havelock North and Heretaunga Plains. This data is available from Council's Engineering Division. If free draining soils exist in these catchments the average runoff coefficient may be lower than the typical District values. However, reductions below typical District values will not be accepted unless soil profile data has been provided from an IANZ accredited soils laboratory.

With small sites the range of onsite storage options is limited, and detention tanks may be the only practical solution.

The North Shore City Council (NSCC) has produced a useful document entitled *"Design Guide for Conventional Underground Detention Tanks for Small Sites"* which contains much useful information. It can be found in Section 4.16.3 of the NSCC *"Infrastructure Design Standards"* at the following website: http//www.nscc.govt.nz/IDSM/IDSM2006

North Shore City Council has developed a spreadsheet for detention tank design which has been adapted for use in the Hasting District. Copies are available on request from Council's Engineering Division.

Miscellaneous Facilities

Components of stormwater drainage systems which have not been specified may be proposed for use. Possible examples include stop banks, dams and spillways. Such items will be subject to the specific design by a suitably qualified professional and Council approval. Early consultation with Council staff is recommended.

Stormwater Quality

Stormwater quality issues shall be considered at all stages of a development, both during construction (short term issues) and resulting from the proposed land use (long term issues). Council prefers treatment at source. If a proposal includes designing stormwater treatment systems that are to be vested in Council, the option(s) delivering least whole of life cost to Council and the community will be used.

Water quality ponds (wet ponds), wetlands, or other effective treatment facilities shall be constructed when required to address either short term or long term sources of contamination.

Pre-treatment devices may be constructed to prevent floating contaminants and debris entering into the wet ponds or other treatment systems.

The design and construction of any treatment facilities shall be undertaken in such a way that future maintenance can be carried out easily.

When considering long term issues, designers are referred to the Hawkes Bay Regional Council Water Design Guidelines 2009 which outlines acceptable low impact stormwater design solutions and the Auckland Regional Council publications; *"Low Impact Design Manual"* and *"Stormwater Management Devices: Design Guideline Manual"*. Other references include Metrowater's *"On-site Stormwater Management Manual"* and *"Stormwater Soakage Manual"*; and Sustainable Urban Drainage Systems design manuals for countries within the United Kingdom. Other appropriate design manuals may also be used. The New Zealand Water Environment Research Foundation (NZWERF) and New Zealand Water and Waste Association (NZWWA) also provide useful internet based design guides and resources.

When using any of the references described above, designers must make allowance for the local soil and climatic conditions.

[Should include most acceptable design solutions from the HBRC design guidelines where appropriate]

Relevant Information

The Council holds a considerable amount of data concerning catchments, flood plains, flood levels, waterways and existing systems. Designers are encouraged to consult with Council's Engineering Division and obtain copies of any information that may be relevant to a proposed development.

Pipe joints and thermal expansion

Where thermal expansion of the pipe may occur, flexible joints capable of accommodating the expected movement for a temperature range of at least 25°C shall be allowed for. Such joints should also be anchored against creep displacement.

Clause 4.3.3.2 Pipe Materials

Council requires that the pipe materials shown in Table D3 below be used in the construction of stormwater drains provided they comply with the latest amendment of the New Zealand Standard cited.

Table D3: Stormwater – Pipe Material/Joint/Minimum Class

Application	Pipe diameter (mm)	Pipe material**	Joint type	Minimum pipe class
Connection within public land	100 to 200	mPVC (modified poly vinyl chloride)	RRJ (Rubber Ring Joint)	SN 8
Sump lead	150 to 225	mPVC (modified poly vinyl chloride) or RC (reinforced concrete) when under a road	RRJ (Rubber Ring Joint)	SN 8 or Class 2
Downstream of manhole in road reserve	300 to 525	RC (reinforced concrete)[1] or Polypropylene Pipe (PP)	RRJ (Rubber Ring Joint) or Proprietary systems for PP Pipe	Class 2
In road reserve	600 and greater	RC (reinforced concrete)[2] or PP Pipes	RRJ or FJ (Flush Joint)[3] or PP pipes	Class 2

Note 1: Reinforced concrete pipes to NZS 4058:2007 (minimum Class 2)

Note 2: Concrete lined steel (CLS) to NZS 4442 : 1988 or Corrugated Steel Pipe (CSP) to NZS 4405 : 1986 for culverts greater than 500mm diameter outside urban areas may be required by Council staff in some applications

Note 3: Flush joints are to be wrapped in filter cloth. Joint detail for pipes 600mm diameter or greater to be approved by Council Drainage Services Manager

Clause 4.3.4 Manholes

General

Manholes shall be provided on all pipelines at each change of direction and/or gradient, at each branching line of a diameter between 150mm and 600mm, at the termination of mains, and at a spacing of not more than 90m unless specifically approved by Council. Manholes using pre-cast component are required, unless the design conditions dictate otherwise in which case specific approval will be required. The standard manholes drawings in NZS 4404 (CM – 004 to 006) are to be used, expect that Council will not allow the use of any rungs or permanent ladders. The use of lock down lids is required in heavily trafficked areas, or where a positive barrier to access is required by Council.

On Drawing CM – 005 designers should note that sufficient workspace needs to be available within any manhole utilising an internal drop. In cases where the manhole does not provide sufficient internal space and external drop shall be used. Within any drop inlet, allowance needs to be made for rodding access in line with the entry pipe. One means of achieving this requirement is to use a Tee junction with screw cap.

For manholes located in road carriageways, the finishing of the concrete manhole lid and cast iron frame and cover must take into account the flexibility or otherwise of the adjoining road pavement. If the adjoining road pavement is a flexible pavement, then the manhole lid needs to be located below the basecourse layer (at least 150mm) and the lid and cast iron frame brought up to the surface using appropriate risers and rings. The lids used in any manhole structure must be compatible with the expected traffic loading.

Manholes requiring person-entry fall within the definition of a "confined space" and the design must facilitate the use of safe operating procedures (e.g. the use of tripods and harnesses) when entry is necessary.

Standard Manholes

Standard manholes (refer Drawing CM – 004) are to be circular with an internal diameter of not less than 1050mm and shall be used on pipelines deeper than 600mm. On shallower pipelines an access chamber can be used. (Refer Drawing CM – 006)

Precast manholes shall consist of 1050mm internal diameter spun concrete pipe to NZS 4058:2007 Class 2 with the holes cast in the side for step irons to be securely plugged with mortar. Precast concrete bases are to be used for manholes with precast barrels. Riser sections shall be jointed as shown on the standard drawing, carried out in accordance with the manufacturer's recommendations, to provide a watertight structure. The top riser is to be made 300mm deep, to allow for easy lowering of the manhole barrel height.

Cast in-situ manholes, where approved shall be constructed using ordinary grade concrete (20 MPa) vibrated to give maximum density and watertight construction.

All holes for pipe entry shall be saw cut. Impact holing is not to be used under any circumstances.

Manholes on Large Pipelines

Manholes on pipelines where the use of a standard manhole is not suitable shall be specifically designed.

Manholes on pipelines greater than 450mm diameter shall be constructed of larger diameter components to ensure benching space can be provided. Chimney style manholes may be used.

Manholes on straight sections of pipelines of 1200mm diameter and larger may be constructed using pre-formed tees.

On pipelines 1m diameter and larger the spacing of manholes may be extended to 200m and curvature on the pipeline may be permitted providing that joint deflections are within the limits of the manufacturer's recommendations.

Deep Manholes

Manholes deeper than 5 metres shall match the wastewater manhole shown on Drawing SEW-1311. Intermediate platforms shall not be used (to facilitate the use of exterior fall restraint and emergency evacuation equipment). Step irons or ladders are not to be installed, unless specifically approved by Council.

Hydraulic Flow in Manholes

Losses in a manhole shall be compensated for by a drop in the invert across the manhole equivalent to 20mm plus 5mm per 10° of change in direction of flow, or as determined from a specific calculation. For a pipeline greater than 1m in diameter the drop shall always be determined by specific calculation.

Benching

The pipe invert and benching through manholes shall either be as detailed in the standard drawings, or can utilise other options (e.g. half pipe) provided that the appropriate energy loss allowance has been made in the design. Edges shall be rounded and the benching given a form and finish which facilitates smooth flow, non-entrapment of debris, and easy access with cleaning rods.

Steps and Ladders

Permanent steps and ladders are not to be used. This policy is to discourage entry to the confined space.

Manhole Lids and Covers

Manhole lids and covers shall be as detailed on Drawing SEW – 1308. The use of Precast spacer rings shall be detailed to allow for the slope of the road, and the need to provide for

the proper construction of basecourse and surfacing construction, taking into account the need to apply both a first and second coat seal in the case of a chip sealed surface.

Aluminium covers are not permitted.

Manholes in Soft Ground and High Water Tables

Where a manhole is to be constructed in soft ground the foundations will require specific investigation and design. Options for foundation strengthening can include undercutting the surrounding area down to stable ground and backfilled with suitable compacted hard fill to provide an adequate foundation bearing capacity. Alternatively, the manhole could be founded on hard fill/reinforced concrete base. The dimensions of this base will require specific design, (refer Section Four, Schedule B) but will not be less than 150mm thick, and twice the area of the manhole.

Where manholes are to be constructed in areas of high water tables and there is a possibility of flotation, specific design shall be undertaken to ensure the manhole is stable under all conditions.

Pipe Main Connections to Manholes

On all rigid pipes (i.e. concrete or earthenware) entering and leaving manholes, a flexible joint must be provided as detailed in Drawing SEW – 1302.

Pipe junctions in manholes shall be aligned to ensure streamlined flows through the manhole, unless specifically approved otherwise by Council.

Drop Connections for Service lines

Drop connections at stormwater manholes will not normally be required.

Manhole Requirements for Pipe Inter-Connections

Manholes are required at all public drain pipe junctions.

Clause 4.3.7 Connections to the Public System

Each residential stormwater connection shall be capable of providing drainage from the whole building area of a lot (including all surface water from the yard), at grades and cover complying with the New Zealand Building Code and any Council requirement to meet the network level of service. However, under special conditions, and subject to certification by the designer and approval by Council of an adequate soakage or stormwater attenuation system, the requirement to include the yard surface water in the capacity of the connection may be waived. The certification from the designer shall include adequate proof that the soil and ground water on the lot can provide sufficient soakage. The designer shall provide a maintenance programme for the facility and compliance with the maintenance programme will be a requirement of the building WOF.

The point of discharge from any property shall be within 500mm of the boundary. The connection shall discharge into a rider stormwater main or the road channel (provided that

the road channel is suitable) but may be connected to a manhole, main pipeline or road sump subject to Council approval. (Refer Section Four Schedule C)

Connections to pipelines must include an access point for cleaning and inspection at the boundary. This access point shall be brought to the surface in a proprietary service box. Connection pipes larger than 100mm diameter shall discharge direct to a pipeline, manhole, or enter the kerb via a back entry sump. The maximum allowable size of connection to a rider main is 200mm diameter.

Where a connection is deeper than 1.8m below ground level, a ramped riser shall be constructed to bring the connection to within 1.2m of ground level, as shown on Drawing CM – 005.

The connection provided for each residential lot shall be capable of taking the spigot end of a 100mm nominal internal diameter PVC pipe.

Connections for commercial and industrial lots shall be specifically designed to accommodate the design flow after any construction, from the area served by the connection to the service level approved by Council, and meet the minimum requirements for stormwater as defined by the NZ Building Code. Connections larger than 100mm diameter shall be made directly to a rider main pipeline, manhole, or road sump. Maximum allowable size of connection is 200mm diameter. Any connection larger than 200mm diameter must go to a manhole.

The end of each connection shall be marked by a 50mm x 50mm timber stake (treated pine) with top painted green, extending from below invert level to 400mm above ground level. The pipe end shall be sealed either by a factory sealed stopper or a plug fixed with a rubber ring and held with stainless steel wire.

Location of Public Pipelines and Other Council Infrastructure

In residential areas stormwater pipelines should be laid within the road reserve. (Refer to Drawing C6 in Section Four: Schedule C) When locating all pipelines, due account should be given to the location of other services, and kerb and channel, when defining pipeline alignments. Space limitations usually require that drainage pipes (sewer and stormwater) must be laid in or nearby the carriageway. Drains shall be laid so that future maintenance access is provided for as described in Council's Bylaws.

Pipelines on private land shall be sited to minimize reduction of the building area available (i.e. within side and rear yards as defined in the District Plan). Pipelines shall be laid at least 1.0m clear of existing buildings, and consideration shall also be given to the width required for maintenance access and interaction with building foundations when locating pipelines. Drainage structures including manholes shall be located clear of boundaries and kerb lines. Design consideration shall be given to providing and maintaining an unobstructed route for any associated secondary flow path, and ensuring that these are located in public open space.

Stormwater services shall be extended to each upstream boundary of a subdivision unless otherwise approved, and shall allow for the future potential development of the upstream

land. Easements shall be provided for any public drainage pipelines located on private property. Any existing secondary flow path should either be secured by creation of public open space as a reserve, or used as a road.

Vicinity of Other Services

The reasons of providing guidelines for separation distances between underground utility services are:

- To prevent damage to either utility service or their function
- To permit access for future maintenance/renewal, and minimise the need for temporary support
- Allow for the two situations, these being where two services cross each other (in which case vertical separation is important and the crossing angle shall be as close to a right angle as possible, with shallow angle oblique crossings to be avoided) and where the two services run in parallel where both vertical and horizontal separation is important

For normal trenching and trench less technology installation, clearance from other service utility assets shall not be less than (and preferably exceed) the minimum vertical and horizontal clearances shown below in Table D3 for services laid within 1m vertically of the surface. For deeper services, the horizontal separation will vary as a function of service depth and ground conditions.

Written agreement on reduced clearances and clearances for shared trenching shall be obtained from Council and the relevant network utility operator.

The clearance shall be measured between the two closest parts of the underground services (e.g. collar to socket).

Table D3: Clearances between Stormwater and other Underground Services

Utility (Existing service)	Minimum horizontal clearance mm		Minimum vertical clearance [1] mm
	New stormwater size		
	≤DN 300	>DN 300	
Sewers ≤DN 300	300	600.	150[2]/300
Sewers >DN 300	600	600	300
Low pressure Gas mains	300[3]	600	150[2]/300
Telecommunication	300[3]	600	150[2]/300

Utility (Existing service)	Minimum horizontal clearance mm		Minimum vertical clearance [1] mm
conduits and cables			
Electricity conduits and cables	500	1000	225[2]/300
Other drains	300[3]	600	150[3and4]/300[4]
Water mains	1000[5]/600	1000[5]/600	500[4]

Notes:

Minimum vertical separation between stormwater pipe and other service
A minimum vertical clearance of 300mm applies if the size of either the existing service or proposed pipe is >DN 300
Clearances can be further reduced to 150mm for distances up to 2m when passing installations such as poles, pits and small structures, providing the structure is not destabilized in the process
Clearance from kerbs shall be measured from the nearest point of the kerb
A smaller clearance can be accepted if the upper pipe is suitably supported on a pedestal either side of the lower service pipe.

Clause 4.4.2 Information to be provided

The information requirements outlined in the first set of sub-paragraphs (a) to (e) and subparagraph (a), (c) and (d) from the second set are to accompany resource consent applications. The other information requirements are generally required for design review and approvals, and may be required for assessment of resource consent applications.
The information is additional to any that is required under Parts 2 and 3 of this document.

Clause 4.5 Construction

In general, the design principles outlined in Clause 4.5 of Section 4 of NZS 4404 are to be followed. The following text provides additional comments and some specific changes that will take precedent over Section 4 in NZS 4404.

Cover to Pipelines

The cover provided to pipeline systems shall be in accordance with the specifications listed above, the manufacturers' published recommendations, and will need to take into account the following:

- Imposed loads during construction of the pipeline or reconstruction of the road or other infrastructure assets above the pipeline (including possible reshaping of the road profile)

- Imposed loads during the lifetime of the pipeline system from backfill, expected traffic, and any surface structures

If the required cover cannot be provided for technical reasons, then other means of protecting the pipeline such as spreading the imposed load should be implemented.

Pipe Strength, Bedding, Surround and Backfilling

In general, with good ground conditions, bedding and other trench details shall be as shown in CM – 001 to CM - 003. In poor ground conditions, potentially unstable ground, or where extreme loadings will be encountered; pipe strength and bedding shall be specifically designed and certified.

Other additions to these drawings are:

- Drawing CM – 002 : Note 7 should also include the use of geotextile separation between granular trench fill (e.g. road basecourse) and the underlying pipe embedment if required to prevent migration of fines

Rigid Pipes up to 525mm diameter (Reinforced Concrete)

Pipe strength and bedding shall be selected for suitability under the design loading conditions. The type of bedding and class of pipe adopted shall be in accordance with *NZS/AS 3725:2007– Design for Installation of Buried Concrete Pipes*, and the appropriate pipe material standard (e.g. *AS/NZS 4058:2007 Precast Concrete Pipes (pressure and non-pressure)*).

Pipe bedding and backfilling shall be carried out in accordance with WSA Drawing SEW 1201 and SEW-1202 Types 1 & 2, and AS/NZS 3725:2007 - Design for Installation of Buried Concrete Pipes. The selected fill (free of organic materials, lumps larger than 75mm, and stones larger than 40mm) shall be placed in 150mm layers and compacted to a density of not less than 95% of Maximum Dry Density as determined by NZS 4402 : 1986 Test 4.1.2 – Methods of Testing Soils for Civil Engineering purposes. The compaction shall be completed using a hand operated vibrating compactor with a total static weight not exceeding 0.5 tonne.

Rigid Pipes greater than 600mm diameter (Reinforced Concrete)

As per rigid pipes up to 525mm diameter except backfilling pipe surround shall be carried out in accordance with WSA Drawing SEW-1202 Type 4. The pipe bedding material shall comply with *AS/NZS 3725:2007 - Design for Installation of Buried Concrete Pipes* and a 150mm diameter subsoil pipe shall be laid for the first 30m upstream of every manhole.

All Other Pipes

Pipe strength and bedding shall be selected for suitability under the design loading conditions. The type of bedding and class of pipe adopted shall be in accordance with

AS/NZS 2566.1 – Buried Flexible Pipelines, Part 1 - Structural Design and AS/NZS 2566.2 – Buried Flexible Pipelines, Part 2 - Installation.

Pipe bedding and backfilling shall be carried out in accordance with WSA Drawing SEW 1201 and SEW 1202 Types 3 & 4. Following placement of the pipe, the granular bedding material shall be placed in layers not exceeding 150 mm and shall be carefully tamped with hand or mechanical tampers, with particular attention to compacting under the pipe haunches. The material shall not be dropped from a height of greater than 600mm. The granular fill shall be compacted to a density of not less than 95% of the Maximum Dry Density as determined by Test 4.1.2 of NZS 4402: 1986 – Methods of Testing Soils for Civil Engineering purposes.

Pipes on Steep Grades (greater than 1 in 10)

If the pipeline gradient is steep (i.e. greater than 1 in 10), and/or ground conditions are poor, sufficient cement shall be added to the granular bedding material to provide a weak concrete with a strength of not less than 7 MPa. The depth of bedding shall be as shown in WSA Drawing SEW 1201 and SEW-1202, and shall be cleanly broken at the pipe joints with a 25mm gap formed with expanded polystyrene to maintain flexibility. Where the pipeline gradient exceeds 1 in 10 anti-scour blocks shall be constructed at the spacing's shown in Table D4, or alternatively, metal cut off plates made specifically as anti-scour blocks may be used.

Table D4 Spacing of Anti Scour Blocks

Grade	Spacing (m)
Steeper than 1 in 5	5
1 in 5 to 1 in 10	10

Construction and Backfilling in Road Reserve

The designer and contractor will need to address compatibility between the often flexible pavement design and the more rigid stormwater construction works, in particular the works associated with manholes, service lids etc, in order to avoid cracks or differential movement. The use of basecourse overlays above lids, in associated with standard risers is one means of compliance.

Acceptance and Testing of Stormwater Drainage System

Acceptance will be on the basis of the quality of materials and the general standard of construction. Inspection during construction shall be as set out below.

The pressure testing of sealed stormwater pipelines will be required, including pipelines that are being designed to operate in a surcharge condition. Testing will be to ground level or 50% above the hydraulic grade line head whichever is the greater. Pressure testing will be for leaks, with the acceptance requirement being that the pipeline must pass one of the three drainage leakage tests described in Clauses 8.1 to 8.3 of Section E1/VM1 of the

Compliance Document for *New Zealand Building Code*. Low pressure air testing is the preferred test. Pipeline inspection and recording by CCTV is required for all pipelines over 225mm diameter.

Inspection during Construction

To ensure that the stormwater drainage works are constructed to the required standards, inspection by the developer's agent during construction shall cover at least the following details:

- Qualifications and experience of the staff constructing the works
- pipe sizes, pipe levels and gradient. The designer will need to specify the tolerances required for construction of all stormwater system components, in particular the tolerances required for pipeline line and level. The design grades around the Heretaunga Plains in particular can be relatively flat. Achieving specified construction tolerances is extremely important
- quality, dimensions and reinforcement of all materials supplied, unless these are supplied by a manufacturer accredited to ISO 9002
- trench depth and width, quality of trench backfill material, and compaction data
- materials and workmanship in joints between pipes, manhole risers, etc
- sizes, construction materials and distances of anti scour blocks
- manhole benching and other details.
- CCTV inspection outcomes and defect reports.

Inspection on site shall be done by a suitably qualified person with a good knowledge of drainage theory and construction practice, who shall have reasonable liaison with and instruction from the design engineer for the works being inspected. The inspector shall not have any financial affiliation with the contractor carrying out the work. The written records and certification of these inspections shall be included in the Completion Report, as specified in Part 1 of NZS 4404.

SURVEYING THE BAY
HAWKE'S BAY | NEW ZEALAND

APPENDIX B : LIDAR CONTOURS

Napier
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info@surveyingthebay.co.nz

Hastings
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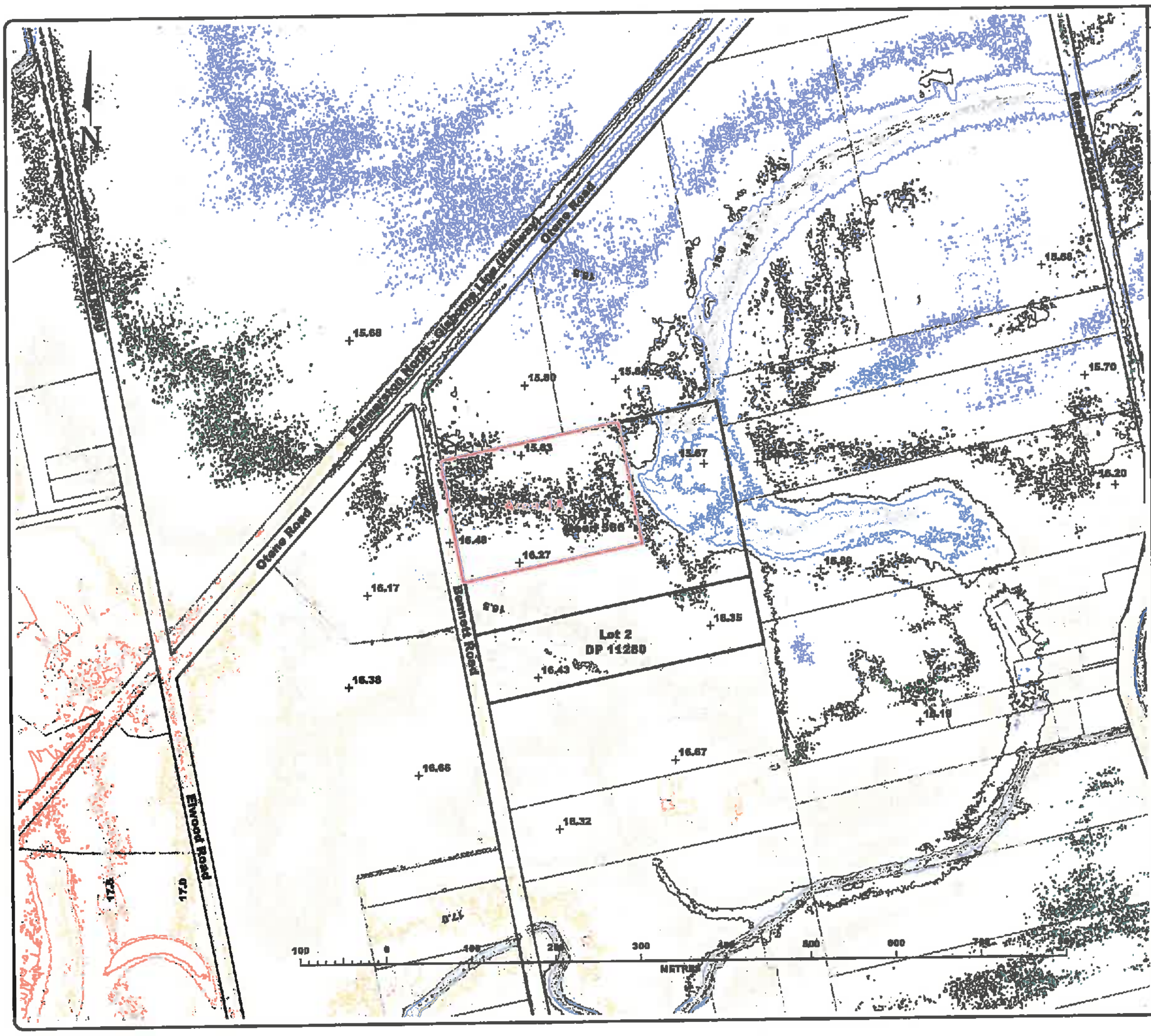

LOCAL AUTHORITY	:	HASTINGS DISTRICT
ZONING	:	PLAINS PRODUCTION
TOTAL AREA	:	9.2471 HA
COMPRISED IN	:	CFR HBB3/462
REGISTERED OWNERS	:	AORANGI MAORI TRUST BOARD

LEGEND:
LIDAR CONTOURS:
18.0m
17.5m
17.0m
16.5m
16.0m
15.5m
15.0m
LEGAL BOUNDARIES
ROAD BOUNDARIES

This plan has been prepared by compiling digital data from Hawkes Bay Regional Council Lidar data (flown 2 July 2003) and other various sources.
No checking of the accuracy of that information has been made by Surveying The Bay Ltd and this plan should be used as general information only.

CLIENT:
MINISTRY OF EDUCATION

PROJECT:
GROUND LEVELS OF
LOT 2 DEED 566 & LOT 2 DP 11280
BENNETT ROAD, HASTINGS

SURVEYING THE BAY
HAWKES BAY | NEW ZEALAND

TITLE:
CONTOUR PLAN

SCALE: 1: 4,000 @ A3
DATE: JUNE 2017
DRAWN BY: PT

DRAWING NO:	REVISION:	SHEET:
4337-1	-	1/1

SURVEYING THE BAY
HAWKE'S BAY | NEW ZEALAND

APPENDIX C : HBRC FLOOD REPORT

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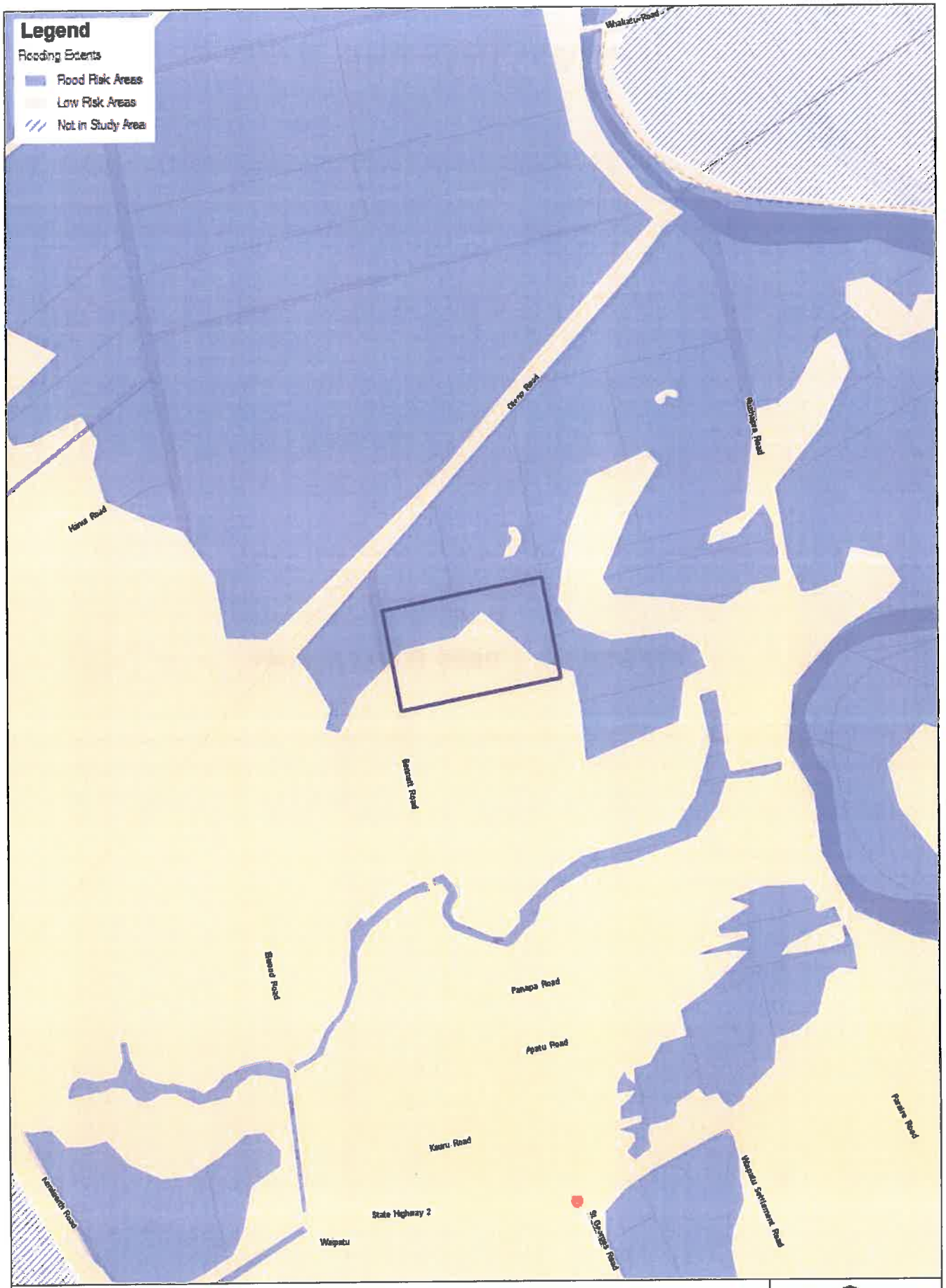


Flooding

The information displayed is schematic only and serves as a guide.
It has been compiled from Hawke's Bay Regional Council records and is made available in good faith but its accuracy or completeness is not guaranteed.
Cadastral information has been derived from land Information New Zealands (LINZ) Core Record System Database (CRS).

NORTH

Scale 1:10000

Thursday, 4 May 2017

Original Sheet Size 210x297mm

Flooding Report

Information provided on the flooding maps shows general details about flooding patterns and areas at risk. They have been produced using computer models using verification with actual events where possible. Flood extents shown in the maps are not meant to show specific flooding details on each property.

These maps should not be relied upon as the sole basis for making any decision in relation to potential flood risk. Contact the Hawke's Bay Regional Council Engineering Department if further information is required with regards to a specific property.

Urban pipe networks and flooding on the street network in the urban areas have not been considered in the flood modelling. Urban areas show flood risk areas that are the result of the capacity of open drains being exceeded.

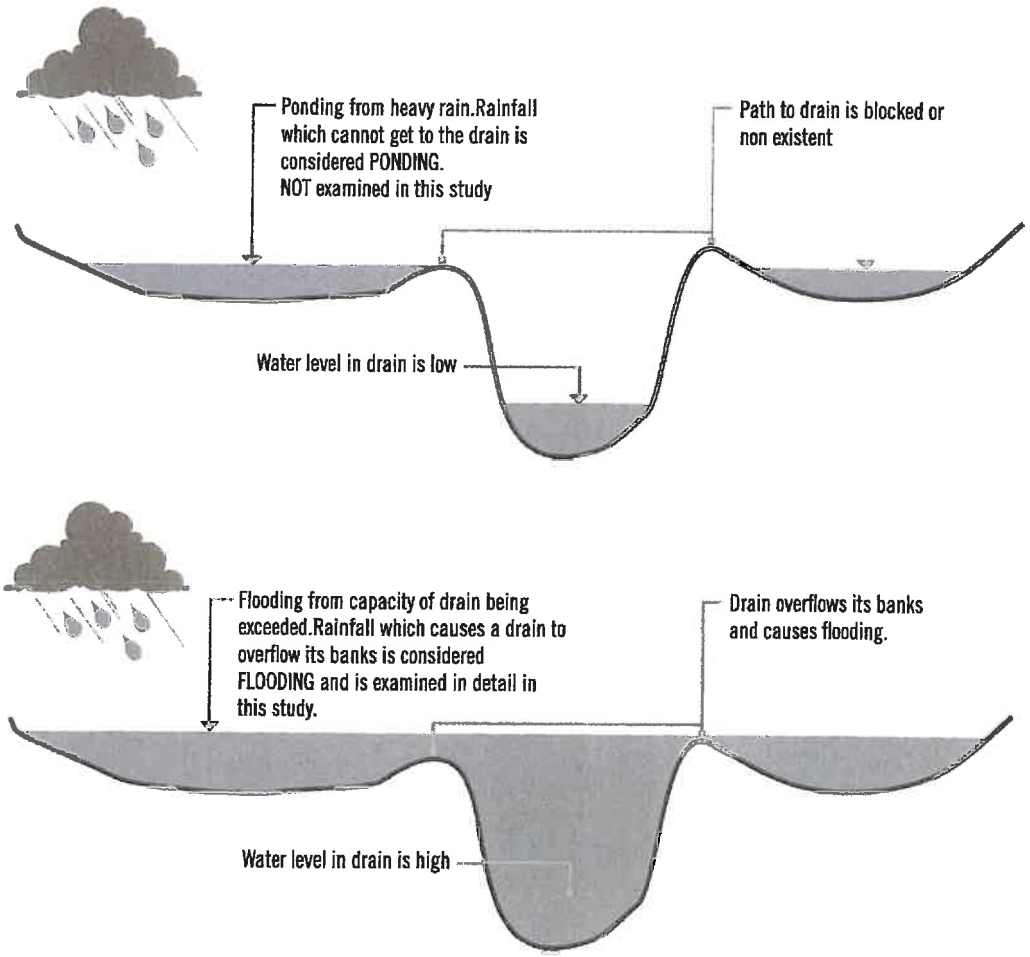
In some flood risk areas, houses and other structures may be elevated above the ground, and would be considered not floodable. These cases are not identified in this flood modelling.

Flood modelling is based on 100 year return period events (1% annual exceedance probability) for river flood risk areas, and 50 year return period events (2% annual exceedance probability) for floodplain flood risk areas.

The effects of climate change have not been included in this flood modelling

Flooding vs. Ponding

Major flooding happens when the capacity of a stream or drain is exceeded. Small scale, localised ponding may occur in areas where water cannot get to the stream through the normal paths of overland flow when the streams are not in flood. The flood hazard study does not consider this type of localised ponding in detail.



SURVEYING THE BAY
HAWKE'S BAY | NEW ZEALAND

APPENDIX D : SITE PHOTOS

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Photo 1 : Looking east from the north-west corner of the block - illustrating the flat nature of the site

Photo 2 : Looking south-east from the north-west corner of the block

Photo 3 : Bennett Rd looking north

Photo 4 : Bennett Rd looking south