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NEW ZEALAND TRANSPORT AGENCY

Water Treatment Standard Assessment

Westchester Drive Linkage Project

Prepared for NZTA

MAY 2009

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QUALITY ASSURANCE STATEMENT

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NZTA

Westchester Drive Drainage Study

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 Introduction

The New Zealand Transport Agency (NZTA) has developed a draft standard regulating stormwater treatment options for State Highways across New Zealand entitled "*Stormwater Treatment Standard of State Highway Infrastructure."* (NZTA – March 2009). NZTA has commissioned MWH NZ Ltd. to take a recent drainage design completed using existing standards and compare this design to methods outlined in this new document. The purpose of this is gain an understanding of what changes, if any, result from using the new NZTA standard in place of local design guidelines.

The project chosen for this comparison is the Westchester Drive Linkage. This project has been designed for the Wellington City Council (WCC). The proposed works are located in the Wellington suburb of Churton Park on the northern outskirts of the city. The proposed link will connect the northern end of Churton Park to SH1 and Grenada. It should be noted that the road development is not a State Highway, but will be treated as such throughout this report.

Figure 1-1 Location Plan of Road Linkage

Four main elements exist to the drainage design of the Westchester Drive Linkage. These are the design of the two culverts under the road extension, the sumps leading to surface water treatment areas, the design of the two bridges across Stebbings Stream and subsequent changes to stream alignment, and the temporary sediment control measures which will be in place during construction.

a) Culverts

Two culverts, 900 mm diameter and 1050 mm diameter, are proposed to convey runoff from the adjacent hillside under the proposed road. Both of these culverts discharge directly into Stebbings Stream. The runoff through these culverts is considered "clean" as the existing catchment remains an undeveloped rural area and does not change as a result of the new road linkage.

b) Sumps and Stormwater Treatment

Surface water which falls directly on the road carriageway is to be conveyed off the road by kerb and channel and discharged from the road via stormwater sumps. These sumps are connected to grass swales that discharge into Stebbings Stream. A total of four grassed swales are proposed for stormwater treatment plus one oil and grit interceptor. The oil and girt interceptor is proposed in an area where there is insufficient room to construct a swale.

c) Stebbings Stream Erosion Control and Bridges

The alignment of the proposed road linkage crosses Stebbings Stream at two locations, both of which will be bridges. The locations of the two bridges are shown in Drawing C001 in Appendix A.

d) Sediment Control

A Construction Management Plan (CMP) was developed to manage stormwater runoff and sediment capture during the construction stages. Sediment control measures were based on Greater Wellington Regional Council (GWRC) guidelines.

2 Environmental Factors

2.1 Description of Catchments

Details of all the catchments associate with the Westchester Drive Linkage will be outlined below.

2.1.1 Terrain

The land upstream of the site (to the north) is mostly covered in thick bush over moderately steep to steep hills. Stebbings Stream cuts through the area and forms a deep incised channel with steep banks from either side. There are open areas on the Reedy property and adjacent to Melksham Drive at the western end of the new road. The upstream catchment is classed as "Rural" in the Wellington District Plan which currently protects the area from future residential development. The area to the south of the proposed linkage is classed as Outer Residential by the District Plan and is currently developed as such.

2.1.2 Area

a) Culverts

Three sub-catchments have been identified above the proposed road extension. These three catchments have been labelled A, B and C and can be seen in figure 2-1 below. Catchment A will discharge directly into Stebbings Stream and will pass under the road Linkage at the Western Bridge. The runoff from catchments B and C will be conveyed under the road through two new culverts. The local catchments are only active during rainfall.

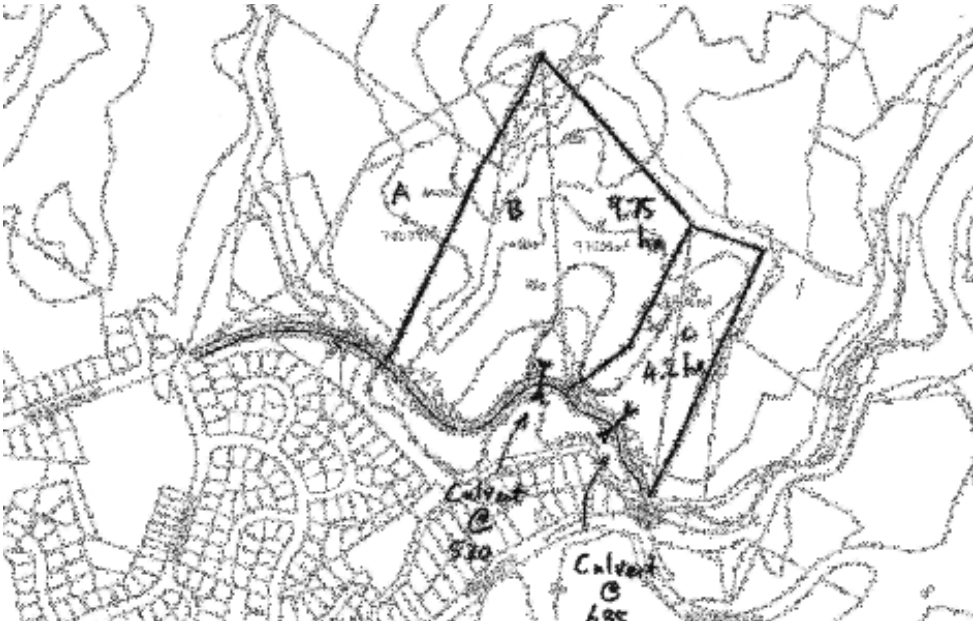

Figure 2-1 Catchment Areas Upstream of Westchester Drive Linkage

Table 2-1 Culvert Catchment Areas

Catchment	Area (ha)
A	7.51
B	9.75
C	4.16

b) Sumps and Stormwater Treatment

Rainfall that lands directly on the road will be collected by kerb and channel before being conveyed off the road surface via sumps. The road surface itself has been divided into 8 sub-catchments as defined by the grade of the road surface. These sub-catchments are shown in drawings C301 and C302 attached in Appendix A. Area information, along with other runoff parameters, can be seen in the following table:

Table 2-2 Sump Data and Design Parameters

Catchment	Area (ha)	Q5 (m^3/s)	Q10 (m^3/s)	Q100 (m^3/s)	Volume 5 Year (m^3)	Volume 10 Year (m^3)	Volume 100 Year (m^3)
1	0.44	0.04	0.043	0.065	36	39	59
2	0.51	0.048	0.052	0.078	43	46	70
3	0.15	0.027	0.029	0.044	25	26	40
4	0.13	0.022	0.024	0.036	20	21	32
5	0.10	0.017	0.019	0.028	16	17	25
6	1.21	0.075	0.087	0.125	101	118	168
7	0.17	0.029	0.032	0.048	27	28	43
8	1	0.06	0.07	0.101	82	95	136

c) Stebbings Stream Erosion Control and Bridges

The catchment area for the Western Bridge is show in the plan titled “Stebbings Catchment” in Appendix A. This area makes no account for the effects of Stebbings dam.

d) Sediment Control

The CMP outlines four stages of work and each will have a unique catchment area. For more details, the reader is referred to the complete CMP attached in Appendix B

2.1.3 Topography

Figure 2-2 below shows the topography of the catchment. The proposed road development is shown in red. There are several old river terraces in this section. Stebbings Stream is deeply incised into these terraces.

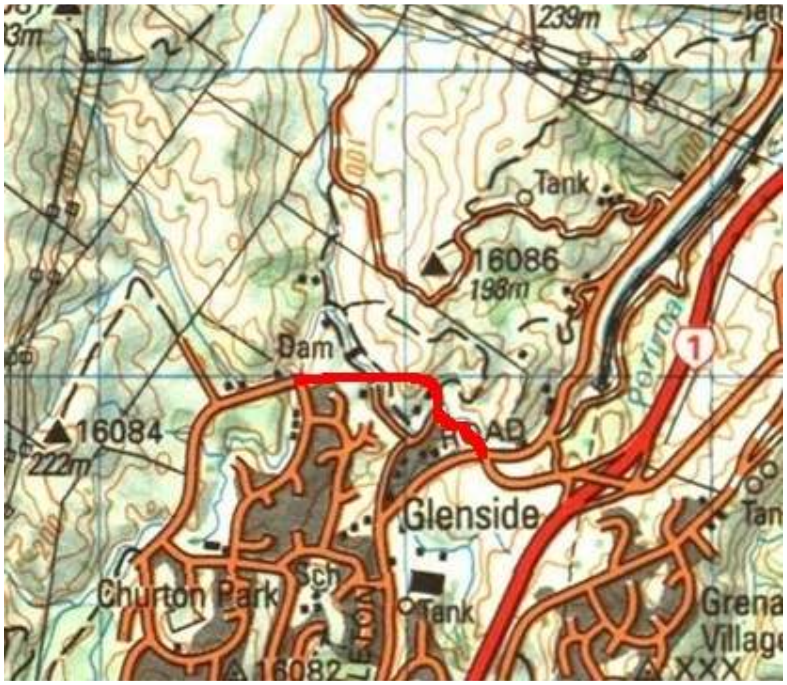

Figure 2-2 Topography Map of the Surrounding Area

2.1.4 Drainage Features

The existing catchment drains into Stebbings Stream at the base of the hill (refer to figure 2-2 above). Stebbings Stream is one of the tributaries of the Porirua Stream system which eventually discharges into Porirua Harbour. The stream system has been highly modified by farming and more recent residential development. It contains few sites of remnant vegetation and relatively little undisturbed stream habitat.

2.1.5 Geotechnical Limitations and Opportunities

The project requires large cuts in the existing hillside. The road alignment will need to be supported with mechanically stabilised earth retaining walls beside Stebbings Stream. A total of four of these walls will be needed in locations detailed in Drawing C001 in Appendix A. In addition to the MSE walls, a single timber solider pile retaining wall will be constructed in front of the existing barn on the Reedy Property.

2.1.6 Soils

The regional map reveals the soils in the area are colluvial silty-gravels overlaying greywacke rock. Soils that are derived from greywacke are typical for the Wellington region. Within the project area Stebbings Stream forms a deep channel with steep sloping banks on either side.

The slopes above the stream are described as moderately steep to very steep greywacke hill country. These soils are made up of shallow Korokoro hill soils and Makara steepland soils. Soil maintenance on this landform requires a complete vegetation cover.

There are several old river terraces in this section. They are formed from consolidated gravels with a mantle of loess. The soils are Judgeford hill soils, silt loam and stony clay loams, which are well drained.

2.1.7 Erosion Potential

The soils mentioned above tend to have a high content of fine sands, which are the more erodible fractions of the soil. The proposal is to undertake earthworks associated with construction of a section of road in the valley of the Stebbings Stream, Glenside. Slopes which will be cut are steeper than 28 degrees and thus the area is identified in the Greater Wellington Regional Council Soil Plan as being erosion prone.

Stebbings Stream itself does not appear to be highly prone to erosion due to the fact that the streambed is composed of rocky material. Stebbings Dam will moderate the flow through Stebbings stream which will further reduce the risk of erosion.

2.1.8 Flooding

Stebbings Detention Dam was constructed in 1994. It is located within one kilometre upstream of the western bridge in the upper reaches of the catchment. It is designed to control stormwater flood flows that enter Porirua Stream. The dam is 20 m high and the culvert under the dam is 100 m long and 1.6 m in diameter. The presence of the dam will control major flooding through Stebbings Stream.

Figure 2-3 Stebbings Detention Dam (Photo from GWRC)

2.1.9 Design Storm Event

In accordance with the Wellington City Council Code of Practice for Land Development (WCC COP), stormwater pipe and channel systems have been designed for the full development zoning under the district plan. As Westchester Drive will be a collector road when construction is complete, the design storm has an Average Recurrence Interval (ARI) of 100 years, or an Annual Exceedance Probability (AEP) of approximately 1%. Times of concentration ranged from 10 minutes to 45 minutes for catchments involved in the linkage project.

2.1.10 Vehicle kilometres travelled at time of opening

The predicted vehicle kilometres travelled at the time of opening the new road is between 4800 and 6400.

2.1.11 Discharge points

Both culverts passing under the road discharge directly into Stebbings Stream and have headwalls and rock rip rap protection.

Surface water from the proposed road carriageway will be discharged into the stream via grassed swales designed to attenuate the peak flow and provide filtration. The locations of these swales along with the culvert discharge points can be found in Drawing LA-01-101 in Appendix A. Discharge points from the swales will be at stable locations along the stream or where placed rip rap provides stable entry points.

2.1.12 Catchment classification

The proposed Westchester Drive Linkage is positioned on a boundary between two different zoning classifications. The Wellington City Council District Plan classes the catchment above the proposed Westchester Drive Linkage as Rural, while the area directly to the south is classed as Outer Residential (refer to the attached plan in Appendix A).

The Wellington City Council District Plan States:

In the Outer Residential Area, houses are usually located on larger sections and developments are more spacious. Residential character varies depending on the type of landform and the extent of vegetation. Most non-residential activities in the area are of a type that directly service local residents.

The landscape of the Rural Area is rugged and is characterised by steep ridges and deep gullies like much of the hill country of the North Island. The Rural Area has important landscape values for the City as a whole, and contains areas of indigenous vegetation and habitat for indigenous fauna.

From the guidelines set out in the *National State Highway Strategy (Transit – June 2007),* and if the project was a state highway, the road development is through an area which is currently peri – urban. This is because the site is located in the hinterland on the edge of Wellington City on the edge of the commuter belt with a variety of land uses. However, there is an argument for Urban classification as the speed limit of the road linkage is proposed to be 50 km/hr and there is potential for the District Plan to change in the future and re-zone the area as entirely Outer Residential. If this happens, the Westchester Drive Linkage would meet the Urban criteria as outlined in the NZTA standard.

2.1.13 Sensitivity of receiving environment

The calculations outlined in the following table are from those identified in section 3.5 *of Identifying Sensitive Receiving Environments Receiving Environments at Risk from Road Runoff* (2007) to assess the sensitivity of Stebbings Stream as a receiving environment. This document is a research report commissioned by Transit New Zealand (Now NZTA). The purpose of the research project was to develop and validate a GIS-based tool for identifying and ranking sensitive receiving environments (SREs) at risk from road runoff, and therefore assist in prioritising sections of the road network that may require installation/upgrade of treatment systems for road runoff.

Table 2-3 Sensitivity of Receiving Environment – Stebbings Stream

Attributes	Attribute Scores	Comments
Sensitivity	M - 20	• Moderate gradient/velocity stream
Ecological Value	L - 5	• No formal conservation status, • Absence of rare, threatened or endangered species • Low species diversity • Low habitat diversity • Habitat values low
Human use value	L - 2	• Low use for food gathering • Low use for contact recreation • Low use for non-contact recreation • Low cultural values • No downstream water supply • Low economic value
Overall sensitivity rating (sum)	**27**	**Medium Sensitivity**

The above calculations indicate that Stebbings Stream is classified as a medium sensitivity receiving environment. As discussed in the aforementioned document, the rating system is not intended to provide detailed analysis of such effects on the receiving environment. The actual risk to a sensitive receiving environment will depend on the contaminant load generated from the source and the type of pathway for contaminant between the road and the receiving environment.

Figure 2-4 Stebbings Stream under winter flow (July 2008)

Protection and enhancement of this and other nearby streams are fundamental principles of the Northern Growth Management Framework and Councils Bush and Streams Management Plan. Measures to meet these principles have been made.

Boffa Miskell Ltd. prepared an *Assessment of Ecological Effects* on Stebbings Stream as part of the Westchester Drive Linkage Project. The conclusions relating to the receiving environment were that: “In deciding to bridge Stebbings Stream and Porirua Stream the proposed alignment has avoided most potential effects. It is therefore considered the best option and supported.”

3 Design Solutions

3.1 Design Philosophy

As outlined in the introduction of this report, the stormwater treatment for the Westchester Drive Linkage project has been broken down into four sections which are culverts, sumps and stormwater treatment, Stebbings Stream erosion control and bridges and sediment control. Each of these elements has different objectives and design criteria and will be discussed separately below. It should be noted that using different practices and methods of stormwater treatment that emphasise stormwater quantity and quality together, is a best practice treatment train approach recommended by both the new NZTA standard and the WCCCOP.

This section will outline the various philosophies and methods of design that were used to create the drainage scheme for the Westchester Drive Linkage. Where applicable, comparisons will be made to the corresponding philosophies, recommendations and design criteria outlined in the Stormwater Treatment Standard for State Highway Infrastructure. If the drainage design differs between what has been proposed for the Westchester Drive Linkage and what is recommend by the NZTA standard, a new design will be completed to assess the significance of any differences.

3.1.1 Culverts

a) Objectives

WCCCOP (Wellington City Council Code of Practice for Land Development)

The objective of this section of the code is ensure the stormwater system protects property, public health and the environment by the safe disposal of rainwater and associated runoff.

NZTA (Stormwater Treatment Standard for State Highway Infrastructure (Draft), 2009)

Objectives include the following items:

- *Ensure runoff from state highways complies with RMA requirements*
- *Limit the adverse effects of runoff from state highways on sensitive receiving environments*
- *Ensure stormwater treatment devices on the network are effective*
- *Optimise the value of water management systems through partnerships with others*

Transit Standard: Section 6.1 – Water Quality Design

There are two purposes for implementation of water control on highway projects:

- *Preventing the existing flooding projects from getting worse, and*
- *Controlling intermediate storms to minimise potential increases in out-of-bank flows downstream*

The situation considered in this Standard is flooding in the context of being caused or exacerbated by highway impervious surfaces. These surfaces increase stormwater runoff from a pre-development condition that may have been pasture or bush.

Comments

The two culverts under Westchester Drive carry flow under the road from the upstream catchment. This catchment will not change (i.e. become impervious) due to the Westchester Drive Linkage because it is entirely located above the road itself. As the purpose of the Stormwater Treatment Standard for State Highway Infrastructure is flooding in the context of being caused or exacerbated by highway impervious surfaces, the design of these culverts will not change if the new standard was used. The WCCCOP emphasis is on protection of property and delivering a consistent level of service of flood protection to rate payers. The NZTA standard assumes that normal design will provide a culvert that allows for a secure

driving environment for road users in extreme storm events. The NZTA Standard emphasises the environmental impact mitigation opportunities that could be applied in a sustainable manner in a roading development or an upgrade retrofit project.

b) Criteria

WCCCOP

- All catchments are to be analysed using the Rational Method except for catchments greater than 500 ha which may be analysed using the modified rational method.
- The runoff coefficient should be based on the catchment that can be expected to ultimately exist when the catchment is fully developed as allowed under the district plan.
- Arterial Roads and major community facilities related to essential services will be designed for the 100 year storm.

NZTA

Normal culvert design criteria involves the peak 100 year ARI rainfall runoff assessment of contributing catchment, with the use of best practice hydrological runoff methodologies to determine design flows. Top water levels are to be restricted to 0.5 m below the level of the white edge line.

Comments

Both standards have similar design criteria.

c) References

Wellington City Council, *W.C.C. Code of Practice for Land Development,* October 2006
Austroads, *Waterway Design – A Guide to the Hydraulic Design of Bridges, Culverts and Floodways,* 1994

3.1.2 Sumps and Stormwater Treatment

a) Objectives

WCCOP

Section D4.2 of the Wellington City Council Code of Practice for Land Development states:

"Stormwater quality consideration is a RMA [Resource Management Act] requirement. There is a growing importance being placed on the quality of stormwater. Strategies to treat the water at the source or near the top of the catchment are to be encouraged. The practicalities of this are fully recognised as suitable land and maintenance costs are influencing factors. However where the possibility of treatment by means of wetland or retention exist, the opportunity is to be considered and may be required."

It continues to say:

Where topography, soils and slope permit vegetated open channels should be used to convey and treat stormwater. Where soils and slope are not suitable for open vegetated channels, rock lined channels or other filtration practices will be considered.

NZTA

The following is stated in section 4.1.3 of the Stormwater Treatment Standard for State Highway Infrastructure:

The purpose of this guide is to provide design guidance for stormwater management practices and thus it primarily is a mitigation manual for stormwater effects. Any one practice, on its own, is unlikely to achieve the stormwater management objectives for a given project. For this reason it is necessary to consider the objectives early in the design process when competing demands can be can be carefully balanced and an integrated solution achieved."

For roading projects that drain into streams, the main issue of concern relates to both water quantity and water quality. Depending on the location of the project in a catchment peak flow control may be an issue. In addition stream channel physical structure may be a concern and consideration given to either extended detention or reducing total volume of stormwater flows by either infiltration or evapo-transpiration.

Water quality is also a concern on urban stormwater discharges on streams and will generally be an issue that must be considered and mitigation provided in regional plans.

Comments

Each of the two standards emphasise that opportunities should be considered for sustainable water quality treatment strategies during design and discuss the importance of mitigation of stormwater runoff before it reaches the receiving environment. The emphasis is on quality and attenuation of the stormwater, not just conveyance away from the site. The underlying assumption is that water quality treatment strategies are to be designed to a frequent design storm, such as a 1 in 2 year or 1 in 5 year magnitude, to catch the first flush. Larger events are assumed to exceed the treatment strategy and overflow the treatment system.

b) Criteria

WCCCOP

- Arterial Roads and major community facilities related to essential services will be designed for the 100 year storm, and so sump capacities will be provided.
- When setting flood levels in open channels and streams a nominal freeboard allowance of 0.3 m is to be included between the top water levels and dwelling floor levels.
- Manning's Formula is to be used when sizing pipes and assessing open channel capacities
- Scour protection must be used for channels susceptible to scour. This occurs when the velocity is greater than 1.8 m/s for grass. (Short duration local velocities up to 3 m/s may be acceptable in some cases without a dissipater where it can be shown that the channel is in stable, strong ground, the consequences of erosion are small and maintenance is easy.)
- Energy dissipation structures are to be designed to minimise collection of debris. Where debris will collect, provision for access must be made for easy removal.
- Bridges shall have a minimum of 500 mm freeboard between the level of the water during peak design flows and the underside of any bridge.

NZTA

Standards related to flooding problems

There are several levels to consider when determining whether peak flow control should be applied to a given highway.

- *Are there existing flooding problems downstream,*
- *Where is a given highway located within a catchment,*

- *What is the development potential for a given catchment, and*
- *Are there downstream points of control that would mitigate any possible effects that a given project might have on flooding?*

There are three recommendations related to peak discharge control:

- *Where there are existing flooding problems downstream and in the absence of a catchment study that evaluates a potential highway in a given location and depending on the location of a project within a catchment (per Section 7.1.2), it is recommended that the post-development peak discharge for the 100-year storm for a new highway be limited to 80% of the pre-development peak discharge.*
- *In terms of intermediate storm control, it is recommended that the 2- and 10- year post-development peak discharges not exceed the 2- and 10- year pre-development peak discharges.*
- *In addition, the rainfall data for the 2- and 10- year storms should be increased by the climate change percentages shown in Table 6-1 (Shown below) unless locally generated data provides more specific information to a given region.*

Table 6-1 Factors (percentage adjustments) for Use in Deriving Extreme Rainfall Information for Screening Assessments

Storm Duration	ARI (Years)						
	2	5	10	20	30	50	100
< 10 minutes	8.0	8.0	8.0	8.0	8.0	8.0	8.0
10 minutes	8.0	8.0	8.0	8.0	8.0	8.0	8.0
30 minutes	7.2	7.4	7.6	7.8	8.0	8.0	8.0
1 hour	6.7	7.1	7.4	7.7	8.0	8.0	8.0
2 hours	6.2	6.7	7.2	7.6	8.0	8.0	8.0
3 hours	5.9	6.5	7.0	7.5	8.0	8.0	8.0
6 hours	5.3	6.1	6.8	7.4	8.0	8.0	8.0
12 hours	4.8	5.8	6.3	7.3	8.0	8.0	8.0
24 hours	4.3	5.4	6.3	7.2	8.0	8.0	8.0
48 hours	3.8	5.0	6.1	7.1	7.8	8.0	8.0
72 hours	3.5	4.8	5.9	7.0	7.7	8.0	8.0

Table 3-1 Swale Design Elements

Table 8-1 Swale design elements	
Design parameter	Criteria
Longitudinal slope	< 5%
Maximum velocity	0.8 m/s for water quality storm
Maximum water depth above vegetation	The water quality design water depth should not exceed design height for grass. This is a key criterion for ensuring Manning roughness coefficient is provided.
Design vegetation height	100 - 150 mm
Manning coefficient	0.25 for WQ storm, 0.03 for submerged flow (10-yr. Storm)
Maximum bottom width	2 m
Minimum hydraulic residence time	9 minutes
Minimum length	30 m
Maximum catchment area served	4 hectares
Maximum lateral slope	0%
Maximum side slope	4 H:1V (shallow as possible for mowing purposes)
Where longitudinal slope < 2%	Perforated underdrains shall be provided
Where longitudinal slope > 5%	Check dams shall be provided to ensure effective slope < 5%
Where concentrated flows enter the swale (from pipes)	Level spreaders shall be placed at the head of the swale to disperse flows
10-year storm velocities	< 1.5 m/s unless erosion protection is provided

(Taken From Stormwater Treatment Standard for State Highway Infrastructure)

Although the NZTA document gives detailed design criteria for swales (refer to table 3.1 above), there is no mention of what design storm should be used to size the swale.

Comments

WCCOP does not currently specify stormwater treatment standard solutions, but asks the designer to incorporate them into the problem area using strategies and methods that are considered to be best practice. The NZTA Standard offers many concepts that could be considered from the current literature on stormwater treatment. Because the urban environment is more enclosed and restrictive, solutions tend to be space saving or compartmental. The State Highway network is likely to offer more space and so treatment methods such as swales and bio-filtration are more logical and practical.

c) References

Wellington City Council, *W.C.C. Code of Practice for Land Development,* October 2006
NZTA, *Stormwater Treatment Standard for State Highway Infrastructure (Draft),* 2009.

3.1.3 Stebbings Stream Erosion Control and Bridges

a) Objectives

WCCCOP

The Council's Bush and Streams Restoration Plan *Wet and Wild* requires that as a first principle the character of streams is to be retained whenever possible. There should be no modification of stream systems unless it is for flood mitigation purposes and there are no viable alternative flood management methods available. This ties into GWRC's Regional Freshwater Plan.

Greater Wellington Regional Plans

The proposed road linkage is required to be consistent with the following Objectives and Policies from the Regional Freshwater and Regional Soil Plans

Regional Freshwater Plan

4.1.4 – The natural character of wetlands, and lakes and rivers and their margins, is preserved and protected from inappropriate subdivision, use and development.

Erosion and Sediment Control Guidelines for the Wellington Region

The GWRC document "Erosion and Sediment Control Guidelines for the Wellington Region" outlines the following key principles for erosion control. This document is used in practice to develop sediment control strategies which minimise impact on the environment during the construction phase.

- Minimise Disturbance
- Stage Construction
- Protect Steep Slopes
- Protect Waterbodies
- Stabilise Exposed Areas Rapidly
- Install Perimeter Controls
- Employ Detention Devices
- Make Sure the Plan Evolves
- Inspect

The Northern Growth Management Framework

Guidelines to ensure natural waterways are not polluted or unnecessarily modified by new construction, and that stormwater systems are not overloaded in flood events, will have an effect on future development and housing styles.

NZTA

2.1.2

While this extended detention of flows attempts to mitigate potential adverse effects on stream channel erosion, the best approach is to minimise potential erosion in the first place. The only way this can be done is to reduce the overall volume of water leaving an urban site.

7.1.3.1

There are two options for protecting the quality of streams:

- *Limit increases in stormwater runoff volume (reduce the percentage of hard stand area)*

- *Release a portion of project runoff over a long period of time to separate that flow from storm flow (Provide stormwater storage volume into designs with a controlled release mechanism into receiving environment)*

Comments

The objectives for erosion control in existing streams are very similar in all of the standards mentioned above. Mitigation of increased rainfall runoff response due to development compared with pre-development is emphasised as the best practice for reducing the risk of erosion in streams and rivers.

b) Criteria

WCCCOP

Section D5. States:

Adequate provision is to be made to prevent scour when returning the water from the drain outlet to the water course.

NZTA

6.6.2

There are three different approaches that can be taken to address stream channel erosion:

1. Check the 2-year stream velocities against Table 6-2 to ensure that velocities are non-erosive. If they are non-erosive in the post-highway condition assuming ultimate development of the catchment under the appropriate district plan land use, then no extended detention is required.
2. Implement extended detention or volume control according to the following:
   - *If the stream is stable under the existing development condition, design detention or retention storage for a 24-hour release of an equivalent volume to the water quality storm.*
   - *If the stream is not stable, multiply the water quality volume by 1.2 to determine the extended detention volume. That volume is then stored and released over a 24-hour period.*
3. Conduct a shear stress analysis for a specific site doing the following:
   - *Conduct catchment modelling, i.e. continuous simulation, using land use, initial losses and time of concentration for the catchment in the pre-development condition without the proposed highway. Another simulation will then have to be done for the catchment with the highway in place.*
   - *Input climate information including evaporation data and long-term rainfall.*
   - *Identify a typical downstream cross-section, slope bed material and channel roughness.*
   - *Apply standard channel hydraulics to the cross-section to get a relationship between the discharge and shear stress.*
   - *Develop the relationship between shear stress and erosion rate.*
   - *Combine this with the discharge/shear stress relationship to get a discharge/erosion relationship.*
   - *Apply the output hydrographs from the hydrological simulations to get the discharge/erosion curve to get the long-term time series of erosion rate.*
   - *Calculate the long-term erosion with and without the new highway to determine whether the highway will make erosion worse.*

Volume control uses the same volumes as recommended for detention but then infiltrates or otherwise uses (water tanks, designed evapotranspiration) the runoff.

Where Applicable

Stream erosion issues are applicable where:

- *There is a new highway project, and*
- *There is a natural stream, and*
- *Catchment imperviousness exceeds 3%, and*

- *There is potential for future development to increase stream channel instability, and*
- *There is no tidal influence to the stream where the new highway discharges to it*

Comments

The Westchester Drive Linkage would meet all of the above criteria which indicates there are impacts on the natural stream. Both standards mention that erosion protection of existing streams is important and required, but leave the onus on the designer to come up with solutions for this. No "hard and fast" design criteria are present in either standard.

c) References

Transit Bridge Manual – (600 mm freeboard)
Wellington City Council Code of Practice for Land Development
IPENZ (Modified Rational Method for Design Flows)

3.1.4 Sediment Control (During Construction Phases)

a) Objectives

WCCCOP

The objectives of the sediment control plan for Westchester Drive met the guidelines stated in the GWRC document Erosion and Sediment Control Guidelines for the Wellington Region, Sept 2002. These are as follows:

- *To minimise adverse environmental effects of land distributing activities through appropriate use and design of erosion and sediment control techniques.*
- *Promote full compliance with resource consent conditions*
- *Promote full compliance with permitted activity standards*

NZTA

The following is stated in section 4.2.1 of the Stormwater Treatment Standard for State Highway Infrastructure:

Most stormwater management programmes in New Zealand and internationally started initially with an intention to mitigate the effects of excess sedimentation into streams and estuaries. The logic was that capture of sediment, while being beneficial, would also provide capture of other contaminants that are attached to the sediments.

Comments

Similar criteria are present in both standards for each are based upon original work carried out in Auckland where sub-division pressures and environmental sensitivities are most acute.

b) Criteria

WCCCOP

The criteria for acceptable solutions are expressed in the Resource Management Act and are required under Local Authority Plans. The means of meeting minimum standards are provided in the GWRC Erosion and Sediment Control Guidelines, September 2002.

NZTA

This standard is bound by the same RMA and Local Authority Plans, but the means of meeting minimum standards are provided through various guidelines and industry best practice.

Comments

The erosion and sediment control guidelines used by WCC project originates from the sub-division and land development activity within the council boundaries and the need to protect stressed water environments from further sediment impacts resulting from land development. The NZTA standard has borrowed the objectives from the Local Authority experience and applied methods of development from the sub-divisions industry. As with sub-divisions, effort is required from the design team to incorporate sediment control strategies into a limited work space, and to monitor and modify these strategies as the project develops. In both cases, the Client is meeting minimum public standard for duty of care for the environment, and a successful strategy is measured by a lack of poor publicity during the construction phase.

c) References

Erosion and Sediment Control Guidelines for the Wellington Region, Sept 2002.

3.2 Methods of Design

3.2.1 Culverts

WCCCOP

The Modified Rational Method was use to calculate a design flow for the two main road culverts passing under the Westchester Drive Linkage. The culvert was sized to pass the 100 year ARI runoff under climate change and fully developed catchment assumptions.

NZTA

The *Stormwater Treatment Standard for State Highway Infrastructure (Draft),* 2009 does not offer any design criteria for culverts, and as passing this runoff under the road via culverts is the most practical solution of this project, this section of the design will not change as a result of the new standard. NZTA designs new stormwater culverts to pass the 100 year ARI rainfall event with a freeboard of 500 mm between culvert headwater level and the State Highway white edge line level.

3.2.2 Sumps and Stormwater Treatment

WCCCOP

The design solution for long term treatment of the surface runoff from the new road linkage was a treatment train approach incorporating various stormwater management practices.

The first step of the design procedure was to divide the road surface into eight sub-catchments. This was based upon the local topography of the road and used to select the discharge points. The area of these sub-catchments and the design flow was found using the 100 year storm in accordance with the WCCCOP. From this information, the required number of sumps was then determined assuming a design intake capacity of 25 l/s

Stormwater quality enhancement was provided by constructing swales or grit interceptors at each of the discharge points that drain sections of the new road corridor. WCC have undertaken the monitoring and operation of the swales as part of its road maintenance programme. The swales were part of a permanent landscaping plan designed by Boffa Miskell.

The design swale data for the Westchester Drive Linkage is shown below.

	Catchments	Length (m)	Average Grade (%)
Swale 1	1,2	40	1.3
Swale 2	3	60	5*
Swale 3	4,5,6	90	9.5
Swale 4	7	30	5*

*Denotes assumed grade. More survey detail is needed for final design and layout.

	Design Flow Q5 (m^3/s)	Design Flow Q10 (m^3/s)	Velocity (Q5) m/s	Velocity (Q10) m/s	Retention Time (Q5) mins	Retention Time (Q10) mins
Swale 1	0.088	0.095	0.565	0.581	1.18	1.15
Swale 2	0.027	0.029	0.563	0.567	1.78	1.76
Swale 3	0.114	0.13	1.17	1.23	1.28	1.22
Swale 4	0.029	0.032	0.57	0.595	0.87	0.84

The swale designers used the Q5 flow to design intake and outlet elements of the swale construction and used velocity and retention time data to design the swale cross sections and longitudinal gradients, including intermediate check dams within the swales to control flows. It is assumed that the larger storm events will not be treated in the swale and will overflow into Stebbings Stream via spillways at the ends of the swales.

Comments

Table 3-2 Swale Design Summary Comparison

Swale Design Element	NZTA Standard	Westchester Design	Westchester Meets NZTA?
Maximum Longitudinal Slope (Without Check Dams)	5%	5%	Yes
Design Velocity	0.8 m/s	~0.6 m/s	Yes
Maximum Velocity	1.5 m/s	1.23 m/s	Yes
Bottom Width	2 m	2 m	Yes
Maximum Side Slope	1:4	1:3	No
Hydraulic Residence Time	9 mins	1 – 2 mins	No
Minimum Length	30 m	30 – 90 m	Yes

It can be seen from the table above that the swales designed for the Westchester Drive Linkage are mostly compliant with what is outlined in the NZTA standard. The two criteria that are not met are maximum side slope and hydraulic residence time. A maximum of the side slope is set for ease of mowing and maintenance and the residence time is a function of the design storm inflow.

3.2.3 Stebbings Stream Erosion Control and Bridges

WCCCOP

Open channel modelling was used to compare velocities of the existing and proposed alignments. This will identify any areas where scour protection or erosion control are needed. Rock protection extents and bridge levels were designed with modelling data as inputs.

NZTA

The upstream catchment is zoned “Rural” by the Wellington District Plan, thus the following applies from the NZTA Standard:

Stream erosion control measures are not considered necessary when:

Catchment impervious surfaces are less the 3%,
The highway discharge is directly into tidewater,
The highway discharges into a stream that has rigid boundaries.

The impervious surface limit of 3% applies to catchments that are rural. If a catchment has been zones urban, even if development has not yet occurred, then the 3% limit does not apply.

Westchester Drive Linkage Project would be above the 3% impervious surface limit and would require stream protection measures to bridges, retaining wall foundations and stream banks near to the road corridor.

Comments

In both cases, best practice erosion protection resources would be applied based on design velocities in Stebbings Stream. In this particular case, two stormwater detention dams are above the project and will control peak events, but attenuate moderate flows for long periods of time. Durability of the protection elements becomes important in the selection of rock materials.

3.2.4 Sediment Control

WCCCOP

Details of the proposed erosion and sediment control strategy for the Westchester Drive Linkage Project are summarised in the Construction Management Plan and Drawings, which can be found in Appendices A and B. The strategy makes use of the available corridor of land and incorporates a staged approach to construction.

NZTA

Similar erosion and sediment control measures would be undertaken if the Westchester Drive linkage Project was a State Highway project.

Comments

In both cases, the needs of a construction period erosion and sediment control are acute and are different to the needs of permanent stormwater treatment devices. This has lead to a separation in location between temporary and temporary water quality treatment elements. Ideally, the location and form of construction phase elements would be modified into permanent treatment devices, but this was not considered to be practical in this project due to space and function. During the construction phase, a transition from sedimentation ponds to swales will be made for water treatment, and the development of swales will need to begin well before commissioning of the swales in order to prepare grasses and levels.

3.3 Cost

The Westchester Drive Linkage Project is a project that is currently making its way through the regulatory consenting process. At the date of this report, the project was going through a notified consent process with public consultations, meetings and assessment underway.

The resource consent application has been made on the basis of preliminary design drawings, pending further designs from Conditions of Consent and landowner specifications. Additionally, a landowner condition is that the construction process must take no more than two years from start to finish, and this includes vegetation clearing and final detailed geotechnical investigations at the bridge abutments, and field survey which will improve the ground contour information and finalise the dimensions of cuts and retaining walls.

The final costs of the project are not completed at this stage. It is estimated that the consenting process will be finalised around August 2009, and the final construction costs will be known approximately two years following the start of construction.

The project has been on the WCC books since the 1980s when a designation for the proposed route was put in place. Since then there have been a number of studies and options investigated, culminating in the current alignment which is due for construction between 2011 and 2013. The estimated total cost of the project since inception to its completion is estimated to be $12M (2009 prices). In comparing the cost with current NZTA standards and guidelines, MWH NZ Ltd estimate that the project would cost an additional $2m due to higher compliance costs associated with meeting NZTAs professional services standard specifications through the I&R, D&PD and MSQA phases plus additional compliance costs for the contractor in their Preliminary and General item.

3.3.1 Resource consents (costs, AEE, council fees, other professional services)

Costs are still being incurred for this stage of the project.

3.3.2 Building and other consents (drawings, council fees, other professional services)

Costs have not yet been incurred for this stage of the project. A building consent application will be lodged following the granting of resource consent.

3.3.3 Final design

Costs for detailed design are yet to be fully accounted for at this stage of the project.

3.3.4 Construction

Construction costs have not been incurred.

3.3.5 Monitoring costs (surveillance, inspection and performance)

Monitoring costs have not been incurred.

3.3.6 Operation and maintenance estimated annual cost

Operations and maintenance costs have not been incurred.

3.4 Time

3.4.1 Resource consents (time to acquire submission of applicant to consent approval)

In June 2007, WCC instructed an application for consents and an alteration to the existing designation be prepared. The application was publicly notified on the 21st February 2009 and the public hearing date is set for the week commencing the 25th May 2009. The anticipated end of construction is Dec 2013. Therefore the time taken to complete the project, since the instruction to prepare the statutory application, is estimated to be 6.5 years. In comparing the time taken to complete the project from the start of the preparation of the statutory applications, using NZTAs procedures as a comparison, MWH NZ Ltd would estimate that the project would have taken approximately 6 months to 1 year less. A large proportion of the detailed design was undertaken for this project prior to submission of the application, whereas for NZTA projects the application is generally made during or at the end of the I&R phase when the project is at a preliminary design stage. MWH believe that WCCs approach has minimised the risk of onerous consent conditions being imposed in comparison with NZTAs approach.

3.4.2 Building and other consents (time to acquire submission of applicant to consent approval)

A building consent application will be lodged following the granting of resource consent.

3.4.3 Final design time

Dependent upon Conditions of Consent and final field survey.

3.4.4 Construction

Expected to be 2 years across private land and another year in Council land.

3.4.5 Operation and maintenance

Unknown at this stage.

4 Discussions and Conclusions

The NZTA document *Stormwater Treatment Standard for State Highway Infrastructure (Draft),* 2009 is closely aligned with the objects set out in the existing documents *W.C.C. Code of Practice for Land Development* and *GWRC Erosion and Sediment Control Guidelines for the Wellington Region*. If the NZTA standard was used to design stormwater treatment aspects of drainage for the proposed Westchester Drive Linkage project, only small changes to the design would result. These changes all relate to the length and grade of the swales used as permanent drainage features. The design runoff event for swale design has not been stated in the NZTA Treatment Standard from which to bare volumes and cross sections upon.

Stormwater treatment devices operate on capturing the "first flush" runoff from regular low intensity events that are most common in the catchment. Effectiveness is based upon space and retention time for water to separate from road impurities. To this end, it becomes important to limit the road catchment areas into the treatment devices to avoid overloading with runoff and attempting to clean water that does not originate from the road surface and corridor. Furthermore, the particle size distribution of road runoff impurities becomes important, where gross pollutants can be strained out of the environment at sumps, gravels and sands can be captured in sump pits, silts can be settled out by low velocity ponding and clays can be filtered by grasses and other biological means. Understanding the chemical composition of road impurities is important for capturing heavy metals, dissolved salts and minerals, hydrocarbons and other compounds. The designer also needs to have an appreciation of maintenance requirements and topography to maximise the potential of plant biology and sunlight exposure. It could be advantageous to have the local authority involved or aware of the proposed water treatment strategy in order to explore economies of scale for maintenance.

4.1 Comments on the NZTA Standard

In the retrofitting section of the Standard, Section 11, an additional relationship between road environment and the type and concentration of road contaminants would be useful to be incorporated into information about the sensitivity of the receiving environment, soil and vegetation parameters, space and topography. For example, what sorts of contaminants are likely in:

- 100 km/h straight sections of road
- Traffic light controlled intersections
- Steep road gradients
- Curving super-elevation
- Peak hour congested parts of highway
- Urban areas

The disposal of concentrated contaminants from sumps, wet lands, filters and swales during maintenance needs to be linked to the regulations for contaminated materials disposal, as well as transport and handling of materials during maintenance operations. Most strategies will require maintenance, and some passive strategies such as ponds require some monitoring to identify overloading or other stresses.

5 References

Auckland Regional Council, *Erosion and Sediment Control – Guidelines for Land Disturbing Activities,* TP 90, 1999.

Auckland Regional Council, *Low Impact Design Manual for the Auckland Region,* TP 124, April 2000

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Boffa Miskell Ltd., *Westchester Drive Link – Assessment of Ecological Effects (Draft),* December 2007

Gardiner, L & Armstrong, W. *Identifying Sensitive Receiving Environments at Risk from Road Runoff,* 2007*. Land Transport NZ Research Report No 315. 68pp*

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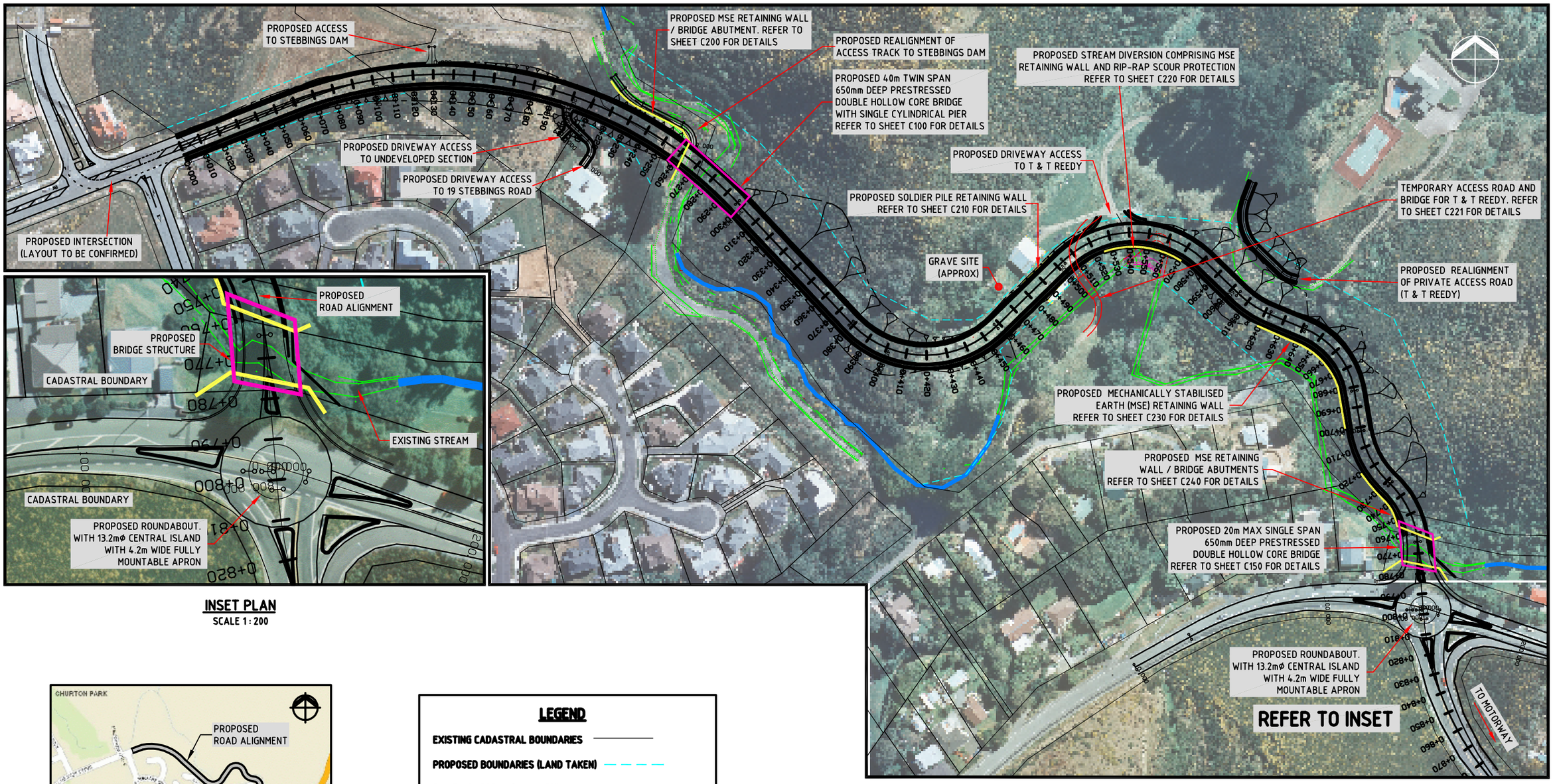
Wellington City Council, *Northern area – a Framework for growth management. Developing a liveable, sustainable and prosperous community,* 2003

Wellington City Council, *W.C.C. Code of Practice for Land Development,* October 2006

6 Appendix A - Drawings

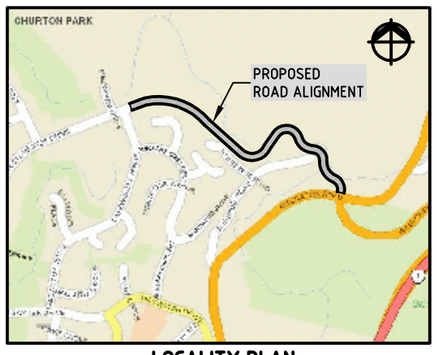
DO NOT SCALE – IF IN DOUBT, ASK

ORIGINAL SIZE A1



INSET PLAN
SCALE 1 : 200

GENERAL ARRANGEMENT PLAN
SCALE 1 : 1000



LOCALITY PLAN
NTS

LEGEND

- EXISTING CADASTRAL BOUNDARIES
- PROPOSED BOUNDARIES (LAND TAKEN)
- EXISTING STREAM (ASSUMED)
- EXISTING ROAD/STREAM (SURVEYED)
- PROPOSED RETAINING STRUCTURES
- PROPOSED BRIDGE STRUCTURE
- PROPOSED STREAM DIVERSION

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	REDRAWN FOR CONSENT	JH	JW		12/9/08

	Name	Date
SURVEYED	NM BERRY	06/07
DESIGNED	AK BALGUHAR	08/08
DESIGN CHECK	JM WALTERS	08/08
DRAWN	JM HUNT	08/08
DRAWING CHECK	JM WALTERS	09/08
APPROVED		

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LOCALITY & GENERAL ARRANGEMENT PLANS

Status Stamp: FOR CONSENT
Date Stamp: 12/09/2008
SCALES (A1) AS SHOWN (A3) HALF SCALE
Drawing No.: Z1266710
Sheet No.: C001
Rev.: A

XREFS : xref_WE_DESIGN8C REV 7, xref_image_WE, W06375 SS-01 2005 version, Mx_Plan_12 Sep

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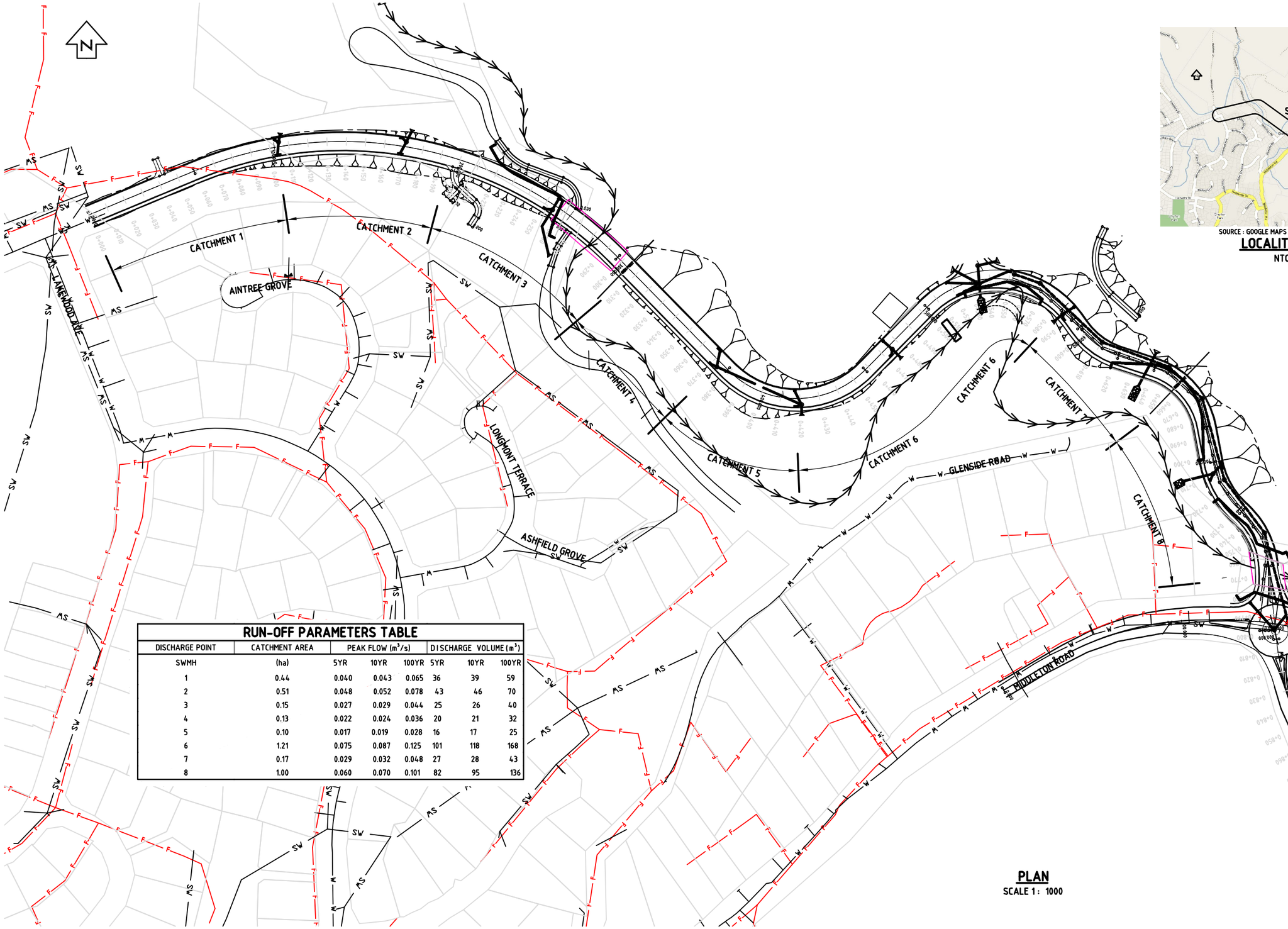
ORIGINAL SIZE A1



SOURCE : GOOGLE MAPS www.maps.google.com

LOCALITY PLAN

NTC

RUN-OFF PARAMETERS TABLE

DISCHARGE POINT	CATCHMENT AREA	PEAK FLOW (m^3/s)			DISCHARGE VOLUME (m^3)		
SWMH	(ha)	5YR	10YR	100YR	5YR	10YR	100YR
1	0.44	0.040	0.043	0.065	36	39	59
2	0.51	0.048	0.052	0.078	43	46	70
3	0.15	0.027	0.029	0.044	25	26	40
4	0.13	0.022	0.024	0.036	20	21	32
5	0.10	0.017	0.019	0.028	16	17	25
6	1.21	0.075	0.087	0.125	101	118	168
7	0.17	0.029	0.032	0.048	27	28	43
8	1.00	0.060	0.070	0.101	82	95	136

PLAN

SCALE 1 : 1000

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REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FOR CONSENT	GBL	NJK	JMW	15/9/08

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DESIGNED	RDW	08/08
DESIGN CHECK	NJK	08/08
DRAWN	GBL	08/08
DRAWING CHECK	JMH	08/08
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WESTCHESTER DRIVE TO MIDDLETON ROAD

DRAINAGE AND UNDERGROUND SERVICES
OVERALL SITE PLAN

Status Stamp	FOR CONSENT
Date Stamp	12/08/2008
SCALES	(A1) AS SHOWN (A3) HALF SCALE
Drawing No.	Z1266710
Sheet No.	C300
Rev.	A

XREFS : X_GIS, MX_plan_24 June

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5. LOCATION OF WINGWALL OUTLETS TO BE CONFIRMED IN CONJUCTION WITH LANDSCAPE PLAN.
6. ALL DOUBLE SUMPS TO BE INSTALLED WITH 300Φ LATERALS.

LEGEND

- PROPOSED SW
- PROPOSED FS
- PROPOSED WATER
- PROPOSED RETAINING STRUCTURES
- PROPOSED UTILITIES DUCT
- EXISTING SW
- EXISTING FS
- EXISTING WATER
- STREAM
- UNDERGROUND POWER
- OVERHEAD POWER
- TELECOM
- GAS
- PROPERTY BOUNDARY
- PROPERTY NUMBER
- PROPOSED BRIDGE STRUCTURE

DO NOT SCALE - IF IN DOUBT, ASK

200 mm 150 100 90 80 70 60 50 40 30 20 10 0

ORIGINAL SIZE A1

STEBBINGS DAM OUTLET

STEBBINGS STREAM

PROP PRE CAST HUMES SERIES 600 WINGWALL OR SIMILAR APPROVED.

PROP 1050Φ SW MH1

PROP 450NB RCRRJ CLASS 3 "Y"

PROP 1050Φ SW MH2

PROP PRE CAST HUMES SERIES 600 WINGWALL OR SIMILAR APPROVED.

LOCATION AND DEPTH OF SEWER MAIN TO BE CONFIRMED

EXTENSION OF WATERMAIN TO BE CONFIRMED BY WCC.

DOUBLE SUMP

DOUBLE SUMP

PROP 1050Φ SW MH3

PROP 375NB RCRRJ CLASS 3 "Y"

PROP PRE CAST HUMES SERIES 600 WINGWALL OR SIMILAR APPROVED.

WESTERN BRIDGE

HIGH POINT

MATCH LINE SEE SHEET C302

CATCHMENT 1

CATCHMENT 2

CATCHMENT 3

CATCHMENT 4

LAKEWOOD AVE

AINTREE GROVE

LONGMONT TERRACE

PLAN
SCALE 1 : 500

RUN-OFF PARAMETERS TABLE

DISCHARGE POINT	CATCHMENT AREA	PEAK FLOW (m^3/s)			DISCHARGE VOLUME (m^3)		
SWMH	(ha)	5YR	10YR	100YR	5YR	10YR	100YR
1	0.44	0.040	0.043	0.065	36	39	59
2	0.51	0.048	0.052	0.078	43	46	70
3	0.15	0.027	0.029	0.044	25	26	40
4	0.13	0.022	0.024	0.036	20	21	32
5	0.10	0.017	0.019	0.028	16	17	25
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REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FOR CONSENT	GBL	NJK	JMW	15/9/08

	Name	Date
SURVEYED	NMB	05/08
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DESIGN CHECK	NJK	08/08
DRAWN	GBL	08/08
DRAWING CHECK	JMH	08/08
APPROVED		

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WESTCHESTER DRIVE TO MIDDLETON ROAD

DRAINAGE AND UNDERGROUND SERVICES LAYOUT PLAN - SHEET 1 OF 2

Status Stamp: **FOR CONSENT**

Date Stamp: **15/09/2008**

SCALES (A1) AS SHOWN (A3) HALF SCALE

Drawing No.	Sheet No.	Rev.
Z1266710	C301	A

XREFS : X_GIS, MX_plan_24 June

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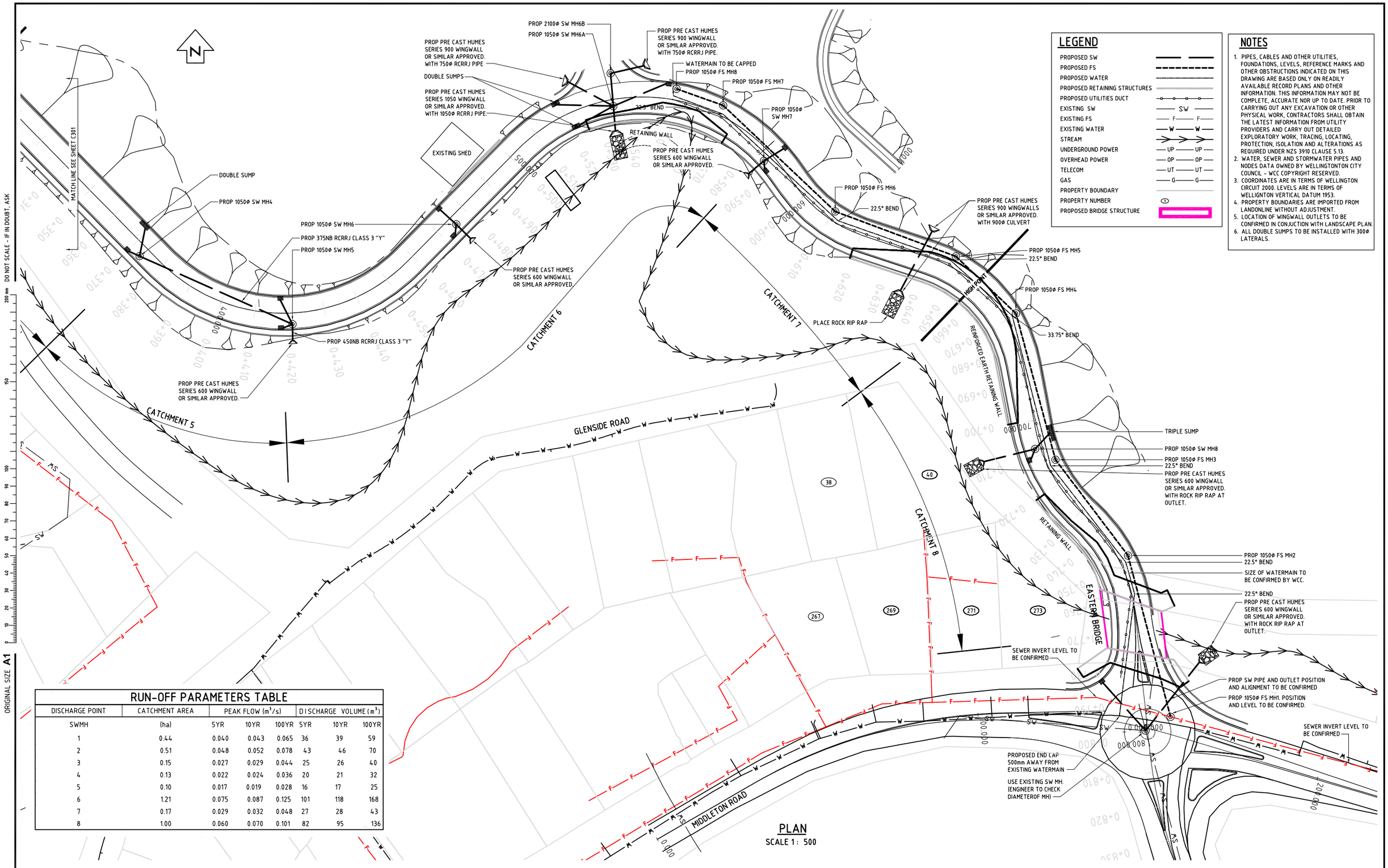
ORIGINAL SIZE A1



PLAN
SCALE 1 : 500

LEGEND

- PROPOSED SW
- PROPOSED FS
- PROPOSED WATER
- PROPOSED RETAINING STRUCTURES
- PROPOSED UTILITIES DUCT
- EXISTING SW
- EXISTING FS
- EXISTING WATER
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- OVERHEAD POWER
- TELECOM
- GAS
- PROPERTY BOUNDARY
- PROPERTY NUMBER
- PROPOSED BRIDGE STRUCTURE

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6. ALL DOUBLE SUMPS TO BE INSTALLED WITH 300Ø LATERALS.

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DESIGNED	RDW	08/08
DESIGN CHECK	NJK	08/08
DRAWN	GBL	08/08
DRAWING CHECK	JMH	08/08
APPROVED		

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WESTCHESTER DRIVE TO MIDDLETON ROAD

DRAINAGE AND UNDERGROUND SERVICES
LAYOUT PLAN - SHEET 2 OF 2

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Date Stamp: 15/09/2008
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Drawing No.	Sheet No.	Rev.
Z1266710	C302	A

XREFS : X_GIS, MX_plan_24 June

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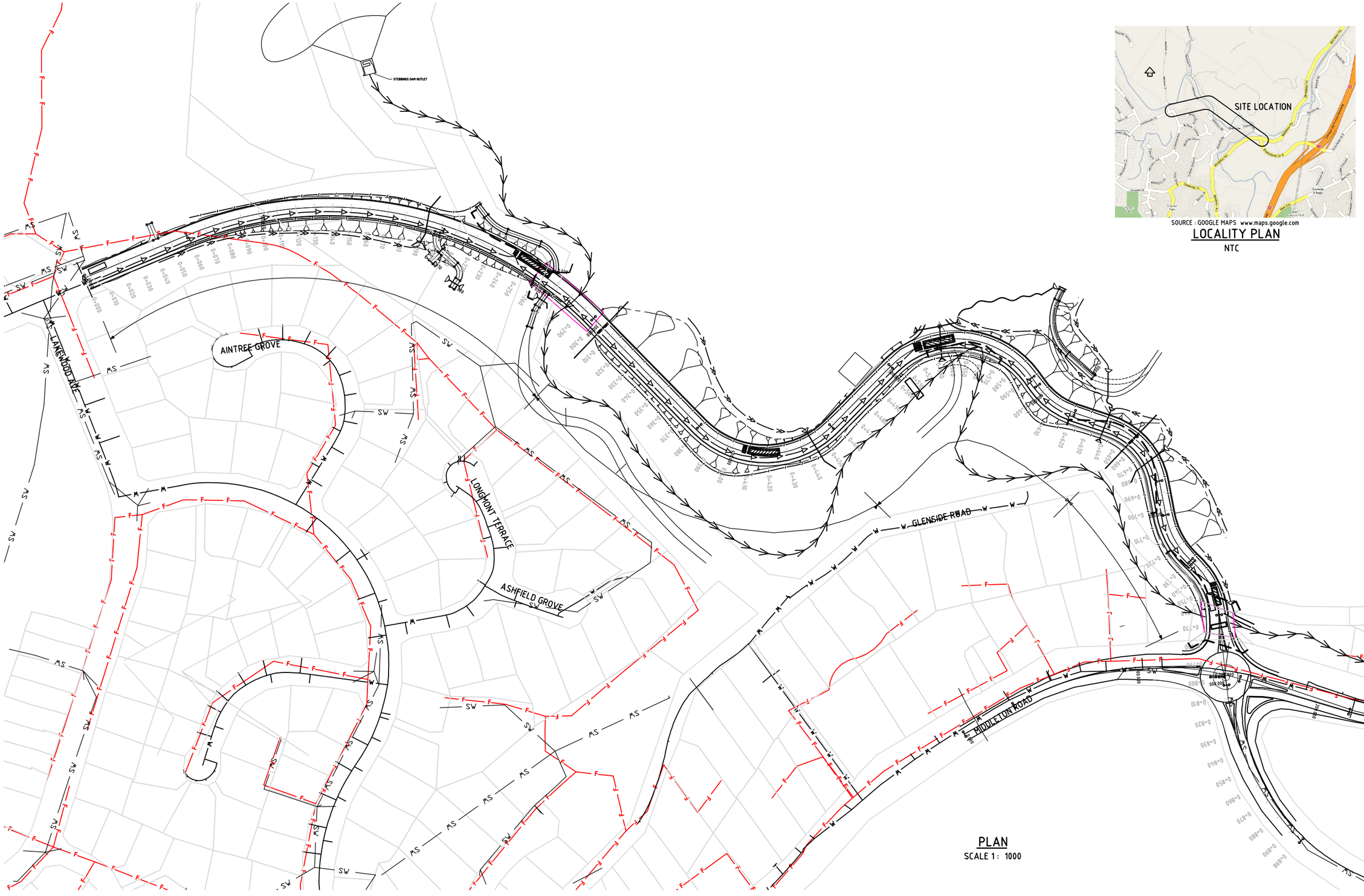
ORIGINAL SIZE A1



SOURCE : GOOGLE MAPS www.maps.google.com

LOCALITY PLAN

NTC

PLAN

SCALE 1 : 1000

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FOR CONSENT	GBL	NJK	JMW	15/09/08

	Name	Date
SURVEYED	NMB	05/08
DESIGNED	RDW	07/08
DESIGN CHECK	NJK	07/08
DRAWN	GBL	07/08
DRAWING CHECK	JMH	07/08
APPROVED		

MWH

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Me Heke Ki Pōneke Wellington City Council

WELLINGTON CITY COUNCIL
WESTCHESTER DRIVE TO MIDDLETON ROAD

EROSION AND SEDIMENT CONTROL
OVERALL SITE PLAN

Status Stamp: **FOR CONSENT**

Date Stamp: **15/09/2008**

SCALES **(A1)** AS SHOWN (A3) HALF SCALE

Drawing No. Z1266710 | Sheet No. C400 | Rev. A

XREFS : X_GIS, MX_plan_24 June

\\nzwgn1gen1\projects\Z12500up\Z12667_WCC Northwest Connector Route\Z1266710 - Westchester CAD Drawings\Z1266710_C400-402 Sediment Control Plan.dwg

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

STEBBINGS DAM OUTLET

STEBBINGS STREAM

INSTALL SILT FENCE ALONG TOE OF CUT SLOPE

300Φ FLEXIABLE PLASTIC PIPE DOWN TO SAFE DISCHARGE POINT ON FLOOD PLAIN FLOOR

FLEXIBLE DRAINAGE OUTLET SOCK 600Φ

INSTALL SILT FENCE ALONG TOE OF CUT SLOPE

SHALLOW EARTH BUND ACROSS ROAD WIDTH TO DIVERT ROAD RUNOFF AWAY FROM SITE

TRUCK WASH. WESTERN END INCLUDING WATER SOURCE

BURIED PIPE

SEDIMENT FOREBAY "A" 1m x 4m x 3m

SEDIMENT POND "A" 1.5m X 20m X 4m DECANT TO STREAM

DAM ACCESS ROAD BELOW WESTERN BRIDGE

TEMPORARY HEADWALL CONSTRUCTED FROM SANDBAGS AND PLASTIC

FLEXIBLE DRAINAGE OUTLET SOCK 600Φ

WESTERN TWIN SPAN BRIDGE

POND CATHMENT A

TEMPORARY HEADWALL CONSTRUCTED FROM SANDBAGS AND PLASTIC. WITH 300Φ BURIED PIPE

FLEXIBLE DRAINAGE OUTLET SOCK 600Φ

WESTERN BRIDGE

HIGH POINT

LAKEWOOD AVE

AINTREE GROVE

LONGMONT TERR

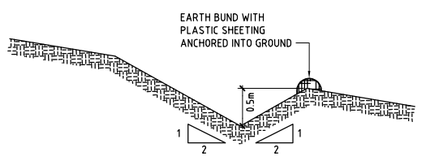
SEDIMENT RETENTION POND	CATCHMENT SIZE (ha)	DESIGN POND VOLUME (m^3)	FOREBAY VOLUME (m^3)
A	0.53	120	12
B	0.40	102	10
C	0.40	102	10
D	0.24	75	6

LEGEND

- CLEAN STORMWATER DIVERSION CHANNEL
- SILT FENCE
- SITE WORKS DIVERSION CHANNEL
- PROPOSED SW
- PROPOSED RETAINING STRUCTURES
- STREAM
- EXISTING SW
- EXISTING FS
- EXISTING WATER
- PROPERTY BOUNDARY
- PROPERTY NUMBER
- PROPOSED BRIDGE STRUCTURE

NOTES

1. PIPES, CABLES AND OTHER UTILITIES, FOUNDATIONS, LEVELS, REFERENCE MARKS AND OTHER OBSTRUCTIONS INDICATED ON THIS DRAWING ARE BASED ONLY ON READILY AVAILABLE RECORD PLANS AND OTHER INFORMATION. THIS INFORMATION MAY NOT BE COMPLETE, ACCURATE NOR UP TO DATE. PRIOR TO CARRYING OUT ANY EXCAVATION OR OTHER PHYSICAL WORK, CONTRACTORS SHALL OBTAIN THE LATEST INFORMATION FROM UTILITY PROVIDERS AND CARRY OUT DETAILED EXPLORATORY WORK, TRACING, LOCATING, PROTECTION, ISOLATION AND ALTERATIONS AS REQUIRED UNDER NZS 3910 CLAUSE 5.13.
2. WATER, SEWER AND STORMWATER PIPES AND NODES DATA OWNED BY WELLINGTONTON CITY COUNCIL - WCC COPYRIGHT RESERVED.
3. COORDINATES ARE IN TERMS OF WELLINGTON CIRCUIT 2000. LEVELS ARE IN TERMS OF WELLIGNTON VERTICAL DATUM 1953.
4. PROPERTY BOUNDARIES ARE IMPORTED FROM LANDONLINE WITHOUT ADJUSTMENT.



CLEAN STORMWATER DIVERSION CHANNEL

NTC

PLAN

SCALE 1 : 500

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE
A	FOR CONSENT	GBL	NJK	JMW	15/09/08

	Name	Date
SURVEYED	NMB	05/08
DESIGNED	RDW	07/08
DESIGN CHECK	NJK	07/08
DRAWN	GBL	07/08
DRAWING CHECK	JMH	07/08
APPROVED		

MWH

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Wellington City Council

WELLINGTON CITY COUNCIL
WESTCHESTER DRIVE TO MIDDLETON ROAD

EROSION AND SEDIMENT CONTROL PLAN AND DETAILS - SHEET 1

Status Stamp	FOR CONSENT
Date Stamp	15/09/2008
SCALES	(A1) AS SHOWN (A3) HALF SCALE
Drawing No.	Z1266710
Sheet No.	C401
Rev.	A

XREFS : X_GIS, MX_plan_24 June

\\nzwgn1gen1\projects\Z12500up\Z12667_WCC Northwest Connector Route\Z1266710 - Westchester CAD Drawings\Z1266710_C400-402 Sediment Control Plan.dwg

Stebbings Dam

Stebbings Stream

Proposed WESTERN bridge

Proposed CULVERT

Proposed CULVERT

Proposed EASTERN bridge

Stebbings Stream

CATCHMENT 1

CATCHMENT 2

CATCHMENT 3

CATCHMENT 4

CATCHMENT 5

CATCHMENT 6

CATCHMENT 6

CATCHMENT 8

AINTREE GROVE

LAKEWOOD AVE

LONGMONT TERRACE

ASHFIELD GROVE

GLENSIDE ROAD

MIDDLETON ROAD

SITE LOCATION

SOURCE : GOOGLE MAPS www.maps.google.com

LOCALITY PLAN

NTC

RUN-OFF PARAMETERS TABLE

DISCHARGE POINT	CATCHMENT AREA	PEAK FLOW (m^3/s)			DISCHARGE VOLUME (m^3)		
SWMH	(ha)	5YR	10YR	100YR	5YR	10YR	100YR
1	0.44	0.040	0.043	0.065	36	39	59
2	0.51	0.048	0.052	0.078	43	46	70
3	0.15	0.027	0.029	0.044	25	26	40
4	0.13	0.022	0.024	0.036	20	21	32
5	0.10	0.017	0.019	0.028	16	17	25
6	1.21	0.075	0.087	0.125	101	118	168
7	0.17	0.029	0.032	0.048	27	28	43
8	1.00	0.060	0.070	0.101	82	95	136

SKETCH PLAN
Supporting GWRC form 10(a)
Bridge and Culvert information.

18/12/08.
N. KEENAN - MWH.

PLAN
SCALE 1 : 1000

DO NOT SCALE - IF IN DOUBT, ASK

200 mm 15 100 90 80 70 60 50 40 35 30 25 20 15

ORIGINAL SIZE A1

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE

	Name	Date
SURVEYED	NMB	05/08
DESIGNED	RDW	08/08
DESIGN CHECK	NJK	08/08
DRAWN	GBL	08/08
DRAWING CHECK	JMH	08/08
APPROVED		

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WESTCHESTER DRIVE TO MIDDLETON ROAD

DRAINAGE AND UNDERGROUND SERVICES
OVERALL SITE PLAN

Status Stamp: FOR CONSENT

Date Stamp: 12/08/2008

SCALES (A1) AS SHOWN (A3) HALF SCALE

Drawing No.	Sheet No.	Rev.
Z1266710	C300	A

XREFS : X_GIS, MX_plan_24 June

\\nzwgn1gen1\projects\Z12500up\Z12667_WCC Northwest Connector Route\Z1266710 - Westchester CAD Drawings\Z1266710_C300-303 Drainage Plan.dwg

[redacted]

180m
160m
140m
120m
100m
80m
60m

A
L=450m
A
75058m²

B
L=450m
B
97505m²

9.75 ha

C
41616m²
C
4.2 ha

Culvert
C
530

Culvert
C
635

RURY DR
WESTCHESTER DR
LAKEWOOD AVE
MIDDLETON RD
WESTCHESTER DR
SH1

DO NOT SCALE – IF IN DOUBT, ASK
ORIGINAL SIZE

NOT FOR CONSTRUCTION

REV	REVISIONS	DRAWN	CHECKED	APPROVED	DATE

	Name	Date
SURVEYED		
DESIGNED	GBL	06/08
DESIGN CHECK	NJK	
DRAWN	GBL	
DRAWING CHECK	JMH	
APPROVED	DAH	

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Westchester

Stormwater Runoff Catchment

Status Stamp	WORKING PLOT
Date Stamp	05/08
SCALES (A1) 1:2000	1:4000 (A3)
Drawing No.	Z1266702
Sheet No.	C101
Rev.	A

XREFS :

\\nzwgn1gen1\projects\Z11500up\Z12667_WCC Northwest Connector Route\Z1266702 Westchester Drive\CAD\Westchester contours parcles.dwg

Boffa Miskell

Boffa Miskell Limited
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Tel: 64-04-385-9315 Fax: 64-04-384-3099
www.boffamiskell.co.nz

Revision

REV	DATE	DESCRIPTION
00	11.06.09	for review
01	26.06.09	For Review
02	11.09.09	For Consent

Westchester Drive Stormwater Management

Overall Road and Swale layout

Design Design | Drawn Drawn
Check Check | Appr'd Approved

0 10 20 30 40 50 60 70 80m

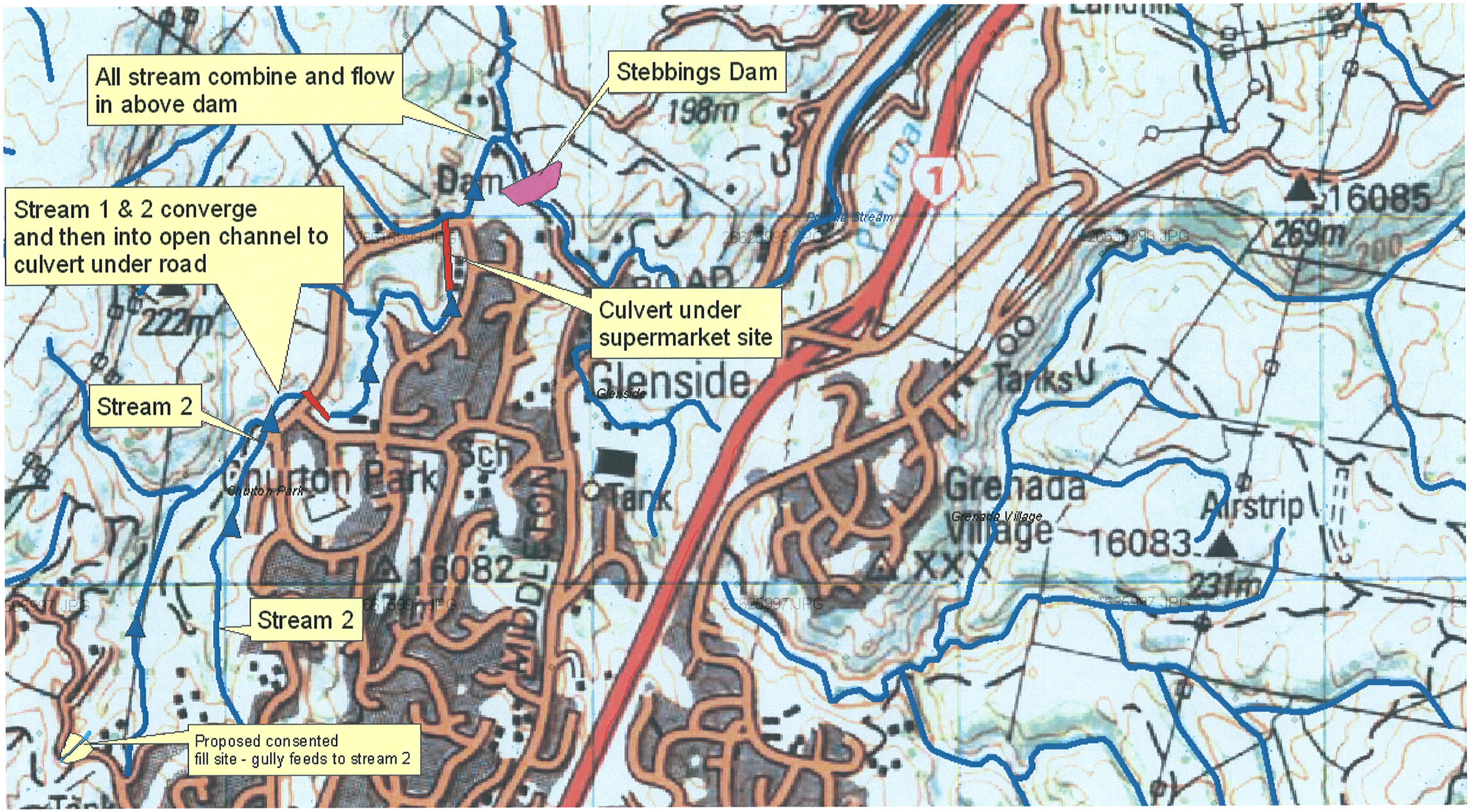
Scale 1:1000 @ A1 1:2000 @ A3

Prepared for
Wellington City Council

DRAWING NO. LA-01-101

REVISION 02

WE7138C


All stream combine and flow in above dam
Stebbings Dam
Stream 1 & 2 converge and then into open channel to culvert under road
Culvert under supermarket site
Stream 2
Proposed consented fill site - gully feeds to stream 2
198m
Dam
222m
Glenside
Glenside
Tanks
Grenada Village
Grenada Village
Airstrip
16085
269m
16083
231m
Charlton Park
Charlton Park
Sch
Park
16082
MIDDLE
1

CATCHMENT AREA
A 5.252 sq km

CATCHMENT AREA
B 2.139 sq km

CENTRAL AREA (APPROX.)

OUTER RESIDENTIAL AREA (APPROX).

RURAL AREA (APPROX)

MAIN FLOW PATH (FOR TOC)

A

B

N

MWH BSG GIS Wellington	**Stebbings Catchment** NB: APPROX. ZONING - INTERPOLATED FROM DISTRICT PLAN (FOR PURPOSES OF ESTIMATING RUNOFF COEFFICIENTS).	Scale 1:20, 000 Original map size: A3 Date: 14 Sept 07

Westchester Drive - Z126670 12/09/07 Sheet 11

N

To TAITA

Porirua Stream

MOTOR WAY

CATCHMENT AREA
= 5.252 sq km

Stebbings Dam

CENTRAL AREA (APPROX.)

Seaton Nossitor Catchment.

SEATON NOSSITOR DAM

CATCHMENT AREA
= 2.139 sq km

CHURTON PARK

PAPARANGI

OUTER RESIDENTIAL AREA (APPROX).

RURAL AREA (APPROX)

MAIN FLOW PATH (FOR TOC)

MWH BSG GIS Wellington	**Stebbings Catchment PLAN** NB: APPROX. ZONING - INTERPOLATED FROM DISTRICT PLAN (FOR PURPOSES OF ESTIMATING RUNOFF COEFFICIENTS).	Scale 1:20, 000 Original map size: A3 Date: 14 Sept 07

7 Appendix B – Construction Management Plan

Westchester Drive Extension

Construction Management Plan

Westchester Drive to Middleton Road

Wellington

December 2008

This report has been prepared solely for the benefit of Wellington City Council (Roading, Traffic and Transportation Department). No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval or to fulfil a legal requirement.

Quality Assurance Statement	
MWH New Zealand Ltd Level 1, MWH House 123 Taranaki Street P O Box 9624 Wellington Tel: 64-4-381 6700 Fax: 64-4-381 6739	**Project Manager:** Barry Wright
	Prepared by: Nicholas Keenan
	Reviewed by: Jeremy Walters ……
	Approved for issue by: Barry Wright ……

Revision Schedule					
Rev. No	Date	Description	Prepared by	Reviewed by	Approved by
1	15.09.08	Draft issued to GHD for consent application	NK	JW	BW
2	17.12.08	Final issued to GHD for consent application	NK	JW	BW

Westchester Drive to Middleton Road

Construction Management Plan

Contents

1. Overview

Wellington City Council (Roading Infrastructure Department) proposes this draft Construction Management Plan (CMP) in relation to the extension of Westchester Drive in Churton Park for the purposes of a land use consent application to the Greater Wellington Regional Council. This draft can then be finalised in consultation with the GW Compliance, Monitoring and Enforcement Team prior to work commencing.

The following specific matters are addressed by this Plan:

- Construction methodology;
- Erosion and sediment control measures;
- Dust suppression measures;
- Control of trucks involved with removal of surplus material;
- Public safety and amenity protection for surrounding residents, including advisory signage;
- Construction noise mitigation;
- Hours and days of operation;
- Traffic management;
- Remediation and compensation for any collateral damage;
- Complaints register and process for resolving issues with surrounding residents (if they arise).

Prior to these specific areas of mitigation being addressed in sections 4 to 8, a number of general mitigation measures are outlined in section 3 of this report. The activity is also briefly described in section 2 to put the proposed mitigation measures into context.

2. Description of the Activity

The proposal is to undertake earthworks associated with construction of a section of road in the valley of the Stebbings Stream, Glenside. Slopes which will be cut are steeper than 28 degrees and thus the area is identified in the Greater Wellington Regional Council Soil Plan as being erosion prone.

The proposed development involves a number of activities and is summarised as follows:

- **Earthworks and Retaining Walls** - Earthworks are required to build the road. Some of the material excavated from cuts will be used to form fills. Excess cut material will be transported to a pre-consented site at 150 Ohariu Valley Road (SR 141035). Before bulk earthworks commence, existing vegetation will be cleared and topsoil removed over the footprint of the proposed route. A topographical survey and a geological field study will be undertaken immediately following this to confirm design assumptions.

  Due to the local topography retaining structures are required throughout the route to prevent encroachment of embankment fills into the stream and to support the bridge superstructures. The proposed wall locations are identified on Drawing Z1266710 C001. For clarity, these structure locations are also detailed below:

  1. Chainage 215m to 260m, western twin-span bridge abutment and eastbound road embankment (see Drawing Z1266710 C200 for further details).
  2. Chainage 480m to 500m, timber pole retaining wall (see Drawing Z1266710 C210 for further details).
  3. Chainage 525m to 570m, mechanically stabilised earth retaining wall, westbound lane (see Drawing Z1266710 C220 for further details).
  4. Chainage 620m to 700m, mechanically stabilised earth retaining wall westbound lane (see Drawing Z1266710 C230 for further details).
  5. Chainage 720m to 760m, single span bridge west abutment and westbound road embankment (see Drawings Z1266710 C240 for further details).
  6. Chainage 760m to 780m, single span bridge east abutment (see Drawings Z1266710 C240, C241 for further details).

  A short length of stream diversion is proposed adjacent to the Reedy property driveway (chainage 550m), and a further stream realignment where it passes beneath the single span bridge at the eastern end of the proposed route (chainage 770m).

- **Bridges** - Two permanent bridges will be required across the stream at chainages 280m and 770m (See Drawings Z1266710 C100 and C150 respectively). The vertical alignment of the proposed route has determined the bridge soffit levels. These levels are well clear of the calculated levels of an ARI 100 event.

  A temporary bailey bridge is to be located at chainage 505m, providing temporary access to Reedy's property throughout the construction of the stream diversion and associated works (see Drawing Z1266710 C221 for further details).

- **Pedestrian Access** – A paved footpath will be provided on the streamside of the proposed road from Westchester Drive to Middleton Road. The current access for pedestrians along Stebbings Road will be maintained in its entirety post-construction.

- **Landscaping and Paving** – Cut and fill slopes will be revegetated with a mixture of hydroseeded grass (for rapid soil stabilisation) and native plant species. Permanent stormwater treatment swales and devices are to be included as shown in the landscaping plans.

- **Traffic Effects** – under this application it is proposed that the excess of cut over fill (cut to waste) will be transported from the site to a pre-consented (SR 141035) site located close to Churton Park, at 150 Ohariu Valley Road.

- **Road Construction and Services –** drainage and services plans show where underground services are proposed, including sewer, water supply, stormwater, power ducts, and telecommunications ducts.

3. General Mitigation Measures

Sedimentation

Measures to control sedimentation are described in Section 4 of this report, which are based on the guidelines presented in the GWRC document "Erosion and Sediment Control Guidelines", Sept 2002.

Inspect and Maintain Sediment Control Measures

It is proposed to properly maintain and inspect regularly all mitigation measures in place on the site. All site control measures will be inspected and maintained by the site manager (to be appointed by Wellington City Council). The Site Manager will be on site at all times during working hours. Truck wash facilities are proposed at the extents of the proposed road construction site.

Dust Suppression

All exposed surfaces will be kept moist during windy periods using sprinklers and, if necessary, additional hand held hoses to ensure the potential adverse effects of dust are mitigated. Reticulated water is not available to the entire site, therefore the physical works contractor will ensure that all areas of exposed soil will be kept moist by having a water truck on site which is also equipped with a hand held hose to enable the upslope batters to be managed. All reasonable means will be used to prevent airborne dust from reaching neighbouring properties.

Incidents and Complaints

If unexpected incidents occur, such as erosion and sedimentation as a result of a slip or unexpected heavy rain, additional silt socks will be installed if possible (depending on the severity of erosion and employee safety). All incidents will be reported to the Wellington City Council Compliance Officer in charge of the site and Wellington Regional Council. The Site Manager (as detailed above) will be available at all times to receive complaints and/or answer queries, and his name and will be clearly stated on the activity board at the front of the site.

A complaints register will be maintained by the Site Manager to log all complaints that arise due to construction issues. All complaints will be logged together with the action taken. This detail will be submitted to Council on a monthly basis.

If there is a complaint made to WCC regarding noise on site, WCC enforcement officers will measure the noise level to ascertain if the noise standard is being complied with. If there is a dispute with the results of the noise test, an independent assessor will be engaged to test the noise level. If noise levels are recorded as being over the noise limit, then appropriate measures will be taken to ensure that the noise standard is met. All complaints will be logged together with the action taken.

Noise

The effects of noise will be minimised by controlling the hours of work and by ensuring that silencers and mufflers on construction plant and equipment are maintained in good working condition. The site adjoins only a small number of residences and thus noise is expected to be less of a nuisance than on some other sites.

Local Signage and Information

At all times there will be a clearly displayed and accessible information board at road level in front of the site but away from construction activities. It is proposed that the signage will be $2m^2$ and will include:

- A concept plan of the overall scheme of the development;
- The names and contact numbers of all consultants, contractors etc involved in the development;
- The name of the Site Manager and their contact number;
- The activities currently being carried out on site.

Indemnity Insurance and Reinstatement

All contractors on site will be required to carry indemnity insurance to ensure that in the unlikely event of damage being sustained to neighbouring properties, vehicles etc through fault of the contractor, there is recourse for compensation. In cases where damage does occur, the preferred option however is for the applicant to reinstate or remedy the damage where possible. The priority is to avoid such situations occurring in the first instance.

Two Copies of the CMP to be kept on site at all times

At all times, the Site Manager will be responsible for ensuring there are two copies of the CMP complete with appendices on site at any time. These will be located in the site office.

4. Construction Methodology

4.1 Methodology

The proposed works will complete the section of Westchester Drive between Lakewood Avenue and Middleton Road. Cut batters will be constructed at a 1:1 slope to improve overall slope stability and minimise slope erosion. The slope also increases the likelihood of re-growth of vegetation on the batter face compared to steeper slope angles.

The design of the project has been conducted under private landowner restrictions that limit detailed survey, site investigation and construction on the proposed road alignment to a two year window of opportunity. The detailed survey and additional site investigation is scheduled to commence immediately following site clearance and just prior to physical works construction over the private property (Reedy land).

This methodology description is general and some aspects may be subject to minor change depending on the successful contractor and the merits of their preferred method of working. Ground conditions encountered and logistics at the time will also play pivotal roles in the overall methodology.

It is anticipated that construction will be carried out over three main stages. The stages are described with reference to the proposed, road centreline, chainage which begins at the Westchester Drive end of the project and ends at Middleton Road (see Drawing Z1266710 C001 for example).

Stage 1 – Prior to entering Reedy Land

1) Construct Eastern Bridge (single span) east abutment, chainage 780m.
2) Construct roundabout intersection, chainage 800m.
3) Construct Eastern Bridge (single span) west abutment and install deck, including erosion protection, as required, chainage 760m to 780m.
4) Drive from chainage 0m to 260m. Complete with silt fences, clean water diversion channels and the western end stabilised construction entrance and truck wash.
5) Construct private vehicle access at chainage 200m.
6) Construct GWRC vehicle access at chainage 130m.
7) Construct Swale 1, chainage 130m to 180m.
8) Construct sediment control Pond A (chainage 200m) and erosion control measures.
9) Construct Swale 2 on Stebbings Rd adjacent to chainage 300m to 370m.
10) Construct eastbound embankment retaining wall and abutment to west end of Western Bridge (twin-span) at chainage 210m to 260m.
11) Install stormwater infrastructure at chainage 0m to 260m.

Stage 2 – Drive to Reedy Intersection

1) Clear site, perform survey, conduct geotechnical testing as required, confirm design, photograph area for reinstatement, over chainage 260m to 760m.
2) Construct pier, east abutment and deck for Western Bridge (twin-span) at chainage 260m to 300m.

3) Construct eastern end stabilised construction entrance and truck wash, temporary earthworks ramp to contain runoff, sediment control pond D, silt fencing and clean water diversion channels, and permanent stormwater drainage pipes, at chainage 740m to 820m.
4) Drive from chainage 760m to 580m.
5) Install 900mm diameter stormwater culvert across road (Chainage 640).
6) Install retaining structures adjacent to stream at chainage 760m to 620m.
7) Construct Swale 4 adjacent to chainage 575m to 600m.
8) Install temporary driveway access and temporary bridge to the Reedy property at chainage 505m.
9) Continue drive from chainage 580m to 520m.
10) Install 1050mm diameter stormwater culvert across road at Chainage 540.
11) Install sediment control Pond C at chainage 520m to 540m.
12) Demolish existing private driveway bridge at chainage 545m, construct stream diversion and associated retaining structure at chainage 535m to 570m.
13) Lay new services in the road from chainage 800m to 540m.
    a. Water/Hydrants
    b. Sewerage/manholes
    c. Utilities/ducts/junction
    d. Streetlighting
    e. Fences to boundary
    f. Hydroseed slopes.
14) Construct intersection to Reedy driveway at chainage 535m.
15) Continue drive from chainage 520m to chainage 480m.
16) Construct timber pole retaining wall supporting Reedy's barn at chainage 500m to 480m.
17) Continue drive from chainage 480 to 400m.
18) Construct swale 3 adjacent to chainage 425m to 520m.
19) Install sediment control Pond B at chainage 425m to 405m.

Stage 3 – Drive to Western Bridge (twin-span)

1) Continue drive from chainage 400m to 300m.
2) Install silt fences and clean water diversion channels at chainage 400m to 300m.
3) Install stormwater infrastructure at chainage 370m to 420m.
4) Construct kerb and channel over full length of project.
5) Install sumps and connections over full length of project.
6) Erect boundary fencing to entire length of project.
7) Road foundations, sub-base, basecourse over full length of project.
8) Sealing and decommissioning and backfilling of sediment control ponds.
9) Connect surface water drainage to permanent treatment swales.
10) Remove temporary bridge and temporary access to the Reedy property.
11) Landscape planting and hydroseed reapplication.

Currently much of the area for the earthworks is covered with thick bush. This will be removed to enable the earthworks to be carried out. Vegetation will be disposed of in an appropriate manner by the physical works contractor. It should be noted that, wherever practicable, significant native vegetation will be retained and identified by a qualified landscape architect or similar professional. Topsoil will be removed and stockpiled for re-use after completing earthworks.

The proposed road crosses Stebbing's Stream at chainage 250m and Porirua Stream at chainage 750m. Subsequently, a significant proportion of the earthworks is not presently accessible to wheeled vehicles or

construction plant. Due to site access constraints, the physical works contractor will be required to construct the new single span bridge at the Middleton Road (eastern) end first to gain access for earthworks.

Earthworks are estimated to include 55,000 m^3 of cut and 8,000 m^3 of fill. Approximately 47,000 m^3 of material will be removed from the site and dumped in a consented fill site in 150 Ohariu Valley Road, about 3 km from the site.

Site drainage is towards the stream. The new road runs broadly parallel to the stream and thus stormwater draining from above the road will be diverted around or through the construction site to prevent mixing with the stormwater runoff from the work areas of the site. The site topography dictates that most of the sediment control measures will be placed in the proposed roadway above the stream. The physical works contractor will be required to construct appropriate sediment control measures in accordance with GWRC Erosion and Sediment Control guidelines and contract drawings at the earliest opportunity before sediment is generated by earthworks. These will be appropriately sized sedimentation ponds with check dams and catch drains to direct all sediment laden runoff into the ponds. In some locations measures such as silt socks and silt fences will be required. (Refer to Erosion and Sediment Control Plans, Appendix 1). When sedimentation ponds are decommissioned, the sediment will be excavated from the pond and hardfill compacted into the void to bring the sub-base up to grade. Decommissioning of the ponds will occur when cutting activity has stopped and slopes have been hydroseeded with reasonable establishment of vegetation, and when permanent stormwater treatment systems are in place ready to be commissioned.

It is expected that a small volume of clean storm water run-off will be generated on the slopes above the site in wet weather. This will be channelled and directed away from the cut and fill slopes to minimise erosion on exposed soils using clean stormwater diversion channels as detailed on drawings Z1266710 C401 and C402.

As earthworks are completed, it is proposed that the exposed cuts and fills be vegetated with a hydroseeded application. Re-vegetation and planting will be as shown in the Boffa Miskell landscaping plans (see Drawings LA- 01-101 to LA- 05-520).

The proposed landscaping plan includes provisions for stormwater treatment swales as part of the permanent works. Once fully established with grass covering, these swales will treat runoff from the finished road surface and become WCC assets. Facilities to treat construction runoff will not be located where the permanent swales are to be sited but will be separate sediment control ponds designed and positioned to perform specific roles. The sediment control ponds will be decommissioned only when the permanent swale designs have been constructed and prepared for duty.

4.2 Bridge Construction

4.2.1 Western Bridge (twin-span)

This structure is detailed on drawings Z1266710 C100 and C200.

Due to land access constraints it is anticipated that the Contractor will construct the west abutment first. This abutment comprises mechanically stabilised earth (MSE) construction supporting a sill beam, which in turn supports the bridge superstructure. Excavation and construction of the abutment can be completed from the existing Stebbings Road access track thus reducing the impact on Stebbings Stream to virtually nothing.

Surface water run-off from this area will be directed into Swale 2 on Stebbings Road for treatment prior to entering Stebbings Stream.

Installation of the proposed central pier cylinder foundation will be conducted using in-stream bunding techniques and de-watering techniques as deemed appropriate. The pier itself will be located on the western flood bank of the stream and will not therefore directly impede on normal stream flows. Due to the narrow stream channel and steep stream banks at this location, it is anticipated that the piling rig will be positioned on Stebbings Road extending out over the bank on a temporary support structure.

Completion of the piled east abutment sill beam will commence following the driving through of the road from Chainage 400m to Chainage 300m and will permit placement of the precast double hollowcore bridge deck beams and associated works. Following this, the remaining bridge elements will be installed including construction of the vehicle barriers and the construction and surfacing of the approaches.

4.2.2 Eastern Bridge (single span)

This structure is detailed on drawings Z1266710 C150 and C240.

The construction of this bridge is anticipated to coincide with the construction of the Middleton Road roundabout, as described in Stage 1 of Section 4.1 above.

Both abutments comprise mechanically stabilised earth (MSE) construction and found onto the shallow greywacke rock on the east side and extend 4 metres onto the dense gravels on the west. MSE retaining structures are inherently quick to construct and as all construction is carried out behind the wall face their impact on the adjacent watercourse is considerably less than other forms of construction. It is anticipated that due to the founding level of the west abutment it will require the use of de-watering techniques as deemed appropriate.

Due to topographical and geotechnical uncertainties in this area a provisional scour protection rock blanket has also been provided. The necessity for this additional scour protection will be assessed during the construction stage.

Completion of the two sill beams will permit placement of the precast double hollowcore bridge deck beams and associated works. Following this, the remaining bridge elements will be installed including construction of the vehicle barriers and construction and surfacing of the approaches.

4.3 Stream Diversion

The scope and length of the stream diversion indicated on the Erosion and Sediment Control Plan and detailed on drawings Z1266710 C220 and C221, in a typical cross section, is to be confirmed following a detailed topographical survey and geotechnical assessment of the location prior to commencement of construction. The anticipated process of stream channel construction is described below and is based on GWRC Erosion and Sediment Control Guidelines, Section 6 - Working in Waterbodies, but will be subject to refinement in consultation with the contractor and GWRC during construction planning:

1. Carefully excavate proposed stream diversion in dry conditions, "off line" from the stream flow, using appropriate in-stream bunding and de-watering techniques whilst maintaining the existing stream route. The new channel will include riprap placement up to 1.5m below the existing stream bed level and will include further undercutting to reach suitable foundation material. Riprap will be backfilled over as shown in typical section at stream diversion, Drawing Z1266710 C220. The proposed diversion channel stream bed will be backfilled with existing bed material to provide an even gradient to match in with levels upstream and downstream. The finished bed material will comprise stream bed silts and material overlying the buried riprap protection layer and over time would revert back to natural levels.
2. Place a non-erodible dam in the upstream position of the stream flow to divert flow into the new stream channel.
3. Allow old stream bed to dry out and encourage fish migration downstream.
4. Place a non-erodible dam in the downstream position of the existing stream and backfill the old stream bed between dams with compacted hard fill. Flows are fully diverted into the new stream channel.
5. Prepare the wall foundation on the outside of the channel bend and install MSE wall. Install rock protection as required as the wall height increases and provide overpumping capacity as required while construction of wall foundations below the adjacent level of the stream flow occurs. The low part of the wall construction is likely to take one to two weeks to rise above the normal stream water level, and for this period a construction pump will be used to dewater the foundation works, and discharge water back into the stream.
6. Remove temporary stream diversion material from the site, and tidy.

4.4 Stockpiles

The amount of topsoil stockpiling is expected to be small and the locations of these will be agreed with the land owner or placed on land made available by negotiation. If an agreement cannot be reached, the topsoil will be carted off site and returned during reinstatement. Fill stockpiles are not anticipated as the required suitable fill materials will be made available from the cut operation. The amount of fill material needed for the project is small compared with the cut volumes to be generated.

4.5 Utilities and Services

Underground services will be installed in the new road as shown on the Drainage and Underground Services plans. The underground services are intended to prevent trenching within the next 5 to 10 years and are placed in anticipation of urban growth in the vicinity of Westchester Drive. As such, the services are not going to be connected into the live networks, and in the cases of telecommunications and power, the ducts will be installed but not the service (to be confirmed by the utility company concerned).

4.6 Hours of Work

In keeping with the above methodology, hours of work for all construction and earthworks activities on site and for deliveries to the site will be:

- 8am to 5.30pm on weekdays;
- 9am to 3pm on Saturdays; and

- No work is to be undertaken on Sundays or public holidays.

It is not anticipated that there will be any works carried out outside of the hours indicated above. In the event that works are required outside of these hours, the Site Manager will advise both Council and relevant adjoining neighbours the day prior to the event.

4.7 Construction Timeframe

Landowner consent conditions dictate that once clearing activity begins on the property owned by Mr Reedy, the construction must be finished on his property within a two year timeframe. In general, the construction programme will attempt to do as much work outside of the Reedy property in order to efficiently gain access and work within the property over the two-year window.

5. Erosion and Sediment Control

Erosion and sediment control measures are based on the guidelines presented in GWRC document Erosion and Sediment Control Guidelines for the Wellington Region, Sept 2002.

5.1 Stormwater Diversion

The land above the site (to the north) is mostly covered in thick bush. There are open areas on the Reedy property and adjacent to Melksham Drive at the western end of the new road. The dense vegetation will reduce the volumes of storm water running onto the site. To minimise erosion, the overland flows generated during rain will be channelled and directed away from cut slopes by check dams running along the top of the cut (upslope) batters. The clean water will be piped across the construction site and outlet directly to Stebbings Stream.

5.2 Sediment Retention Ponds

The road falls from an elevation of 94.58m at the tie in to Westchester Drive to 63.12m at Middleton Road. The gradient is not uniform and there are three sag curves in the vertical alignment. Two of these are at the stream crossings and the third at an intermittent water course running through the Reedy property. Sediment retention ponds have been designed near to these locations. See Appendix 1 for Erosion and Sediment Control drawings.

Site slopes are generally in excess of 3%, thus the sedimentation ponds will be designed to retain 300 m^3 of volume per hectare. The area of the road footprint is approximately 1.33 Ha, with a mix of steep (>10%) and moderate (<10%) runoff slopes, equating to a total of 343 m^3 (minimum) of on site stormwater to be retained.

It is anticipated that the site will be divided into five catchments to deal with potential surface runoff from the site. From west to east, the areas of the catchments are approximately 5260 m^2, 4030 m^2, 4040 m^2, 2440 m^2 and 100 m^2. There will be one sediment retention pond for each of the four larger catchments to provide containment for any sediment in surface flow from the site. The pond volumes to be catered for in each catchment are 120 m^3, 102 m^3, 102 m^3 and 75 m^3. Each pond has a forebay volume that is 10% of the volume of the primary sedimentation pond. One catchment (between Middleton Road and the bridge) is small and will be catered for with silt socks and sump filters in Middleton Road. Extra capacity of the sediment retention ponds has been considered and added to cater for the water that will be used in order to clean the trucks at the truck wash. Extensive use of silt fencing is to be employed and maintained along the toes of all cut and fill slopes.

The landscaping plan (Boffa Miskell) allows for the construction of permanent swales and treatment sumps to treat storm water discharging from the road after construction. It is likely that wherever possible the physical works contractor will construct these facilities early and use them for sediment control and stormwater treatment when the sedimentation ponds are able to be decommissioned.

Sediment retention ponds, silt fences and silt socks will be maintained and monitored to ensure effectiveness.

5.3 Silt Fences

The topography of the site dictates that little, if any, run off will be towards adjacent properties. As a precaution, however, silt fences will be erected against adjacent properties on Lakewood Avenue and Aintree Grove at the western end of the site and Middleton Road at the eastern end. This is in addition to the fences erected at the base of cut and fill slopes, and any slope that has been cleared of vegetation along the project.

Silt fences and filter cloth used in the control of water borne sediment will be regularly maintained in a controlled manner to keep the effectiveness of the devices at a high operational level.

5.4 Bridges

Two bridges are to be constructed. The western bridge has a centre pier located on the stream flood bank with a sill beam at one abutment and reinforced earth structure at the other, both constructed some way back from the stream. The eastern bridge has a single span with reinforced earth abutments constructed some way back from the stream. Excavations for three abutments and the fill for the fourth abutment will require minor earthworks. Sediment laden run-off from these earthworks will be intercepted with silt socks and silt fences.

5.5 Construction in Middleton Road

A new roundabout is to be constructed in Middleton Road. Stormwater arising in and adjacent to Middleton Road will run into sumps in the road which are believed to discharge directly into the stream. Silt in the storm water during construction will be treated by filters in the sumps, complemented by silt socks in the water channels at the side of the road if necessary.

The permanent treatment option for the finished road from chainage 655m to 710m is proposed to be a 1500 litre grit and oil interceptor tank before discharge into the stream, and is small enough to fit into the narrow road corridor at this part of the project. The interceptor has three chambers separated by high and low baffles to trap floating material and greases or oils, and to catch grits by settlement. Maintenance is gained through standard manholes and is cleaned out in the same way as road sumps by vacuum truck.

5.6 Truck Wash and Filtration System

Cleanliness of trucks leaving the site is to be monitored on an ongoing basis. To ensure mud is not tracked onto Westchester Drive or Middleton Road by vehicle movements, two truck-wash facilities will be placed close to the stabilised construction entrances from these roads. Each truck wash will be constructed before earthworks trucks use the adjacent access and will be based on section 4.8 of GWRC Erosion and Sediment Control guidelines, with site specific modifications as described below.

The truck-wash facility will consist of a thickness of approximately 500mm of 50-75mm washed aggregate placed over a concrete pad or geotextile filter cloth. It is proposed that a water-blaster or high pressure hose and water supply connection will be made available to wash down the trucks and truck tyres. Sediment will be trapped in the gravel, with the runoff entering into the nearest sediment control pond. The gravels will be flushed from time to time during the construction period to reduce clogging.

Truck wash water volumes will be easily accommodated in the sediment control ponds during construction activity which is most likely to be mainly during suitable weather and ground conditions. During serious rainfall events of any size the construction activity is assumed to be stopped due to the effects on the working conditions, in which case truck wash water volumes will not add to rainfall runoff volumes.

It is recognised that a truck wash primarily deals with preventing mud being tracked onto public roads, but the truck wash will also allow for the cleaning/dampening of trucks to prevent dust nuisance to neighbouring properties as trucks leave the site. Refer to Appendix 1 for the location of the proposed truck washes.

5.7 Sediment Control Drawing

The above mitigation measures will be shown in plan view on a conceptual drawing that will be appended to this plan. The proposed sediment and erosion control measures are detailed in Appendix 1.

5.8 Landscaping Plan

The landscaping plan for the Westchester Drive project will describe the permanent landscaping features and requirements for the project, including the permanent stormwater treatment strategy and specifications, planting and hydroseeding, visual enhancement and other aspects of form. Permanent stormwater treatment swales will be constructed and stabilised with grass cover during the project, but will not be used to treat sediment loadings during the construction phase. Dedicated sediment control ponds will capture construction sediments, while the permanent swales will be commissioned near the end of the project when the road is fully sealed. The swales are to be maintained by WCC thereafter.

6. Traffic Management and Vehicle Movements

6.1 Machinery and Truck Movements

There will be a number of different items of construction plant and machinery operating on the site at any one time. The number of haulage trucks operating on the site is dictated to a certain degree by the conditions of consent imposed on the site where the fill is to be deposited (150 Ohariu Valley Road). As identified in Service Request SR 141035, the fill for the 150 Ohariu Valley Road site is anticipated to come from roading improvements such as the Westchester Drive Extension. The amount of cut to waste from the proposed earthworks at the Westchester Drive site is in the order of 47,000m^3, which will equate to 4700 return trips (based on a haulage truck moving 10m^3).

To reduce the impact of truck movements during peak hour, the operation of truck movements to and from the site will be restricted. It is proposed that truck movements are restricted to a maximum of **four per hour** between the hours of 8am and 9am and then again between the hours of 3pm and 4pm, this will reduce the potential effects that the vehicle movements will have around the hours school are starting and finishing.

There will be numerous other vehicle movements such as contractor vans, utes and cars, and their numbers will be extremely variable depending on the stage of the development.

6.2 Traffic Management

All traffic management measures will be in strict accordance with the Wellington City Council 'Code of Practice for Working on the Road'. It is anticipated that other than vehicles directly involved with the excavation on site, all other vehicles will be prohibited from using the site. Essentially the site is a construction site, and will be treated as such. The only exception to this will be access across the site onto Reedy's property via the temporary bridge.

The works include the construction of a new roundabout at the intersection of Westchester Drive with Middleton Road. Both Middleton Road and the section of Westchester Drive to the motorway (and beyond) carry significant volumes of traffic and careful attention will be paid to traffic management for the work at the roundabout.

The site will be physically fenced off to exclude the public from the site during the entire construction period.

6.3 Private Access for Affected Property Owners

The project affects the vehicle access to two properties – the Reedy property and the Pender property near the Western Bridge at chainage 200 .

The Reedy property access will be maintained during construction via a temporary bridge at chainage 505m. Provision of this bridge enables the removal of the existing bridge and installation of the retaining wall, stream diversion and proposed road. Following construction, access will be directly onto the new Westchester Drive.

The property near the western bridge currently accesses Stebbings Road and this will be maintained until the new access road, directly onto Westchester Drive, is built.

6.4 GWRC Access to Stebbings Dam Outlet

GWRC maintain the Stebbings Dam with access to the outlet structure gained from Stebbings Road. After the construction of the western bridge, access will be along the existing road but will have restricted vertical clearance to the underside of the bridge. The clearance will be approximately 3.75m but will be confirmed following site survey and construction. This has been raised with GWRC and accepted by them.

7. Public Safety and Amenity

7.1 General

The following measures will be implemented to ensure public safety is maintained and the amenity of the surrounding area is preserved:

- In keeping with the general mitigation measures outlined above, advisory signage will be provided at both ends of the site providing the name and contact number of the site manager. This will enable people to contact the site manager if they have a complaint or issue they would like resolved.
- Temporary fencing (2m) and hazard tape will be positioned in front of the entrance and work areas immediately at each end of the site at night and during the weekends when there is no work. This will keep people out of the site and will ensure that it is obvious to residents, motorists and passers by that it is a construction site to be kept away from.
- Appropriate hours of work (see section 4.2). To be confirmed by the conditions of consent.
- Appropriate noise mitigation (see section 8 below). Appropriate performance standards as per NZS 6803P:1984.
- Appropriate erosion and sediment control measures (see section 5 above). Appropriate performance standards are set out in the Wellington Regional Erosion and Sediment Control Guidelines for small sites.
- A general undertaking to act in good faith with neighbouring property owners and residents during the construction period, and to be responsive to issues and complaints when they arise.

7.2 Property Access

The access to one property on Stebbings Road will be affected by the new road. A new access from the proposed road (Westchester Drive) will be provided and the physical works contractor will be required to maintain access to the property at all times.

8. Noise Mitigation

8.1 Overview

It is likely that the construction of this section of road will generate noise through the operation of trucks, diggers and other machinery. Although most of the road is being constructed some distance away from adjacent properties, there will be noise effects on the immediately adjacent properties. It is therefore proposed that the noise levels for the construction works be stipulated to be in accordance account NZS 6803P:1984 (the New Zealand Standard for the measurement and assessment of noise from construction, maintenance, and demolition work). The standard, although implemented in 1984, is still operative and sets a benchmark for noise mitigation for construction activities.

It is noted that noise nuisance will depend on a number of factors as identified in the standard, namely:

- The existing background noise level;
- The distance between the site and nearby residential areas;
- The nature of the construction noise;
- The nature of the buildings and the activities where construction noise is likely to be heard;
- The likely duration of construction operations and the hours during which they will be carried out (whether during the day, night or weekends).

With respect to the above, and the nature of the site with neighbouring dwellings, a 'best practicable option' approach has been adopted to keep noise levels low, and takes into consideration those matters set out in Appendix B,C and D of the standard.

With respect to the acceptability of noise levels, attention is drawn to Table 1 in part five of the standard. All noise limits contained within the table will be adhered to, and it is noted that there will be no noise on Sundays or late on Saturdays given the proposed hours of operation.

8.2 Mitigation Measures

Estimation of Noise Levels

Table 1 in section five of the standard sets the maximum allowable noise levels for L_{10}, L_{eq} and L_{max}. The works will not involve any demolition requiring the use of jack hammers and other similar equipment for long periods, but earthworks are expected include excavation in rock. Present indications are that the rock will be weathered and broken sufficiently to be excavated by excavator buckets. In this case it is unlikely that the maximum noise limits of 75 L_{10} 60 L_{eq} and 90 L_{max} will be exceeded. It is possible that some of the rock will need to be broken by hydraulic breakers, which will probably increase noise levels on site and at adjacent properties. If rock requiring the use of breakers is encountered, noise levels will be monitored whilst the breakers are in use and if the noise levels are close to the limits the times of operation will be limited to minimise nuisance to adjacent property owners.

Where there is dispute as to the noise level, the applicant will be happy to assist with noise level measurements from the property in question. It is anticipated that the noisiest work will be from earthworks excavation.

Specific Mitigation Measures

The following mitigation measures will be implemented in accordance with the standard to ensure noise is kept to an acceptable level:

- **Generators and Compressors** – Generators or compressors may be required on site for bridge construction. One of the bridges is to be constructed adjacent to one property and so efficient noise muffling of any such equipment will be required.
- **Bulldozers, compactors, dumpers, excavators, loaders etc** - All trucks and machinery will be required to be in a good state of repair with exhaust muffling to the standard of new equipment. This will enable them to comply with noise standard NZS 6803P: 1984.
- **Maintenance Activities** - All maintenance on machinery will be undertaken at a time of the day when it will be less intrusive on the neighbouring residents. Any maintenance activities will be carried out with as much distance as possible between residents and vehicles that are being worked on.
- **General Construction Activities** - No materials, such as timber pallets and framing, will be dropped on to hard surfaces. All hand held machinery will be kept in a good state of repair.

Training of Personnel

All contractors will be made aware of the requirement to operate in accordance with the above mitigation measures and that NZS 6803P:1984 will be the benchmark in terms of performance standards. The site manager will have a copy of the standard on site as it will be appended to the CMP, two copies of which will be available on site at all times. Any sub-contractors will be required to comply with work documents such as the CMP. It will be the responsibility of the Site Manager to ensure that these standards are adhered to.

The applicant acknowledges and recognises that there is a need to ensure the emission of noise from the site does not exceed a reasonable level in accordance with Section 16 of the Resource Management Act 1991.

9. Summary

The implementation of this Construction Management Plan, along with the measures outlined in the AEE submitted with the application, will ensure that any adverse effects associated with the construction stage of the project will be avoided, remedied or mitigated. Detailed mitigation measures are proposed covering the construction methodology and work programming, erosion and sediment control, traffic management and vehicle movements, public safety and amenity, noise mitigation, and a host of other more general mitigation measures.

Collectively, the implementation of these measures will ensure that construction effects will not cause any significant adverse effects on the surrounding area, and ensure a high level of amenity is maintained in the surrounding residential area.

APPENDIX 1 – Erosion and Sediment Control Plan