Duffill Watts
Consulting Group

Tomlinson and Carruthers

Stormwater Treatment and Discharge Management Options

Woodlands Road
Carterton

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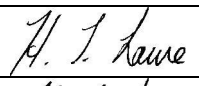
QUALITY RECORD	Name	Date	Signature
Prepared By:	Doyle Richardson	November 07	
Reviewed By:	Hamish Lowe	November 07	
Authorised By:	Hamish Lowe	November 07	
Revised By:			

Prepared by:

Duffill Watts Consulting Group
Level 3, 89-93 Rangitikei Street
PO Box 562
PALMERSTON NORTH
Phone: (06) 354 4501
Fax: (06) 354 4516
E-mail: palmerstonnorth@duffillwatts.com

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CONTENTS

1.0 INTRODUCTION

1.1 Background

Tomlinson and Carruthers (TC) are managing the development of a subdivision on Tiffin Hill, Woodlands Road near Carterton. The owners of the site are proposing to subdivide 48 ha of the property into 17 Lots with residential dwellings being built on 16 of the planned lots. The property is referred to as 'The Site' in this report.

This report is to be used in conjunction with DWG's November 2007 'Tomlinson and Carruthers - *Wastewater Treatment and Discharge Resource Desktop Evaluation and Site Inspection'* report which outlines the existing environment surrounding the property as well as providing a soil assessment.

1.2 Purpose and Scope

The purpose of this report is to provide highlight stormwater management options for the Tiffin Hill site based on information collected as part of the desktop study and site assessment of the site. It is not a stormwater design report, as this will be dependent on roading and lot design.

2.0 SITE DESCRIPTION

2.1 Location and Setting

A description of the site can be found in another supporting document for the proposed subdivision. The document is titled *"Wastewater Treatment and Discharge resource Desktop Evaluation and Site Inspection".*

There are a number of gullies that run from the site, see Appendix A, Figure 1. These gullies currently receive and are likely to be the only option for the discharge of stormwater from the site. Ground soakage is not an option. The building platforms are located on spurs adjacent to these gullies with roading likely to track the ridgelines around the property.

The increase in hardstand area adjacent to these gullies is variable. Some gullies may receive stormwater runoff from one or two dwellings, associated hardstand area and access ways, while other gullies may receive stormwater runoff from up to six dwellings, associated hardstand area and access ways.

All discharges from the development (except for stormwater from Lot 15 to the south of the site) is likely to be discharged to gullies that discharge to the north east of the site. Below these gullies is farm land which is intersected by the Kokotau Water Race. Water discharged from these gullies would flow into this water race. The stormwater water discharge from lot 15 to the south of the site is likely to be discharged into a gully which flows in a southerly direction from the site.

3.0 ISSUES REGARDING MANAGEMENT OF STORMWATER

3.1 Proposed Development

The development will consist of large rural/residential lots each greater than 2 ha in size. Access to the site is to be via an existing gravel road. It is proposed that this road will be vested with the Carterton District Council (CDC). As the lots being developed are large, the percentage change in ground cover as a result of the development will be small. Despite this it is still necessary to ensure that the increased runoff from roofed, sealed and roading areas is managed appropriately.

3.2 Increased Stormwater Runoff

The change in future land use from rural to rural residential is likely to result in an increase in stormwater runoff rate due to the fact that:

- It is likely the overall stormwater runoff coefficient over the subdivision will be increased due to housing and road developments (i.e. increased hard stand area). The sealed nature of the road and roof surfaces as well as compacted/sealed driveways/hardstands will mean quicker stormwater runoff from the rural residential development in a shorter period of time;
- Roading and other hardstand areas will result in the flows being confined to channels, increasing flow and velocity in areas which may not have historically been subject to the flows; and
- The addition of wastewater discharges within the subdivision area will add additional loading to the soil and groundwater system. This will increase soil moisture levels and potentially contribute to greater run off.

3.3 Stormwater Contamination

Some degree of stormwater contamination will be unavoidable due to the subdivision. Contaminants may come from the internal roading and vehicular traffic, roofing materials, and other domestic activities. This has to be balanced against contamination from current land use activities, including excreta from animals.

Contaminants will be primarily an additional sediment load, but may contain metals and hydrocarbons.

3.4 High Groundwater Table and Low Permeability Soils

The area has a naturally high groundwater table due to low permeability soils. This means that stormwater needs to be managed correctly on the site so as to not add to current land management constraints.

3.5 Erosion

The proposed development increases impervious surfaces in small discrete areas with roading on top of ridges and driveways and houses down spurs of this carriageway. Runoff currently flows overland on the grassed spurs then down all the gullies to a variable extent. After development, the

proposed formulisation of flow paths means that the larger volume and faster flows will be concentrated within roadside drainage and a few gullies. This has the potential to cause erosion of the soil and development of rill channels in these gullies if not managed appropriately.

3.6 Flooding

There could be an increase in peak runoff from the area of the development to the gullies as the extra impervious area inhibits infiltration to subsoil layers and buffering otherwise provided for in normal pasture settings. The major area of concern will be down stream waterways, which may see quicker and higher flow peaks.

3.7 Aquatic Ecosystems

Sedimentation of streams downstream of the site is also a possibility as a result of an increase in erosion if not managed correctly within the development.

4.0 OPTIONS FOR MITIGATION OF INCREASED STORMWATER FLOW FROM SUBDIVISION DEVELOPMENT

4.1 General

This section provides a brief outline on some of the options available to control stormwater on the Tiffin Hill site.

4.2 Stormwater Events

NIWA's High Intensity Rainfall Design System (HIRDS version 2 produces data that characterises storm events. Data for the site is presented below in Table 1. It indicates that a 1 in 50 year 20 minute storm event produces 17.3 mm of rain or 51.9 mm/hour.

Table 1: HIRDS Stormwater Intensity Data

ARI	10m	20m	30m	60m	2h	6h	12h	24h	48h	72h
2	5.7	8.2	10.2	14.7	20	32.5	44.2	60.1	76.4	88
10	8.4	11.9	14.5	20.5	27.9	45.4	61.7	83.9	105.2	120.1
20	10	13.9	16.9	23.7	32.2	52.4	71.2	96.9	120.8	137.4
30	11	15.3	18.6	25.8	35.1	57.2	77.7	105.7	131.3	149
40	11.9	16.4	19.9	27.5	37.4	60.9	82.8	112.6	139.5	158.2
50	12.6	17.3	21	28.9	39.3	64	87.1	118.4	146.4	165.8
60	13.2	18.2	21.9	30.2	41	66.8	90.8	123.5	152.4	172.4
70	13.8	18.9	22.8	31.3	42.5	69.2	94.1	128	157.7	178.2
80	14.3	19.6	23.5	32.3	43.9	71.4	97.1	132.1	162.6	183.6
100	15.2	20.8	24.9	34	46.3	75.3	102.5	139.4	171.1	192.9
125	16.2	22	26.4	35.9	48.9	79.6	108.2	147.2	180.3	203

4.3 Overall Concept

Due to the nature of the terrain and the site soils, a stormwater discharge to the numerous gullies around the site has been determined to be the only feasible option. The design could feature a large number of features to attenuate flows and retain sediment from roof, lot hardstand and roading areas.

It is possible to control stormwater peaks could be managed collectively or individually both close to the source or within the gullies. Despite this, it is recommended that given the distances between each of the lots and the base of the gullies, that most of the stormwater be managed close to the source rather than solely at the base of the gullies.

As part of the basic overall concept the following should be considered:

- All structures put in place to manage the stormwater should be designed to cope with a design storm event of at least a 10% AEP;
- Impervious areas will be typical of a low density development, involving the construction of contemporary dwellings;
- Given that roof water is likely to be the only potable water supply source, roof runoff will be captured for potable and other domestic supply;
- Any modification of the gullies will be designed so that it assumes a natural form; and
- Vegetation in gullies will be retained to reduce contaminant loadings.

4.4 Roof and Lot Hardstanding Runoff

There are a number of methods to reduce the impact of roof and hardstand areas. A basic requirement to provide for source attenuation is recommended. An example of such options are shown in an individual lot concept plan included as Figure 2. In this particular case roof runoff will be directed to an appropriately sized rainwater tank for use as a potable and general domestic supply. Once the tank is full, it is designed to overflow to a constructed on-site retention pond (which could be underlain by drainage pipe to allow complete drainage). This could be used in conjunction with small check dams which allow for flow attenuation via a choked outfall

Lot hardstand runoff should be managed in a similar fashion to the roof runoff using check dams sized accordingly for the catchment

To minimise erosion, the outfall to the gullies could be armoured with a cascade of rocks, geotextile fabrics and plants or alternatively a sock could be used to control flow. Figure 3 of Appendix A shows an armoured stormwater outfall in Christchurch. Figure 4 of Appendix A shows a sock used to control flow.

4.5 Roading Runoff

There are a number of options for the management of roading runoff. These include using kerb and channel with sumps, in addition to the check dam structures discussed above. However given the amenity values likely to be associated with the site, the stormwater from the internal roading is likely to be discharged to parallel swales/shallow drains.

In order to protect the integrity of the swales, vegetation could be planted between the swales and the road or an appropriate fencing system could be used to protect the swales. From the swales, the stormwater will either be discharged to choked check dams or directly to small ponds or wetlands type areas at the base of the gullies.

As with the roof and lot hardstand areas, the slope below the roading attenuation structures and the gullies below should be armoured with rock and durable vegetation, or some other form of erosion control structure.

Check dams should be installed at the beginning of roading construction to control silt accumulation.

4.6 Retention Dams and Additional Wetland

Storm flows reaching the gully base should be further attenuated to ensure the discharge beyond the development area does not place any additional pressure on downstream river control and roading structures. This can be achieved using larger scale check dams, retention dams or wetlands. Their sizing and design is location specific and will be somewhat dependent on the structures used up gradient and potential storm flows.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This report has provided a number of possible options for dealing with stormwater flow from the Tiffin Hill site. Options have been presented for management of roof runoff, lot hardstand runoff and roading runoff. The general concept is to provide for storm peak attenuation and retainment of contaminants, especially sediment.

In general, a stormwater system for the development could consist of:

- Roof runoff directed to an appropriately sized rainwater tank for use as a potable and general domestic supply;
- Overflow from the rainwater tank could be directed to a constructed on-site retention pond or check dam.
- Lot hardstand could be directed to the same system as the rainwater tank overflow, or to a separate on-site retention pond or a choked check dam with overflow from the roof runoff.
- Roading runoff is likely to be discharged to parallel swales/drains for discharge through culverts to choked check dams and the base of the gullies.
- The slope below the on-site check dams and attenuation ponds should be armoured with either rock, durable vegetation and/or geotextile fabrics.
- A collective attenuation of peak flows and water quality improvement could be provided by the establishment of retention dams or improvement of the current wet areas within the gullies.

APPENDIX A

Figures

FIGURE 1: SITE LOCATION

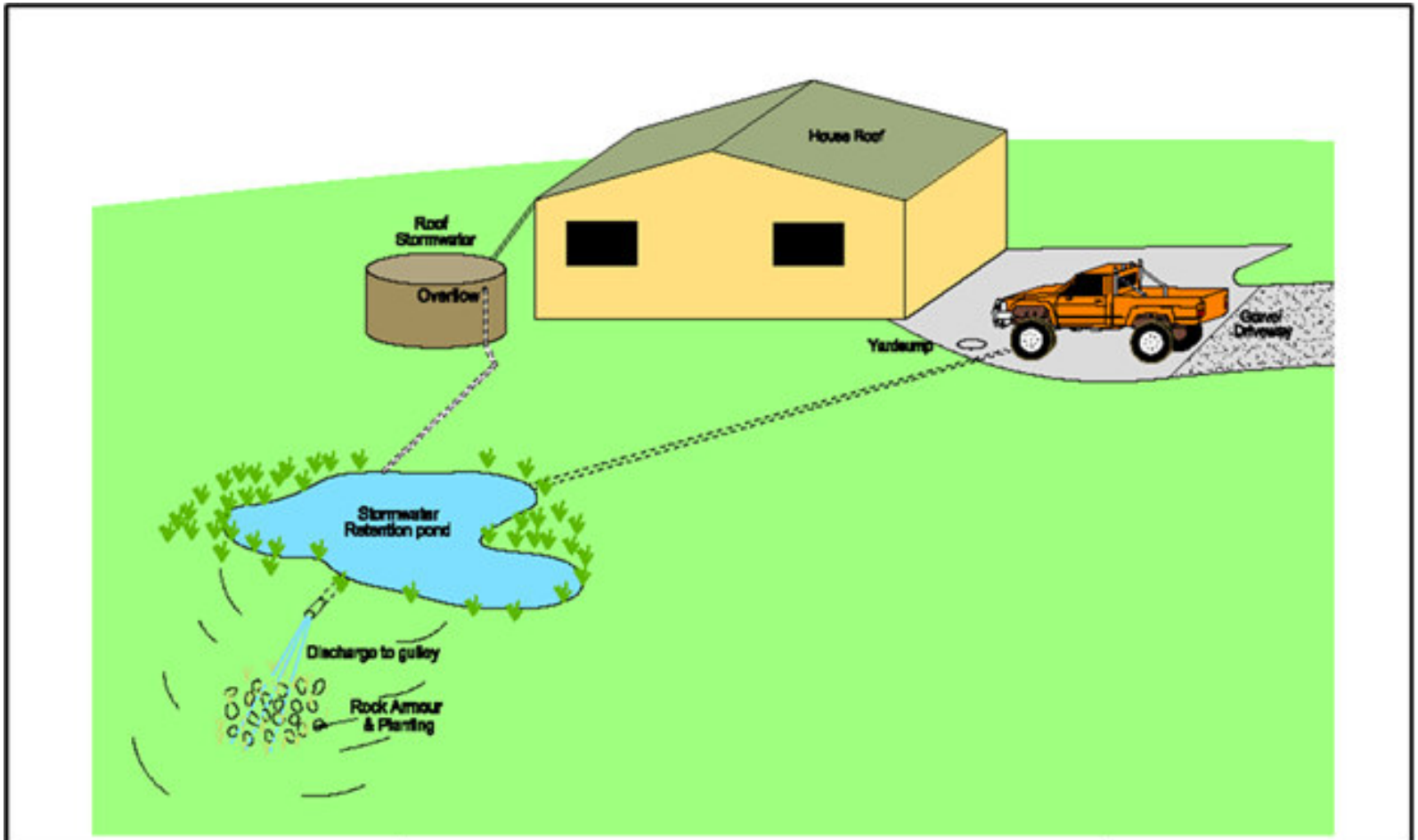

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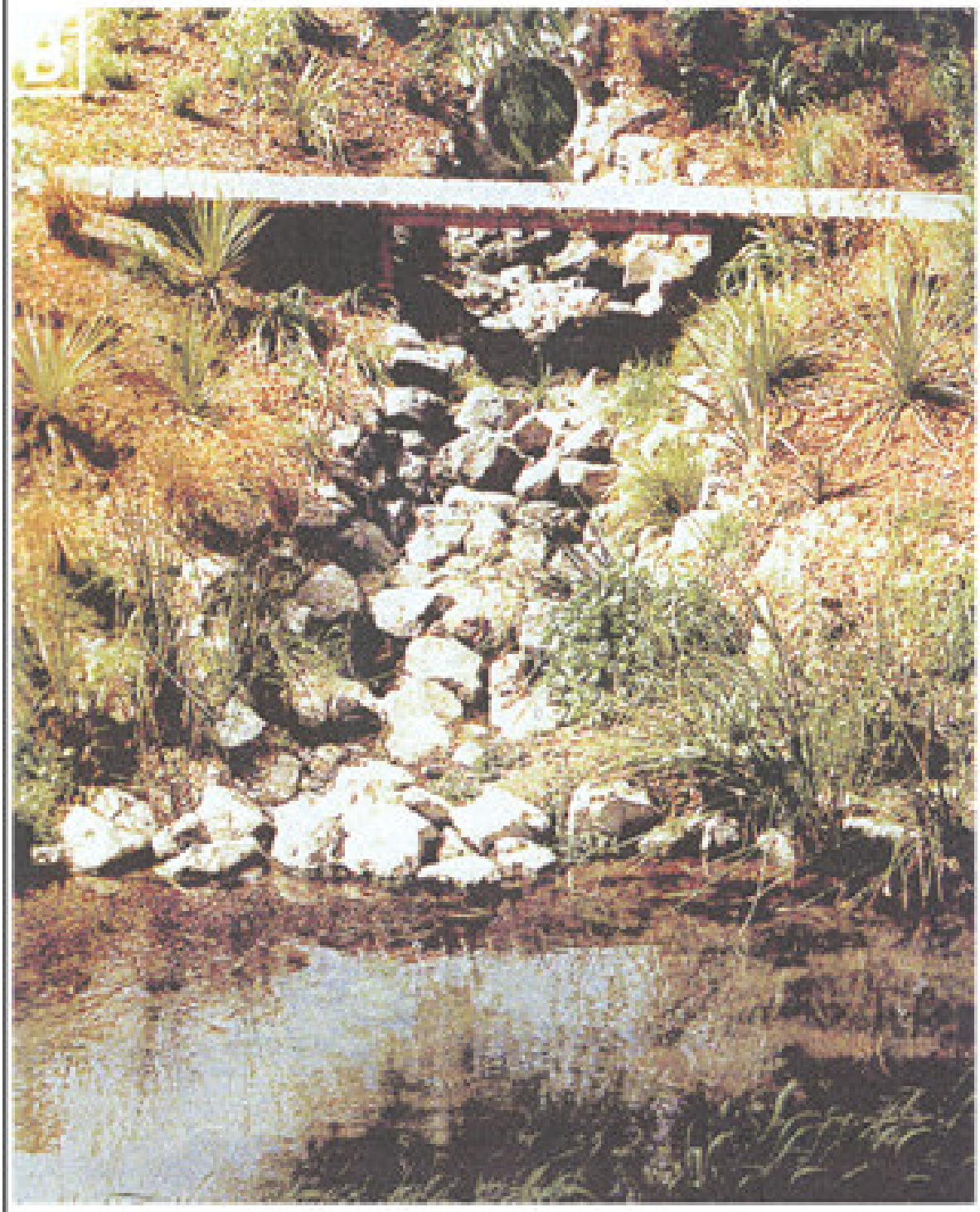
Figure 2: Individual Lot Concept Plan

Duffill Watts Consulting Group

85-93 Rangitikei St, PO Box 562, Palmerston North, New Zealand
Ph (06) 354-4501 Fax (06)354-4516
Email palmerstnorth@duffillwatts.com



Date: 16/11/2007	Figure 3: Armoured Stormwater Outfall	Duffill Watts Consulting Group
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Figure 4: A sock to control flow

Duffill Watts
Consulting Group

Ph (06) 354-4501 Fax (06)356-4518

www.duffillwatts.com