Categorisation of Open Stormwater Drains in Waihi Beach, Te Puke, and Maketu

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Date: 8 February 2008
Reference: g:\5project\9z178.01_drains_phase_2\final document\main document.doc
Status: FINAL

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1 Scope

Many communities in New Zealand rely on Open Stormwater Drains as part of their stormwater systems. These open drains were usually the original drainage system for these communities. As development increased and the load on these Drains increased proportionately, safety and aesthetic concerns surfaced. Councils come under pressure from communities to address the situation.

An Offer of Service was prepared and submitted to Duffill Watts & King Ltd on 26 January 2007. The Offer of Service was accepted on 14 February 2007 whereby Opus was commissioned to devise a model to categorise Open Stormwater Drains (also referred to as Drains) using the Drains at Waihi Beach to test the model.

The Pilot Study in Waihi Beach was completed in March 2007.

A further Offer of Service was accepted on 5 November 2007 whereby the study done for Waihi Beach was extended to include Te Puke and Maketu. The results of both investigations are contained in a single Report.

2 Objectives

The objectives of the Waihi Beach study were to:

- devise a model whereby Drains can be categorized according to a set of parameters which will include, inter alia, location relative to other assets, drain geometry, inlet/outlet protection, health, environmental and aesthetic factors, to give the Drains an overall asset rating;
- Test the categorisation model on Drains at Waihi Beach to prove the system.

3 Review of Legislation and Literature

The Offer of Service proposed to investigate any legislature that relate directly or indirectly to Drains.

The Legislature that was researched is as follows:

- Resource Management Act 1991
- Local Government Acts 1974 and 2002
- Public Works Act 1981

The only legislation that had a bearing on the subject that is being researched is the Resource management Act which is discussed further.

3.1 Resource Management Act 1991

3.1.1 Background

The Resource Management Act does not prescribe to Local Authorities as to how to deal with Open Stormwater Drains. The Open Stormwater Drains however form part of the bigger picture and the intent is certainly there to ensure that the Local Councils manage the urban environment of which the Open Storm Water Drains form an integral part.

3.1.2 Legislative History

3.1.2.1 Introduction

In 1997 the Parliamentary Commissioner for the Environment identified the management of the urban environment as a key area for investigation in his 'Five Year Strategic Plan'.

During the same year, the Parliamentary Commissioner for the Environment recommended to the Minister for the Environment, that his Ministry should:

"Develop environmental indicators for amenity values to assist local authorities and

Communities to monitor and report on the state of amenity values [and]

Invest in, and encourage research into, urban design that will be appropriate to New Zealand to provide information to local authorities to assist them in promoting the sustain able management of urban environments and the management of amenity values."

3.1.2.2 Definitions

The terms, Amenity Values and Urban Amenities are phrases that will be used throughout this Report and it would be appropriate to define these phrases.

Urban Amenities is defined as the liveability of urban environments.

Urban environments consist of tangible facilities such as parks/open spaces, bike paths and swimming pools. Open Storm Water Drains are located in Public Spaces and therefore form part of Urban Amenities such as parks. Most Open Storm Water Drains are located in Road Reserves which are also Public Spaces.

Amenity Values are less tangible matters and are defined in the Resource Management Act (RMA) as those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

3.1.2.3 Technical Paper 54 – June 1999

In June 1999 the Ministry for the Environment published Technical Paper 54 which proposed an approach to develop indicators for urban amenity (MfE, 1999, Technical paper 54). The purpose of this report was to produce a proposal for discussion by stakeholders on an approach to developing urban amenity indicators.

The discussion document suggests a policy goal that includes the definition of amenity values in the RMA. The proposed policy goal is:

"To manage our urban environments in such a way as to maintain or enhance those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes".

Open Storm Water Drains will form part of the aesthetic coherence of the Urban Environment and would be a tangible factor that can be measured.

3.1.2.4 Technical Paper 63 – Urban Amenity, 2000

The Technical Paper 54 published in 1999 was followed by a further Technical Paper 63 a year later.

The purpose of that Report was to:

"suggest an approach to developing urban amenity indicators to the Ministry for the Environment and other practitioners in central and local government, which might be used nationally to:

- *measure the impact of urban systems on the environment; and also*
- *assess the amenity in urban and peri-urban environment's in New Zealand – or measures of how liveable urban environment's are for the people who live, work and play in them; and to*
- *highlight some possible indicators of urban amenity for use throughout New Zealand. It may then be possible to apply such indicators at a variety of scales, for example at regional or local levels."*

This Paper acknowledges the fact that there is no formal national policy for managing urban amenity in New Zealand. The Report however does refer to the Environment 2010 Strategy which has as a key vision:

"A clean, healthy, and unique environment, sustaining nature and people's needs and aspirations".

The Consultant Team that produced the Technical Paper were further tasked to develop a small set of environmental performance indicators that may be used to monitor urban amenity.

3.1.2.5 Conclusion

The New Zealand way has always been to protect the natural beauty of the country. The rural areas were the focus point initially but there is a growing appreciation for the rate of urban expansion.

The rate of urban expansion since 1969 has been averaging 4% which means that the urban areas have more than quadrupled in size since then. The Urban Areas now cover more than 4% of the total land area. (This Report has taken the liberty of extrapolating

information that was contained in a document of The State of New Zealand's Environment, Ministry for the Environment, 1997).

The focus has therefore shifted towards the protection of the Urban Environment.

The process has been set in motion with the publication of the Technical Papers mentioned above whereby Local Councils will be measured on a set of environmental performance indicators at some time in the future.

3.2 Subdivision and Code of Practice: Western Bay of Plenty District Council

The Code of Practice that is referred to above makes reference to natural open drain systems in Section 3 under paragraph 3.2.6.

The Code of Practice states the following:

- That the maximum batters for such drains should not exceed 20% (1:5).
- That the drains be cleared of all unsuitable plant growth and be replanted to an appropriately approved landscape design.
- The stream bed of these drains must also be protected against scour and erosion.

4 Categorisation Model for Open Stormwater Drains

The Drain Index is an assessment that makes use of six parameters. These parameters are weighted relative to each other which is done in a subjective manner based on professional judgement.

4.1 Parameter Selection

4.1.1 Discussion

A number of parameters are identified that are used to quantify the risk that is associated with an Open Stormwater Drain. These parameters are discussed below. Each parameter is assigned a value between one and ten based on visual field observation. In addition each parameter is assigned a weighting which is a value between zero and one. The equation used to determine the resultant Drain Index is as follows:

Σ {value of parameter (n) x weighting of parameter (n)} = Drain Index

The Drain Index is a value between zero and ten which provides the risk associated with an Open Stormwater Drain.

The weighting of the various Parameters is shown in Table 1.

Table 1 – Parameter Weighting for Drain Index	
Parameter	**Weighting**
Geometrical Factors	0.35
Inlet/Outlet Protection	0.15
Position relative to sensitive facilities	0.15
Aesthetic Considerations	0.15
Health Considerations	0.1
Environmental Considerations	0.1
Sum of weightings	1.0

4.1.2 Geometrical Considerations (Weight = 35%)

Open Stormwater Drains deeper than one meter, with batter slopes greater than 1:1 and closer than 2 meters from the tar surface are seen to constitute risk. Children could fall into these drains and would not be able to exit the drain if the batter slope is to steep.

The above three geometrical factors are assigned secondary weights which is used to calculate a resultant risk value for the geometrical parameter.

The values assigned to the three factors that determine the Geometrical Parameter is shown in Tables 2, 3 and 4.

Table 2 - Depth	
Field Observation	**Assigned Value**
0 – 0.5 m	0
0.5 – 1 m	5
1 – 2 m	9
> 2 m	10

Table 3- Batter Slope	
Field Observation	**Assigned Value**
< 2:1	0
2:1 – 1:1	5
> 1:1	10

Table 4 – Distance Road Surface to Drain	
Field Observation	**Assigned Value**
> 4 m	0
2 – 4 m	5
< 2 m	10

The Geometrical Parameter Value is determined by three factors which is depth, batter slope and the distance between road and drain. Each of these factors is assigned a secondary weight which is used to determine a resultant parameter value. The secondary weightings are shown in Table 5:

Table 5 – Geometrical Sub-Parameters	
Geometrical Sub-Parameter	**Assigned Value**
Depth	0.45
Batter Slope	0.45
Distance from road to drain	0.1

4.1.3 Inlet/Outlet Protection (Weight = 15%)

A subjective ruling is done that inlet/outlet protection will only be done on diameters > 300mm.

An unprotected inlet or outlet can be accessed by children. The issue of safety rails are seen as part and parcel with the safety of inlets and outlets.

The values assigned to the Inlet/Outlet Protection parameter is shown in Table 6.

Table 6 – Values assigned to the Inlet/Outlet Protection Parameter	
Field Observation	**Assigned Value**
Not applicable/< 300 mm in diameter	0
Inlet/Outlet protection sufficient	0
Inlet/Outlet protection fair	2.5
Inlet/Outlet protection poor	5
Inlet/Outlet does not have safety rails	5
Inlet/Outlet not protected /has safety rails	7.5
Inlet/Outlet not protected/no safety rails	10

4.1.4 Position Relative to Sensitive Facilities (Weight = 15%)

Sensitive facilities are classified as schools, playgrounds, old age homes and medical centres. It is considered a high risk an Open Stormwater Drain is adjacent to one of these facilities.

The values assigned to the position of the Drains relative to sensitive facilities are shown in Table 7.

Table 7 – Position relative to sensitive facilities	
Field Observation	**Assigned Value**
Removed from sensitive facilities	0
Fairly close to sensitive facilities	5
Adjacent to sensitive facilities	10

4.1.5 Health Considerations (Weight = 10%)

There are two health issues identified which is if there is a chance of mosquito breeding and/or water pollution. These are not weighted relative to each other and a value of ten will be assigned to this parameter if any one of these conditions occurs.

The values assigned to the Health Parameter are shown in Table 8.

Table 8 - Health Parameter	
No Health issues	0
Standing water/Mosquito breeding	10
Chances of water pollution	10

4.1.6 Environmental Considerations (Weight = 10%)

The Subdivision and Development Code of Practise that is applicable to the Western Bay of Plenty District Area makes specific mention that the stream beds of Drains must be protected against scouring and erosion.

The onus is therefore on the custodians of these Drains or their designated Agents to ensure that the Code of Practise is enforced.

The values assigned to the Environmental Parameter are shown in Table 9.

Table 9 - Environmental Parameter	
No Environmental issues	0
Mild erosion	5
Severe erosion	10

4.1.7 Aesthetic Considerations (Weight = 10%)

Open Stormwater Drains have an impact on the aesthetic value of the environment as a whole. This parameter does not constitute a direct risk to the community but will be gaining prominence if a National Urban Amenity Policy is implemented. A few Technical Papers have already been published that indicates the intent to pass Legislature in this regard.

The values assigned to the Aesthetic Parameter are shown in Table 10.

Table 10 - Aesthetic Parameter	
Aesthetically pleasing	0
Aesthetically fair	5
Aesthetically poor	10

Examples against which to test this parameter are as follows:

Aesthetically pleasing

Aesthetically fair

Aesthetically poor

4.1.8 Other Parameters

4.1.8.1 Importance of a Drain

This is a parameter that will measure the importance of a Drain to the Politicians or Councillors. It is considered that the Parameter that defines a Drain relative to sensitive facilities should cover those aspects.

4.1.8.2 Accessibility of a Drain

If a Drain is situated close to development but isn't easily accessible such as in a marshy area which isn't developable, then the Drain Index should reflect that fact. This parameter may well be of use and is used in the Safety Risk Index. If this should become a parameter in the calculation of the Drain Index, there might be a possibility to use a single Index.

4.2 Indices

4.2.1 Drain Index

An Excel Spreadsheet has been set up that automatically calculates the Drain Index based on the values that were inputted into the Spreadsheet for each parameter. The values for the parameters vary between zero and ten. The ratings for each parameter have been chosen in such a way that a risk is identified if the Drain Index is equal to 5 or above. The Drain Index value is shown on the bottom right hand corner of the various pages that is contained in Appendix 1.

The Drain Index values are shown in Appendix 3 in descending order with regards to the value of the Drain Index. It can be seen that the Drains are evenly divided below and above the median value of five.

The Excel Spreadsheet is on the CD that forms part of this Report and the various Spreadsheets are contained in a single Worksheet.

Appendix 3 consists of a table where the Drains are sorted based on the Drain Index value.

4.2.2 Safety Risk Index

The parameters used for the Drain Index can also be used to calculate a Safety Index for each Drain. The aesthetic and environmental parameters can be substituted with two different parameters that measure the accessibility of the Drain by the public and the risk of flooding.

The Drain and Safety Indexes will therefore not be far removed from each other in value. If the Drain and Safety Risk Index information contained in Appendix 3A are compared to each other, it can be seen that all the Drains in the top section of the Drain Index is also contained in the top section of the Safety Risk Index with the exception of Drain 7 which is in the top section of the Drain Index column but not so in the safety Risk Index column and visa versa for Drain 17.

A storm-water drain is the recipient of water that is generated from a rain storm. This is an obvious observation but it also implies that risk is created during the rain storm itself and that the sheer mass of water that runs down a Drain creates a safety risk. The risk is therefore increased if new development is approved upstream of a Drain. This is definitely the case with Drain 7. New developments have already been established on the site upstream of this Drain. The parameters and their weightings are shown in table 11.

Table 11 – Parameter Weighting for Safety Index

Parameter	Weighting
Geometrical Factors	0.35
Inlet/Outlet Protection	0.15
Position relative to sensitive facilities	0.15
Accessibility	0.15
Health Considerations	0.1
Flooding risk	0.1
Sum of weightings	**1.0**

4.3 Remedial Measures for Open Drains

4.3.1 Introduction

The remedial actions listed below are as per the work already done by my colleagues in the Orewa office.

4.3.2 Providing Piped Drains

Some of the Drains are more than a metre deep and the consequence of falling into it could be serious. The easily accessible open drains in this category need an adequate protection. Replacing these with piped drains is an efficient way of eliminating unacceptable or undesirable hazards.

4.3.3 Reducing Drain Batter Slopes

Vertical sided Drains are difficult to climb out of the drain. A cost-effective measure to minimise this hazard is to cut back the sides, reducing the batter slopes where space is available. It does however have the disadvantage that the usable area in the vicinity of the Drain is reduced.

4.3.4 Close Boarded Fence

There are stone and mortar lined, high flow Drains running within developments. In the absence of adequate protection children are likely to use these as playing areas.

Close boarded fencing is the standard recommended protection in these circumstances.

Where Drains are placed in easements the fencing at the boundary of the easement is normally provided by the adjacent owners.

4.3.5 Grating for Inlet of Pipes

A considerable number of Drains either start or end with a pipe without any protection. There is a risk of children getting trapped into the pipe or falling into the manhole. Providing gratings for pipe inlets/outlets would minimise the potential hazard. However, special consideration would be required to minimise debris collection and not to create excessive maintenance.

Occasionally, culvert inlets and outlets are not far from the road edge and thus become a hazard. This circumstance requires a guardrail or handrail for protection of pedestrians and/or vehicles.

The use of gratings for inlet and outlet protection involves a trade-off situation where the safety of the Drain is increased but the functionality of the Drain is decreased due to the grating becoming blocked with debris.

There is merit in providing protection to the inlet of a storm-water pipe because it would keep driftwood and similar larger size objects from accumulating inside the pipes and will assist in keeping the full bore of the pipe available to handle stormwater. This will however not apply to pipes that are only used to cross a road. Protecting the outlet of a pipe however creates other problems. The protection mechanism will have to be removable to enable maintenance to be done.

It is suggested that only inlet protection be provided to storm-water pipes that are longer in length than just a road crossing. It could be considered to place warning signs at unprotected outlets. Guardrails or handrails will be required in most cases where an outlet is not protected.

4.3.6 Warning Sign Posts

Awareness is one of the efficient and cost-effective means of identifying hazards. Drains in public places such as reserves, and car parks, should have adequate warning signs to inform the public about the potential hazards.

4.4 Easements

4.4.1 Discussion

The standard procedure for a Council is to protect its services with an Easement. This allows the Local Authority to perform any maintenance work that may be required.

Whether a Drain is piped or open, it remains a Council service that has to be maintained by the Local Authority. The situation in smaller Councils is that a Drain evolved from an insignificant structure into a Drain that gained prominence due to development that occurred in its catchment area. Where Easements weren't part of the equation to start with it may become an issue at a later stage.

4.4.2 Conclusion

The registration of Easements should be done where new developments take place. The Status Quo however may be maintained where the situation exists where development took place without the registration of the appropriate Easements due to the following reasons:

- Owners of properties may have taken ownership of a Drain/Stream and won't relinquish that "right" that was in place for a number of years.
- The safety of properties may be compromised.
- The costs may be a factor for smaller Councils which will include the acquisition of the Easements and additional maintenance costs.

5 Pilot Study

5.1 GIS Presentation

All the Open Stormwater Drains are shown spatially on Drawing Number 1 which forms part of this document. Drains that exceed a Drain Index value of five are shown in red. The position of the Drains resembles the actual position on the ground.

The direction in which the photos, which is shown in Appendix 1, were taken is shown on the drawing with an arrow and a photo number.

5.2 Field Survey

5.2.1 Existing Data

Drawings were received from Duffill Watts & King Ltd that showed surveys of the Open Stormwater Drains which were done a couple of years ago. These drawings were used as a basis and updated with the results from the field study.

5.2.2 Discussion of Drains and Remedial Action Required

Appendices 1A, 1B and 1C consist of a page for each drain which has the following information:

- One or more photos of the drains in question.
- Three columns in which the parameter is listed with the field observation regarding the parameter and the rating of the parameter based on the field observation.

Appendices 2A, 2B and 2C consist of a table where the condition of the various Drains is discussed and remedial action that might be required is shown in a separate column.

Appendices 3A, 3B, and 3C consist of two tables sorting the drains from highest to lowest by their safety and drain indices.

5.3 Maintenance Requirements

Appendices 4A, 4B and 4C consist of tables that provide information on the maintenance that is required for the Drains.

The total length of Drains in Waihi Beach, for example, that are situated within developments amount to 5,345 metres of which 2,070 metres required maintenance of some sort. The type of maintenance is described in the table and can be used to initiate a Maintenance Programme to be done at regular intervals.

5.4 Capital Expenditure Requirements

Appendices 5A, 5B and 5C consist of tables that set out the Capital Expenditure that is required on the short to medium term. The main objective for this expenditure is to address the safety requirements surrounding the Drains.

5.5 Easements

5.5.1 Waihi Beach

As mentioned in the Report whether a Drain is piped or open, it remains a legal service that has to be maintained by the Local Authority. The initial development that took place at Waihi Beach was very low key and consisted of low density beach houses. The planning during this period did not include the registration of Easements. Waihi Beach has however gained prominence during the past decade or two and various new developments have been established. Some Easements were registered such as the Easement that Drains 17, 18 and 19 are situated in. This specific Easement also doubles as Open Public Space.

In Waihi Beach a Drain where the lack of Easements may create problems is Drain 8 which is situated amongst sections for most of its length and which is not protected with Easements. Drain 8 can be classified as a Waterway and will be referred as such. The legally correct way to address the situation is to register Easements at this point in time. After careful investigation on site the case for keeping the Status Quo is preferred due to the following reasons:

- The owners of the various sections which abut against this Waterway has adjusted their gardens to the Waterway as can be seen on the photos in Appendix 6 and will not look kindly upon the creation of an Easement in their back yard.
- The creation of an Easement will also create a walkway between the properties and the Waterway which will intrude on the privacy and security of the sections involved. A number of these owners do not reside in their properties on a permanent basis and the security of these properties will be compromised.
- The Waterway meanders behind the main business centre which is situated in Wilson Street. The creation of Easements will compromise the security of these businesses.
- The various houses are situated at a reasonable distance from the Waterway and there is no real threat of flooding to the houses along the Waterway with the exception of one property as shown in Appendix 7.
- The registration of Easements will have a financial implication and will also incur maintenance costs.

It was observed that some of the fences along the Easement were collapsing due to the Drains being to close to fence. If it is assumed that these fences are in the correct position, then the possibility that Council could be held liable for damage in such a case must be borne in mind.

5.5.2 Maketu

In Maketu, the following potential issues were observed:

- The fence on the property boundary on the corner of Maketu Road and Spencer Ave is falling over toward the open Drain 2. The fence has the potential to fall into the drain.
- Access to Drain 1b for maintenance is limited. According to Western Bay of Plenty District Council's property information, there looks to be an easement set aside for a road adjacent to the Drain for maintenance reasons. However, the easement is part of the Drain and not accessible. Access to the Drain from the south would be on private property. The Drain doesn't currently need any maintenance but the permission of the property owner(s) may be needed in order to complete any future maintenance.
- There is no legal access to most of Drain 1c between Wilson Rd North and Church Rd. There are property fences along the Drain's bank preventing any equipment from trimming any overgrowth in the Drain.

6 References

1. Ted B. Prawdzik, "Environmental and Technical Factors for Open Drainage Channels in Urban Areas."

2. Murray Triggs and Sulojana Shanmuganathan, "Risk Analysis and Management of Infrastructure."

APPENDIX 1A

WAIHI BEACH

Drain Index

Drain 1 – The Esplanade
Drain 2 – The Esplanade
Drain 3 – West Street
Drain 4 – Camping Site –both sides of Beach Road
Drain 5 – Ocean View Road/The Esplanade
Drain 6 – Perpendicular to Beach Road
Drain 7 – Beach Road/Leo Street
Drain 8 – Between Edinburgh Street and Wilson Road
Drain 9 – Lower End of Edinburgh Street
Drain 11 – Hillview Road
Drain 13 – Adjacent to Waihi Beach Road
Drain 14 – Perpendicular to Wilson Road
Drain 15 – Snell Crescent
Drain 16 – Snell Crescent
Drain 17 – Between Otto Road and Patterson Place
Drain 18 – Between Snell Crescent and Hereford Place
Drain 19 – Seaforth Road
Drain 20 – Perpendicular to Seaforth Road
Drain 21 – Perpendicular to Waihi Beach Road
Drain 22 – Adjacent to Wilson Road
Drain 23 – Adjacent to Citrus Avenue

Drain 1-The Esplanade

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	< 0.5 m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	>4 m	0
INLET/OUTLET PROTECTION	Not Applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Next to main beach	10
AESTHETIC CONSIDERATIONS	None	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	10
SAFETY INDEX	The drain is well demarcated and doesn't constitute a safety risk	3.00
DRAIN INDEX		1.50

Drain 2-The Esplanade

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	> 1 m	10
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road.	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Adjacent to development and beach	10
AESTHETIC CONSIDERATIONS	Excessive growth.	10
HEALTH CONSIDERATIONS	None.	10
ENVIRONMENTAL CONSIDERATIONS	None.	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	10
SAFETY INDEX	The drain is adjacent to a play park and should be better protected	7.15
DRAIN INDEX		7.15

Drain 3-West Street

Photograph - February 2007

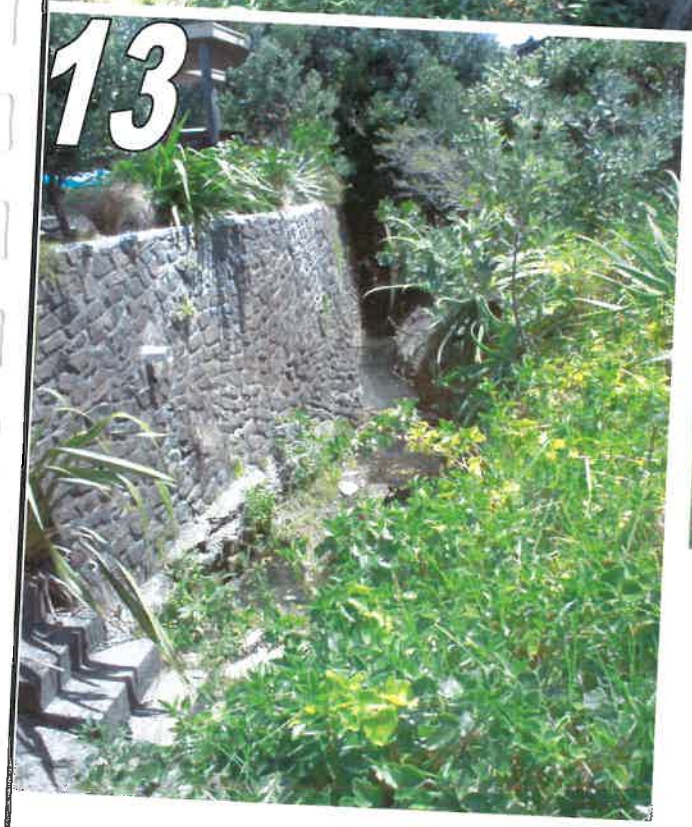
PARAMETER	OBSERVATION	RATING
DEPTH	0.5-1 m	5
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	10
INLET/OUTLET PROTECTION	Intlet not protected but not required as per Report	0
PROXIMITY TO SENSITIVE FACILITIES	Removed form sensitive facilities	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Easily accessable	10
SAFETY INDEX	The drain is at the toe of an escarpment and adjacent to a gravel road. There are no real safety	3.43
DRAIN INDEX		2.68

Drain 4-Camping Site-both sides of Beach Rd

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	> 1 m.	10
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	Drain is perpendicular to road.	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Adjacent to development and beach	10
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	10
SAFETY INDEX	Three chidren were slightly injured after falling into the open drain during the past holidays.	6.65
DRAIN INDEX		5.40

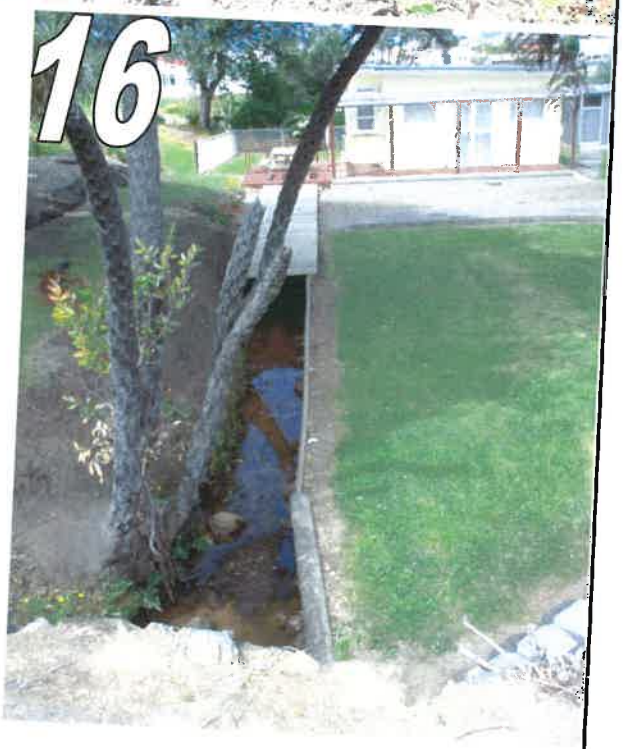
Drain 5-Ocean View Rd/The Esplanade



Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	2.2 m along sections	10
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Inlet not protected but has safety rails.	0
PROXIMITY TO SENSITIVE FACILITIES	Adjacent to development and beach	10
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	10
PROXIMITY TO DEVELOPMENT	Adjacent to development	5
SAFETY INDEX	The drain isn't easily accessable and is mostly on private land	6.90
DRAIN INDEX		7.40

Drain 6-Perpendicular to Beach Rd



Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.8 m	5
BATTER SLOPE	One side strutted with corrugated iron	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	safety rail required at outlet to road crossing	5
PROXIMITY TO SENSITIVE FACILITIES	Next to open park	5
AESTHETIC CONSIDERATIONS	Excessive growth along top section	10
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	10
SAFETY INDEX	The corrugated iron battering is a safety concern.	6.86
DRAIN INDEX	The lower section of this drain could be piped	6.36

Drain 7-Beach Rd/Leo St

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1-2 m	9
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	Drain is perpendicular to road	0
INLET/OUTLET PROTECTION	Two inlets are protected	2.5
PROXIMITY TO SENSITIVE FACILITIES	No	0
AESTHETIC CONSIDERATIONS	Slight to excessive growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Fair distance from development	5
SAFETY INDEX	The drain is not easily accessable and doesn't constitute a high safety risk	6.12
DRAIN INDEX		5.12

Drain 8-Between Edinburgh St & Wilson Rd

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	> 2m	10
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Traverses beach	10
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to development and beach	10
SAFETY INDEX	The drain traverses private properties where no easements exist	7.65
DRAIN INDEX		6.40

Drain 9-Lower end of Edinburgh St

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5-1 m	5
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Not close	0
AESTHETIC CONSIDERATIONS	Normal growth	0
HEALTH CONSIDERATIONS	None	5
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Removed from development	0
SAFETY INDEX	The drain is in a marshy area which is not easily accessable. No substantive safety issues	5
DRAIN INDEX		2.33
		2.33

Drain 11-Hillview Road

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1,2 - 1,5 m	9
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Intlet not protected but not required as per Report	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Removed from development	5
SAFETY INDEX	The drain is in a marshy area which is not easily accessable. No substantive safety issues	2.96
DRAIN INDEX		2.96

Drain 13-Adjacent to Waihi Beach Road

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	2.5 m along sections	10
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road	0
INLET/OUTLET PROTECTION	Inlets and outlets are part of road crossings.	5
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Removed from development	0
SAFETY INDEX	This drain is in open veld and would be very difficult to secure even if it was required which it is not	5.40
DRAIN INDEX		5.65

Drain 14-Perpendicular to Wilson Road

30

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1 -2 m	9
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	< 2 m	10
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Next to horse paddocks	10
AESTHETIC CONSIDERATIONS	Fair	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	New development on upstream side	0
SAFETY INDEX	The drain is protected on both sides with wooden fences	7.09
DRAIN INDEX		6.59

Drain 15-Snell Crescent

Photograph - February 2007

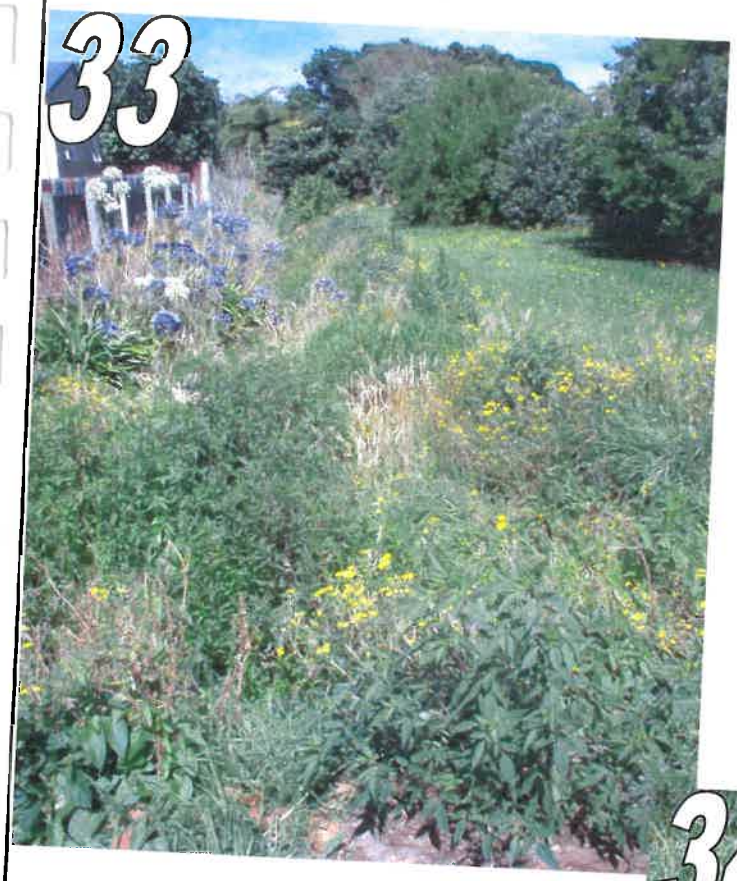
PARAMETER	OBSERVATION	RATING
DEPTH	< 0,5 m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Inlet/outlet are < 300 mm	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Neat concrete channel	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within developed area	0
SAFETY INDEX	This is an unobstrusive small drain with no safety concerns	10
DRAIN INDEX		1.50
		0.00

Drain 16-Snell Crescent

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	< 0,5 m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Inlet/outlet are < 300 mm	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Neat concrete channel	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within developed area	0
SAFETY INDEX		10
	This is an unobstrusive small drain with no safety concerns	1.50
DRAIN INDEX		0.00

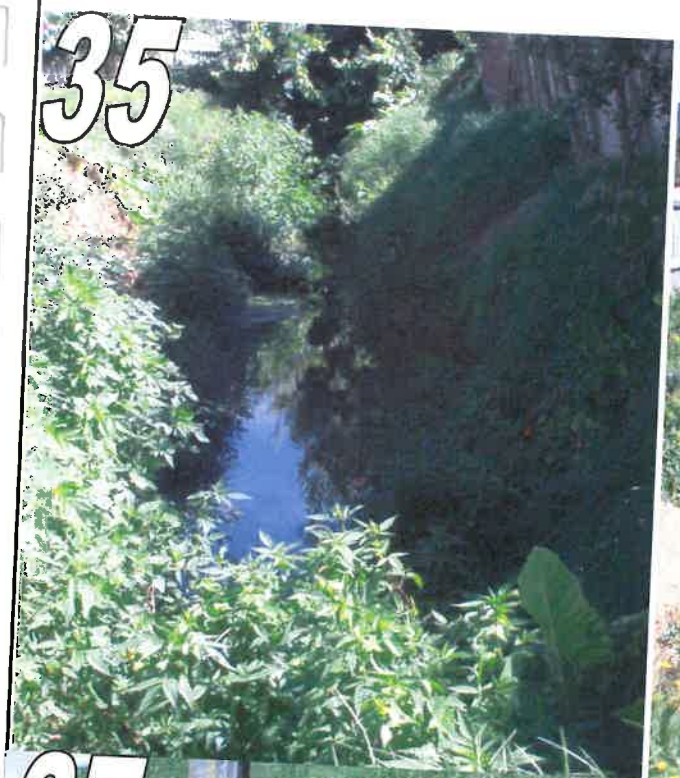
Drain 17-Between Otto Rd & Patterson Place

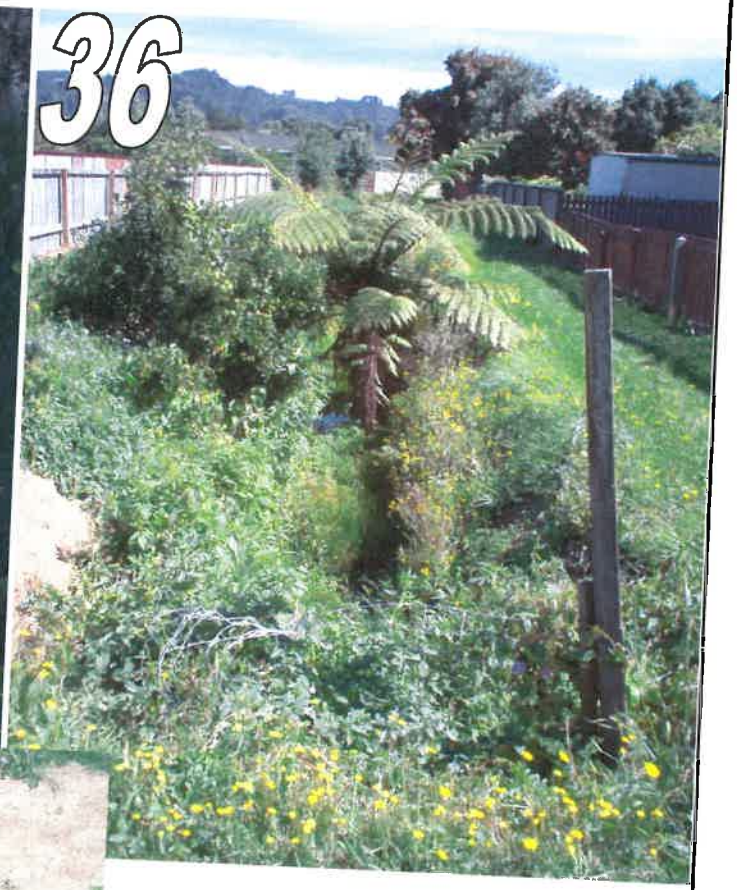


Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	> 2 m	10
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Intlet not protected but not required as per Report	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Excessive growth	10
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within development	10
SAFETY INDEX	Drain is situated within easement. Access to the easement could be restricted	4.65
DRAIN INDEX		4.65

Drain 18-Between Snell Cres & Hereford Place

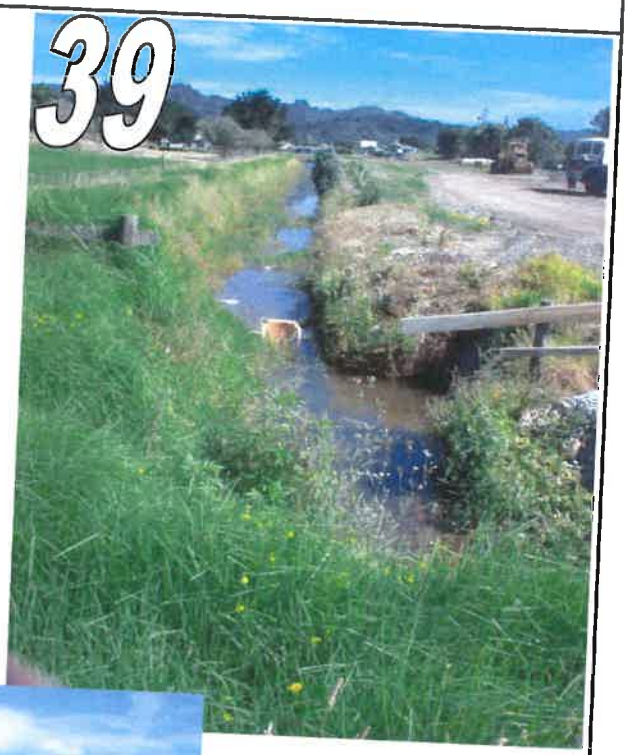




Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	2,5 m along sections	10
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Outlet not protected	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Excessive growth	10
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within development	10
SAFETY INDEX	Drain is situated within easement. Access to the easement could be restricted	6.15
DRAIN INDEX		6.15

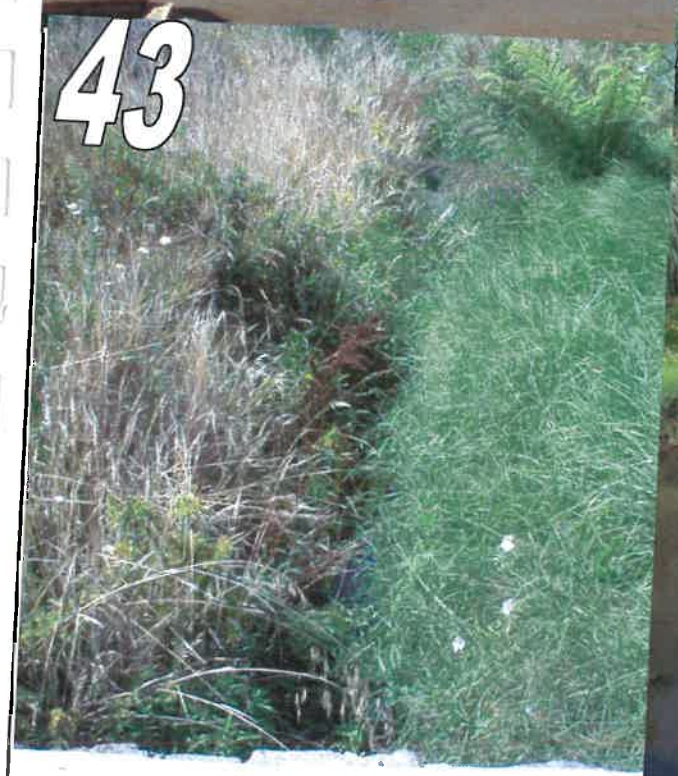
Drain 19-Seaforth Road



Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1 - 2 m	9
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	5
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal to slightly more than normal growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to new development	10
SAFETY INDEX	The batter slope of the drain varies which reduces the safety risk	6.74
DRAIN INDEX		5.49

Drain 20 - Perpendicular to Seaforth Road

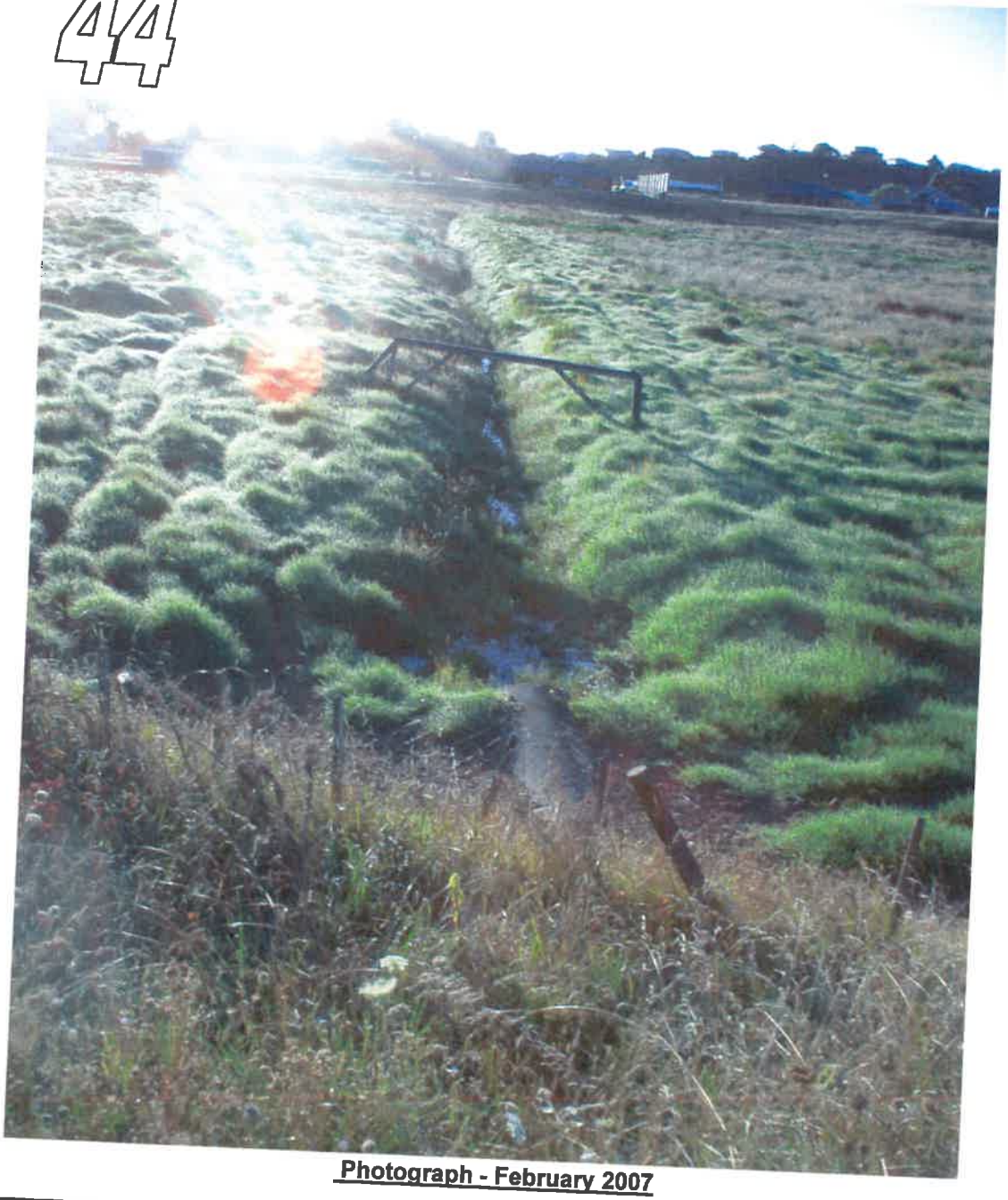


Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	>2 m	10
BATTER SLOPE	Vertical along sections	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Crosses the beach	10
AESTHETIC CONSIDERATIONS	Standing water	5
HEALTH CONSIDERATIONS	Excessive growth along sections	10
ENVIRONMENTAL CONSIDERATIONS	No erosion	0
PROXIMITY TO DEVELOPMENT	Within development	10
SAFETY INDEX	The drain is slightly removed form development and not easily accessable	7.65
DRAIN INDEX		6.40

Drain 21-Perpendicular to Waihi Beach Rd

44



Photograph - February 2007

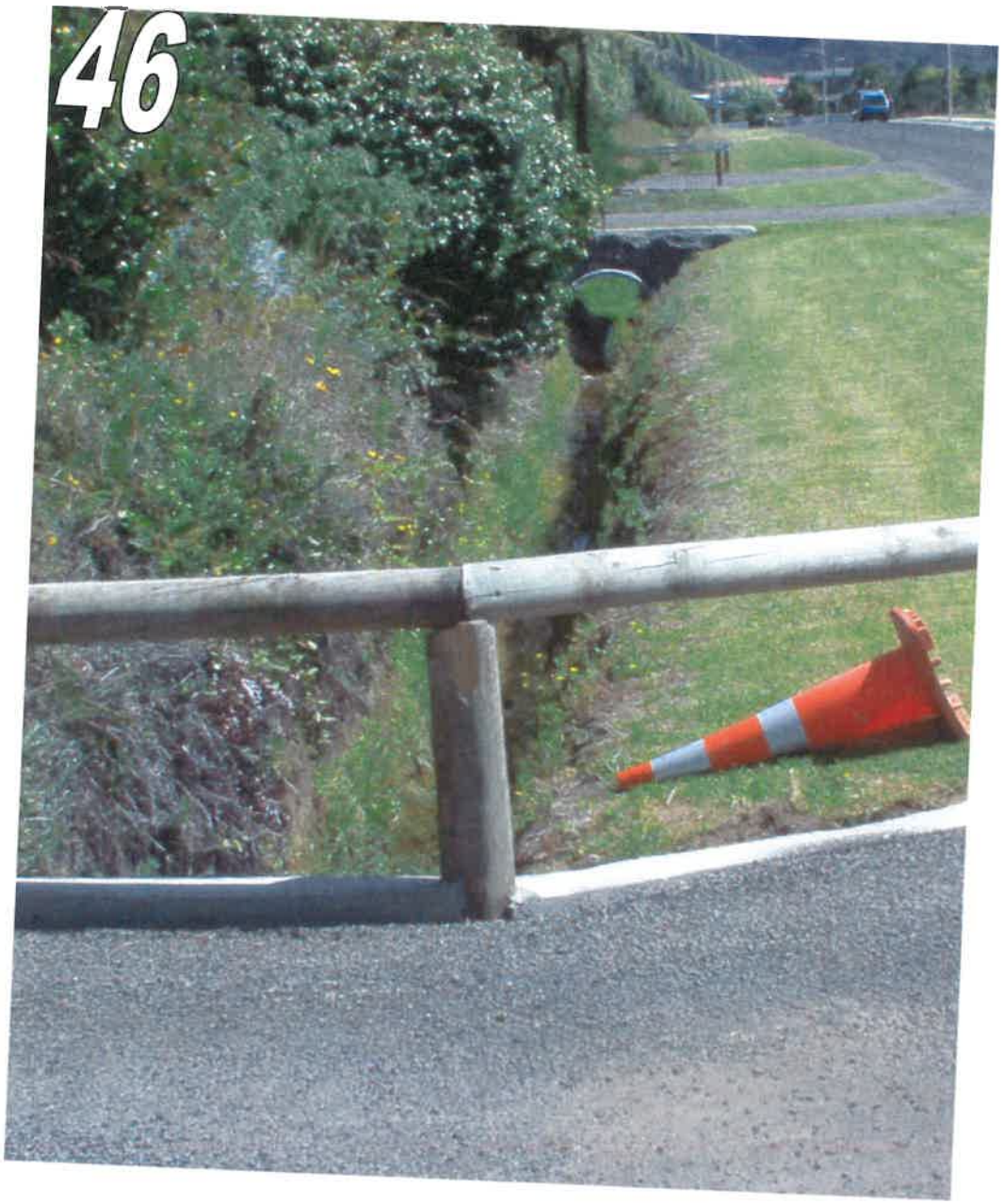
PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1 m	5
BATTER SLOPE	2:1-1:1	5
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Intlet not protected but not required as per Report	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	In open veld	0
PROXIMITY TO DEVELOPMENT	Removed from development	0
SAFETY INDEX	This Drain discharges into Drain 13 and is a secondary Drain	2.58
DRAIN INDEX		3.33

Drain 22-Adjacent to Wilson Rd

Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1 m	5
BATTER SLOPE	2:1-1:1	5
DISTANCE ROAD SURFACE AND DRAIN	5 m	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Opposite Waihi Beach Hotel	5
SAFETY INDEX	The drain is far enough from the road not to constitute a safety risk	3.33
DRAIN INDEX		3.33

Drain 23-Adjacent to Citrus Ave



Photograph - February 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1 m	5
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Intlet/Outlets not protected/not required as per Repo	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Well maintained	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within development	0
SAFETY INDEX	The drain is well maintained and is at a reasonable distance from the road	10
DRAIN INDEX		3.86
		2.36

APPENDIX 1B

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Drain Index

Drain 1 – Between Bayview St and Hayward Court

Drain 2 – Atuaroa Ave

Drain 3A – Between Hayward Court and Valley Road (Macloughlin Rd End)

Drain 3B – Between Hayward Court and Valley Rd (Atuaroa Ave End)

Drain 4 – Adjacent to Sportsfield at Atuaroa Ave

Drain 5 – Between Jellicoe and Atuaroa Ave

Drain 8 – End of Washer Rd

Drain 9 – Middle of Washer Rd

Drain 10 – Ohineagaanga Park

Drain 11 – East of George St

Drain 12A – Crossing with Hookey Rd

Drain 12B– Crossing with Tui St

Drain 12C – Crossing with Queen St

Drain 12D – Crossing with Jellicoe St

Drain 13 – Station Rd

Drain 14 – Adjacent to No 1 Rd

Drain 15 – Landscape Rd

Drain 1-Between Bayview St and Hayward Court

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	< 0.5 m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	>4 m	0
INLET/OUTLET PROTECTION	Outlet of drain prone to be blocked	5
PROXIMITY TO SENSITIVE FACILITIES	None	0
AESTHETIC CONSIDERATIONS	Wild growth	10
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	10
SAFETY INDEX	The drain is well demarcated and doesn't constitute a safety risk	2.75
DRAIN INDEX		2.25

Drain 2-Atuaroa Avenue

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	> 1 m	10
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	Close to road.	5
INLET/OUTLET PROTECTION	Excessive sediment in inlet pipes	0
PROXIMITY TO SENSITIVE FACILITIES	None.	5
AESTHETIC CONSIDERATIONS	Excessive growth.	10
HEALTH CONSIDERATIONS	None.	0
ENVIRONMENTAL CONSIDERATIONS	None.	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	10
SAFETY INDEX		5.58
DRAIN INDEX	The drain is not adequately protected from the road.	5.58

Drain 3A-Between Hayward Court and Valley Road
Macloughlin Road End

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	< 0.5 m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Intlet not protected but not required as per Report	0
PROXIMITY TO SENSITIVE FACILITIES	Removed form sensitive facilities	0
AESTHETIC CONSIDERATIONS	Pleasing	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Not easily accessable to the public	0
SAFETY INDEX	The drain is situated on undulating terrain with no safety risks.	5
DRAIN INDEX		0.75
		0.00

Drain 3B-Between Hayward Court and Valley Rd
Atuaroa Avenue End

Photograph - October2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1 m	5
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	Drain is perpendicular to road.	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	None	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to development	5
SAFETY INDEX	It is assumed that the drain is situated on private property. Not accessible to the general public.	2.83
DRAIN INDEX		2.33

Drain 4-Adjacent to Sportsfield at Atuaroa Ave

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	Drain is in the process of being piped	0
BATTER SLOPE		0
DISTANCE ROAD SURFACE AND DRAIN		0
INLET/OUTLET PROTECTION		0
PROXIMITY TO SENSITIVE FACILITIES		0
AESTHETIC CONSIDERATIONS		0
HEALTH CONSIDERATIONS		0
ENVIRONMENTAL CONSIDERATIONS		0
PROXIMITY TO DEVELOPMENT		5
SAFETY INDEX		0.75
DRAIN INDEX		0.00

Drain 5-Between Jellicoe St and Atuaroa Avenue

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	< 0.5 m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	None	0
PROXIMITY TO SENSITIVE FACILITIES	Next to commercial area	5
AESTHETIC CONSIDERATIONS	Excessive growth	10
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Close to development	5
SAFETY INDEX	No safety issues	2.50
DRAIN INDEX		3.25

Drain 8-End of Washer Road

Photograph - October 2007

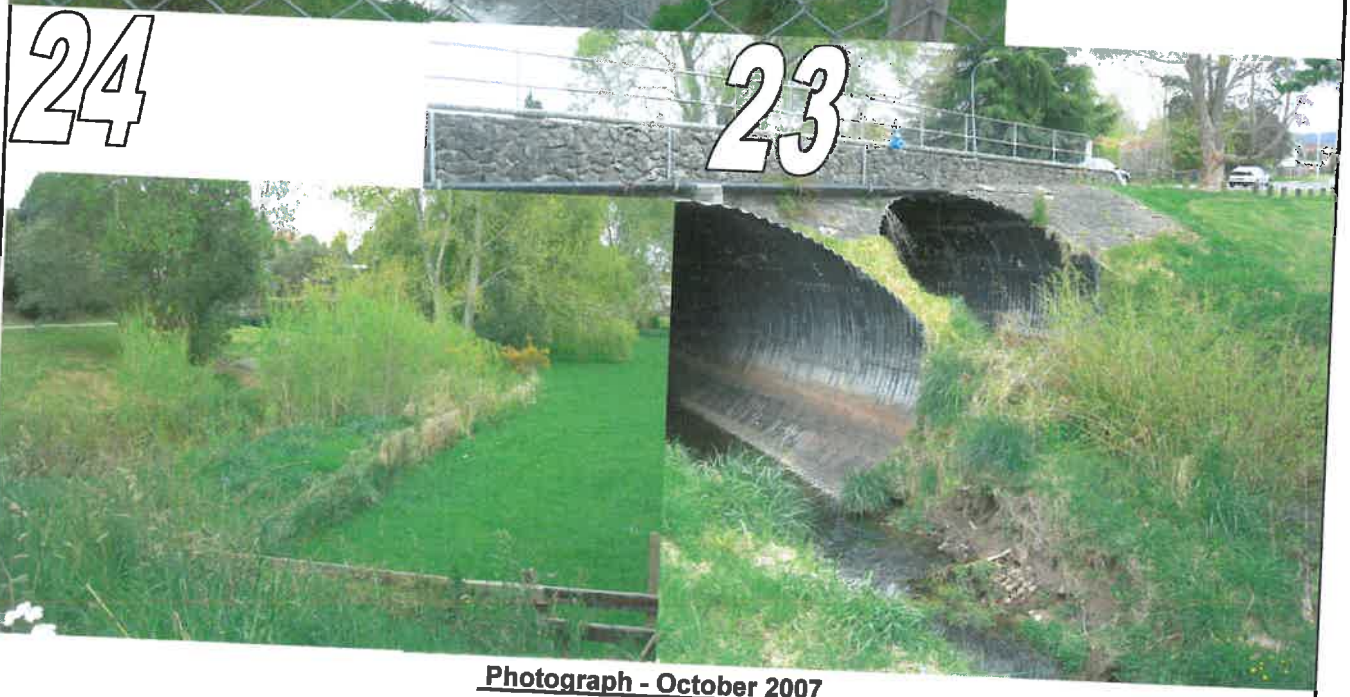
PARAMETER	OBSERVATION	RATING
DEPTH	1 - 2 m	9
BATTER SLOPE	Steeper than 45 degrees	10
DISTANCE ROAD SURFACE AND DRAIN	2 - 4 m	5
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Situated inside an industrial area	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Situated inside an industrial area	5
SAFETY INDEX		3.92
DRAIN INDEX	No significant safety risk	3.92

Drain 9-Middle of Washer Road

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1 - 2 m	9
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Not close	0
AESTHETIC CONSIDERATIONS	Excessive growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Removed from development	0
SAFETY INDEX	The drain is removed from any residential areas and do not constitute a safety risk	3.99
DRAIN INDEX		4.74

Drain 10- Ohineagaanga Park



Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1 m	5
BATTER SLOPE	2:1-1:1	5
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Intlet not protected but not required as per Report	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	In open veld	0
PROXIMITY TO DEVELOPMENT	Removed from development	0
SAFETY INDEX	This Drain discharges into Drain 13 and is a secondary Drain	2.58
DRAIN INDEX		3.33

Drain 11 - East of George Street

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0 -0.5 m	5
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Situated in Industrial area	0
AESTHETIC CONSIDERATIONS	Overgrown	10
HEALTH CONSIDERATIONS	Pollution possible due to proximity of Industries	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Removed from development	0
SAFETY INDEX	The drain is removed from residential development and is fenced off	1.79
DRAIN INDEX		3.29

Drain 12A-Hookey Rd Crossing

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1.0 m	5
BATTER SLOPE	<2:1	0
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road	0
INLET/OUTLET PROTECTION	Inlets and outlets are part of road crossings.	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal growth	0
HEALTH CONSIDERATIONS	None	5
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Between residential properties	0
SAFETY INDEX	This drain is not easily accessible and does not constitute a safety risk	5
DRAIN INDEX		1.54
		1.54

Drain 12B-Crossing with Tui Street

Photograph - October 2007

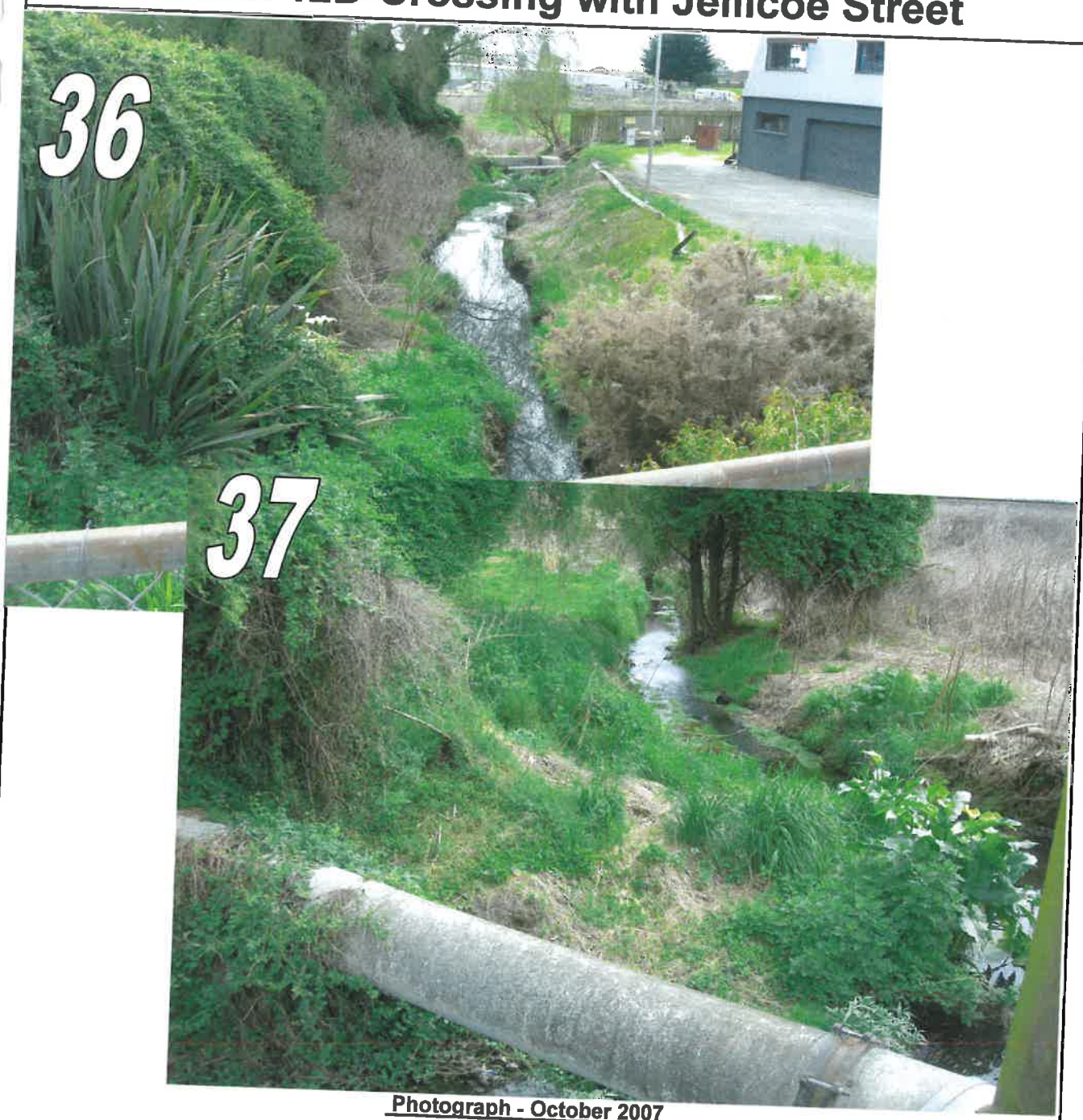
PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1.0 m	5
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing	0
PROXIMITY TO SENSITIVE FACILITIES	Not close	0
AESTHETIC CONSIDERATIONS	Fair	5
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Between residential properties	0
SAFETY INDEX	The drain does require access protection where it crosses Tui Street	2.33
DRAIN INDEX		2.33

Drain 12C-Crossing with Queen Street

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5 - 1.0 m	5
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Not close	0
AESTHETIC CONSIDERATIONS	Fair	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within developed area	5
SAFETY INDEX	The protection of the drain where it crosses the road should be enhanced	3.33
DRAIN INDEX		3.33

Drain 12D-Crossing with Jellicoe Street



Photograph - October 2007

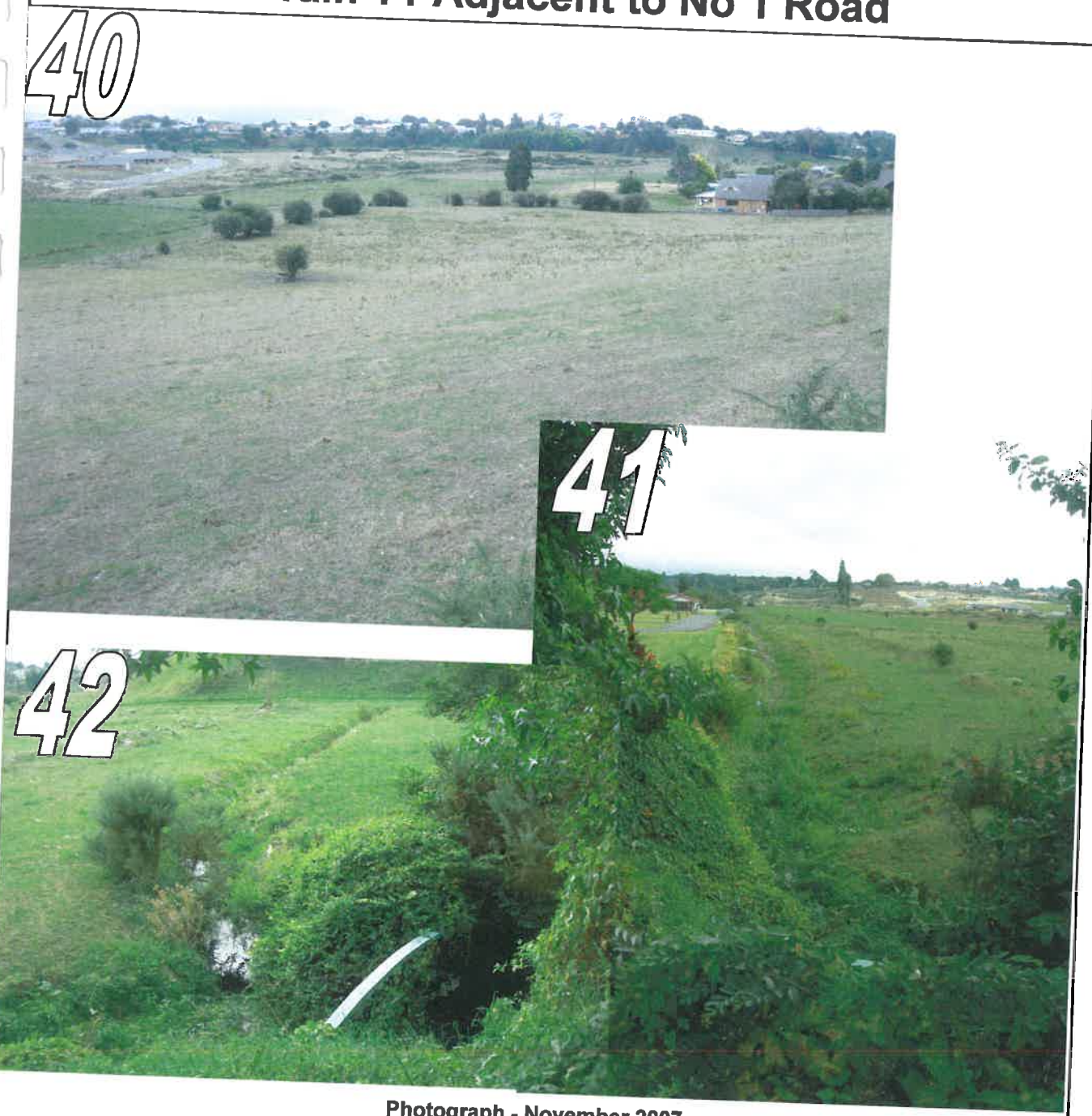
PARAMETER	OBSERVATION	RATING
DEPTH	1 - 2 m	9
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	2 - 4 m	5
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Fair	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Within developed area	10
SAFETY INDEX	A wooden barrier has been damaged ans should be repaired	5.67
DRAIN INDEX		4.92

Drain 13- Station Road

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	> 1 m	10
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	Perpendicular to road	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Excessive growth	10
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Removed from development	5
SAFETY INDEX	The drain is situated in the industrial area and does not constitute a risk.	3.90
DRAIN INDEX		4.65

Drain 14-Adjacent to No 1 Road



Photograph - November 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1 - 2 m	9
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Road crossing	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Pleasing	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to retirement village	10
SAFETY INDEX	The drain is deep where it enters the culvert crossing the road.	3.71
DRAIN INDEX		2.21

Drain 15-Landscape Road

Photograph - November 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1 - 2 m	9
BATTER SLOPE	>1:1	10
DISTANCE ROAD SURFACE AND DRAIN	> 4 m	0
INLET/OUTLET PROTECTION	Inlet and outlet is part of a road crossing.	0
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Normal to slightly more than normal growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Fair distance from development	5
SAFETY INDEX	The section between the culvert and the pedestrian bridge should be protected.	4.74
DRAIN INDEX		4.74

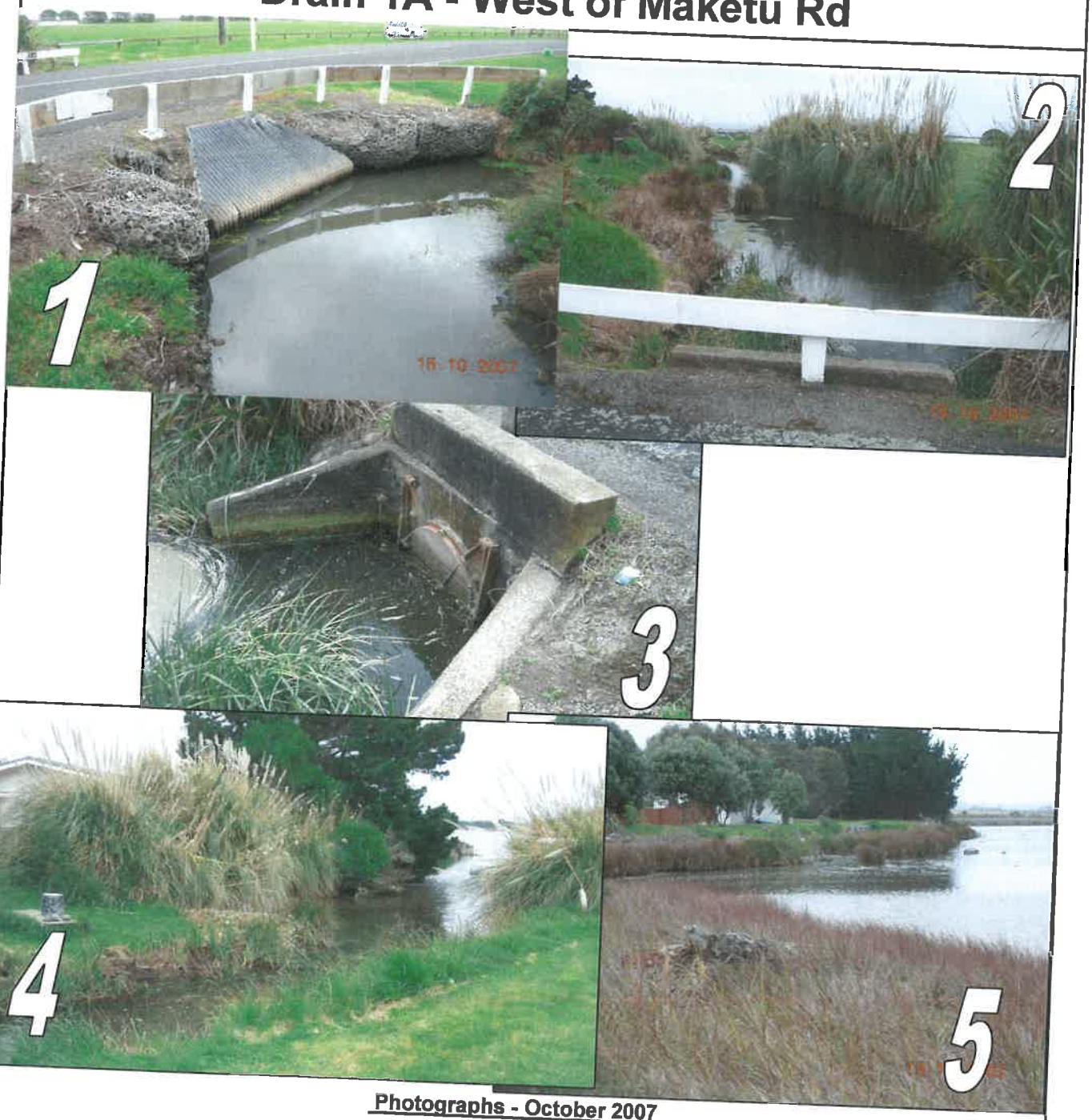
APPENDIX 1C

MAKETU

Drain Index

Drain 1A – West of Maketu Rd
Drain 1B – Between Maketu Rd and Wilson Rd Nth
Drain 1C – Between Wilson Rd Nth and Church Rd
Drain 1D – East of Church Rd
Drain 2 – Spencer Ave South
Drain 3 – Spencer Ave North
Drain 4 – Between Drain 1B and Maketu Rd
Drain 5 – Off-shoot South of Drain 1B
Drain 6 – Parallel to West of Wilson Rd Nth
Drain 7 – Parallel to East of Wilson Rd Nth
Drain 8 – Adjacent to Town Pt Road

Drain 1A - West of Maketu Rd



Photographs - October 2007

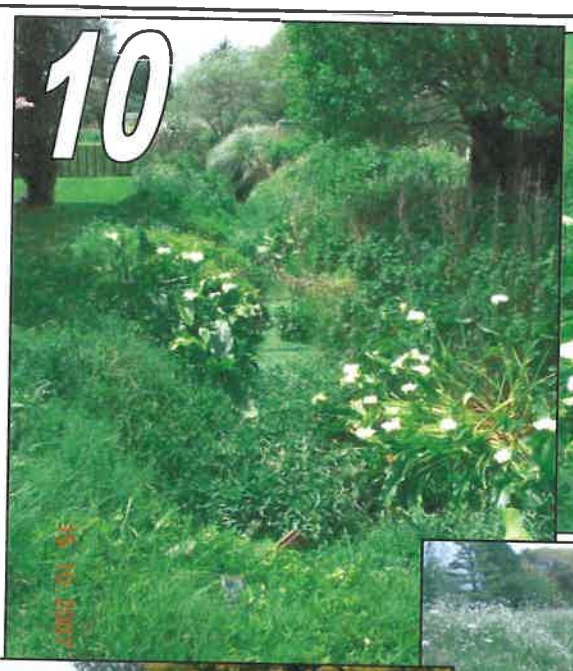
PARAMETER	OBSERVATION	RATING
DEPTH	1-2 m	9
BATTER SLOPE	2:1 - 1:1	0
DISTANCE ROAD SURFACE AND DRAIN	2-4 m	0
INLET/OUTLET PROTECTION	Protection fair, some sight railing present	5
PROXIMITY TO SENSITIVE FACILITIES	Adjacent to Maketu Sports Ground	10
AESTHETIC CONSIDERATIONS	Fair, some growth in middle of drain	5
HEALTH CONSIDERATIONS	Standing water/mosquito breeding	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent houses are at sea level or slightly above	10
SAFETY INDEX	The drain is adjacent to a the sports grounds. Slight possibility of flooding for one or two homes.	7.04
DRAIN INDEX		5.79

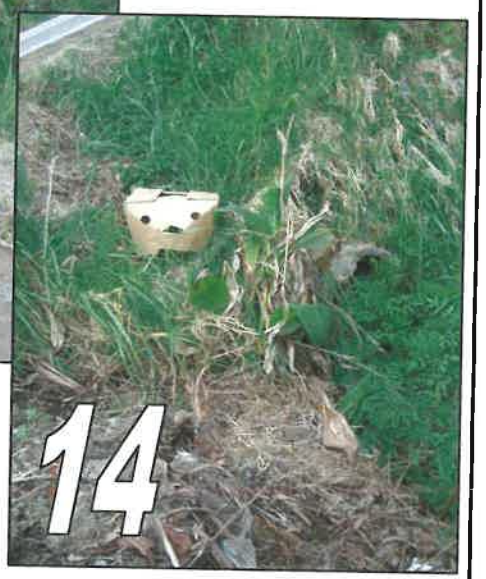
Drain 1B - Between Maketu Rd & Wilson Rd Nth

Photographs - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1-2 m	9
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	Not applicable	0
INLET/OUTLET PROTECTION	No safety railing at Wilson Rd Nth crossing	10
PROXIMITY TO SENSITIVE FACILITIES	Removed form sensitive facilities	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water/Chance of water pollution	10
ENVIRONMENTAL CONSIDERATIONS	Erosion of gabions at outlet	5
PROXIMITY TO DEVELOPMENT	Mostly on private property	0
SAFETY INDEX	The drain is cut between two properties and connects to Drain 3 at Maketu Rd.	9.71
DRAIN INDEX		5.96

Drain 1C - Between Wilson Rd Nth & Church Rd





Photographs - October 2007

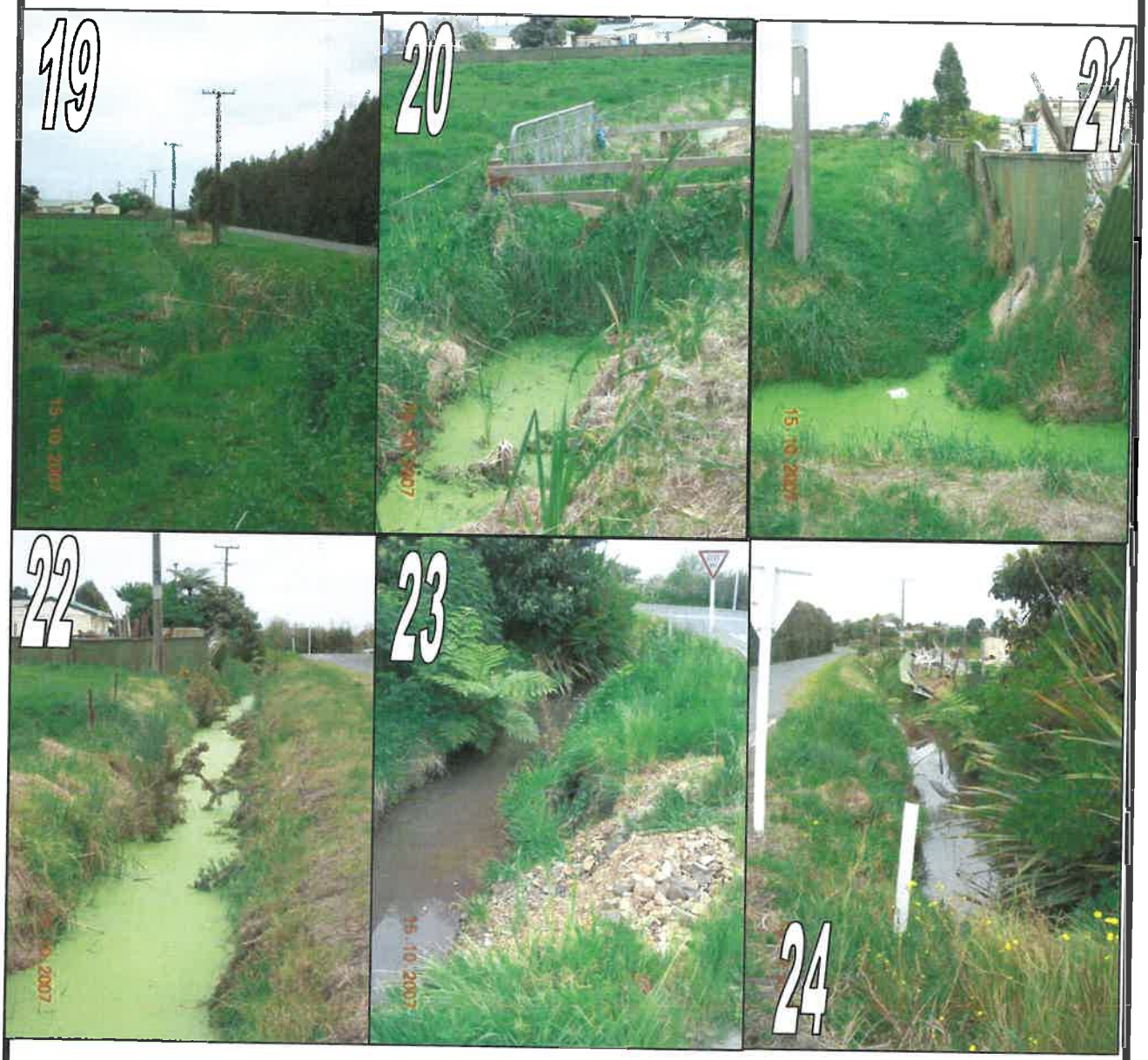
PARAMETER	OBSERVATION	RATING
DEPTH	2-4 m	10
BATTER SLOPE	>1:1	10
DISTANCE ROAD SURFACE AND DRAIN	>4 m	0
INLET/OUTLET PROTECTION	No safety railing at Wilson Rd Nth & Church Rd	10
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Excessive growth	10
HEALTH CONSIDERATIONS	Standing water/Chance of water pollution	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to houses and empty lots	10
SAFETY INDEX	A deep drain near several homes that is severely overgrown.	12.15
DRAIN INDEX		7.15

Drain 1D - East of Church Rd

Photographs - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	2-4 m	10
BATTER SLOPE	>1:1	10
DISTANCE ROAD SURFACE AND DRAIN	>4 m	0
INLET/OUTLET PROTECTION	No safety railing at culvert inverts	10
PROXIMITY TO SENSITIVE FACILITIES	Removed form sensitive facilities	0
AESTHETIC CONSIDERATIONS	Excessive growth	5
HEALTH CONSIDERATIONS	Standing water/Chance of water pollution	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to houses and empty lots	10
SAFETY INDEX	A deep drain near several homes that is severely overgrown.	7.15
DRAIN INDEX		6.40

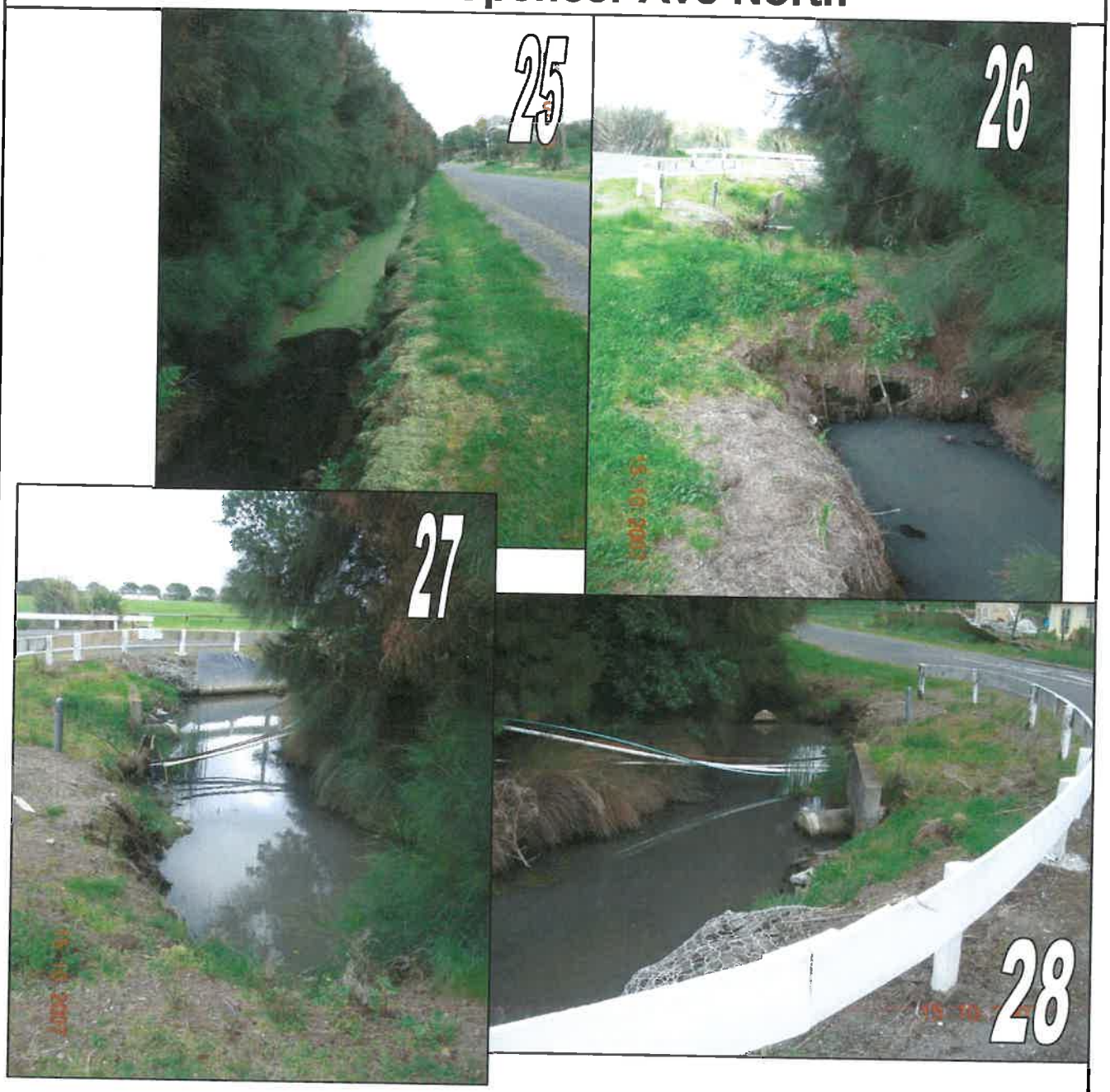
Drain 2 - Spencer Ave South



Photographs - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1-2 m	9
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	2-4 m	5
INLET/OUTLET PROTECTION	Inlet/Outlet not protected/no safety rails	10
PROXIMITY TO SENSITIVE FACILITIES	Removed from sensitive facilities	0
AESTHETIC CONSIDERATIONS	Poor - algae present on surface	10
HEALTH CONSIDERATIONS	Standing water/Mosquito breeding	10
ENVIRONMENTAL CONSIDERATIONS	Mild erosion at end of kerb	5
PROXIMITY TO DEVELOPMENT	Close to a few homes. Private fence leaning over drain.	0
SAFETY INDEX	The drain is near a few houses and one is currently in danger of flooding in an extreme rain event.	5.38

Drain 3 - Spencer Ave North



Photographs - October 2007

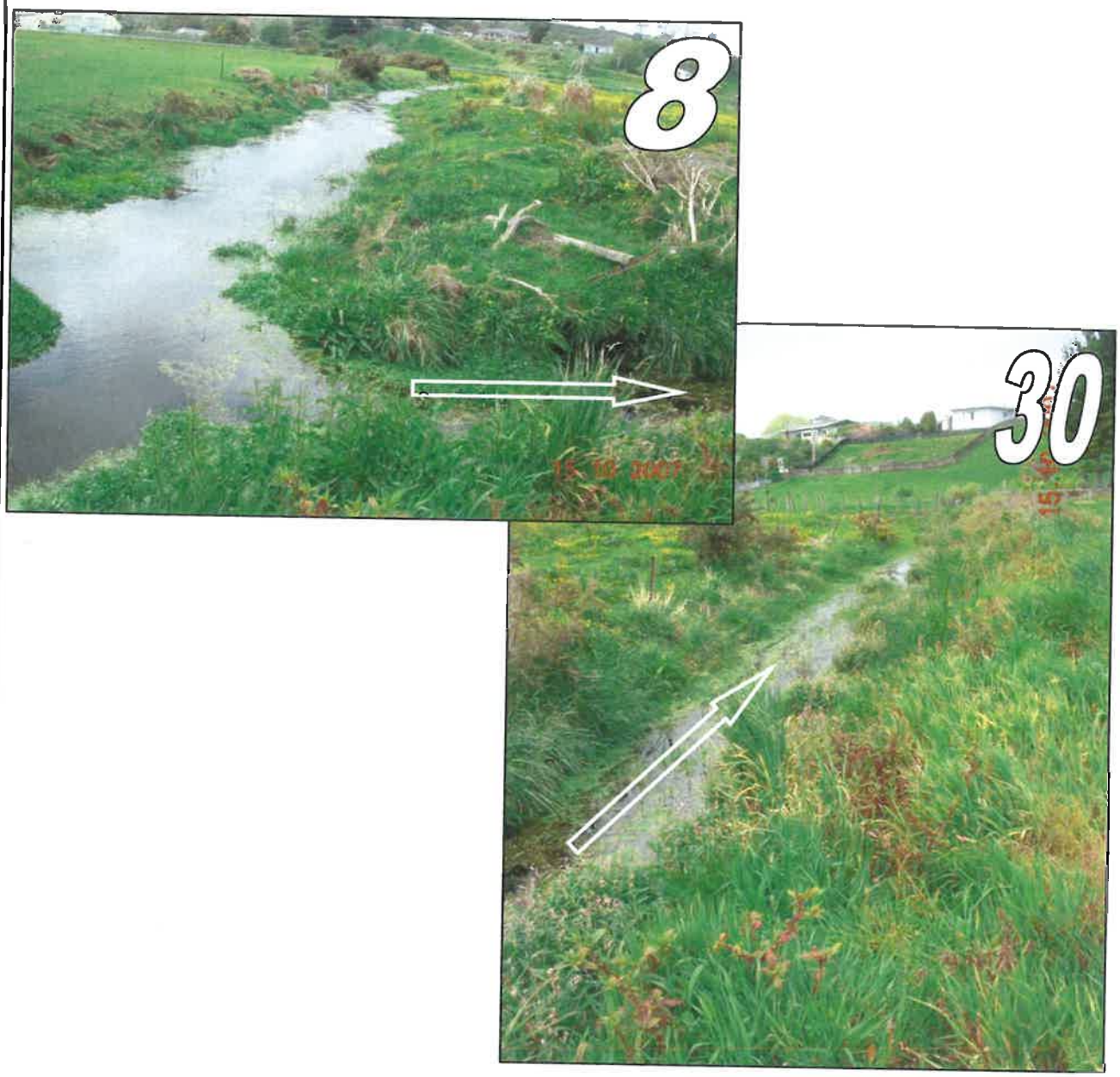
PARAMETER	OBSERVATION	RATING
DEPTH	1-2 m	9
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	2-4 m	5
INLET/OUTLET PROTECTION	Protection fair, some sight railing present	5
PROXIMITY TO SENSITIVE FACILITIES	Not applicable	10
AESTHETIC CONSIDERATIONS	Poor - algae present on surface	10
HEALTH CONSIDERATIONS	Standing water upstream/mosquito breeding	10
ENVIRONMENTAL CONSIDERATIONS	Mild erosion possible, deterioration of gabions	5
PROXIMITY TO DEVELOPMENT	Adjacent to a paddock	0
SAFETY INDEX	Drain 3 meets with Drain 1b at Maketu Rd and together they empty into Drain 1a.	6.51
DRAIN INDEX		8.01

Drain 4 - Between Drain 1b & Maketu Rd

Photographs - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0 - 0.5m	0
BATTER SLOPE	< 2:1	0
DISTANCE ROAD SURFACE AND DRAIN	Not applicable	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Not applicable	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water/Chance of water pollution	10
ENVIRONMENTAL CONSIDERATIONS	Slight erosion	5
PROXIMITY TO DEVELOPMENT	Not easily accessible, mostly on private property	0
SAFETY INDEX	The drain is cut between two properties and connects to Drain 3 at Maketu Rd.	1.00
DRAIN INDEX		2.25

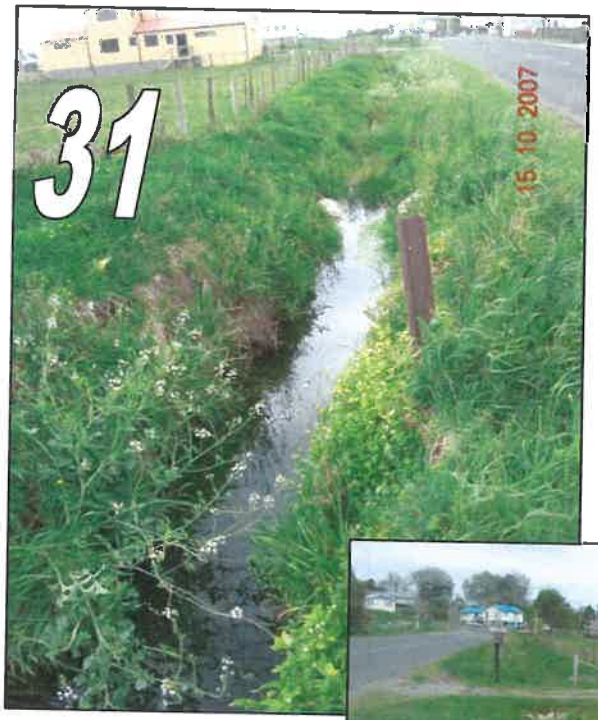
Drain 5 - Off-shoot South of Drain 1b



Photographs - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	1-2 m	5
BATTER SLOPE	2:1 - 1:1	0
DISTANCE ROAD SURFACE AND DRAIN	Not applicable	0
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Not applicable	0
AESTHETIC CONSIDERATIONS	None	0
HEALTH CONSIDERATIONS	Standing water/Chance of water pollution	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Not easily accessible, mostly on private property	0
SAFETY INDEX	The drain is is an off-shoot from Drain 1b.	1.79
DRAIN INDEX		1.79

Drain 6 - Parallel to West Side of Wilson Rd Nth



Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5-2 m	9
BATTER SLOPE	> 1:1	10
DISTANCE ROAD SURFACE AND DRAIN	2-4 m	5
INLET/OUTLET PROTECTION	No safety rails	5
PROXIMITY TO SENSITIVE FACILITIES	Not applicable	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to a house at the shallow end of drain.	0
SAFETY INDEX	This drain is located along mostly paddock with one house in close proximity.	5.42
DRAIN INDEX		5.67

Drain 7 - Parallel to East Side of Wilson Rd Nth

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	>2 m	10
BATTER SLOPE	>1:1	10
DISTANCE ROAD SURFACE AND DRAIN	2-4 m	5
INLET/OUTLET PROTECTION	No safety rails	5
PROXIMITY TO SENSITIVE FACILITIES	Not applicable	0
AESTHETIC CONSIDERATIONS	Slight growth	5
HEALTH CONSIDERATIONS	Standing water	10
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Not applicable	0
SAFETY INDEX	This is a short drain opposite Drain 4a with very little water present.	5.08
DRAIN INDEX		5.83

Drain 8 - Adjacent to Town Point Road

Photograph - October 2007

PARAMETER	OBSERVATION	RATING
DEPTH	0.5-1 m	5
BATTER SLOPE	2:1 - 1:1	5
DISTANCE ROAD SURFACE AND DRAIN	2-4 m	5
INLET/OUTLET PROTECTION	Not applicable	0
PROXIMITY TO SENSITIVE FACILITIES	Not applicable	0
AESTHETIC CONSIDERATIONS	Excessive growth along top section	0
HEALTH CONSIDERATIONS	None	0
ENVIRONMENTAL CONSIDERATIONS	None	0
PROXIMITY TO DEVELOPMENT	Adjacent to houses on lower end.	10
SAFETY INDEX	The drain is pretty clean, inlet and outlet under gravel driveway at no. 13 needs to be cleared.	3.75
DRAIN INDEX		1.75

APPENDIX 2

Discussion of Drain Condition and Remedial Actions Required

APPENDIX 2A: Waihi Beach

APPENDIX 2B: Te Puke

APPENDIX 2C: Maketu

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
1	**Position:** The Drain is situated on the beachfront. **Depth/Batter:** The Drain is shallow with well battered sides. **Safety:** It is cordoned off with wooden poles with rope in between.	No remedial action is required.
2	**Position:** This Drain is strategically placed close to a play-park and the beach. **Depth/Batter:** The Drain between 1 and 2 metres in depth, with a batter slope in excess of 1:1. **Inlet/Outlet Protection:** The inlet to the Drain is not protected and neither is the inlet and outlet underneath the road. **Aesthetic Considerations:** The Drain is overgrown and in need of maintenance. **Safety:** The Drain constitutes a safety risk due to the proximity to the playground.	**Depth/Batter:** It is suggested that a drainage pipe be placed which will extend the play-park area and which will simplify the maintenance of the area. **Inlet/Outlet Protection:** The culvert underneath the road is 500 mm in diameter and if the section through the play-park is piped then only the outlet will remain unprotected. **Aesthetic Considerations:** The piping of the Drain will solve the aesthetic problems but if that is not implemented then the excessive growth should be removed, the batter improved and the side of the Drain be grassed.
3	**Position:** This Drain is removed from any development and is adjacent to a gravel road. **Depth/Batter:** The Drain is shallow.	No remedial action is required.
4	**Position:** The Drain is situated primarily within a caravan park area.	**Depth/Batter:** The waterway needs to be protected by some form of barrier. The least obtrusive barrier would be similar to the barrier used at drain 1 which can be seen on

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Depth/Batter: The Drain is in excess of 2 metres and has vertical sides. **Inlet/Outlet Protection:** There are twin 1600 mm diameter pipes underneath the road surface. **Safety:** This is a waterway which has potential for accidents. The owner of the caravan park has indicated that there have been three incidents over the holiday period where youngsters have injured themselves by falling into the waterway.	photographs 1 and 2. This will have to be done in conjunction with the owner of the caravan park. **Inlet/Outlet Protection:** As suggested in the body of the Report, no protection will be provided where storm-water pipes only cross under a road surface. **Further Suggestions:** The galvanized water pipe that is placed inside the drain pipe as shown on photograph 8 must be diverted along a safer route.
5	**Position:** The Drain is situated close to the beach and runs between sections before discharging onto the beach. **Depth/Batter:** The Drain is in excess of 2 metres in depth with vertical sides at the point where it discharges onto the beach. **Inlet/Outlet Protection:** There are twin inlet pipes being 600 and 700 mm in diameter that discharges into the Drain. There is a protective barrier along the side of the road which prevents direct access to the storm-water outlets. **Safety:** This Drain is not of significant length but there are safety concerns where the drain discharges onto the beach. The drain is 2.2 m deep with near vertical sides.	**Depth/Batter:** A solid wooden barrier is required over a short distance with a warning sign at the beach side.
6	**Position:** The Drain is situated next to an Old Age Home and a large diameter (±500	**Depth/Batter:** The wooden barrier between the road and the Drain need to be replaced. The drop in

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	mm) pipe that discharges somewhere in the middle of the property between Jenkinson and Beach Streets. The origin of this pipe however could not be determined. **Depth/Batter:** The Drain does not exceed 1 metre in depth except at the road crossing and has vertical sides. **Aesthetic Considerations:** This Drain is heavily overgrown on the higher laying side of Beach Road. **Safety:** Corrugated iron is used to prop the sides of the drain on the lower laying side of Beach Road which does leave some sharp ends at places.	elevation between the road sidewalk and the Drain is between 3-4 meters and it is important that this barrier be safe for pedestrians. **Aesthetic Considerations:** It was initially thought that the growth on the higher laying side of Beach Road had to be curbed and replaced with plant growth that will not impede the flow of water as is partially the case at the moment. On closer scrutiny the plant growth is aesthetically pleasing and the flow of water is not unreasonably impeded. **Further Suggestions:** The section of this drain which is between Beach and Marine Roads is very close to existing houses which impedes on the usable area of these sections. It is suggested that this section of the Drain be piped. If the Drain is piped then inlet protection is required as per the recommendations in the Report. The Drain that crosses the road is 900 mm in diameter.
7	**Position:** This Drain is situated below a considerable catchment area. A reasonably large development has also just been completed within this catchment consisting of 89 new sections. **Depth/Batter:** The Drain is between 1 and 2 metres in depth with batter slopes in excess of 1:1. **Inlet/Outlet Protection:** There is inlet protection where the Drain crosses the road and where the Drain discharges into a storm-water pipe. **Aesthetic Considerations:** A section of the Drain is overgrown. **Flood Risk:**	**Depth/Batter:** The Drain is removed from development and the depth and batter slope does not constitute a risk. **Aesthetic Considerations:** A short section, ± 200 meters, of this drain need to be cleared of growth. **Flood Risk:** The 500 mm diameter stormwater pipe which is situated at the lowest end of this Drain seems inadequate and a study should be done to determine whether the stormwater system should not be upgraded.

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Once the houses have been constructed the run-off will be increased. There are two retention ponds on the higher laying side of Beach Road which will alleviate the effect of stormwater run-off but this Drain still constitutes a risk for flooding in the years to come. All the stormwater that is accumulated in this Drain discharges into a single 500 mm diameter pipe that disappears in the direction of Leo Street. **Safety:** The flood risk is the major risk associated with this Drain.	
8	**Position:** This is a Drain that discharges into the sea and can be classified as a Waterway. This Waterway is situated in between sections and is initially situated within an Easement but for the most part is situated on the various sections in its path. **Depth/Batter:** The depth of the Drain is in excess of 2 metres and has near vertical batter slopes. **Legal Considerations:** It was initially felt that the existence of the Waterway should be legalised and easements should be created which are fenced off. A more thorough investigation of the properties along the Waterway however changed this view and due to the reasons mentioned in the Report the Status Quo with regards to Easements should remain.	**Depth/Batter:** The Drain is not easily accessible to the general public and is situated at the back of the various sections along the way. Protection of the embankment could be considered. **Flood Risk:** As mentioned in the Report, this Drain constitutes a flooding risk to at least one property as shown in Appendix 7.
9	**Position:** This Drain is situated in an overgrown, marshy area and is slightly removed from development. The drain is also short in length and is not of real significance.	No remedial action is required.

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
10	**Position:** This Drain could not be found on site but judging on the length that was drawn on the plan that Duffill Watts & King provided, it is not a drain of any significance anyway.	No remedial action is required.
11 & 12	**Position:** Only one Drain could be located in the area that drains 11 and 12 are indicated. This Drain collects storm-water from Hillview Road. A storm-water pipe has recently been installed from Hillview Road across Lot 1 and 2 of DPS 326449 and then discharges with an outlet structure (See photograph 25) into drain 11/12. **Safety:** This Drain is situated in a marshy area slightly removed from development and does not pose any safety or health problems. It was completely dry at the time of inspection and consisted of the same growth as the surrounding marsh area.	No remedial action is required.
13	**Position:** This Drain emanates in the hills behind Waihi Beach and is probably in excess of 2 kilometres. **Depth/Batter:** The depth is in excess of 2 metres and the batter slope is more than 1:1. **Aesthetic Considerations:** The growth is not excessive and consists of the same growth as the surrounding area. **Safety:** The Drain is primarily in an undeveloped area where it does not pose any safety or health threats to the community. It is also unlikely that that development will take place in the vicinity of this drain.	**Depth/Batter:** Due to the remoteness of the Drain no remedial action is required.

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
14	**Position:** This Drain emanates in the hills behind the Beach area. The drain is situated between an entrance road and horse paddocks. **Depth/Batter:** The Drain is between 1 and 2 metres deep with a batter slope of 1:1. **Distance from Road:** The owner of the house adjacent to the Drain is worried about his access road and also alleges that the Drain is detrimental to his horse paddocks that are flooded for extensive periods of time. The Drain is close to the access road but does not constitute a substantial risk. **Safety:** The Drain is reasonably inaccessible to the public and is well fenced off. The depth and batter slope are not excessive either. The Drain does not constitute risk.	**Depth/Batter:** The Drain is well fenced off on both sides and is not accessible to the public. The depth and batter slope does not constitute a risk. **Distance from Road:** The situation with regard to the access road must be monitored but no remedial action is required at this stage.
15 & 16	**Position:** These two Drains are situated amongst development on the same section and are both constructed with a concrete channel. **Depth/Batter:** The drains are of minimal length and size and not of great significance. **Inlet/Outlet Protection:** The Drains discharges into a storm water pipe which is 300 mm in diameter. **Safety:** The Drains are safe.	No remedial action is required.
17	**Position:** This Drain is situated between sections and is contained in an easement and is properly fenced off.	**Depth/Batter:** Drain 17 and 18 is situated on an easement and can also easily be fenced off at the two entry points to the drains. It is suggested that access to these drains be fenced

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Depth/Batter: The Drain is in excess of 2 m in depth and the batter slope exceeds 1:1. **Aesthetic Considerations:** The drain however is overgrown with weeds and is not aesthetically pleasing. **Safety:** The Drain constitutes risk and public access should be eliminated.	off. **Aesthetic Considerations:** The full length of the drain must be cleared of excess growth.
18	**Position:** This Drain is an extension of Drain 17 and has the same characteristics. **Depth/Batter:** The Drain is in excess of 2 m in depth and the batter slope exceeds 1:1. **Inlet/Outlet Protection:** An effort was made to protect the outlet of Drain 18 but this was probably done by the public **Aesthetic Considerations:** There is a full grown palm tree in the middle of the drain as can be seen in photo number 36. **Safety:** The Drain constitutes risk and public access should be eliminated.	**Depth/Batter:** Drain 17 and 18 is situated on an easement and can also easily be fenced off at the two entry points to the drains. It is suggested that access to these drains be fenced off. **Inlet/Outlet Protection:** The Drain discharges into a storm-water pipe which must be protected in line with the recommendations contained in the Report. **Aesthetic Considerations:** The full length of the drain must be cleared of excess growth.
19	**Position:** This Drain is a further extension of drain 18. It is also contained in an easement. **Depth/Batter:** The Drain is between 1 and 2 metres deep with a batter slope in excess of 1:1.	**Depth/Batter:** The depth of the Drain is not excessive and doesn't require remedial action. The batter slope should however be improved. **Aesthetic Considerations:** This Drain should be put onto the maintenance schedule considering the new development that is taking place adjacent to this Drain.

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Inlet/Outlet Protection: Drain 18 discharges via a pipe into Drain 19. There is also a pipe under a road crossing at the lower end of the Drain. **Aesthetic Considerations:** The Drain is reasonably open and not as overgrown as the upper sections. It has however widened relative to the upper sections. A new development is in progress adjacent to this drain. The general condition of this drain is fair. The Drain Inter Alia contains a pipe under a road crossing. **Safety:** The Drain is constantly filled with water up to a certain level and it is very accessible. The batter slope should be improved for increased safety.	
20	**Position:** This Drain discharges into the sea and can be classified as a waterway. The section of this Drain which runs in Atlas Avenue has different characteristics and has been shown as a different Drain (drain 23).	No remedial action is required.
21	**Position:** This Drain handles stormwater that is generated from a catchment area to the north of Waihi Beach Road. The drain is primarily in an undeveloped area where it does not pose any safety or health threats to the community. This drain discharges into drain 13. **Aesthetic Considerations:** The growth is not excessive and consists of the same growth as the surrounding area. **Safety:** The Drain is in a rural area and it is also unlikely that development will take	No remedial action is required.

APPENDIX 2A – WAIHI BEACH: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	place in the vicinity of this Drain.	
22	**Position:** This is the only Drain that runs adjacent to a Council road. **Depth/Batter:** The Drain is less than 1 metre deep with gentle batter slopes. **Aesthetic Considerations:** The Drain is slightly overgrown. **Safety:** The Drain is fenced off from the road and has a moderate depth and batter slope. The Drain does not constitute risk.	**Aesthetic Considerations:** The full length of Drain must be cleared of excess growth.
23	**Position:** The Drain is situated along Citrus Avenue. **Depth/Batter:** The Drain is less than 1 metre in depth but the batter slope exceeds 1:1. **Inlet/Outlet:** The access road ways to the various houses are well constructed with stormwater pipes placed at each entrance with a small bridge structure constructed over the stormwater pipe. The sides of the access ways are protected with wooden barriers. **Aesthetic Considerations:** The Drain has a pleasing appearance. **Safety:** It would be safer to fence the Drain off but much will be lost aesthetically. The Drain is highly visible and not excessively deep. The Drain as is represents moderate risk but not to the extent that remedial action is required.	**Further Suggestion:** One access way is not protected with wooden barriers on the sides and must be upgraded to the same standards as the other entrances.

APPENDIX 2B – TE PUKE: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
1	**Position:** The Drain is situated adjacent to residential properties **Inlet/Outlet Protection:** The open drain discharges into a drain pipe via an inlet structure that is shown in picture 3. The grate that serves as an inlet structure is prone to blockage. **Aesthetic Considerations:** The open drain section consists of wild growth. **Safety:** Although the Drain is very overgrown it does not constitute risk.	**Inlet/Outlet Protection:** It is recommended that a scruffy dome inlet structure be constructed where the open drain discharges into the piped drain. This drain could be slightly raised to keep debris at bay. **Aesthetic Considerations:** The Drain is not in the public eye and it would be uneconomical to keep it in a tidy condition. It is recommended that the status quo be retained.
2	**Position:** This Drain is of considerable depth and is in close proximity to the road. **Depth/Batter Slope:** The depth, batter slope and close proximity to the road constitute a risk. **Aesthetic Considerations:** There is excessive growth along the banks of this open drain as is evident from photos 4 and 5. The drain is adjacent to a major sport field and very much in the public eye. **Safety:** This Drain is unsafe.	**Depth/Batter Slope:** The open drain just downstream from this drain is in the process of being converted into a closed drain and it recommended that this drain be closed as well. A less effective alternative would be to provide a sturdy fence between the road and the open drain. **Aesthetic Considerations:** An effort must be made to remove the excessive growth and to keep it maintained. This problem however will be solved if the drain is converted into a closed drain.
3A	**Position:** This Drain meanders through the centre of the town and consists of a wide drain with gradual slopes. The drain is fenced off and is not normally accessed by the public. **Safety:** There are no safety issues.	No remedial action required.

APPENDIX 2B – TE PUKE: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
3B	The Drain does become a more defined stream at its lower reaches. The depth and slope however is not of any significance. **Safety:** There are no safety issues.	**Outlet Conditions:** The outlet of this Drain is silted as can be seen in photo 12. The Drain underneath the road must be cleared of silt and debris to maintain a flow of storm-water.
4	**Position:** This Drain is in the process of being piped.	N/A
5	**Position:** This drain is situated between a commercial development and an open field. **Aesthetic Considerations:** The Drain is not maintained but the position of the drain does not necessitate that it be maintained. The field adjacent to the drain is in the same state as the drain itself and it would seem odd if the drain is trimmed down but the field remains in the condition that it is in. **Safety:** There are no safety issues.	No remedial action required.
6	This Drain could not be found.	N/A
7	**Position:** This Drain is situated in an industrial area and on private property and was not accessible.	Unknown
8	**Position:** This Drain is situated in an industrial area and on private property but is accessible. The general public however will not frequent this area. **Batter Slope:** A section of this Drain does have steep batter slopes. These Drains are not positioned to create risk and the onus should be on the land-owner to manage these drains. The Council should not become involved in the maintenance of	No remedial action required.

APPENDIX 2B – TE PUKE: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	these drains. **Safety:** The Drain can be better protected but that should be the responsibility of the land-owner.	
9	**Position:** The Drain is situated in Washer Road which is in the industrial area. **Depth/Batter Slope:** The depth and batter slope is excessive especially on the northern side of Washer Road. The drain is removed from any residential areas and the problematic section of the drain is situated on farm land. **Safety:** The problematic section of this Drain is on Agricultural land and difficult to access.	No remedial action required.
10	**Position:** This drain runs through the main park of Te Puke. It could probably be classified as a stream. **Health Considerations:** There is standing water but it is not excessive. **Corrugated Iron Culvert:** The culvert that is shown in photo 23 has ragged edges which could be classified as a health and safety risk. **Safety:** The corrugated iron culvert should be better protected at the edges.	**Health Considerations:** There is standing water but it is not excessive. **Corrugated Iron Culvert:** The ragged edges of the culvert could be bent inward and/or cut back. Refer to Drain 15 photo 45 for an example of a corrugated iron culvert that has been finished off safely.
11	**Position:** This Drain is situated in an industrial area which is not frequented by the general public.	**Aesthetic/Health Considerations:** The area adjacent to the Drain has developed into a dumping ground which should be cleaned up.

APPENDIX 2B – TE PUKE: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Aesthetic/Health Considerations: The Drain is not neat and is subject to pollution as can be seen in photo 25. The whole area however is subject to pollution and the problem will not be solved if something is done to the drain. The drain is not of any significance and due to its remote location it is suggested that the status quo be maintained. **Safety:** No safety issues.	
12	**Position:** This Drain is situated within residential properties and crosses various streets on its route. Each crossing with the various streets is discussed separately.	N/A
12A	**Position:** The crossing of Drain 12 with Hookey Road. **Depth/Batter Slope:** This section is at the higher laying section of the Drain is not of any significant depth or excessive slopes. **Safety:** No safety issues.	No remedial action required.
12B	**Position:** The crossing of Drain 12 with Tui Street **Depth/Batter Slope:** The depth and batter slope of the Drain is within limits with the exception of the drain immediately to the north of Tui Street. It can be seen in photo 31 that a wooden barrier has been damaged. **Safety:** A wooden barrier has to be repaired.	**Depth/Batter Slope:** The wooden barrier as shown in photo 31 has to be reinstated. There is a steep fall from the road surface to the invert of the drain at this point.
12C	**Position:**	**Depth/Batter Slope:**

APPENDIX 2B – TE PUKE: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	The crossing of Drain 12C with Queen Street. **Depth/Batter Slope:** The depth and batter slope on both sides of Queen Street does not constitute risk with the exception of the area directly adjacent to the southern side of Queen Street. The distance from road surface to invert of drain is in excess of 3 meters. **Safety:** The Drain has to be better protected from the road.	The section of the drain that is directly to the south of Queen Street is protected with a wooden fence as shown on photo 35. This fence is overgrown and not in a good condition. The fence is in need of replacement.
12D	**Position:** Drain 12 crosses Jellicoe Street which is the main street that runs through Te Puke. Photos 36 and 37 are taken between Jellicoe Street and the railway line. **Distance from Road/Proximity to Development:** The Drain is situated adjacent to a commercial development. An area that is used for parking is right adjacent to the drain. **Safety:** The Drain has to be better protected from the road.	**Distance from Road/Proximity to Development:** A wooden barrier existed between the parking area and the Drain. The remains of the wooden fence can be seen on photo 36. This wooden fence should be reinstated to its original state.
13	**Position:** This Drain is situated in the industrial area and is the extension of Drain 12. Drain 13 is on the northern side of the railway line whilst Drain 12 is on the southern side. **Depth/Batter Slope:** The Drain is deep with steep slopes but it is removed from residential development and not easily accessible especially on the northern side of Station Road. It is also reasonably well barricaded from the road as shown on photo 38. **Aesthetic Considerations:** The Drain is overgrown on the northern side of Station Road but it already in	No remedial action required.

APPENDIX 2B – TE PUKE: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	agricultural land and it wouldn't make sense to spend funds on the upkeep of the drain. **Safety:** The problematic section of this Drain is on Agricultural land and difficult to access.	
14	**Position:** This Drain is on the edge of town and is contained within cow paddocks. It is wide at its upper reaches and only becomes a defined drain before it crosses underneath the main road. **Depth:** The Drain is deep at the point where it enters the culvert that crosses the road. **Proximity to Development:** The Drain passes directly in front of a retirement village. There are no barriers between the retirement village and the Drain. **Safety:** There is moderate risk due to the proximity to the retirement home and the Drain not being fenced off.	**Depth:** The Drain is deep at the point where it enters the culvert that crosses the road. There is a wooden barrier that protects pedestrians and traffic from the Drain. The barrier is adequate but regular inspections (6 monthly) should be made to ensure that the barrier is still intact. **Proximity to Development:** The installation of a barrier such as wooden poles connected with rope can be considered but is not essential.
15	**Position:** This Drain is the continuation of Drain 14 but just on the northern side of the main road. The Drain is reasonably sheltered from development. **Depth:** The section of the Drain between the outlet of the culvert and the pedestrian bridge is accessible to public being adjacent to a public park. This is also the deepest section of the Drain. **Safety:** It is recommended that a section of the Drain be fenced.	**Depth:** The Drain is protected from the public park after it crosses the pedestrian bridge. The more accessible and deepest section of the Drain however is before the pedestrian bridge. This section should be provided with a similar barrier as is the case for the section beyond the pedestrian bridge.

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
1A	**Position:** The Drain runs from Maketu Rd west into the estuary and is situated adjacent to the Maketu Sports Ground on one side. On the other side, the Drain is in close proximity to a few homes. From the outlet of the 600mm pipe, the Drain flows for about 100m until it empties into the estuary. There are a couple of houses adjacent to this part of the Drain that may be susceptible to flooding (Photo 4). **Inlet/Outlet Protection:** The tidal flap valve on the 600mm pipe looks to be in good condition. However, standing water in the Drains upstream warrant a look into its usefulness in keeping water from travelling upstream during the incoming tide. **Health Considerations:** There was standing water in the Drain but this is mainly due to the incoming tide. **Aesthetic Considerations:** There is vegetation growing in the middle of the Drain (Photo 2) that may cause some disturbance of flow but the drain is fairly aesthetically pleasing.	**Inlet/Outlet Protection:** The usefulness of the tidal flap valve at the outlet of the 600mm pipe under Maketu Rd should be investigated. The reason for the installation of the tidal flap valve at this location could be warranted but looks to be causing standing water upstream. **Health Considerations:** If the tidal flap valve is removed, potentially less water will build up against the wingwall adjacent to Maketu Rd. **Aesthetic Considerations:** Removal of vegetation in the middle of the drain would provide better storage of tide water and a more aesthetically pleasing waterway.
1B	**Position:** This Drain is located almost entirely adjacent to private property between Wilson Rd Nth and Maketu Rd. The Drain meets with Drain 2 (Photo 1) and discharges into Drain 1A via a culvert under Maketu Rd. **Inlet/Outlet Protection:** The outlet pipe at Wilson Rd Nth could not be inspected. It is overgrown with grasses and weeds. There is also a conduit with services crossing over the drain and buried at both ends (Photo 9). There is no safety or site rail at this location either which could pose a safety risk as well.	**Inlet/Outlet Protection:** The pipe outlet at Wilson Rd Nth should be cleared and inspected for blockage. Look at installing safety rail at culvert inlet and outlet at Wilson Rd. Nth. **Aesthetic/Health Considerations:** Re-assess the effectiveness of the Drain to prevent flooding once the tidal flap valve investigation is completed. Some of the vegetation and growth could be removed to create more storage capacity for any future flood waters. **Proximity to Development:** If maintenance becomes a problem then formalising one of the easements into a maintenance track should be investigated. Currently, maintenance will require land

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Aesthetic/Health Considerations: In general the shallow Drain looks to be functioning well with some flower and grass growth throughout (Photo 7). There is standing water in the Drain stemming from the same issue of tidal flap valves on pipes in Drain 1a. **Proximity to Development:** Access for maintenance seems to be limited, although there is land for legal roads both from Maketu Road, behind 660 Maketu Rd down to the drain (it's actually Drain 4), and along the drain to Wilson Rd Nth (called Tereina Rd on the site map). The adjacent property owners along this boundary have moved their fences to the edge of the drain. **Flood Risk:** Dependant on the blockage at Wilson Rd Nth and the tidal flap valves, the properties between no. 37 and Wilson Rd Nth could be susceptible to flooding in extreme rain events.	entry consent from landowners.
1C	**Position:** This Drain is located upstream of Drain 1B. It is a deep drain, 2-3 m deep that meanders from Church Rd between several properties to Wilson Rd Nth. Property fences between Church Rd and Wilson Rd Nth are near the bank's edge of the deep Drain (Photos 10 & 13). **Inlet/Outlet Protection:** This Drain is very deep and steep with no protection at both ends. This poses a potential problem for motorists and cyclists along Wilson Rd Nth or any kids playing in the area. There is also no outlet protection at Church Rd. The pipe under Church Rd is blocked by growth at both the inlet and outlet. **Aesthetic/Health Considerations:** The Drain is heavily overgrown with grasses and weeds throughout (Photos 10,	**Inlet/Outlet Protection:** The inlet at Wilson Rd Nth and inlet/outlet at Church Rd should be cleared to allow investigation and to ensure free drainage. **Aesthetic/Health Considerations:** The overgrowth should be trimmed to the extent possible because of limited access. It may have to be cleared by hand. Re-assess the effectiveness of the drain to prevent flooding once tidal flap valve investigation is completed. **Proximity to Development:** Establishment of a formal easement for maintenance should be investigated.

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	11, 13, and 14). The inlet pipe at Wilson Rd Nth is overgrown and there are also two pieces of metal sticking out of slope (Photo 11). Their function is unknown. The water at the inlet adjacent to Wilson Rd Nth is stagnant with algae growing on the surface. **Proximity to Development:** As mentioned above, there are several homes located near the top edge of the Drain batter. Access to the Drain will be limited because of the location of the fences.	**Safety Concerns:** Safety rails should be installed on the inlet and outlet of culverts under Church Rd and Wilson Rd Nth.
1D	**Position:** This Drain is located upstream of Drain 1C east of Church Rd. It is a deep drain, 2-3 m, meandering from the bottom of the hills up Little Waihi Road between several properties to Church Rd. **Inlet/Outlet Protection:** The inlet pipe at Church Rd is overgrown. The pipe under Church Rd is blocked by growth at both the inlet and outlet. There is no safety railing at the Church Rd outlet. **Aesthetic/Health Considerations:** The Drain is heavily over grown with grasses and weeds throughout (Photos 15-18). **Proximity to Development:** The Drain actually meanders under a driveway at 37 Little Waihi Rd (Photos 15 & 16). Once past this property the flood risk is minimal to adjacent properties.	**Inlet/Outlet Protection:** The inlet at Wilson Rd Nth and inlet/outlet at Church Rd should be cleared to allow investigation and to ensure free drainage. **Aesthetic/Health Considerations:** The overgrowth should be trimmed to the extent possible because of limited access. It may have to be cleared by hand. **Proximity to Development:** Re-assess the effectiveness of the drain to prevent flooding once tidal flap valve investigation is completed.
2	**Position:** This Drain runs parallel to Spencer Ave, starting from a paddock near the cul-de-sac and ending at Maketu Rd. The drain begins as lowest point for runoff from paddock to flow in to (Photo 19).	**Inlet/Outlet Protection:** The cause of the stagnant water seems to stem from the tidal flap valves on the ends of the outlet pipes in Drain 3 (Photo 28) and Drain 1A (Photo 3). If the flap valves are removed, storm water in Drain 2 could flow into Drain 3 then out to the estuary.

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	Inlet/Outlet Protection: The inlet/outlet at the paddock access from Spencer Ave. is blocked with growth (Photo 20). The pipe's size could not be determined. There is a secondary drain that empties into Drain 2 (Photo 21). The outlet pipe at Maketu Rd is grown over with various grasses so the size of the pipe could not be assessed (Photo 23). The pipe discharges into Drain 3 from a 450mm diameter pipe. There is no railing along the Drain, which is located between 2-3 m from Spencer Ave. However, a low speed environment exists on the rural Spencer Ave. **Aesthetic/Health Considerations:** Once the Drain begins there is noticeable standing water 0.5 to 1m deep. The water has been stagnant for some time as there is algae present on the surface (Photos 20-22). **Proximity to Development:** There is a fence leaning over the Drain from the property on the corner of Spencer Ave and Maketu Road (Photos 21, 22, & 24).	**Aesthetic/Health Considerations:** See above. If the stagnant water should be allowed to empty all the way into the estuary, the algae on the surface could disappear. The rubbish should be removed from the Drain. **Proximity to Development:** The fence leaning over the Drain should be repaired or replaced so it doesn't fall into the Drain and cause further blockage.
3	**Position:** This Drain is adjacent to Spencer Ave, across from Drain 2. The Drain collects storm water from the carriageway as well as from properties at the end of Spencer Ave. The Drain has some rip rap at the beginning to help with scour. **Aesthetic/Health Considerations:** Like Drain 2, this Drain has a significant amount of stagnant water with algae on top of the water's surface (Photo 25) suggesting the water has been there for a significant length of time. There are also pine tree branches hanging into the Drain. The branches do not hinder flow but could cause blockage if the	**Aesthetic/Health Considerations:** See above. If the stagnant water should be allowed to empty all the way into the estuary, the algae on the surface could disappear. The rubbish should be removed from the Drain. **Inlet/Outlet Protection:** It is suggested that the removal of the tidal flap valves be investigated where Drain 1 discharges into Drain 2 and also at the pipe outlet from under former access way (Photo 10). Grates at these locations could be considered as an alternative.

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	branches were to fall into the Drain. **Inlet/Outlet Protection:** A 300mm drain pipe under a former access way to the adjacent property is partially blocked and should be cleared (Photo 26). There are tidal flap valves present on the outlets of 3 pipes (Photo 28). The pipe underneath Maketu Road is 500mm in diameter and is protected by a grate at its inlet and a tidal flap valve at its outlet. The grate was clear at the time of the site visit. **Environmental Considerations:** There are gabion baskets present around the 600mm pipe inlet. The gabion baskets are beginning to deteriorate.	**Environmental Considerations:** The gabion baskets should be monitored for further degradation and repaired or replaced if failing to support the slope and road surface.
4	**Position:** Located in road reserve (according to Quickmap) between Drain 1b and Maketu Rd. **Aesthetic/Health Considerations:** There was a small amount of standing water at the time of inspection. **Environmental Concerns:** A small amount of erosion is evident on the sides of the Drain.	No action required at this particular Drain.
5	**Position:** This Drain is an off-shoot from Drain 1b. **Aesthetic/Health Considerations:** There was some standing water at the time of inspection.	No action required.
6	**Position:** This Drain is not of significant length and is not identified on the storm water	**Inlet/Outlet Protection:** Clear overgrowth from the culvert on south end.

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	services layout plan supplied by Duffill Watts. However, it should be included in the study as it drains into Drain 1B. The Drain is adjacent to Wilson Rd Nth between no. 649 and Spencer Ave and varies in depth from 0.5m to 2.5m along that line. **Inlet/Outlet Protection:** There is no railing located along the Drain but the speed limit is only 50km/hr. The culvert emptying into the Drain at the south end is overgrown. **Aesthetic/Health Considerations:** The Drain is overgrown with grasses and has about a metre of standing water where it meets Drain 1b. **Proximity to Development:** The pipes under driveways at address no. 647 are blocked. This blockage could cause some flooding of the adjacent property and roadway in an extreme rain event. The house located on this property is elevated about a metre indicating that flooding could be a problem.	**Aesthetic/Health Considerations:** The Drain should be cleared of overgrowth to provide storm water storage in an extreme rain event. **Proximity to Development:** The culverts under the driveways at 647 Wilson Rd Nth should have their inlets cleared of vegetation and debris to allow flow.
7	**Position:** Much like Drain 6, this Drain is not of significant length and is not identified on the storm water services layout plan supplied by Duffill Watts. However, it should be included in the study as it drains into Drain 1C. Located adjacent to Wilson Rd Nth across from Drain 6. **Inlet/Outlet Protection:** The Drain is located between 3 and 4 metres from Wilson Rd Nth. There is no railing located along the Drain but the speed limit is only 50km/hr. **Aesthetic/Heath Considerations:** The Drain is overgrown but deep enough, at 2-4 metres, to handle a significant	**Aesthetic/Heath Considerations:** Overgrowth should be trimmed back.

APPENDIX 2C – MAKETU: DISCUSSION OF DRAIN CONDITION AND REMEDIAL ACTION REQUIRED		
Drain No	**Discussion**	**Remedial Action Required**
	amount of storm water. The culvert emptying into the Drain at the south end is overgrown.	
8	**Position:** This Drain outlets on to the beach behind the Maketu Surf Club through an underground 750mm RCP about 150-200m from the inlet on the northeast corner of the intersection of Town Point Rd and Ngaroma Lane. The Drain follows Town Point Rd on the North side for about 50m, crosses under, and continues up the road on the South side for at least another 200-300m. **Inlet/Outlet Protection:** The depth of the Drain varies between 0.5m, at the intersection of Town Point/Ngaroma, and a depth of 1.5m at the northeast end of the Drain. There is debris covering the inlet and outlet of the culvert under the gravel driveway at 13 Town Point Road (Photos 39 & 40). **Proximity to Development:** There is a small rock and soil pile next to the power pole just upstream of the headwall (Photo 37). There are also telecommunications cables crossing the Drain in conduit (Photo 37).	**Inlet/Outlet Protection:** The blocked inlet and outlet at the gravel driveway should be cleared of all debris (Photos 40). **Proximity to Development:** The small pile of rock and soil (Photo 37) should be removed with care taken not to damage the telecommunications conduit crossing the Drain.

APPENDIX 3

Drain and Safety Risk Index

APPENDIX 3A: Waihi Beach

APPENDIX 3B: Te Puke

APPENDIX 3C: Maketu

APPENDIX 3A – WAIHI BEACH: DRAIN & SAFETY RISK INDEX			
DRAIN INDEX SORTED		SAFETY RISK INDEX SORTED	
Drain No	Drain Index Value	Drain No	Safety Risk Index
5 ✓	7.4	8	7.65
2 ✓	7.15	2	7.15
14	6.59	4	6.65
8 ✓	6.4	14	7.09
20	6.4	5	6.9
6 ✓	6.36	20	7.65
18 ✓	6.15	17	4.65
13	5.65	18	6.15
19	5.49	19	6.74
4 ✓	5.4	6	6.86
7 ✓	5.12	13	5.4
17	4.65	7	6.12
22	3.33	22	3.33
21	3.33	23	3.86
11	2.96	11	2.96
3	2.68	3	3.43
23 ✓	2.36	1	3
9	2.33	21	2.58
1	1.5	9	2.33
15	0	15	1.5
16	0	16	1.5

APPENDIX 3B – TE PUKE: DRAIN & SAFETY RISK INDEX			
DRAIN INDEX SORTED		SAFETY RISK INDEX SORTED	
Drain No	Drain Index Value	Drain No	Safety Risk Index
2 ✓	5.58	12D	5.67
12D ✓	4.92	2	5.58
9	4.74	15	4.74
15 ✓	4.74	9	3.99
13	4.65	8	3.92
8	3.92	13	3.9
10 ✓	3.33	14	3.71
12C ✓	3.33	12C	3.33
11	3.29	3B	2.83
5	3.2	1	2.75
3B	2.33	10	2.58
12B ✓	2.33	5	2.5
1 ✓	2.25	12B	2.33
14 ✓	2.21	11	1.79
12A	1.54	12A	1.54
3A	0	3A	0.75
4	0	4	0.75

APPENDIX 3C – MAKETU: DRAIN & SAFETY RISK INDEX			
DRAIN INDEX SORTED		SAFETY RISK INDEX SORTED	
Drain No	Drain Index Value	Drain No	Safety Risk Index
3	8.01	1C	12.15
1C	7.15	1B	9.71
2	6.88	1D	7.15
1D	6.40	1A	7.04
1B	5.96	3	6.51
7	5.83	6	5.42
1A	5.79	2	5.38
6	5.67	7	5.08
4	2.25	8	3.75
5	1.79	5	1.79
8	1.75	4	1.00

APPENDIX 4

Maintenance Schedule

APPENDIX 4A: Waihi Beach

APPENDIX 4B: Te Puke

APPENDIX 4C: Maketu

APPENDIX 4A – WAIHI BEACH: MAINTENANCE SCHEDULE					
DRAIN NUMBER	TOTAL LENGTH		LENGTH THAT REQUIRES		TYPE OF MAINTENANCE
	Within Development	Outside Development	Maintenance	Piping	
1	20				This Drain is in essence a shaped dune and should not be interfered with.
2	90		40	50	Minimal trimming is required.
3		130			This Drain is for all intent and purposes outside of development and is situated at the toe of natural bush which should not be interfered with.
4	350	350	350		This Drain is lined with stone and mortar over half of its length which can be cleaned. The remaining half is not lined but can also be cleaned along the bottom to remove stone and debris.
5	100		15		The initial 15 metres of this drain is open to the public and is not aesthetically pleasing and should be cleaned by removing rocks and weeds.
6	165		50	60	The western section of this Drain is extensively overgrown. It is however not aesthetically unacceptable and creates a hedge between the two adjacent properties. The owners might even object if the drain is cleaned. It is suggested that the owners be consulted and that only the inlet be exposed if the owners are against the removal of the growth.
7	235	1720	235		The initial 80 metres is dense grass that has to be trimmed. The remainder is less dense but still requires a bit of trimming
8	680				This Drain is situated in between private properties and this evaluation is based on what can be seen on photos 22 and 23 and the photos in Appendix 6. This is a waterway and it won't serve much purpose to do maintenance also taking into consideration that it is difficult to access inside the private properties.
9	45				These Drains should be left in its natural environment.
11	200				
13	750				
14	400	900			This Drain only affects one or two properties directly and could also cause potential problems with the owners in the vicinity. It is suggested that the drain be left as it is.
15	40		40		These Drains consist of half-round concrete channels which can easily be cleaned.
16	50		50		
17	70		70		Drain 18 is an extension of drain 17 and both will be subject to the same maintenance. These Drains are

APPENDIX 4A – WAIHI BEACH: MAINTENANCE SCHEDULE					
DRAIN NUMBER	TOTAL LENGTH		LENGTH THAT REQUIRES		TYPE OF MAINTENANCE
	Within Development	Outside Development	Maintenance	Piping	
18	225		225		situated in easements which also act as open spaces for the public. These Drains are extensively overgrown and most of the weeds should be removed and be replaced with more appropriate plant material.
19	630		630		This Drain does not require extensive maintenance but it would be beneficial to initiate a maintenance programme at this point in time. The initial maintenance however should be minimal.
20	800				This Drain is slightly removed from development and funds could rather be spent elsewhere.
21	130				This Drain should be left in it's natural environment
22	120		120		This Drain should be left in it's natural environment
23	245		245		This Drain requires regular trimming which seems to be happening already.
TOTAL	5,345	3,100	2,070	110	

APPENDIX 4B – TE PUKE: MAINTENANCE SCHEDULE					
DRAIN NUMBER	TOTAL LENGTH		LENGTH THAT REQUIRES		TYPE OF MAINTENANCE
	Within Development	Outside Development	Maintenance	Piping	
1	193		0	0	The drain will be very difficult to maintain.
2		207	0	207	The drain is adjacent to a sports field and it would be to the benefit of the community as a whole to keep the drain in a neat condition or be piped.
3	523		0	0	The drain is fenced off and not easily accessible to the general public. There is livestock that graze on it and it is in a general neat condition as it is.
4			0	283	The drain is in the process of being piped.
5	152		0	0	The drain is overgrown but it wouldn't make sense to keep it in a neat condition as the area adjacent to it will remain overgrown.
6	256		0	0	Cannot find drain
7	306		0	0	The drain is inside private property and the condition couldn't be assessed.
8	564		0	0	The drain is on private property and should be maintained by the owners of the property.
9		537	0	0	The drain is removed from residential development and for the most part on agricultural land. No maintenance required.
10	702		0	0	The drain is situated within a park area. The park area is maintained up to the drain. No additional maintenance is required.
11		380	0	0	The drain is very remote and is situated in an area that is generally untidy. To do maintenance will not add value to the community.
12	1,409		37	0	The only section of this drain that requires maintenance is the section between Jellicoe Street and just short of the railway line. This section can be seen on photo 36. It is accessible and in the public eye.
13		1,156	0	0	The drain is removed from residential development and for the most part on agricultural land. No maintenance required.
14		1,336	0	0	The drain is kept in a tidy state due to livestock that grazes on it.

APPENDIX 4B – TE PUKE: MAINTENANCE SCHEDULE					
DRAIN NUMBER	**TOTAL LENGTH**		**LENGTH THAT REQUIRES**		**TYPE OF MAINTENANCE**
	Within Development	**Outside Development**	**Maintenance**	**Piping**	
15		1,295	0	0	The drain is removed from residential development and for the most part on agricultural land. No maintenance required
Total	**4,105**	**4,911**	**244**	**490**	

APPENDIX 4C – MAKETU: MAINTENANCE SCHEDULE					
DRAIN NUMBER	TOTAL LENGTH (m)		LENGTH THAT REQUIRES (m)		TYPE OF MAINTENANCE
	Within Development	Outside Development	Maintenance	Piping	
1A		100	20	n/a	The pampas grass in the middle of the drain downstream from Maketu Road should be removed. Investigate the usefulness of the tidal flap valves on the outlet pipes and whether or not they can be removed or replaced with grates.
1B		350		n/a	The outlet pipe under Wilson Rd Nth should be cleared of all growth and inspected for blockage. Monitor the gabion baskets and replace if further degradation occurs.
1C		250	250	n/a	This Drain should be trimmed as much as possible with the lack of access. The areas around the inlet/outlet at Wilson Rd Nth and the pipe inlet/outlet at Church Rd should be cleared. Hand clearing may be needed if a machine cannot gain access. The Pipe inlet/outlets should be inspected for blockage and damage.
1D		250	250	n/a	This Drain should be trimmed of overgrowth and outlet/inlet at Church Rd cleared. The Pipe inlet/outlets should be inspected for blockage and damage.
2		150	30	n/a	Fence should be repaired, replaced, or removed if on Council land. The vegetation around the outlet pipe at Maketu Rd and the inlet/outlet at the gated access way should be cleared.
3		125	25	n/a	Minimal trimming and tree/bush removal is required. The pine tree branches hanging into the drain should be trimmed. Investigate the usefulness of the tidal flap valves on the outlet pipes and whether or not they can be removed or replaced with grates.
4		100	100	n/a	This Drain needs no maintenance currently.
5		115	115	n/a	This Drain needs no maintenance currently.
6		200	200	n/a	The complete length of this drain should be trimmed. The pipes under the driveways at 647 Wilson Rd Nth should be cleared of all debris around the inlets and inside.
7		65	65	n/a	The complete length of this drain should be trimmed.
8		410		n/a	The blockage at the inlet/outlet of the pipe under the gravel road at 13 Town Point Road should be removed. The small pile of rock and soil just upstream of the headwall in front of 9 Town Point Road should be cleared with care taken not to damage the service crossing the drain.

APPENDIX 5

Capital Programme

APPENDIX 5A: Waihi Beach

APPENDIX 5B: Te Puke

APPENDIX 5C: Maketu

APPENDIX 5A – WAIHI BEACH: CAPITAL PROGRAMME					
Drain	**Description**	**Unit**	**Quantity**	**Rate**	**Amount**
2	525 mm diameter stormwater pipe	m	50	$ 450	$ 22,500
2	1050 manhole	No	1	$ 2,500	$ 2,500
4	Wooden poles with rope barrier	m	200	$ 40	$ 8,000
5	Wooden fence	m	20	$ 120	$ 2,400
6	750 mm diameter stormwater pipe	m	60	$ 500	$ 30,000
6	1050 manhole	No	1	$ 2,000	$ 2,000
6	Wooden guardrail	No	1	$ 1,000	$ 1,000
7	Possible upgrade has to be determined				
8	Protect embankment	m^2	100	Medium term	Medium term
18	Outlet Protection	No	1	$ 4,000	$ 4,000
23	Entrance protection as shown on photo 46	No	1	$ 400	$400
					$ 72,800

APPENDIX 5B – TE PUKE: CAPITAL PROGRAMME					
Drain	**Description**	**Unit**	**Quantity**	**Rate**	**Amount**
1	Scruffy Dome manhole	Each	1	$ 4,000	$ 4,000
2	800 mm stormwater pipe	m	207	$ 750	$ 155,250
10	Corrugated iron culvert adjustments	Sum			$ 4,000
12B	Repair wooden fence	Sum			$ 3,000
12C	Repair wooden fence	Sum			$ 3,000
12D	Construct barrier	m	40	$ 80	$ 3,200
14	Wooden poles with rope barrier	m	100	40	$ 4,000
15	Construct barrier	m	80	120	$ 9,600
					$ 186,050

APPENDIX 5C –MAKETU: CAPITAL PROGRAMME					
Drain	**Description**	**Unit**	**Quantity**	**Rate**	**Amount**
1B	Gabion replacement	m^2	10	$400	**$ 4,000**
1B	Wooden guardrail	No	1	$ 1,000	**$ 1,000**
1C	Wooden guardrail	No	2	$ 1,000	**$ 2,000**
1D	Wooden guardrail	No	1	$ 1,000	**$ 1,000**
2	Removal, replacement or repair of fence.	Will need to be priced if fence is on council land.			
6	Wooden guardrail	m	150	$ 40	**$ 6,000**
7	Wooden guardrail	Sum			**$ 6,000**
8	Remove debris from Drain.	Hr	3	$150	**$ 450**
					$ 20,450

APPENDIX 6

Waihi Beach: Easement Considerations – Drain 8

APPENDIX 7

Waihi Beach: Flooding Risk – Drain 8

APPENDIX 8

Offers of Service

6 March 2006

Duffill Watts & King Ltd
PO Box 330
TAURANGA

ATTENTION: Donald Richardson

File: 4/Client.Gen

Dear Donald

CATEGORISATION OF OPEN STORMWATER DRAINS AND SUBSEQUENT PILOT STUDY IN THE WESTERN BAY OF PLENTY DISTRICT COUNCIL AREA

Further to discussions held between yourself and Graham Sweetlove and Paul Viljoen from Opus International Consultants on 17 January 2007, we are pleased to offer the following proposal:

SCOPE OF SERVICES

Open storm water drains of various shapes and sizes exist in the Urban Areas that fall under the jurisdiction of the Western Bay of Plenty District Council. The Urban Areas that are primarily involved are:

- Waihi Beach
- Te Puke
- Katikati
- Maketu.
- Island View
- Athenree
- Bowentown

The initial phase will involve the categorization of open storm water drains according to factors such as:

- Geometrical Parameters
  - Depth
  - Batter Slope
  - Distance between tar surface and drain
- Inlet/Outlet Protection
- Position to sensitive facilities
- Health Issues
  - Standing water/Mosquito breeding

NEW ZEALAND EXPORT AWARDS SUPREME WINNER 2006

Opus International Consultants Limited
Tauranga Office

405 Cameron Road
PO Box 646
Tauranga, New Zealand

Telephone: +64 7 578 2089
Facsimile: +64 7 578 2086
Website: www.opus.co.nz

Chances of Water Pollution

- Aesthetic issues
- Safety
- Importance
  - Political
  - Council

On acceptance of the various categories of open storm water drains, a pilot study will be conducted with Waihi Beach as the focus area. Existing records as provided by Duffill Watts & King Ltd, will be used and augmented with on site investigations.

The following outputs will be provided:

- The various categories of drains will be shown spatially for the focus area.
- Remedial action for each category will be suggested where remedial action is deemed to be required.
- Any Legislation that is applicable to open storm water drains will be investigated and documented. The remedial action that is suggested will take cognisance of the requirements laid down by any legislative documents. The Legislation that will be looked into are:
  - Resource Management Act 1991
  - Local Government Acts 1974 as Amended 2002
  - Drainage Act 1908
- The outcome of the pilot study will also involve a cost estimate to do the remedial work that is required.
- An indication of the extent of the problem in relation to the total length of roads in the urban area.
- The assimilated data will be provided in an Excel spreadsheet. The feasibility to augment the Council's GIS with the additional data will be investigated.

METHODOLOGY

The study will be done in two phases with the categorization of open storm water drains done during the initial phase. This will involve on site investigation. The Pilot study will be conducted as a second phase.

PERSONNEL

Key personnel proposed for the scheme are as follows:

Paul Viljoen:	Project Manager
Keith Caldwell:	Review/Verification

PROGRAMME

The initial phase to be completed within 2 weeks after the Offer for Service has been accepted.

The second phase to be completed within two weeks after the categorization of the open storm water drains have been agreed upon.

FEE PROPOSAL

The Study is estimated to consume 96 man hours to be charged out at $120/hr. The time allocated to the Project is as follows:

Determine parameters and design spreadsheet	1 day
Write main Report	2 days
Legislation research and document findings	2 days
Financial analysis/Review/Verification	1 day
Site work and document findings	4 days
GIS related work	2 days
Total	12 days (96 hours)

The transport cost for the field work is estimated at $ 300. The total cost of the Project will thus amount to $ 11820 (Excluding GST).

The IPENZ General Conditions of Engagement apply and we enclose a Short Form Agreement for this offer for your approval. Please do not hesitate to contact me should you wish to discuss any item in our proposal. If you think that the Project has been under – or over scoped we would be happy to discuss an alteration to the scope. We look forward to your approval of this offer and receiving a copy of the authorised agreement in due course.

Yours sincerely

Paul Viljoen
PROJECT MANAGER
g:\4client.gen\01-offersof service\offers-2007\WBOPDC_Drains_Structures

13 September 2007

Duffill Watts & King Ltd
Level 2, Regency House
1 Elizabeth Street
PO Box 330, Tauranga
New Zealand

ATTENTION: Donald Richardson

Dear Donald

CATEGORIZATION OF OPEN STORM WATER DRAINS IN TE PUKE AND MAKETU.

Further to discussions held on 30 August at your offices we are pleased to offer the following proposal:

SCOPE OF SERVICES

Duffill Watts Consulting Group appointed Opus in February 2007 to establish a general categorisation of open stormwater drains that can be applied to any study area. The emphasis of the study concerned the safety of the drains and what remedial action was required if any.

This appointment was completed on 19 March 2007 and the general principles contained in the Report were accepted. The Report also included a field study of the open drains situated within Waihi Beach.

Opus has been requested to extend the field studies to include the Te Puke and Maketu areas. The format that was used for the field study for Waihi Beach will be duplicated for the new study areas.

EXCLUSIONS

METHODOLOGY

An on site investigation will be done in both the Te Puke and Maketu areas. The results of the investigation will be used to categorize each drain.

GIS maps were received from Duffill Watts and these will be used to identify the open stormwater drains that will be evaluated.

PERSONNEL

Key personnel proposed for the scheme are as follows:

Paul Viljoen: Project Manager
Johan Meintjies: Review/Verification

PROGRAMME

The study to be completed within four weeks after the Short Form Agreement has been signed.

FEE PROPOSAL

The Study is estimated to consume 80 man hours to be charged out at $125/hr. The time allocated to the Project is as follows:

Write Report	2 days
Financial analysis/Review/Verification	2 days
Site work and document findings	4 days
GIS related work	2 days
Total	10 days (80 hours)

The transport cost for the field work is estimated at $ 300. The total cost of the Project will thus amount to $ 10,300 (Excluding GST).

The IPENZ General Conditions of Engagement apply and we enclose a Short Form Agreement for this offer for your approval. Please do not hesitate to contact me should you wish to discuss any item in our proposal. If you think that the Project has been under – or over scoped we would be happy to discuss an alteration to the scope. We look forward to your approval of this offer and receiving a copy of the authorised agreement in due course.

Yours sincerely,

Paul Viljoen

PROJECT MANAGER

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APPENDIX 9

Drain Inspection Sites Map

APPENDIX 9A: Waihi Beach

APPENDIX 9B: Te Puke

APPENDIX 9C: Maketu

APPENDIX 9A

Waihi Beach Drain Inspection Sites Map

N

Seaview Road
Pacific Road
Ocean View Road
Pyle Road
Walnut Avenue
Parade Avenue
Beach Road
Brighton Road
Leo Street
Bilital Street
Gibson Street
Elizabeth Street
Shaw Road
Hillview Road
The Crescent
Curtis Avenue
Bruce Crescent
Seaforth Road

Waihi Beach Drain Inspection Sites

Legend

- Culvert
- Photo direction
- Low drain index
- High drain index

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SHEET	REVISION
PROJECT NUMBER 2-9Z178.01_001TC	

APPENDIX 9B

Te Puke Drain
Inspection Sites Map

Te Puke Drain Inspection Sites

Legend

- Photo Direction
- Low Drain Index
- High Drain Index

OPUS INTERNATIONAL CONSULTANTS

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SHEET	REVISION
PROJECT NUMBER - 29Z178.01_000TC	

APPENDIX 9C

Maketu Drain
Inspection Sites Map

Maketu Beach Drain Inspection Sites

Legend

- High Drain Index
- Low Drain Index
- Photo Direction

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