STORMWATER DESIGN CHALLENGES – HAMPTON DOWNS MOTORSPORT PARK

Dr Sean Finnigan, Senior Environmental Engineer & Associate, Fraser Thomas Ltd

ABSTRACT

Fraser Thomas were commissioned by GP Farms Ltd to prepare a Stormwater Management Plan for a new motorsport complex and associated Business Park covering some 90ha at Hampton Downs, North Waikato. This paper describes the stormwater management systems adopted for the complex and the issues experienced in implementing these systems in a unique and dynamic motorsport raceway environment.

A comprehensive Stormwater Management Plan was prepared in accordance with relevant guidelines which determined hydrological characteristics of the area encompassing the motorsport circuit and business park catchments and included detailed design of stormwater collection, conveyance, treatment, detention and monitoring measures for these catchments.

Effective stormwater treatment and detention was designed and implemented for both the motorsport and business catchments as appropriate to satisfy stormwater quantity, quality and channel protection requirements. A "treatment train" approach was adopted, involving the use of suitable devices for the removal of litter and hydrocarbons from runoff, swales for stormwater treatment and conveyance and downstream wetlands to provide contingency treatment and peak flow attenuation and to improve the flooding situation which occurs at times on the Flats below the site.

The motorsport complex is now operational, with an extension to the race track and completion of the business park planned for the near future.

KEYWORDS

Stormwater, motorsport, treatment train, swales, wetlands, detention

PRESENTER PROFILE

Dr Sean Finnigan is a senior environmental engineer with over 15 years experience and specialist stormwater expertise. He has been involved in around 90 stormwater projects, including integrated catchment management planning; design and consenting for residential and rural-residential subdivisions and some commercial/industrial developments in the upper North Island.

1 INTRODUCTION

GP Farms Ltd are currently developing a new and unique motorsport complex and an associated Business Park at Hampton Downs, North Waikato. The site is located between State Highway 1 and the Waikato River, four kilometres south of Meremere as shown in Figure 1.

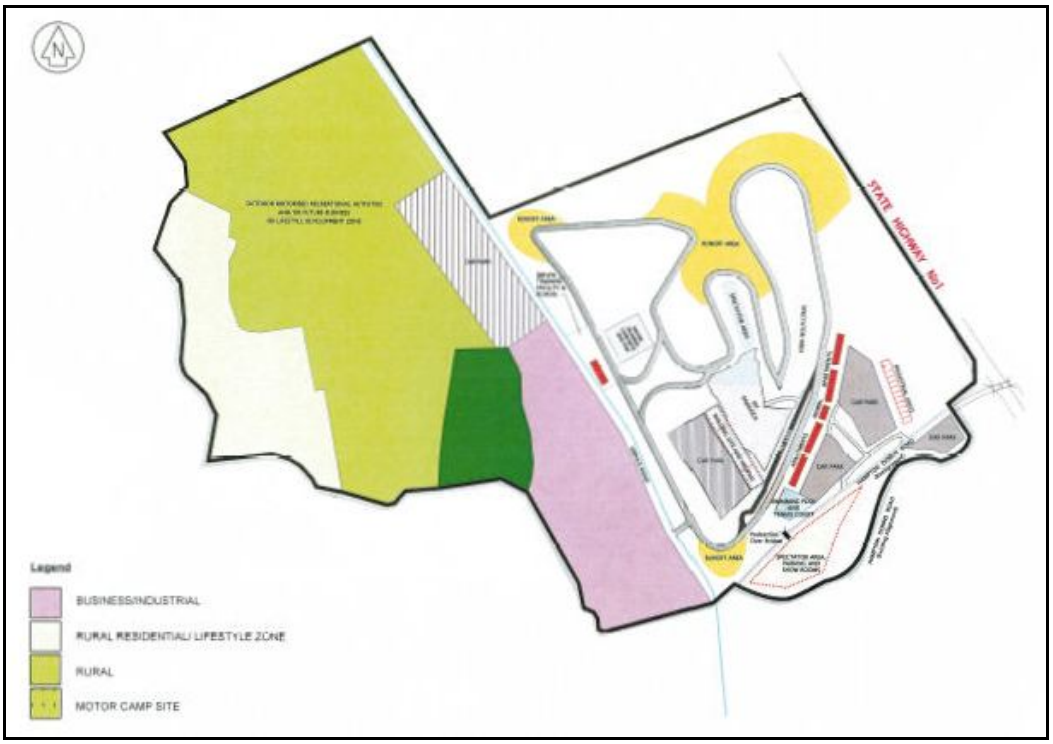

Figure 1: Motorsport and Business Park Development – Original Schematic Plan

The motorsport circuit is being developed within a sub-catchment of the Waipapa stream and occupies a total area of 69.2ha ("motorsport catchment"). It comprises an approximately 3.8km long motorsport circuit with pit garages and associated ancillary facilities, including spectator seating, convention centre/restaurant, driver training school, motel style accommodation, carparking, etc. The Business Park is being developed immediately west of the motorsport park and occupies a total area of 16.6ha ("business catchment"). It will comprise light industries that will generally support motorsport park activities. The Waipapa Stream itself is approximately 19.9km^2 in area and 9km long. The relative locations of these catchments and the site location are shown on Figure 2.

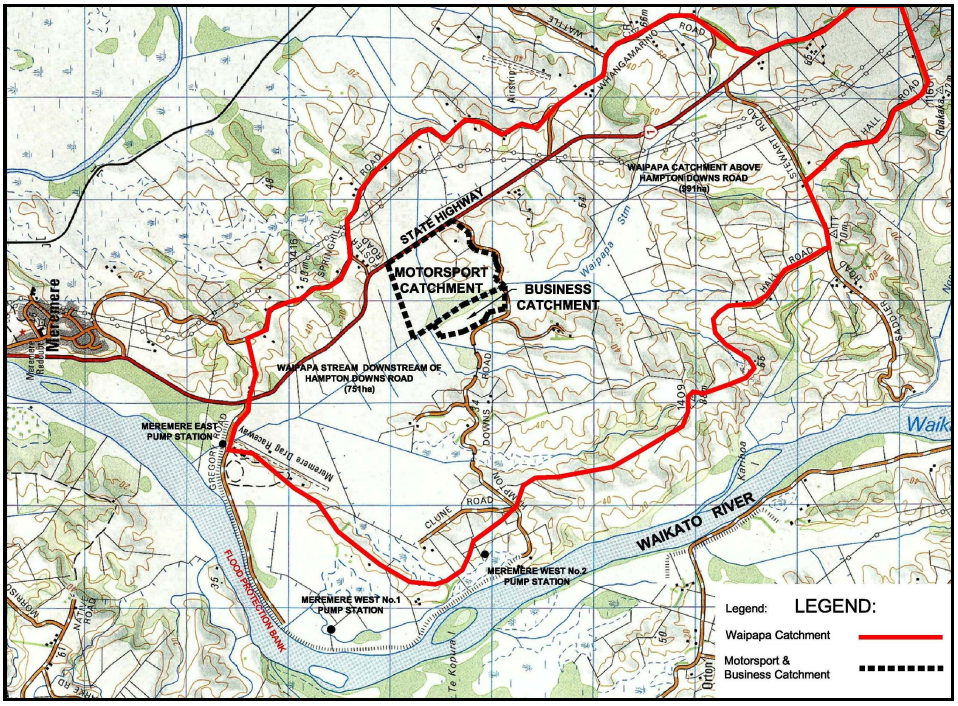

Figure 2: Waipapa Stream Catchment and Site Location Plan

Construction of the motorsport complex and associated stormwater system is largely complete, except for a proposed future extension of the track, which is to be constructed along with the Business Park in the near future.

Fraser Thomas' stormwater commission was challenging, providing stormwater planning and engineering expertise for a dynamic and unique project, with the goalposts changing frequently throughout project design and construction.

Photograph 1: Pre-development situation – farm land.

Photograph 2: During construction, showing extensive modifications of Motorsport catchment.

Photograph 3: National circuit opened 24 January 2010.

2 SCOPE

Specific tasks undertaken by Fraser Thomas for this commission included the following:

(a) To prepare guidelines for stormwater control, treatment and monitoring requirements.

(b) To calculate storm peak flows and volumes for the pre-development and post-development stages within affected catchments.

(c) To develop specific concepts and undertake detailed design of stormwater collection, conveyance, treatment, detention and monitoring measures in accordance with these guidelines.

(d) To describe potential risks associated with adverse flooding, stream bed scouring and erosion, and stormwater quality (arising from both routine and non-routine contaminant discharges) and associated stormwater management and implementation methods to avoid, remedy or mitigate such risks.

3 CATCHMENT DETAILS

3.1 PRE-DEVELOPMENT

The motorsport catchment is located immediately north of Hampton Downs Road and bounded by the Waipapa stream to the west and State Highway 1 to the east, as shown on Figure 2. The land within the motorsport catchment was formerly used for grazing, with around 45% of it comprising low lying flats, that were extensively drained by a network of excavated drains some 1.5m deep. The realigned Hampton Downs Road runs through the southern part of the Motorsport complex. The Waipapa stream is permanent below the Hampton Downs Road culvert.

The Business Park catchment comprises approximately 16.6ha of land, including some external land allocated for a wetland, and is located adjacent to the motorsport catchment on the western side of the Waipapa stream. The land within the business catchment comprises low lying, swampy flats and is currently drained by a network of excavated drains some 1.5m deep. It used to be grazed, but is now under preloading to induce consolidation of the underlying peat prior to construction works.

3.2 POST-DEVELOPMENT

The post-development motorsport and business catchments will be significantly modified from the pre-development situation, as described in the following and shown on Figures 1 and 3.

3.2.1 MOTORSPORT CATCHMENT

An existing major drain (perimeter drain) running east to west across the upper third of the site has been diverted along the eastern and southern boundaries of the site, with the drain characteristics (dimensions and gradient) replicated.

The existing topography has largely been preserved, with stormwater piped under the racetrack where necessary. However, stormwater catchments within the main complex have been significantly modified, primarily due to the presence of the main racetrack running through the catchment. A small area (catchment H) to the south has also been modified by its development for use as a carparking area.

The impervious surface area within the catchment will significantly increase from 1.0% to around 45%. New impervious areas comprise the racetrack and associated pit area, apartment blocks, conference centre and restaurant, showroom, motorsport servicing utilities and main carparking area, driver training facility/school, concrete skid pad and associated carparking.

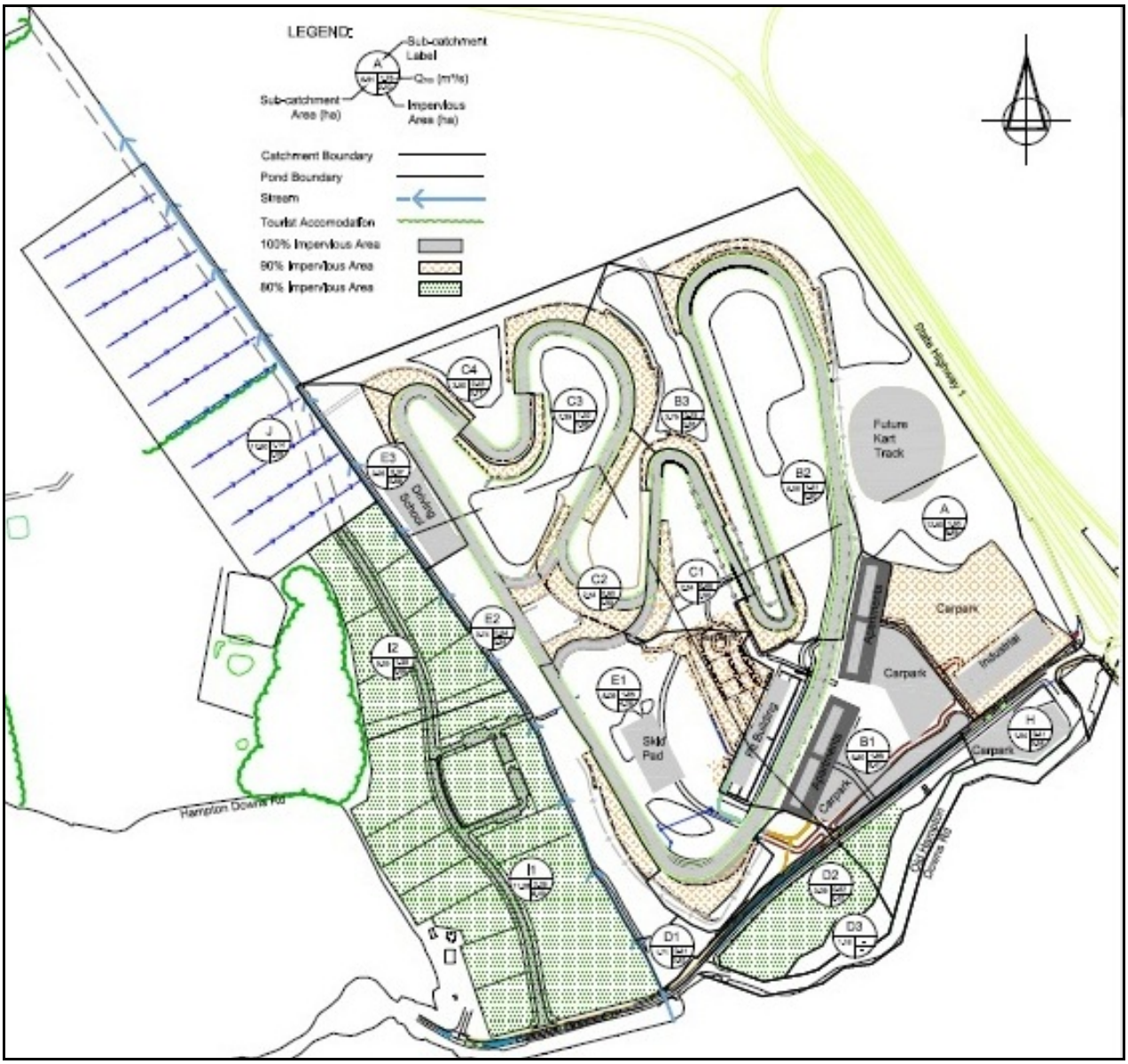

Figure 3: Post-development Catchment Plan

These carparking areas may or may not be paved, but have been assumed to be impervious for the purposes of this study, this being a conservative approach. The proposed wetlands comprise 5% of the catchment area and their bases have also been considered as impervious surfaces for modelling purposes.

"Runout" areas have been constructed around the circuit particularly at the northern end and on the south-western corner of the circuit. These comprise an approximately 50m wide "safety" strip, of which the first 10m will be gravelled and slope back towards the circuit. These runout areas were included as impervious areas in the stormwater analysis.

3.2.2 BUSINESS CATCHMENT

The Business catchment has had structural fill placed on it to raise the ground level to generally achieve the 1% AEP minimum floor level. The ground will be contoured to ensure the site continues to drain to the Waipapa Stream via engineered grassed swales at an average slope of 1%. The Business catchment will be used for light industrial activities and a maximum catchment imperviousness (buildings, paved surfaces and wetlands) of 79% has been adopted for it.

3.3 DOWNSTREAM RECEIVING ENVIRONMENT

The Waipapa Stream is the receiving environment for stormwater runoff from the Motorsport Park. A comprehensive ecological assessment of the Waipapa Stream and its tributaries by Kingett Mitchell Ltd (2004) in support of the land use application for the Motorsport Park found:

(a) The Waipapa stream and its tributaries are highly modified by agricultural practices and flood control works.

(b) The aquatic biological resources of the Waipapa Stream reflect the nature of these impacts on the physical habitats that remain.

(c) Low Quantitative Macroinvertebrate Community Index (QMCI) scores for the Waipapa Stream and tributaries are indicative of modifications to the channels and wider catchments as well as nutrient enrichment of the waterways.

(d) Low diversity and community composition of the fish population are further indications of the level of impact that farming and flood control works have had on the Waipapa stream and its catchment.

The wetland proposals and landscape planting of the site were considered to have positive ecological benefits.

4 STORMWATER MANAGEMENT

4.1 PRINCIPLES

Effective stormwater treatment and detention is provided for both the motorsport and business catchments through the adoption of a "treatment train" approach, targeting the removal of removal of litter, grease/oil and other hydrocarbons, suspended solids and heavy metals (e.g. from racing car tyres, brake linings, etc.) from stormwater runoff, using suitable devices such as grit/oil separators, swales for stormwater conveyance and treatment and wetlands for treatment and detention.

Stormwater management measures have been designed in accordance with Waikato and Auckland Regional Council guidelines to satisfy stormwater quantity, quality and channel protection requirements, ensuring that post-development flows do not exceed pre-development flows; sediment and other contaminants are adequately removed; and downstream erosion of the Waipapa stream does not increase.

Appropriate spill containment and emergency equipment and facilities are being provided to deal with any incidents that may contaminate stormwater runoff within the motorsport catchment and from individual lots within the business catchment.

Appropriate stormwater monitoring requirements have been formulated, based on a monitoring strategy for stormwater treatment and discharge, including developing interpretation and contingency measures.

4.2 BASIS

The stormwater management system is based on the following:

(a) Division into sub-catchments for pre- and post-development situations, with post-development catchments being classified as significantly modified ("dirty" catchments) or somewhat modified (i.e. "slightly dirty" catchments).

(b) The main design criteria for the stormwater management system are:
   (i) Water quality: 75% total suspended solids removal on a long term average basis.

(ii) Extended detention volume (34.5mm event) capture and release over 24 hours.
(iii) Attenuation of post-development flows to pre-development levels for the 2-100yr storm events.

(c) Adoption of a "treatment train" approach targeting:
(i) Litter and gross solids removal.
(ii) Oil/grease/hydrocarbon removal.
(iii) Removal of suspended solids, heavy metals and other contaminants via swales and wetlands.

4.3 STORMWATER MANAGEMENT SYSTEM

An overview of the stormwater management system is provided in Table 1 and shown on Figure 4.

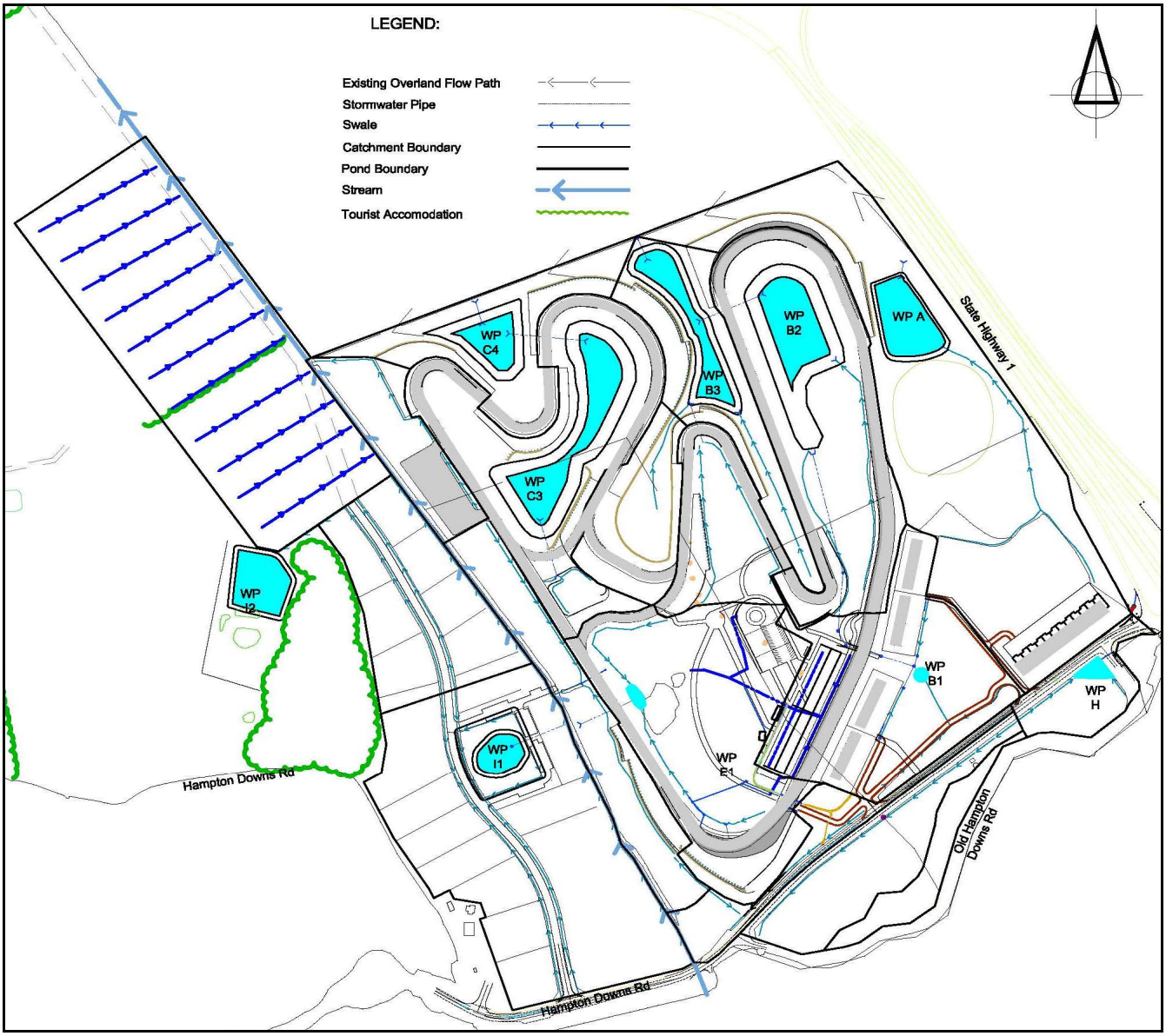

Figure 4: Stormwater Management Measures – Overview

Table 1: Stormwater Management System Details

Catch-ment	Description	Catchment Area (ha) (Imp, %)	Swale	Wetland			Other	Discharge Point
				Treat-ment	Deten-tion	Area (ha), Volume (m^3)		
A	Industrial units, carparking, possible future kart track	12.8ha (48%)	Yes	Yes	Yes	0.90ha; 8,610m^3		Perimeter open channel drain along eastern boundary
B	Significant portion of circuit, apartments, most of spectator/carparking areas, pits	18.6ha (51%)	Yes	Yes	Yes	Two (B2, B3) 3.11ha, 20,630m^3	Ecosep grit/oil interceptor for pit drainage	Perimeter open channel drain along northern boundary
C	Significant portion of circuit, large carparking/showroom area.	18.5ha (43%)	Yes	Yes	Yes	C2: 0.63ha, 5,330m^3; C3+C4: 3.55ha, 22,300m^3)		Perimeter open channel drain along northern boundary
D	Reception/conference centre and showroom/carparking area	4.8ha (67%)	Yes	No	No			Waipapa Stream
E	Part circuit, driver training facility/school	11.9ha (27%)	Yes	Yes	No	0.44ha; 1,580m^3		Waipapa Stream
H	Carparking	1.5ha (64%)	Yes	No	No	0.09ha, 780m^3		Table drain along Hampton Downs Rd
I	Business park	16.6ha (79%)	Yes	Yes	Yes	Two: I1: 0.93ha, 5,850m^3; I2: 1.13ha, 11,890m^3		Waipapa Stream

Note: Impervious percentages include allowance for the wetland surface area as impervious cover.

4.3.1 CONVENTIONAL DRAINAGE

Conventional drainage systems comprising concrete kerb and channel, open drains and piped reticulation complement the swale drainage network, with the former being installed in areas where swales are not suitable or due to other design constraints.

4.3.2 PIT DRAINAGE – SLOT DRAINS AND GRIT/OIL REMOVAL

This area posed some specific design challenges, relating to providing for the collection and treatment of stormwater runoff from the track pits area, where race cars would be routinely stopping for refuelling, tyre changes, servicing, etc. Various drainage collection options were investigated for this area, leading to selection of the Gatic slot drainage system as the preferred option, followed by treatment in an Ecosep grit/oil separator.

The Gatic slot drainage system comprises individual 3m long units with a narrow 10mm wide slot at the top and an underlying hexagonal drainage section or variable width (100-300mm), as shown in Figure 5.

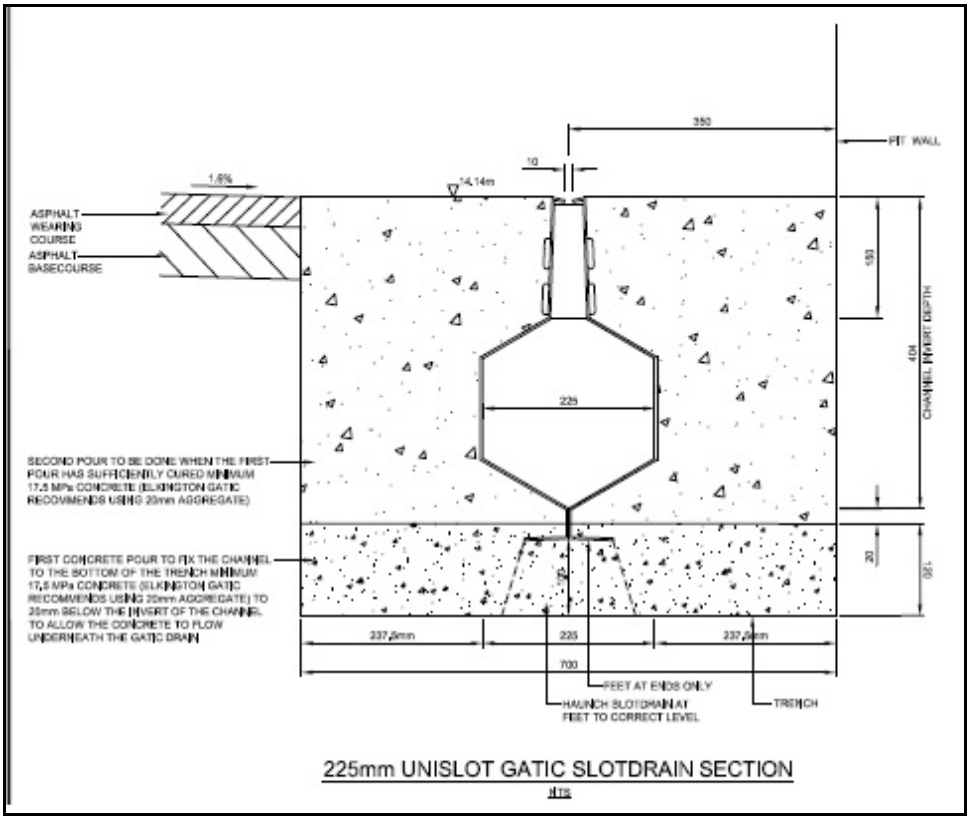

Figure 5: Stormwater Management Measures – Overview

This system has a number of specific characteristics making it suitable for this application:

(a) Safety: The gatic system is heavy duty and comes as a single unit with no removable components, providing a totally safe system with no risk of components working loose and causing a hazard to drivers. The surface area of the slot drain on the track surface is also much less than a conventional channel with grating.

(b) Efficient drainage: The gatic system is able to intercept and collect high volumes of water, with the longitudinal slot design ensuring there is maximum interception along the full channel length.

(c) Low cost installation: The gatic system comes in varying channel sizes, which can all be interconnected to form long runs with a single outlet, reducing underground pipework requirements and thus overall installation time and costs.

(d) Durability: The gatic system is capable of withstanding high loadings, impacts and is resistant to fuels and oils. Its estimated lifespan can be up to 60 years in some locations.

(e) Ease of maintenance: The v-shaped channel bottom of the hexagonal section design helps to achieve a self-cleansing action at low flow rates, reducing cleaning requirements, while the system is relatively simple to clean, particularly for jet washing.

Overall, it was considered a functional, practical and elegant solution, albeit at higher cost compared with other similar systems, and GP Farms endorsed this selection.

However, the supplier then advised that the only available Gatic drainage in New Zealand would be sufficient to collect up to approximately the 2 year storm event and it would take 6-8 weeks to import larger capacity drains from Europe. This delay was not acceptable whilst the client was still strongly in favour of using the Gatic system if at all possible.

Hence, a specific overland flow/flooding analysis was undertaken of larger storm events for the pit lane geometry, which found that ponding of up to 20-30mm might occur in the 100 year event, which gave a freeboard to the pits building of 170mm, which was considered acceptable. This assessment together with it being unlikely to hold a race event during storm events of 50mm/h or more gave the client sufficient confidence to proceed with this system. However, the importance of maintaining an overland flowpath from the pit lane was reinforced and incorporated more strongly into the drainage system design. The slot drainage system has been installed and is now operational.

The NS-10 Ecosep system was recommended for the pits area, comprising a two chamber grit and oil separator, capable of treating flows up to 10L/s and achieving separation of oil and water to 5ppm. Heavy duty lids were specified, due to this device being located in a trafficable area, while a high flow bypass also had to be provided with very tight tolerances for the pipes and Ecosep system to the Pits building. This has been installed and in operation for some time without any problems.

4.3.3 SKID PAN RUNOFF CAPTURE AND REUSE

The skid pan comprises a large, paved area (~0.50ha) forming a U-shaped circuit where drivers can be trained in car manoeuvres in controlled wet or aquaplane conditions. The concept was based on incorporating a number of water walls into the skidpan to create a "chicane" for cars to drive through and perimeter water sprinklers to maintain a shallow film of water across the skidpan surface to provide ideal aquaplane conditions.

Fraser Thomas were involved in civil/stormwater engineering design of the skid pan system together with other pumping/irrigation specialists, based on a water reuse system, whereby the skid pan grades at 0.5-1.0% to one end, where surface runoff is collected in catchpits and conveyed to underground storage tanks, from where it is pumped on demand to two water walls and perimeter water sprinklers. These catchpits had to be recessed to minimise potential for cars using this facility to hit them.

Analysis of this system involved undertaking a detailed water balance, taking into account the facility operating regime (20 days/month, 4h/day over 6 month summer season), average monthly rainfall, the variable demands of the water walls (10s per min at 100m^3/hr) and sprinklers (3min on, 10min off at 45m^3/hr) and estimated evaporative/windblown losses of 65%. This analysis determined the optimum tank storage to comprise two 27m^3 tanks, with "topup" from the water supply system kicking in when the water level drops to 65% of tank capacity. Skid pan runoff reuse may reduce water topup requirements by around 590m^3/yr (25% of total topup water). This recirculation system results in significant cost savings to the Motorsport complex, as they have to pay for the topup water, which is sourced from the Te Kauwhata Irrigation Society's screened non-potable water supply system.

Figure 6: Skid Pan in Action

Detailed design of this system involved careful checks for clashes with other services running through this area – water supply, wastewater and stormwater reticulation; electricity cables, communications, etc. and several large underground wastewater flow balancing tanks.

4.3.4 SWALES

The swales have a dual function. The bottom 100mm portion is designed for treatment of the "water quality volume" storm to ARC TP10 standards, while the entire swale itself is designed for conveyance of both primary and secondary stormwater flows (i.e. 1% AEP storms from the contributing catchment). Specific design criteria include:

(a) Provision of sufficient length to achieve treatment to TP10 standards in the bottom 100mm of the swale.

(b) Water quality volume (WQV) velocity of less than 0.8m/s, in accordance with TP10.

(c) 10% annual exceedance probability (AEP) flow velocity of less than 1.5m/s for stability reasons, in accordance with TP10.

(d) 1% AEP flow velocity of less than 1.8m/s on a grassed surface for scour prevention (NZ Building Industry Authority Handbook Verification Method E1/VM1 Table 5).

(e) Product of velocity x flow depth for the 1% AEP storm of less than $0.4m^2/s$ for safety[1].

In general, all swales satisfy the adopted design criteria in terms of velocity, flow depth and safety. Scour/erosion protection measures were also provided at swale discharge points.

4.3.5 WETLANDS

The wetlands are all located near the bottom of their respective catchments and provide water quantity, water quality and erosion control functions. They include a sediment forebay for stormwater treatment and permanent water quality volume with banded bathymetry (i.e. alternating shallow and deep sections) and live storage to provide extended detention and storm peak flow attenuation. In terms of water quality, these wetlands provide contingency treatment and adsorption of any residual contaminants from

[1] This can be derived from the NSW Floodplain Management Manual (2001) and strictly is applicable for flood depths of up to 0.2m, although it is in use by some Councils in NZ as a more general guideline without an upper limit.

upgradient areas served by swales as well as treating runoff from their respective direct contributing catchments.

Wetland detention was not provided in all sub-catchments, as this was not practical. Instead, wetlands B, C and I2 were oversized to compensate for the lack of detention elsewhere, with HMS modelling being undertaken to check the design objectives were achieved.

Planted swale draining to wetland B2.

Planting of "variable volume" portion of wetland B2.

Wetland A – Recently planted permanent water quality volume.

Wetlands - pest plant control.

Photograph 4: Wetlands during and following planting.

Wetlands B2 and C3 are located within the circuit. The circuit itself acts as the wetland embankment in each case, with modelling demonstrating that peak water levels should be maintained well clear of the track. These wetlands are joined to wetlands B3 and C4 by flow balancing pipes due to hydraulic constraints, so that wetlands B2+B3 and C3+C4 are essentially single wetlands.

Wetland design had to take into account the track layout and safety concerns over vehicles "flying" off the track into the wetlands. Safety barriers comprising tyre walls and Armco barriers have been installed around the track in strategic locations to minimise this potential, while the permanent water areas, particularly the deeper sections, have been located behind these barriers as much as practical to further reduce the associated safety hazard.

4.3.6 OVERLAND FLOWPATHS

In general, the swale and wetland system forms the overland flowpath network through the Motorsport Park, with 1% AEP flows being piped under the track in critical locations. The main piped reticulation system serving catchment B is also sized to take the 1% AEP flows. No overland flows will occur across the motorsport track up to and including the 1% AEP event.

5 HYDROLOGY

A HEC-HMS model was set up for the combined Motorsport and business catchments, with peak flows and volumes calculated using the ARC TP108/TP10 SCS methodology employing rainfall data for the site sourced from Hirds v2.

5.1 PEAK FLOWS

Modelling predicted post-development, unattenuated flows from the Motorsport/Business catchments to be some 2.3-3.3 times greater than pre-development flows, primarily due to the large increase in the imperviousness of the motorsport catchment from 1% to 45% and of the business catchment from 0% to 79%.

However, modelling showed that the combined wetland system would reduce peak flows to 74-93% of pre-development levels. This is primarily due to the detention storage provided for catchments B and C within the motorsport catchment and within the business catchment (I), which has the effect of significantly reducing peak flows from these catchments and delaying the time to peak, so that the flow peaks from catchments A, D and E do not coincide with those from catchments B, C and I.

Combined motorsport and business catchment pre-development peak flows constitute a significant proportion (6.7–7.1%) of total Waipapa catchment peak flows. Post-development, attenuated combined motorsport and business catchment peak flows are significantly reduced, representing 5.1-6.6% of total Waipapa catchment peak flows. Based on the relative magnitude of the motorsport/business and Waipapa catchment peak flows, it can be expected that development of the Motorsport and business parks with the wetland detention measures proposed should lead to a small but measurable reduction in peak flows in the Waipapa stream catchment.

5.2 PEAK VOLUMES

Modelling predicted post-development unattenuated storm volumes to be 1.4-2.0 times greater than corresponding pre-development flows, primarily due to the large increase in the imperviousness of the motorsport catchment from 1% to 45% and of the business catchment from 0% to 79%. Inspection of the catchment hydrographs shows that these storm volumes are essentially discharged within 24h, as for the pre-development situation.

Attenuated and unattenuated post-development storm volumes are expected to be approximately the same, except that attenuated storm volumes will be discharged over a much longer period, which may result in some stormwater volume being "lost" as soakage and evapotranspiration during wetland detention and passage through the stormwater system due to the extended discharge time. Modelling results show that attenuation of stormwater flows results in 88-94% of the total post-development storm volumes being discharged over a 60 hour period.

Hence, although motorsport and business catchment post-development storm volumes are likely to increase by as much as 1.4-2.0 times for different storm events, these flows will be discharged over at least a 2.5 times longer time period of 60h, compared with pre-

development (24h), resulting in the post-development storm volumes within any 24h period being smaller than for pre-development.

The combined effects of peak flow reduction (see section 5.1) and delayed volume discharges should slightly improve the flooding situation which occurs at times on the flats in the lower Waipapa stream, as the pump stations controlling stormwater discharges from this area effectively have to deal with less stormwater within a 24 hour period.

5.3 FLOODING OF THE WAIPAPA FLATS

A flood protection bank which runs from State Highway 1 along the true right bank of the Waikato River to the end of Hampton Downs Rd, prevents the flooding by the Waikato River of the land to the east of the flood protection bank. The flood protection bank contains two separate drainage schemes, namely the Meremere West and Meremere East Drainage Schemes. The Meremere West Scheme is physically separated from the Meremere East Scheme by the ridgeline to the west of Clune Road, the Clune Ridge, which also forms the western backdrop to the Meremere Drag Raceway.

The Motorsport and Business Park sites are located within the Meremere East Drainage Scheme, which contains the Waipapa Stream catchment. This catchment, as shown on Figure 2, is approximately 19.9km^2 in area, 9,000m in length and gently sloping (0.61%). It is intensively farmed and has highly modified drainage. Approximately a third of the catchment comprises low lying flats through which drainage channels have been constructed, particularly in the area downstream of Hampton Downs Road.

The natural low level of the land coupled to land settlement that has resulted from the farming and drainage activities, precludes a gravity outlet to the Waikato River and all water is required to be discharged by pumping. The main pump station (Meremere East pump station) is located on the Waipapa Stream adjacent to the Meremere Drag Raceway. Environment Waikato[2] have advised that the stopbank crest level opposite the Meremere East pump station is 7.42 (Moturiki datum[3]), as surveyed in 1998. Back drainage of the Waikato River into the Flats is prevented by flap gates on the discharge pipes from the pumps. The embankment and pump station were built as part of the Lower Waikato and Waipa Flood Control Scheme. Hence, any flooding which occurs in the area is from the Waipapa Stream itself and not the Waikato River.

A detailed flooding assessment was undertaken of this area, involving a topographical analysis and consideration of pumped outflows from the Flats area. This study estimated the 1% AEP flood levels to be:

- 3.71m (pumps off, no initial ponding);
- 3.60m (pumps on, no initial ponding).

This assessment recommended adopting a 1% AEP flood level of 3.71m RL for the Flats, representing bad case conditions – pumps off but no initial ponding to 3.6m RL. This flood level has been accepted by EW and WDC.

The implications of the 3.71m RL 1% AEP flood level on the Motorsport and Business catchments are that stormwater is expected to back up within the main wetlands – A, B2, B3, C3, C4, I1 and I2, with all of these wetlands except for I1 having significant surplus capacity. The motorsport circuit itself should not be overtopped (4.0m RL), while all buildings and other important infrastructure (e.g. carparks) are located above 4.0m RL and hence should be protected from flooding.

---

[2] Tel conversation with Russell Lamb, Environment Waikato, 6 July 2007

[3] Moturiki datum can be converted to Auckland datum by subtracting 9mm.

Hence, no additional measures were proposed to protect the stormwater management system or the Motorsport/Business Park complexes from such flooding events.

6 MOTORSPORT COMPLEX MANAGEMENT

6.1 OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) Manual is to be prepared for the Motorsport Park stormwater management system, including the wetland treatment and detention structures, in accordance with Environment Waikato consent requirements. This Manual will set out who is responsible for maintaining the stormwater facilities and the nature of the proposed monitoring and maintenance. A maintenance log will be kept and made available to Environment Waikato on request. The O&M Manual will form part of an Environmental Management Plan for the site, which will also include a site specific Spill Response Plan. All of these documents will be submitted to Environment Waikato and Waikato District Council on completion of construction.

6.2 INCIDENTS AND EMERGENCY EVENTS

Motorsport circuits have the potential for incidents that may result in the release of large quantities of contaminants that could potentially enter the stormwater system. The main incidents of concern in this context relate to hydrocarbon spills (e.g. fuel, oil) along the race circuit and associated areas, particularly the pits, resulting from human error, mechanical problems, accidents, etc.

Stormwater management facilities are equipped with hydrocarbon removal facilities as near to the source as possible and within the wetland forebays. In addition, spillage containment facilities have been provided around the motorsport park at appropriate locations, including in the pit areas and at critical road sections. Spillages will be dealt with using "dry" methods, where practicable, avoiding hosing down contaminants into the stormwater system.

Motorsport park staff have been trained in how to handle any incidents so as to avoid stormwater contamination.

Similarly, appropriate spill containment and emergency equipment and facilities will be provided to deal with any incidents that may contaminate stormwater runoff within individual lots within the business catchment, according to the nature of the activities being undertaken on each lot.

6.3 MONITORING AND CONTINGENCY MEASURES

Consent conditions require that there shall be no conspicuous oil, grease, scums or foams present after reasonable mixing, in any permanently flowing watercourse, as a result of the exercise of this consent and that the discharge shall not contain concentrations of hazardous substances that may cause significant adverse effects on aquatic life or the suitability of the water for human consumption after treatment.

The point of compliance is the combined discharge from wetlands A, B and C to the perimeter open channel drain.

Routine and non-routine monitoring systems were developed along with corresponding contingency measures.

7 CONCLUSIONS

The Motorsport development presented a dynamic and unique stormwater problem, requiring the application of both conventional and low impact stormwater design methods and the application of first principles in working through some of the finer details. It has been an exciting and challenging project to work on that was developed in a very dynamic way.

The draft Stormwater Management Plan was reviewed by both Environment Waikato and Waikato District Council and a revised version, incorporating their feedback, was approved in November 2008.

Most of the proposed stormwater management measures have now been constructed and are in operation. The stormwater system is understood to be working well and there have been no non-compliance issues to date.

ACKNOWLEDGEMENTS

We wish to thank GP Farms Ltd for allowing Fraser Thomas to prepare and publish this conference paper.

REFERENCES

Auckland Regional Council, Technical Publication 10 (TP10), second edition, May 2003

Fraser Thomas Ltd (November 2008), "Hampton Motorsport Park – Stormwater Management Plan", Version 2, report prepared for GP Farms Ltd

Kingett Mitchell Ltd (September 2004), "Hampton Downs Proposed Motorsport Park – Freshwater Ecology Report"

New South Wales Government (2001), "Floodplain Management Manual: the Management of Flood Liable Land"