



**The Surfacing of the  
Hampton Downs Race Track  
– developing cutting edge asphalt design**

“Both clients and drivers are thrilled with the new track, particularly its extra width of the track at 15 metres wide and the standard of smoothness and grip that has been achieved compared to other circuits in New Zealand.”

CLIENT Hampton Downs Motorsport  
PRINCIPAL CONTRACTOR Ross Reid Contractors Ltd  
CONSULTANT Fraser Thomas



Analyse | Solve | Construct



Research | Design | Analysis



Recycle | Produce | Aggregate

## The surfacing of Hampton Downs racetrack

Tony Roberts and Chris Watson, international motorsport champions, had a dream of creating another racing facility around Auckland. Today that dream is a reality – the Hampton Downs Motorsport Park.

Ross Reid Construction Ltd was commissioned to build the track and turned to Blacktop Construction to help them with the surfacing.

If ever a project is to be an example of ‘using kiwi ingenuity to triumph over unique challenges’ or of innovation and collaboration, this would qualify in spades.

Blacktop Construction Ltd has succeeded in creating a single-layer asphalt paving solution that has a smooth riding surface with a flatness tolerance not exceeding 3mm over a 4m straight edge, high grip (in braking zones and corners) and durability and rut resistance.

So sceptical that an appropriate solution could be found the BNZ appointed Tonkin & Taylor as a risk advisor for this project. There was no risk, just a successful international first, a single asphalt layer FIA Category 2 racetrack.

Both clients and drivers are thrilled with the new track, particularly “its extra width of the track at 15 metres wide and the standard of smoothness and grip that has been achieved compared to other circuits in New Zealand.”

## Project Description

In November 2006 the Waikato District Council granted resource consent for the track. The Road/Track Controlling Authority is the Historic Racing Club (HRC) and the track is certified as a FIA Category 2 circuit (one step below Formula One.)

The principal contractor for the project was Ross Reid Contractors Ltd, engaged by the client Tony Roberts, Managing Director, Hampton Downs Motorsport.

For this project Blacktop Construction and its associated company Bitumen and Pavement Ltd were subcontracted to develop an appropriate mix design for the surfacing of the track, to be audited by Tonkin & Taylor, the financiers (Bank of New Zealand’s) risk advisor, and then to construct the paved racetrack.

Blacktop Construction was required to design and construct a smooth-riding surface that had high grip, was durable, yet flexible enough (due to the expected sub-grade settlement). A multi-layered asphalt surface was precluded due to budget constraints.

Project investigations/preparations began in May, surfacing works commenced on September 29th 2009 and practical completion was achieved on 23rd October 2009.

Tony Roberts (Managing Director of Hampton Downs) going for the first drive on the newly surfaced international circuit at Hampton Downs race track.

**“a smooth riding surface  
that had high grip, was  
durable, yet flexible enough.”**



**“They came up with a tarmac design that met our requirements and has proven to be a big hit with the users.”**

### **Smooth Riding surface, high grip and durability critical to clients requirements**

*Sitting in the car in the pit road I was thinking I was somewhere in Europe, surrounded by the rolling hill country and it all seemed very professional.*

*“Out on the track there was more elevation than I expected and you really need to think about your racing lines.”*

*“You are in sixth gear down the long front straight – just slightly slower than Puke’s back straight – and the first corner is awesome. You go down two gears and the track drops away, a bit like Paddock Hill Bend at Brand Hatch. It’s challenging and you are hard on the gas as you exit.”*

*“The slower second gear infield corners work well and then you arrive over a crest and you are braking downhill for the second gear left-handed hairpin. This is mega because you are braking on the brow and the track drops away.”*

*“It was fantastic .....*

Daniel Gaunt, NZ Grand Prix Winner. An evaluation of the Hampton Downs Motorsport Park track – initial track test

### **Challenges of the project brief**

Tony Roberts with partner Chris Watson as past international motorsport champions and developers of Hampton Downs had a vision to create an integrated motorsport park that would be the premier race track venue in New Zealand which would raise the profile of motorsport in the country.

For this project Blacktop Construction was a sub-contractor to the principal contractor, Ross Reid Contractors Ltd. The brief for Blacktop Construction was to design and construct the new thin Asphaltic Concrete (AC) surface layer for the Hampton Downs motorsport racetrack pavement that would provide:

- A single layer AC solution
- A smooth riding surface with a flatness tolerance not to exceed 3mm over a 4m straight edge
- High grip (in braking zones and corners)
- Durability and rut resistance (in the race line, braking zones)

And provide:

- Value for money (a multi-layered asphalt surface was precluded due to budget constraints)
- A sustainable solution that was acceptable to Fraser Thomas and the Bank of New Zealand’s appointed risk advisors Tonkin & Taylor
- A flexible surface to allow for settlement of the parts of the race track due to construction on fill over deep soft sub-grades.

Upon completion the race track had to be certified as a Federation Internationale de l’Automobile (FIA) Category 2 circuit (one step below a Formula One rating). The surfacing had to meet strict FIA track build criteria and incorporate FIA approved safety measures.

There was a proposed mix design provided by the consulting engineers, Fraser Thomas, but it was only a recommendation based on typical race track surfaces around the world. However a typical racetrack has multiple asphalt layers and the intention was for Hampton Downs to be sealed with a single surface layer. No track in the world had been surfaced with a single thin AC surface layer. Blacktop Construction was to provide a design and build this unique solution as part of its sub-contract to Ross Reid Contractors Ltd, the principal contractor.

Due to the pavement conditions there is no truck racing at Hampton Downs as the thin AC surfacing mix would not withstand the loadings and shear stresses from the truck racing.

### **Pavement design and construction criteria – Key Performance Indicators**

#### **Smooth Riding, Flat Surface**

The FIA track build criteria has very fine tolerances for flatness, with the plane equality of the surface required “to be exempt from any undulations so that a 4m long straight rod laid on any part of the finished surface uniformly contacts it, the tolerance admitted not to exceed 3mm”. This requires the finished surface to be far superior to a highway surface, as measured by a National Association of Australia State Roading Authorities (NAASRA) count. NAASRA counts are a standard measure of the road surface riding comfort. The roughness values are obtained by a special-purpose vehicle travelling over the trafficked lanes of a road. Typically, the roughness value for a new road is between 70 and 90 NAASRA counts per km. The aim for the race track surface was to achieve a NAASRA count of less than 50.

#### **High grip surface**

Due to the nature of racing – high speeds, acceleration, braking and cornering, the client required a high grip surface. This was achieved by supplying all aggregate from a quarry that produces high Polished Stone Value (PSV) aggregate. The New Zealand Transport Authority TRANSIT specifications state that the PSV for asphalt mixes should not fall below 45. This was exceeded with the PSV of the aggregates used in the asphalt mix design being  $\geq 60$ .

## **Durability**

With the repetitive forces exerted from tyres during racing under heavy braking, accelerating and cornering it is important that the asphalt mix has a degree of elasticity, including rut resistance, weathering resistance and be able to tolerate high shear stress loadings. The elasticity of the mix has to allow the mix to move slightly with forces and return to its original position. As the track is to be used in all weather conditions ranging from extreme cold and frosts to hot sun soaked days, it was important the mix could withstand the temperature extremes. As the surface is constructed as a thin AC layer it was important that there was a strong bond between the mix and the granular base course layer so that the mix did not move under the extreme loadings from racing. If the surface was not durable it would lead to pavement failures such as rutting and shoving creating bumps and potholes.

## **Flexibility**

As the Hampton Downs race track is a granular pavement, constructed on clay fill over reclaimed swamp land there is potential for long term settlement. The thin asphalt mix is designed to move with the settlement of the sub-grade without cracking and failing.

## **Value for Money**

Due to financial constraints a cost effective mix design was required. There was a lot of discussion over the surfacing thickness, whether to have multiple layers, a thick or a thin layer. In collaboration with the client's consulting engineer and the financial partners risk assessors it was agreed to use a thin, 30mm AC pavement to surface the track to mitigate financial constraints and underlying pavement conditions. The cost difference between a single 30mm layer of asphalt and more than 80mm of surfacing is considerable. If price was not an issue a dual layer system would have been preferable, although subsequent settlement issues would then be a concern (due to rigid pavement structure). However, cost was of importance. BCL believed that the proposed Race Track Mix (RTM 10) surfacing design was a proven and robust wearing course fit for purpose and financially acceptable.

## **Delivery of the project**

The surfacing of the international circuit commenced on September 29th and was completed on the 18th of October ready for use. During this period there were only nine suitable working days for race track surfacing. Practical completion for all surfacing work was achieved on the 23rd October 2009.

A plan of the track is attached in the appendices - Appendix 2: Hampton Downs Race Track Paving Date and Runs. The total area of the international circuit is 41,939m<sup>2</sup>. 2,954.66t of Race Track Mix 10 was used to surface the racetrack with an average thickness of 29.82mm, a fraction under the target thickness 30mm. The paved track length of the international circuit is 2.52km (Centreline).

## **Client satisfaction – evidence of the successful completion of the project**

The letter of client satisfaction in the attached appendix (Appendix 1) from Tony Roberts, the Managing Director of Hampton Downs, expresses the challenges of the surfacing requirement and the satisfaction of a job well achieved. Hampton Downs is the first race track Blacktop Construction Limited has surfaced and had requirements greater than that of a typical roading project. It is the only race track in the world to be surfaced with a single thin asphalt layer on a granular base so it was a high risk and high exposure project. It required Blacktop Construction to design, produce and pave a suitable mix that would meet the specific Hampton Downs race track criteria.

## **New benchmarks established for pavement tolerances to meet the FIA track build specifications**

The specific contract specifications allowed for a 12mm deviation on a 3m straight edge for the base course preparation finished level and a 3mm deviation on a 4m straight edge on the completed asphalt surface on the race track. This meant the asphalt surfacing tolerance for the race track was tighter than the standard TNZ P9 specification (Transit New Zealand Specification for Construction of Asphaltic Concrete Paving).

It is internationally accepted that on a single paver laid overlay you can anticipate a 70% improvement on the pavement roughness. With this in mind an innovative and collaborative approach was taken by the Fraser Thomas, Ross Reid and Blacktop Construction to achieve the required FIA 3mm flatness specification, as a 12mm basecourse specification would have resulted in a finished surfacing tolerance of 3.6mm with no margin for error. It was proposed to the engineer and agreed that Ross Reid would aim for a deviation of less than 10mm on a 4m straight edge on the base preparation and that Blacktop Construction would undertake pre-levelling in areas to achieve an 8mm deviation prior to overlay work commencing. A 70% improvement on a 8mm deviation results in a 2.4mm deviation on the final surface layer allowing for a 0.6mm margin on the required FIA flatness tolerance of a 3mm deviation on a 4m straight edge.

The TNZ P9 specification states a typical levelling course tolerance to provide zero thickness over high spots and to fill depressions until the pavement shape is restored and the gap under a 5 metre straight edge placed at any position on the road base does not exceed 6mm. It was further agreed that a nominal surface thickness of 30mm of RTM 10 would be placed with a minimum of 25mm to allow for any pre levelling or deviation in the base levels.

Blacktop Construction had a commitment to ensure it achieved and/or exceeded the specified FIA surface flatness requirements. Prior to application of the prime coat pre-levelling level checks were undertaken on the completed base course layer in 4m grids over the whole circuit as per specifications. The measurements were taken using a 4m aluminium straight edge and 2mm measuring plates to record readings to an accuracy of 2mm. Agreed areas that exceeded the base tolerance were reworked to ensure compliance. Pre-levelling was then carried out on agreed areas to meet an 8mm tolerance prior to the overlay.

### Asphalt mix design developed to provide benefits for race traffic

Motor race track asphalt requires slightly different properties to that of a heavily trafficked road. A race track has to withstand the surface shear stresses of cornering, braking and accelerating tyres just like a road. However it does not endure the straight line channelised heavily loaded truck tyre loadings that a road does. Very stiff rut resistant, high air void mixes are designed to withstand these truck loadings, however by adopting a lower air void and higher binder content, a less stiff mix provides more resistance to surface abrasion and offers extended resistance to deterioration by oxidation.

The race track pavement was designed so the final surface material had a maximum deflection of 1mm in accordance with specified pavement design tolerances agreed with Fraser Thomas, Ross Reid and Blacktop Construction.

The proposed asphalt mix design - Race Track Mix 10 (RTM 10), was developed specifically for this contract at the Bitumen and Pavements laboratory. It was made and placed in a field lay down trial based on a recognized international mix design specification and procedure. The mix design was developed for its superior resistance to higher traffic stresses and higher traffic volumes than roads typically found in the road network have to withstand. Although the top size stone is slightly smaller than that of the original NRB Mix 15 design, it has a higher proportion of the mid to large sized fraction giving the mix more large stone structural interlock thereby increasing its shear strength and rut resistance.



**Photo 1:** A typical core cross-section demonstrating the structural interlock of the RTM 10 – this offers increased rut resistance and shear strength due to a higher proportion of mid to large sized fraction.

This grading has the added benefit of producing a more uniform finished asphalt surface without the occasional isolated large stone that can be prone to “plucking” under high turning traffic shear stresses. Research into recent international motor race track trends has found that these types of smaller top size but higher large stone fraction mixes dominate the most recent race tracks built or resurfaced with asphalt.

The maximum deflections in the initial design of 1.5mm and/or 1.2mm on the finished layer were on the high side of acceptability for a dense graded asphalt surfacing layer to tolerate. This reinforces that a polymer modified thin asphalt layer (less than 40mm) was the most suitable choice of surfacing for the race track pavement. It was later agreed between the client and contractor that the maximum surface deflection was to be 1mm.

The proposed Race Track Mix 10 (RTM 10) design deliberately targeted a higher binder content, therefore achieving lower air voids to improve the pavements resistance to surface abrasion as well as extending its resistance to weathering, caused by exposure to sun and air. We also added 4% solids of an asphalt specific Styrene Butadiene Styrene (SBS) polymer to the binder mix. SBS is the most frequently used asphalt polymer in the world and this addition rate it will provide additional adhesion (binder to stone), cohesion (binder to binder) and elastic recovery (binder returning to its pre-stress location). We chose to use 80/100 penetration grade bitumen with polymer to keep the blended PMB (Polymer Modified Binder) sufficiently flexible as addition of SBS does increase the stiffness of the asphalt.

We also allowed for the addition of 1.5% Sasobit (by weight of binder) into the PMB. At this addition rate the workability and compactability of the asphalt will be improved at paving/rolling temperatures, overcoming the stiffening tendencies of the polymer, and overcoming problems created by cold ambient temperatures during paving due to the winter construction period. It will also not have a significant stiffening effect on the mix at in service temperatures. Laboratory tests were undertaken by Bitumen and Pavements to confirm bitumen content, viscosity, additive rates and to determine the ideal paving temperatures with the additives.

All crushed aggregates used in this mix have a PSV (Polished Stone Value or Indication of grip provided) of  $\geq 60$ . Research into overseas trends shows a preference for “higher than normal road but not the highest possible” skid resistance aggregate – which this is. This provides drivers and spectators with higher than normal cornering speeds, but still allows for the excitement of spectators of drivers over accelerating in a controlled fashion. For this reason, all aggregate for the pavement was sourced from Baldwin’s Quarry in the Waikato as aggregate from this source has a PSV  $\geq 60$ .

The bond between the RTM 10 asphalt surfacing and the unbound granular pavement was identified as the most critical shear plane. Therefore it was proposed and accepted to use a bitumen membrane in the form of a light application bitumen prime coat and grade 4 sealing chip. The light application rate allowed the bitumen to penetrate the base course layer and was sufficient to adhere to the underside of the asphalt mix thereby creating a bond between the two layers. The membrane would also provide a waterproof layer that would prevent any moisture that passed through the asphalt surfacing from getting in to the granular base course.

### **Innovative methodology adopted to ensure a smooth, high grip, durable pavement surface**

To meet key performance indicators for smoothness, grip and durability for the finished surface layer an innovative paving methodology was devised. This started with the material supply by way of a Material Transfer Vehicle (MTV). All paving work was completed with the use of the MTV to ensure the smoothness of the surface. The MTV helps to reduce segregation of the asphalt as it passes through the paver and ensures that the asphalt paver operated independently of the material supply operation. Segregation of the mix could result in 'boney' areas of large stone left in the centre of the paving run which could be prone to plucking and fretting during the life of the race track.

During a typical paving operation the truck transporting the asphalt will reverse up to the paver and tip the asphalt into the open paver hopper. The risk with this is that as the truck reverses it can bump the paver, this can result in the paver being pushed backwards creating bumps in the already paved surface layer. As the MTV is not attached to the paver in any way it does not affect the paver when trucks reverse up to the hopper of the MTV. Another benefit is that the MTV provides a constant supply to the paver as there is no down time for the change over of trucks in front of the paver.

To comply with the required flatness specifications of the finished surface layer the paver was equipped with a Road Scanning System (RSS) and a sink link on the first paver run and a single RSS and a joint matcher on the following paving runs. A surveyor was on-site daily to measure and calculate paving runs to ensure that the RTM 10 was paved at the target 30mm thickness. Blacktop Construction also used an asphalt heater to warm cold joints prior to paving with the aim of achieving a seamless joint between paver runs.

Recent trials undertaken on the Auckland City Urban road network have proven that this methodology could achieve smoothness results of less than 50 NAASRA counts - well within the TRANSIT requirements for Motorway surfacing.



**Photo 2:** The innovative paving process applied for the surfacing of the Hampton Downs race track

Compaction of the RTM 10 mix was tested on-site with a nuclear densometer to ensure the required air void targets were met. The compaction was applied with 7 tonne Combination roller and 7 tonne tandem steel roller. Rolling patterns were adjusted taking into account the temperature of the mix, the grading and bitumen content.

Upon the completion of the surfacing a straight edge test was completed at 20m intervals across the full width of the pavement to ensure that the strict FIA tolerance of a 3mm deviation under a 4m straight edge had been met. Blacktop Construction achieved this criteria.

### **Innovative design ensures value for money**

The asphalt surfacing was designed to meet the financial constraints of the client. A 30mm surfacing layer was the cost effective solution accepted by the engineer, the client, and financial partners after review by the risk assessors – Tonkin & Taylor – the engineering consultants employed by the BNZ Bank.

For a full explanation please refer back to Pavement design and construction criteria – KPI's – Value for Money.

### **A sustainable pavement solution**

The inclusion of Sasobit in the asphalt mix design allowed for a sustainable environmental benefit by allowing the RTM 10 asphalt to be produced and placed at lower than normal temperatures. These factors resulted in energy savings that decreased Green House Gas (GHG) emissions and the use of fuel and electricity - a reduction of embodied carbon emissions.

**“the finished seal has achieved higher grip levels than expected especially in the wet.”**

## Benefits for the community and wider sector

*“Hampton Downs is very, very good. To make a new track such as this that is safe and yet still gives the drivers a challenge is very tricky.”*

Sten Pentus, Winner – NZ Motorcup race, Hampton Downs 2010

As a motorsport venue there is an emphasis at the Hampton Downs track on driver training and the track being used as a testing facility. Hampton Downs is host to six driving schools that offer driver training and host corporate events. The race track is also used for public open track days and private events.

Downforce is one of the six driving schools on offer at Hampton Downs and were the first group to drive on the track after owner Tony Roberts and since October 2009 they have held more than 50 days at the track. Downforce specialises in auto events and driver training and works with some of the best drivers in New Zealand such as NZ A1GP driver Johnny Reid who gave the Hampton Downs race track a big tick of approval, comparing the track to some of the great European race tracks in an article in the Waikato Times on October 29, 2009 – Appendix 3.

In speaking with Tim Martin of Downforce he commented that the track surface is very smooth with really high grip, in combination with the track layout, the high grip of the surface is evident by increased tyre wear on the front left tyre. There are no bumps in the surface and it has not moved. Downforce operates in all weather conditions and in the wet there is higher risk with the speeds that are reached around the track, but due to the smoothness of the track there is no puddling. The surfacing does not provide a huge advantage over other tracks but it is nice to have a quality finished product and he is looking forward to hosting more events at Hampton Downs track.

## Collaborative approach adopted to develop surfacing mix design

### Multi-party collaboration

Client: Tony Roberts, Managing Director, Hampton Downs Motorsport Ltd

Consulting Engineer: Fraser Thomas

Financial Partner: BNZ Bank

BNZ Risk Advisors: Tonkin & Taylor Ltd

Principal Contractor: Ross Reid Contractors Ltd

Surfacing Sub-contractors: Blacktop Construction Ltd

## Multi-party collaboration to achieve success

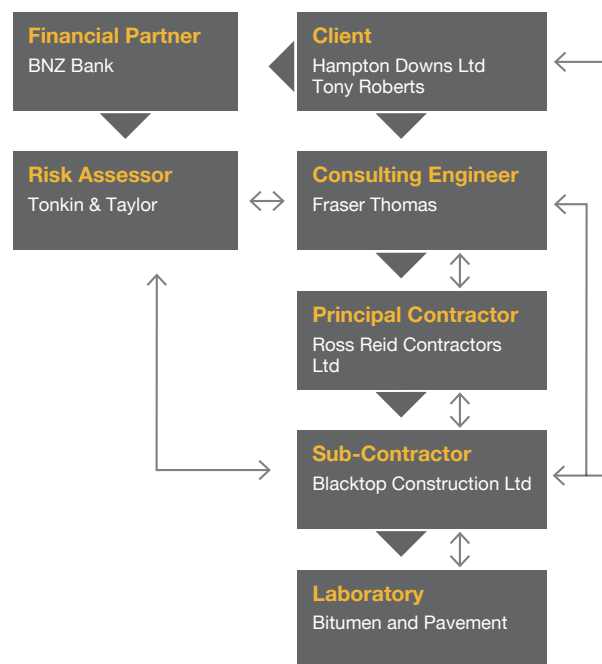


Figure 1: Multi-party collaboration to achieve success – this shows the relationships between multiple parties involved in the project that had to collaborate to ensure a successful innovative project solution.

The expectation was to create Hampton Downs as the premier motorsport facility in NZ and comply with a FIA level 2 category so there needed to be a ‘better than normal’ surface to differentiate the track from others in the country and meet the FIA track build specifications. The design constraints, existing site conditions and financial constraints meant that an off the shelf pavement design was not an option and hence a new innovative mix design was required (as discussed in the previous section - Innovation - Asphalt mix design developed to provide benefits for race traffic.) As the surfacing design was experimental the main financial partner of the Hampton Downs project, the BNZ bank employed their own engineers to review the proposal and assess the inherent risk alongside with consulting engineers Fraser Thomas.

In collaboration with Blacktop Construction and the Bitumen and Pavements laboratory a proposed mix design was conceived to meet the unique requirements of the race track based on a typical highway asphalt mix design with additives. As the contract was a design and build contract the responsibility lay with Blacktop Construction for the mix design. Blacktop Construction had the proposed mix design reviewed by an independent contractor from within the roading industry. Following the independent review and feedback the proposed mix design was submitted to Fraser Thomas for review. At this point the design was also reviewed by Tonkin & Taylor. Tonkin & Taylor queried technical aspects of the job mix formula and it was proposed by Blacktop Construction to undertake a field trial to satisfy all parties and test the proposed RTM 10 mix.

## Local maintenance site used for lay down trial

Once the laboratory tests had been completed, and the proposed mix design agreed to in theory by the engineer (Fraser Thomas) and risk assessors (Tonkin & Taylor), it was determined that a field trial would further satisfy parties and eliminate any inherent risk.

In collaboration with the Manukau City Council, Blacktop Construction and the Hampton Downs race track team an appropriate site was selected from Blacktop Construction's Manukau City Council maintenance contract. The site selected for the field lay down trial was the Kirkbride Road, Wallace Road round about in Mangere. The site represented similar traffic conditions to that of the race track with high turning, braking and accelerating stresses. The site was milled, a bitumen and grade 4 chip membrane applied and 30mm of RTM 10 paved. A racing expert put forward by the client tested the mix by driving on the new surface and gave his approval.

The results of the field trial were successful with noticeably higher grip and durability. The surface of the mix was smooth which provided added abrasion resistance. This satisfied the client, the engineer and Tonkin & Taylor resulting in the proposed RTM 10 asphalt being approved for the surfacing of the Hampton Downs race track.

## Collaborative pre-surface preparation and checks in conjunction with principal contractor ensures best result for client

As described in the Innovation section (Tolerances reviewed to ensure a smooth surface from the base up) new benchmarks were established for the base course preparation to ensure compliance with the FIA track build specifications. This was an agreement reached between the engineer (Fraser Thomas), principal contractor (Ross Reid) and the sub-contractor (Blacktop Construction).

Once the revised tolerances were agreed, Ross Reid and Blacktop Construction worked together to undertake surveys and grid checks to ensure that each party was constructing to their required tolerances. Results from these field surveys were reviewed by the engineer and agreed to by both parties to determine areas that were satisfactory for resurfacing or that required additional work to meet the revised base tolerances of a 10mm deviation, or that required pre-levelling to meet pre-surfacing tolerances of an 8mm deviation.

## On-site collaboration to meet project outcomes

As there were two parties undertaking the physical works of the Hampton Downs race track contract with Ross Reid undertaking the pavement construction and base preparation and Blacktop Construction undertaking the surfacing works, it was essential that there was clear communication between both parties and the consulting engineer on what areas had met the required tolerances and were ready for surfacing. The prime coat, pre-levelling and surfacing was reliant on the programme of Ross Reid and this was continually communicated.

For the surfacing works undertaken by Blacktop Construction, the contract manager had constant communication with the consulting engineer to ensure that the base levels and pre-surfacing levels had been accepted, that surfacing was going to take place and how much surfacing was planned to take place on each working day. Paving runs were pre-calculated so that

equal length runs were paved to ensure a full pavement width section was completed each day, leaving no longitudinal joints overnight, only full width transverse joints.

As the surfacing was completed at the end of September through to mid October, early in the surfacing season temperatures were monitored in collaboration with the engineer to ensure that compaction could still be achieved given the cooler temperatures.

## A unique pavement solution required

Typical Race Track (i.e. Melbourne F1 circuit – Structural asphalt pavement (SAC))

- Multi-layer full depth structural asphalt pavement
- SAC used more in Australia due to higher traffic volumes and less readily available quality aggregate sources
- Asphalt is cheaper in Australia due to higher production quantities and economies of scale
- Requires low deflection sub-grades due to commonly present characteristics associated with Australia's low rainfall weathered rock geology
- High unit area cost justifiable against F1 Race returns
- Multiple paving layers assists in achieving the very accurate finished surface smoothness required for F1
- Combined depth and bond between layers transfers horizontal forces to sub-grade.

## Hampton Downs circuit (Unbound granular pavement)

- Thin asphalt surfacing over unbound granular pavement
- Granular pavements used more in New Zealand due to lower traffic volumes and readily available high quality aggregate sources
- Asphalt is dearer in NZ due to lower production quantities therefore lower economies of scale
- Flexible pavement able to tolerate higher sub-grade deflections and settlement over clay and/ or clay on peat sub-grades in a high rainfall climate
- Relatively low unit area construction cost
- Can achieve required surface smoothness if both base course and asphalt surfaces constructed to best achievable tolerances
- Horizontal forces transferred from asphalt to sub-grade via high penetration membrane seal and highway quality base course pavement compaction and construction.

## Unique design criteria

No track in the world has ever been surfaced with a single layer, thin Asphaltic Concrete surface (30mm) however it was required for Hampton Downs due to funding constraints and underlying sub-grade conditions. This presented the largest 'problem' and meant that Blacktop Construction would have to create a new job mix formula to satisfy all the requirements of the client, trial it, be confident with it, and then place it to super high quality standards.

**It was evident from the finished job that a great deal of care had been put into the job and especially by Blacktop manager, Lew Morgan, who treated it as personal endeavour to get the best result possible.**

The back calculated surface deflections from the underlying pavement conditions gave deflection results of 1.2mm – 1.5mm, a deflection that is too high for a densely graded asphalt surfacing layer to tolerate. This meant that a flexible, polymer modified, thin (less than 40mm) asphalt was the most suitable choice for the race track pavement. The Race Track Mix 10 (RTM 10) is a dense graded wearing course asphalt fundamentally designed in accordance with the Australian Asphalt Pavement Association National Asphalt Specification and the New Zealand Supplement and is based on a typical mix15 job mix formula for its rut resistance and durability qualities. The mix was designed to have lower air voids, stiffer binder and tougher aggregate to improve abrasion and rut resistance. The higher binder content primarily improves the cracking and weathering resistance.

The mix design also required the addition of two materials to modify the asphalt properties; these were Styrene Butadiene Styrene (SBS) Polymers and Sasobit. The SBS is a thermoplastic co-polymer originally developed for use in the production of tyres and the soles of shoes. It offers elastic benefits in the form of added flexibility. This is helpful as there is likely to be mid to long term settlement of parts of the race track as it is constructed on fill over deep soft clay and peat sub-grades,

Sasobit is the second key additive in the mix design and was selected for its workability and compactability improvement properties. The Sasobit helps to maintain heat in the asphalt and allow it to be placed at lower than normal temperatures; this was a benefit due to the fact that the race track is approximately 50kms from the Blacktop Construction yard where the asphalt was produced, with a haul time of one hour from plant to track. The Sasobit also helps with placing – paving and compacting the material at these reduced temperatures.

**Specialist equipment, staff expertise and integrated operation were key to successful project execution**

#### **Staff**

The most experienced Blacktop Construction staff were involved with the Hampton Downs race track project. Surfacing Manager Adriaan Engelbrecht, Blacktop Technical Manager at the time Rhett Bishop, Steve McCone from the Bitumen and Pavement Laboratory all helped to develop the unique Race Track Mix 10 asphalt design. This experience extended to the field with Lew Morgan Blacktop Construction's senior surfacing supervisor with 40 years experience in the roading industry on-site for the complete surfacing operation.

#### **Methodology**

The development of the RTM 10 was a unique requirement and was a result of the technical knowledge of Blacktop Construction and Bitumen and Pavement. The review was a collaborative effort with all project parties.

The finished surface had to meet a strict FIA track building specification and be exempt from any undulations over 3mm measured on a 4m straight rod. This finished level requirement was half of the 6mm allowed under the TNZ P9 Specification, a unique characteristic of the project which meant that a high importance was placed on surveys prior to pre-levelling and surfacing. Surveys were also undertaken on the basecourse layer in a 4m grid over the whole circuit. These surveys were necessary to determine the levels before and after the surfacing was completed. To meet the flatness and surface texture (grip) requirements a unique surfacing methodology had to be utilised. The race track was the largest project that the Material Transfer Vehicle (MTV) has been used for by Blacktop Construction and it proved to be a key performer, helping to produce a finished paved surface that complied with the FIA and contract specification with no undulations greater than 3mm under a 4m straight edge.

Paving runs were calculated on a daily basis to minimise seal joins and help achieve the smoothness criteria. The track layout was unique and varied greatly in width, from 15m on the straights to 25m on the sweeping corners. The paver screed has a maximum width of 6m this meant that some areas were five paving runs wide. This had to be calculated so that the correct amount of mix was produced and so that at the end of the day the full width of the track would be paved up to one transverse end joint.

A nuclear densometer was used to complete plateau tests on the first three days of surfacing to establish the required rolling patterns. The nuclear densometer was also used to measure the air voids of the mix during the surfacing to determine the compaction had been completed as typical core samples were not able to be taken upon completion of the surface layer.

#### **Outstanding delivery**

To show that Blacktop Construction was totally satisfied with the quality, workmanship and performance of the RTM 10 surfacing of the Hampton Downs race track, an extended guarantee period of three years was agreed to.

*"They came up with a tarmac design that met our requirements and has proven to be a big hit with the users of the circuit. Everyone comments on the extra width of the track at 15 metres wide and the standard of smoothness and grip that has been achieved compared to other circuits in New Zealand"*

Tony Roberts – Managing Director of Hampton Downs Race track – Client Satisfaction Letter



12 July 2010

Eddie Hayman  
Operations Project Manager  
Auckland Road Maintenance Alliance - West  
PO Box 68-853, Newton,

Auckland, 1145

Dear Eddie

I am pleased to support your submission for the NZ Roading Excellence Awards for 2010, under the category of 'Excellence award for a minor road project' (works less than \$5 million in value).

As managing Director of Hampton Downs Motorsport Park and a long time racing participant, I had a keen interest in the track compound to be used from early on in the project. I checked the overseas compounds and evaluated the Melbourne Formula One surface when I was in a supporting race in 2008.

Hampton Downs was designed by Clive Bowen of Apex Engineering, one of the few F1 track designers in the world and incorporates all modern FIA approved safety measures.

The FIA track build criteria has very fine tolerances for flatness, with the plane equality of the surface "to be exempt from any undulations so that a 4m long straight rod laid on any part of the finished surface uniformly contacts it, the tolerance admitted not to exceed 3mm." It is very important that a race circuit is as smooth as possible across all surfaces including joins and elevation changes. What is acceptable on a 100 kph highway is nowhere near the finish required for a race track where racing cars are achieving speeds of 280 kph! The FIA Track Inspector has visited the track twice from the UK and has been positive about the tarmac finish. With the high downforce and grip of modern racing cars it is very difficult to build a pavement that can handle the ongoing stresses of racing. Even F1 circuits quickly become bumpy going into braking areas with tarmac 'push' and will lift off manhole covers on street circuits if they are not welded down.

Financial constraints meant that one layer of finished asphalt would have to do the job, so a lot of thought went into how thick this layer should be. Too thick and the surface would be subject to slight undulations due to uneven roller compaction and too thin could be worn through or peeled off. Blacktop were the one of the few contractors to discuss the appropriate mix and to lay a sample mix at a high wear roundabout in Auckland to assess the shear strength of the formula.

The Technical Manager at Blacktop Ltd, Rhett Bishop, and Surfacing Manager, Adriaan Engelbrecht, worked through these issues with me and came up with what we considered a good solution, with a membrane, chip seal and RTM10 mix with added SBS polymers and Sasibit.

Blacktops confidence was such that a three year warranty was placed on the seal, which gave Hampton Downs Management and our bankers BNZ confidence in the company. Ross Reid Ltd were contracted to achieve the high standard of finish required in the sub grade and purchased GPS controlled graders to perform this task. A lengthy time was spent checking the levels in October 2009 before proceeding with the membrane layer and the chip sealing. Final sealing of the circuit was completed on November 18<sup>th</sup> 2009.

It was evident from the finished job that a great deal of care had been put into the job and especially by Blacktop manager, Lew Morgan, who treated it as a personal endeavour to get the best result possible. Everyone who has subsequently used the circuit has been impressed with the standard of smoothness. Hampton Downs has surpassed all other circuits in New Zealand with its rise and fall and the sheer width of some of its corners. For instance, turn one is 27 metres wide and turn ten is 24 metres wide.

The finished seal has achieved higher grip levels than expected especially in the wet. We get a lot of feedback from professional drivers, such as Greg Murphy, who race all over the world and many comment on the secure feel of the tarmac.

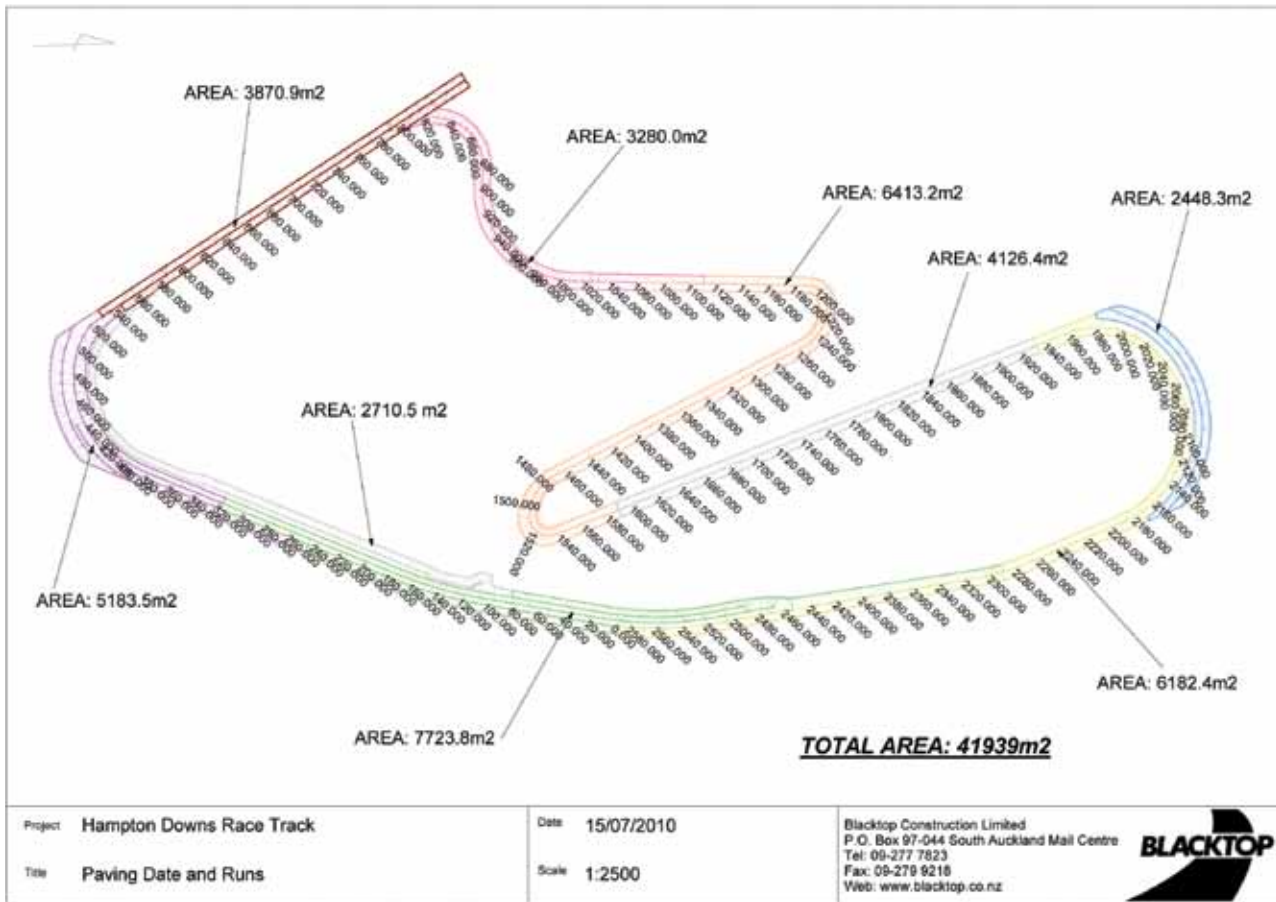
Because of track build delays over the winter, the track bookings were piling up and the circuit had to be used immediately. Unfortunately being unable to allow time for the tarmac to 'weather' and the high grip levels have lead to a reasonable amount of wear on some of the tight corners which have since been repaired under the guarantee.

It has become evident that over winter the tarmac is 'toughening up' and with little further wearing of the surface taking place. It would have been an advantage to have been able to let the circuit weather for a while (the FIA recommend 60 days) before putting cars on it, but delays had meant a backlog of events and driving schools that needed to use the circuit.

All in all a good job by Blacktop Construction Ltd. This was a challenging project and virgin territory for them. They came up with a tarmac design that met our requirements and has proven to be a big hit with the users of the circuit. Everyone comments on the extra width of the track at 15 metres wide and the standard of smoothness and grip that has been achieved compared to other circuits in New Zealand.

Regards

Tony Roberts  
MANAGING DIRECTOR



Appendix 2: Plan: Paving date and runs



# Reid gives track big thumbs up

**Matt Richens**

[matt.richens@waikatomtimes.co.nz](mailto:matt.richens@waikatomtimes.co.nz)

One of New Zealand's top drivers has given the Hampton Downs circuit a big tick of approval and a few punters – including this one – a scare.

Jonny Reid, best known for his work in A1 Team New Zealand's Black Beauty, took a lucky handful around the new Hampton Downs circuit yesterday and said it compared to some of the world's best.

With all the stress of a Sunday drive and as he happily chatted away about the weather and anything else that crossed his mind, Reid swung a 2009 V10-powered RS Audi around the new Hampton Downs circuit at break-neck speed.

Sponsorship permitting, Reid is nine days away from the start of the Porsche GT3 Cup and showed he's in top form, ripping the "road car" around the undulating circuit at up to 230kmh.

"The track's like a billiard table," he said to me while maneuvering the Audi with a big smile on his face. "I love this sport and have a huge passion for it so to share that with people and show them my passion is great."

Reid was working for Downforce, one of three companies who will host corporate days and driver training at the circuit – Hampton Downs' bread and butter.

And while he said he loved showing people how fun his career was, and giving them a scare, racing was still what he loved and he had already analysed the track and how it would likely pan out when he was in race-mode.

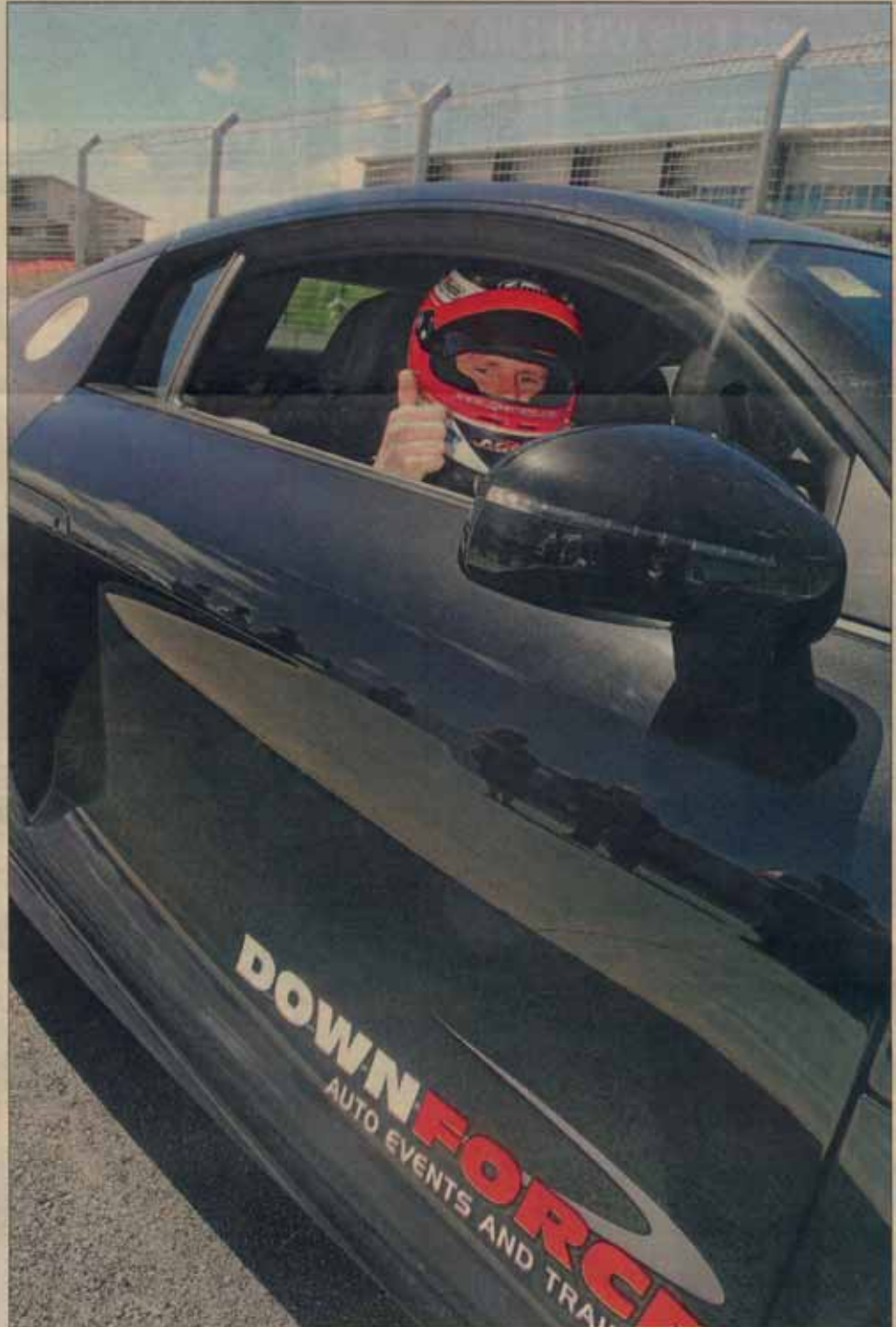
"The width of the track is going to create exciting racing. The opportunity to throw your opponent off line is very great here and you could see the lead change a number of times through a lap. The brave will be rewarded, you know, last of the late brakings."

Reid has raced in Europe and said the elevation made the circuit comparable to Spa, in Belgium, where Formula 1 had often raced in the past. "This compares to some of those great European tracks," he said.

What did I think?

The circuit was brilliant. When you enter three corners, you can't see the exits so you're on the edge of your seat the whole time and the elevation makes a huge difference to braking and cornering.

What makes it most impressive is the brave will be rewarded and there will be no shortage of excitement because of the opportunities to pass.



**All set:** Jonny Reid gives the thumbs up before heading out around the Hampton Downs circuit with a very nervous Matt Richens as passenger.

Photo: ALAN McDONALD MACSPEEDFOTO