Final.

STATEMENT OF EVIDENCE
OF RICHARD STOCKER

1. My name is Richard Val Stocker. I am a Consulting Engineer and my speciality is flood and river engineering. I have a Batchelor of Engineering (Civil) degree with first class Honours from the University of Auckland (1978) and a Diploma of Science from Massey University (1993). I have practised as an engineer since 1984 and for some years held the position of River Engineer with the Westland Catchment Board.

2. Adcock & Donaldson Properties Limited have made application for resource consent to establish and operate a motorsport park on river flats on the west branch of the Stanley Brook. I have inspected the site and made enquiries of Tasman District Council and the previous land owner in the preparation of my report.

3. I am aware of the Environment Code of Practice for expert witnesses and have prepared this evidence in accordance with that Practice Note.

4. It is proposed to carry out realignment of the channel of the west branch of the Stanley Brook and its berms, to carry out diversion, and to construct a lake and a number of bridged or culverted crossings.

5. The park includes 4 sites where there will be significant building as follows:

   (i) Accommodation adjacent to the proposed lake;
   (ii) Storage buildings on the south side of Rabbit Gully Road;
   (iii) Caretakers house and retail on the north side of Rabbit Gully Road;
   (iv) A grandstand overlooking the drag strip.

   It is intended to locate toilets and other small buildings on the valley floor in due course.

6. I was engaged by the Applicant to under an investigation of the site and in particular:

(i) To confirm that the 4 building areas are not subject to flooding from the west branch of the Stanley Brook during a flood with a 2% annual exceedence probability (AEP); and

(ii) To access flood hazard to the valley floor generally.

It needs to be acknowledged that the works to the channel and berm diversion and lake construction will affect flood levels and those local issues will be addressed at the time when detailed plans for each of the areas are developed.

7. The purpose of my investigation was to:

   (i) Confirm that the areas where the buildings will be placed are not subject to flooding from the west branch of the Stanley Brook during a flood with a 2% annual exceedence probability; and

   (ii) To assess flood hazard to the valley floor generally.

8. The flood hazard assessment process involved:

   (i) Calculation of the magnitude of the 2% AEP flood flow in the Stanley Brook – with this assessment the flood was calculated at the down end of the site (where it would be greatest) and then projected forward to 2090 with a climate change allowance;

   (ii) Survey of two cross sections of river channel and adjacent buildings – one immediately downstream of the ford and one adjacent to the proposed accommodation area;

   (iii) Calculation of the 2% AEP flood levels at each of the cross sections;

   (iv) Comparison of the 2% AEP flood levels with ground levels at the proposed building sites.

   It is noted that both the caretaker/retail and grandstand areas are located on gully fans. The matter of debris movement onto those sites is appropriate for consideration at the time when the detailed plans for each of these areas are developed.

9. Tasman District Council holds no flood records for the site, but Mr Adcock who manages the property for the current owner for 15 years, has not seen any flooding beyond the berm areas during his time. The previous owner, a Mr Reynolds was approached for comment on his observations but declined to comment as he was an objector to the application.

10. The results of my calculations are **annexed** as **Appendix 1** which sets out in detail the basis for my calculation and they show:

Site	**Minimal Ground Level – Local Data (m)**	**2% AEP Flood Level (m)**	**Ground Level Free Board above 2% AEP Flood Level (m)**
Accommodation	9.0	8.3	0.7
Storage	256	245.5	10.5
Caretaker/Retail	253	245.5	6.5
Grandstand	249	245.5	3.5

The 2% AEP flood is contained within the berm areas at both sites cross sectioned.

11. According to my calculations a 2% AEP flood would be contained within the channel and berm area. Service buildings (toilets, etc) on the valley floor outside of the berm area could be located on sites for security against the 2% AEP flood.

12. The 4 principal building sites have general security against flooding from the Stanley Brook during a 2% AEP flood.

13. I have been asked to comment on the matter of egress from the site in the event of flood. I comment as follows:

(i) It is not practicable to construct normal culvert crossings in the watercourses – they would be over top during flood conditions and would be washed out. Rather, to provide for dry crossing for vehicles I suggest that there be formation of concrete fords (that can be overtopped by flood water with minimal damage) with small culverts underneath to provide for the normal flow keeping the decks of the fords dry, and for fish passage. It is proposed to locate one of the dry fords where the road currently crosses the Stanley Brook. This ford will be the normal access to the grandstand area.

(ii) It is proposed to construct 3 substantial bridges across the Stanley Brook to provide for all weather crossings. The upper bridge will cross in the vicinity of the accommodation block so that the occupants can leave in times of floods. The lower two bridges will be on the sealed racetrack and will provide egress from the grandstand at times of flood. It would be normal practice to design a bridge of this size to survive a 100 year return period flood. On my investigation, I confirm that it is practicable to build bridges at these locations to this standard. The application for resource consent acknowledges that the bridge be substantial.

(iii) It is important to appreciate that the severity of weather that would cause a significant flood in the Stanley Brook would result in any outdoor events being cancelled or postponed, so that apart from the accommodation block, it is most unlikely that there would be any public in the park during a significant flood. The accommodation block is addressed in (ii) above.

14. I am happy to answer any questions.

APPENDIX I

CALCULATIONS

FLOOD FLOWS

Using the Regional Flood Method:

For the Stanley Brook from Figure 4.9:
q100 = 2.8 ,

From table 5.1
For q100 = 2.8 and T = 50, $Q_T/Q_{mean} = 2.49$

from Figure 3.5, $Q_{mean}/ A^{0.8} = 2.$

and from topographical map, A = 31.2 km^2 (to the downstream end of the site).

Gives: $Q_{mean} = 2 \times 31.2^{0.8}$
$= 31.4\ m^3s^{-1}$

and $Q_{2\%} = Q_{mean} \times 2.49$
$= 31.4 \times 1.83\ m^3s^{-1}$
$= 57.5\ m^3s^{-1}$

TDC Gumbel analysis of their flow recorder record in the Stanley Brook yields a 2% AEP flood of 146 m^3s^{-1}.

Scaling this flow to the Stanley Brook Motor Sport Park site using the Regional Flood method ratio of $area^{0.8}$ gives:

Flow at site = flow at recorder x (site catchment area / recorder catchment area)$^{0.8}$
= 146 x (31.2/81.6)0.8
= 68 m^3s^{-1}

So have:

Method	calculated $Q_{2\%}$ (m^3s^{-1})
Catchment comparison	68
Regional Flood	57.5

Hence adopt 68 m^3s^{-1} as a conservative estimate of current $Q_{2\%}$.

CLIMATE CHANGE ADJUSTMENT

Adjusting the current $Q_{2\%}$ estimate for climate change to 2090 using Ministry for the Environment predictions (MfE 2008) for rise in mean annual temperature (Figure 1), National Institute of Water and Atmospheric Research's (NIWA) HIRDS V3 system for predicting increase in rainfall (Table 1) and scaling up the estimate of current $Q_{2\%}$ gives:

Table 2.3: Projected changes in seasonal and annual mean temperature (in °C) from 1990 to *2090*, by regional council area. The average change, and the lower and upper limits (in brackets), over the six illustrative scenarios are given.

	Summer	Autumn	Winter	Spring	Annual
Northland	2.3 [0.8, 6.6]	2.1 [0.6, 6.0]	2.0 [0.5, 5.5]	1.9 [0.4, 5.5]	2.1 [0.6, 5.9]
Auckland	2.3 [0.8, 6.5]	2.1 [0.6, 5.9]	2.0 [0.5, 5.5]	1.9 [0.4, 5.4]	2.1 [0.6, 5.8]
Waikato	2.3 [0.9, 6.3]	2.2 [0.6, 5.6]	2.1 [0.5, 5.2]	1.8 [0.3, 5.1]	2.1 [0.6, 5.6]
Bay of Plenty	2.2 [0.8, 6.2]	2.2 [0.6, 5.6]	2.0 [0.5, 5.2]	1.8 [0.3, 5.1]	2.1 [0.6, 5.5]
Taranaki	2.3 [0.9, 6.1]	2.2 [0.6, 5.3]	2.1 [0.5, 5.1]	1.8 [0.3, 4.9]	2.1 [0.6, 5.3]
Manawatu-Wanganui	2.3 [0.9, 6.0]	2.2 [0.6, 5.3]	2.1 [0.5, 5.0]	1.8 [0.3, 4.9]	2.1 [0.6, 5.3]
Hawke's Bay	2.1 [0.8, 6.0]	2.1 [0.6, 5.3]	2.1 [0.5, 5.1]	1.9 [0.3, 5.1]	2.1 [0.6, 5.4]
Gisborne	2.2 [0.8, 6.2]	2.2 [0.6, 5.6]	2.0 [0.5, 5.2]	1.9 [0.3, 5.2]	2.1 [0.6, 5.5]
Wellington	2.2 [0.9, 5.7]	2.1 [0.6, 5.1]	2.1 [0.6, 5.0]	1.8 [0.3, 4.8]	2.1 [0.6, 5.2]
Tasman-Nelson	2.2 [0.9, 5.6]	2.1 [0.6, 5.1]	2.0 [0.5, 4.9]	1.7 [0.3, 4.6]	2.0 [0.6, 5.0]
Marlborough	2.1 [0.9, 5.6]	2.1 [0.6, 5.0]	2.1 [0.6, 5.0]	1.8 [0.3, 4.8]	2.0 [0.6, 5.1]
West Coast	2.2 [0.9, 5.3]	2.1 [0.7, 5.0]	2.1 [0.6, 4.9]	1.7 [0.4, 4.5]	2.0 [0.7, 4.9]
Canterbury	2.1 [0.8, 5.2]	2.1 [0.7, 4.9]	2.2 [0.8, 5.1]	1.8 [0.4, 4.7]	2.0 [0.7, 5.0]
Otago	2.0 [0.7, 4.8]	2.0 [0.8, 4.6]	2.2 [0.8, 4.8]	1.7 [0.5, 4.3]	2.0 [0.8, 4.6]
Southland	2.0 [0.7, 4.7]	2.0 [0.8, 4.6]	2.1 [0.8, 4.7]	1.6 [0.5, 4.1]	1.9 [0.8, 4.5]
Chatham Islands	1.9 [0.8, 4.6]	2.1 [0.6, 4.9]	2.0 [0.3, 4.5]	1.8 [0.3, 4.6]	2.0 [0.5, 4.7]

Note 1: This table covers the period from 1990 (1980–1999) to 2090 (2080–2099), based on downscaled temperature changes for 12 global climate models, re-scaled to match the IPCC global warming range for six illustrative emission scenarios. Corresponding maps (Figures 2.3, 2.5) should be used to identify sub-regional spatial gradients.

Note 2: If the seasonal ranges are averaged, the resulting range is larger than the range shown in the annual column, because of cancellation effects when summing over the year.

Note 3: Projected changes for the 15 regional council regions were the result of the statistical downscaling over mainland New Zealand. For the Chatham Islands, the scenario changes come from direct interpolation of the General Circulation Model grid-point changes to the latitude and longitude associated with the Chathams.

Figure 1: MfE's estimate of increase in mean annual temperature.

From Figure 1, the predicted increase to mean annual temperature to 2090 is 2°C.

High Intensity Rainfall System V3

Intensity-Duration-Frequency results (produced on Wednesday 8th of February 2012)
Sitename: Stanley Brook West
Coordinate system: NZTM2000
Easting: 1588750
Northing: 5416100

Rainfall intensities (mm/h)

					Duration			
ARI(y)	aep	10m	20m	30m	60m	2h	6h	12h
1.58	0.633	40.8	30.9	26.2	19.8	13.7	7.6	5.3
2	0.5	44.4	33.6	28.4	21.5	14.8	8.2	5.7
5	0.2	57.6	43.5	36.8	27.9	19.1	10.5	7.2
10	0.1	68.4	51.6	43.8	33.1	22.6	12.3	8.4
20	0.05	80.4	60.9	51.6	39	26.4	14.3	9.7
30	0.033	88.2	66.9	56.6	42.8	29	15.6	10.5
40	0.025	94.2	71.4	60.6	45.8	30.9	16.6	11.2
50	0.02	99.6	75.3	63.8	48.2	32.5	17.4	11.7
60	0.017	103.8	78.3	66.6	50.3	33.9	18.1	12.2
80	0.012	111	83.7	71	53.7	36.1	19.2	12.9
100	0.01	116.4	88.2	74.8	56.5	38	20.2	13.5

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 degree Celsius
Rainfall intensities (mm/h)

					Duration			
ARI (y)	aep	10m	20m	30m	60m	2h	6h	12h
?								
1.58	0.633	47.4	35.7	30	22.5	15.4	8.4	5.8
2	0.5	51.6	38.7	32.4	24.4	16.7	9.1	6.2
5	0.2	66.6	50.1	42.2	31.9	21.6	11.8	8
10	0.1	79.2	59.7	50.4	38	25.8	13.9	9.4
20	0.05	93	70.5	59.6	45	30.4	16.4	11.1
30	0.033	102.6	77.7	65.6	49.6	33.6	18.1	12.2
40	0.025	109.2	82.8	70.2	53.1	35.9	19.2	13
50	0.02	115.8	87.3	74	55.9	37.7	20.2	13.6
60	0.017	120.6	90.9	77.2	58.3	39.2	21	14.1
80	0.012	129	97.2	82.4	62.3	41.9	22.3	15
100	0.01	135	102.3	86.8	65.5	44	23.4	15.7

Table 1: Estimates of high rainfall intensities

From Table 1, taking 6 hours as the nearest time of concentration of the catchment, then the increase in the critical rainfall to 2090 is 20.2/17.4 = 1.16.

And the $Q_{2\%}$ estimate for 2090 $= Q_{2\%}$ current x 1.16
$= 68m^3s^{-1}$ x 1.16
$= 79m^3s^{-1}$

Hence use 70 m^3s^{-1} as design flow.

FLOOD LEVELS

Using Manning's formula to calculate flood levels at surveyed cross sections:

Slope: taken from 1:50,000 scale topographic map

Manning's "n": Using Arcement, G.J. Jr. and Schneider, V.R. " Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains United States Geological Survey Water-supply Paper 2339"

Channel

$n = (n_b + n_1 + n_2 + n_3 + n_4) \times m$

$n_b = 0.04$ *bed composed of cobbles*
$n_1 = 0.015$ *Badly sloughed or scalloped banks of natural streams*
$n_2 = 0.012$ *the main flow frequently shifts from side to side*
$n_3 = 0$ *negligible obstructions*
$n_4 = 0$ *negligible vegetation in the channel*
$m = 1.3$ *Ratio of the channel length to valley length is greater than 1.5*

gives $n = 0.087$

Berm

$n = (n_b + n_1 + n_2 + n_3 + n_4) \times m$

$n_b = 0.03$ *firm soil*
$n_1 = 0.015$ *Flood Plain very irregular in shape. Many rises and dips*
$n_2 = 0$ *n/a*
$n_3 = 0.004$ *negligible obstructions.*
$n_4 = 0.005$ *Dense growths of flexible turf grass or weeds growing where the average depth of flow is at least two times the height of the vegetation*
$m = 1$ *n/a*

gives $n = 0.054$

		#subsections	Start	eoss#1	eoss#2	eoss#3			
CROSS SECTION				"n" #1	"n" #2	"n" #3			
Chainage	**Elevation**								
		3	0	15	29	47	**Slope**	0.01	
				0.054	0.087	0.054	**Flow**		
0	244.54	*Berm LH*					**Water level**	245.5	n
15	244.54	*Tob LH*							
21	243.00	*Bob LH*						**W.L.**	
23	242.59	*centre channel*					0	245.50	
25	243.01	*Bob RH*							
29	244.61	*Tob RH*							
44	244.61	*Berm RH*				**n**	0.054	0.087	
47	245.39	*Terrace*							
						A	7.2	28.0	
						P	15.0	14.6	
						Vmax	1.1	1.8	
						R	0.5	1.9	
						Q	8.2	49.6	
						Fr	0.55	0.43	
						D=11rs	53	211	

Table 3: Calculation of flood level, downstream of ford

		#subsections	Start	eoss#1	eoss#2	eoss#3			
CROSS SECTION				"n" #1	"n" #2	"n" #3			
Chainage	**Elevation**								
		3	0	20	30	77	**Slope**	0.01	
				0.054	0.087	0.054	**Flow**		
0	7.56	*Berm LH*					**Water level**	8.3	n
18	7.36	*Tob LH*							
20	7.97	*Stopbank LH*						**W.L.**	
22	6.72	*Bob LH*					0	8.30	
24	6.26	*centre channel*							
28	6.72	*Bob RH*							
30	8.31	*Stopbank RH*				**n**	0.054	0.087	
32	7.59	*Tob RH*							
73	7.32	*Berm RH*				**A**	9.7	14.3	
77	9.00	*Acomodation site terrace*							
						P	20.1	11.0	
						Vmax	1.1	1.4	
						R	0.5	1.3	
						Q	11.1	19.7	
						Fr	0.54	0.40	
						D=11rs	53	144	

Table 4: Calculation of flood level, adjacent to accommodation site