DESIGN ANALYSIS FOR THE PROPOSED GOULBOURN TRACK (DRAWING NO. 5143)

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Design analysis for the proposed Goulburn track
(Drawing No. 5143)

Executive summary

For the oval-shaped track design, of all the starts the 520 m distance start has the highest Jerk of just under 3 m/s³ and snap of just over 10 m/s⁴. For both the 450 m and 370 m distance starts the jerk is below the accepted threshold of 2 m/s³. It was noted that the 520 m distance start would expose the greyhounds to high and varying jerk values within the first 200 m after the jump. UTS suggested that alternative ‘equivalent’ start distances be investigated. Two similar but alternative start distances are compared with the proposed 520 m distance start in the path tracing section of the report. Both these alternative distances showed improved greyhound path navigation and dynamic outcomes. It is strongly suggested that the 520 m start distance be reconsidered and a similar but different racing distance that improves the dynamic outcomes be investigated.

For the partial-turn track straight track design, the 460 m distance start on the turn exposes greyhounds to acceptable levels of jerk and snap, namely: a jerk value just above 1 m/s³ and snap value just under 6 m/s⁴.

Background

GRNSW instructed UTS to review the proposed Goulburn Design No. 5143.

The proposed Goulburn Design No. 5143 has two tracks with different configurations as shown in Figure 1. These configurations are:

1. A 70 m radius oval-shaped track with four 60 m clothoid transitions; and
2. A straight track with a 140 m radius partial turn with two 40 m transitions leading into and out of the radius.

The proposed Goulburn Design No. 5143 has six starting distances, namely:

1. 250 m chute start along the straight track and straight into a catching pen;
2. 340 m puppy start on a 70 m radius bend, along the home straight past the finish post and into a catching pen located immediately after the apex of a 70 m radius bend;
3. 370 m start the with drop-on boxes along the back straight, around a 70 m radius bend, along the home straight past the finish post and into a catching pen located immediately after the apex of a 70 m radius bend;
4. 450 m start onto the back straight, around a 70 m radius bend, along the home straight past the finish post and into a catching pen located immediately after the apex of a 70 m radius bend;
5. 460 m start onto a partial 140 m radius turn and along a 260 m straight into the catching pen; and
6. 520 m start on a 70 m radius bend, onto the back straight, around a 70 m radius bend, along the home straight past the finish post and into a catching pen located immediately after the apex of a 70 m radius bend.
Oval track 370 m Start

For the 370 m distance start, the greyhounds are subjected to a full 180 degree bend where their bodies are exposed to gradual and stable centrifugal forces with the highest force of 176 N occurring at approximately 124 m from the boxes. The lower jerk and snap values were considered relatively stable for the entire race period.

![Graphs showing centrifugal force, jerk, and snap](image-url)

Figure 2: Oval track 370 m start depicting the centrifugal force, jerk and snap plotted against distance; where 0 m is the starting box and 370 m the finish post.
**Oval track: 450 m start**

For the 450 m distance start, the greyhounds are subjected to a single full 180 degree bend where their bodies are exposed to gradual and stable centrifugal forces with the highest force of 171 N which occurs at approximately 151 m from the boxes. The lower jerk and snap values were considered relatively stable for the entire race.

![Diagram showing centrifugal force, jerk, and snap](image)

*Figure 3: Oval track 450 m start depicting the centrifugal force, jerk and snap plotted against distance; where 0 m is the starting box and 450 m is the finish post*
**Straight track with a partial-turn 460 m start**

For this distance start, the greyhounds are subjected to a partial-turn where their bodies are exposed to gradual and stable centrifugal forces with the highest force of 88 N occurring at approximately 125 m from the boxes. The lower jerk and snap values were considered relatively stable for the entire race period.

![Graphs showing centrifugal force, jerk, and snap plotted against distance.](image)

*Figure 4: Partial-turn 460 m start depicting centrifugal force, jerk and snap plotted against distance; where 0 m is the starting box and 460 m is the finish post*
Oval track: 520 m start

For the 520 m distance start, the greyhounds are subjected to an initial partial-turn, a straight section, a full bend and then a straight to the finish post. For the initial partial-turn the greyhounds’ bodies are exposed to relatively gradual and stable centrifugal forces with the highest force experienced being 161 N which occurs approximately 270 m from the boxes. Both the maximum jerk and snap occur at approximately 90 m from the boxes which also coincides with the end of a high acceleration phase. This concurrence of high jerk and snap with the near maximum speed was considered hazardous.

Figure 5: Oval track 520 m start depicting the centrifugal force, jerk and snap plotted against distance; where 0 m is the starting box and 520 m is the finish post
Oval track: 500 m start

For the 500 m distance start, the greyhounds are subjected to an initial partial-turn, a straight section, a full 180 degree bend and then a straight to the finish post. For the initial partial-turn the greyhounds’ bodies are exposed to relatively gradual and stable centrifugal forces with the highest force experienced being 161 N which occurs approximately 270 m from the boxes. The initial centrifugal force after the jump from the boxes is under 100 N, considerably less than the 520 m distance start. The peak jerk value is slightly less compared to the 520 m distance start at approximately 2.4 m/s³ at around 70 m from the boxes combined with a maximum snap of approximately 7 m/s⁴ making this distance start more suitable for safe initial race acceleration than either the 520 m or 540 m starts. It is suggested that there may be a safer start distance that lowers the jerk below 2 m/s³ while also lowering the snap value.

Figure 6: Oval track 500 m start depicting the centrifugal force, jerk and snap plotted against distance; where 0 m is the starting box and 500 m is the finish post
Oval track: 540 m start

For the 540 m distance start, the greyhounds are subjected to an initial partial-turn, a straight section, a full 180 degree bend and then a straight to the finish post. For the initial partial-turn the greyhounds' bodies are exposed to relatively gradual and stable centrifugal forces with the highest force experienced being 161 N which occurs approximately 270 m from the boxes. The initial centrifugal force after the jump from the boxes is just above 150 N, slightly higher compared to the 520 m distance start. The peak jerk value is identical to the 520 m distance start which occurs at around 110 m from the boxes making the 540 m distance start more suitable than the 520 m start.

Figure 7: Oval track 540 m start depicting the centrifugal force, jerk and snap plotted against distance; where 0 m is the starting box and 540 m is the finish post.
500 m, 520 m and 540 m start comparison using simulated path tracing

The current predicted jerk for the 520 m start is above the accepted minimal safety and welfare threshold of 2 m/s³.

Figures 8 depicts the simulated path tracing of a greyhound for a 500 m, 520 m and 540 m starts for two different racing scenarios which are commonly observed navigation phenomena after a race start namely: a straight run after the jump from the boxes and an S-shaped run after the jump.

500 m is depicted by the green combs;
520 m is depicted by the blue combs; and
540 m is depicted by the yellow combs.

The combs are a computer generated array of lines representing the greyhound path navigation probability. Ideally, the envelope of the combs should be smooth and have no sudden changes as this suggests the greyhounds are more likely to exhibit behaviour that increases the probability of an incident during the initial stages of the race.

The 520 m distance start occurs on the bend and predicts higher path inflection for greyhounds coming out of the boxes. The rate change of the path smoothness is also high for the 520 m distance start compared to the other two distances namely 500 m and 540 m distances. This indicates that the 520 m distance start is not an ideal start distance and alternative start distances should be investigated.

The 500 m start would be a pseudo chute start. As it is closer to the horizontal transition and straight section there is less path inflection with this distance start. Ideally, this start would have minimum path curvature variations when the alignment of both the lure and the boxes is optimised compared to both the 520 m and 540 m distances starts.

The 540 m start would require the catching pen to be relocated. This start shows slight improvements in the path inflection compared to the 520 m distance start.
Figure 8: Depicts navigation comparison between the 500 m, 520 m and 540 m starts for three different starting scenarios (1 depicts a straight out-of-box run probability and 2 depicts an S-shape out-of-box run probability)