THE COTTAGE

GLEDHOW SPORTS & SOCIAL CLUB

CRICKET BALL STRIKE ASSESSMENT

LABOSPORT

BALL STRIKE ASSESSMENT– GLEDHOW SPORTS & SOCIAL CLUB – CRICKET PITCH

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INTRODUCTION	To assess the potential risk of cricket balls surpassing the boundaries of a cricket pitch at Gledhow Sports & Social Club, Labosport Ltd has reviewed the site distances and topography to analyse the risk of balls surpassing the site boundaries. The analysis uses a cricket ball trajectory model that has been developed by Labosport, in collaboration with the ECB. If required, the report will identify the height of any ball trajectory mitigation to minimise the potential risks. **Note:** This is a desk study, Labosport have not visited the site, taken measurements, or carried out a visual inspection. All measurement information has been provided by the client and any error in measurements are not the responsibility of Labosport. This assessment is undertaken on the basis of accurate data.

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Section 1 – Executive Summary of Conclusions

Executive Summary of Conclusions

This report has been prepared to assess the potential risk of cricket balls surpassing the boundaries of a cricket pitch at Gledhow Sports & Social Club and advise on the height and location of mitigation recommended to provide a suitable level of protection.

Orientation	Recommended mitigation height (based on recreational cricket)
West	No mitigation required

The trajectory analysis shows that for recreational cricket, the distance to the proposed pavilion provides sufficient mitigation without the need for additional ball stop fencing or netting

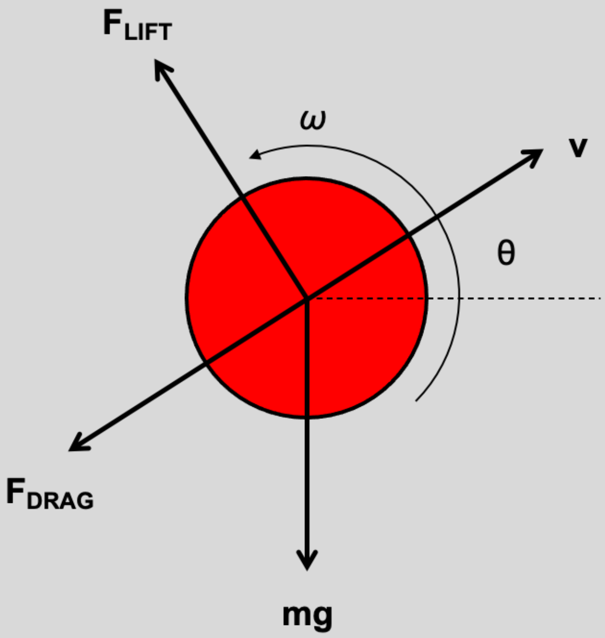
Please Note: This may not stop all shots from landing beyond the site boundary, but it is believed from the assessment of the ball trajectory it will significantly reduce their frequency.

Section 2 – Cricket Ball Trajectory Model

Trajectory Model Overview

Previous work undertaken by Labosport for the England and Wales Cricket Board (ECB) led to the development of a sophisticated trajectory model to estimate the distance a ball would travel, and its trajectory given a specific velocity, angle, spin rate and atmospheric conditions (i.e. altitude).

The trajectory model uses aerodynamic principles and Newtonian physics to predict the ball flight path whilst accounting for the effect of air resistance. The model uses aerodynamic coefficients taken from published wind tunnel studies on cricket balls at different velocities.



The aerodynamic forces of drag (F_D) and lift (F_L) are proportional to the ball's velocity relative to the air flow, frontal area, air density and the drag coefficient respectively lift coefficient. The forces are defined as:

$$F_D = \frac{1}{2} C_D \rho V^2 A$$
$$F_L = \frac{1}{2} C_L \rho V^2 A$$

where C_D and C_L are the non-dimensional drag and lift coefficients, ρ is the air density in kg/m^3, V is the air stream velocity in m/s and A is the frontal area of the ball in m^2. Due to the complexity of the flight dynamics, the trajectory can only be resolved by using a numerical time step approach whereby the ball conditions are calculated at small timesteps throughout the trajectory. The conditions at time step 1 are used to calculate the conditions at time step 2; the conditions are timestep 2 are used to calculate the conditions at time step 3 and henceforth. A timestep of 0.001 seconds was used to generate high-resolution trajectory data.

Trajectory models are known to exhibit high accuracy and Labosport have undertaken extensive experimental validation of this trajectory model to refine its accuracy. However, it is not possible to simulate the full complexity of the real world and this model does not account for variations in bat/ball restitution or wind (speed and direction). Due to these limitations, the model is regarded as an indicative prediction tool.

Trajectory Scenarios

The hit angles and velocities are estimated from in-game action to cover a range of ‘typical’ shots ranging from 20 degrees to 50 degrees and 20 m/s (45 mph) to 50 m/s (112 mph). The exact frequency of shots resulting in a cricket ball being hit into adjacent areas is unknown and impossible to predict with certainty (player skills, type of game and many other factors can influence this) hence a proportionate approach needs to be taken to provide safety to users. In reality, there may be a “freak” shot that will result in a further than expected trajectory; however, the implications of planning for this type of worst-case approach could result in the closure of hundreds of cricket grounds across the country and hence a balanced risk mitigation strategy needs to be implemented that is proportionate. Indeed, there are risks associated with many everyday activities, but plans need to be developed to reduce risk following good practical health and safety principles including a combination of likelihood and severity.

Trajectories at an angle to the pitch

In scenarios where the direction of the trajectory is perpendicular to the direction of the pitch (or within 45 degrees of perpendicular), the analysis considers one trajectory scenario. This scenario is a ball trajectory played from the closest batting crease in the trajectory direction.

Trajectories parallel to the pitch

Where the direction of the trajectory is parallel to the direction of the pitch (or within 45 degrees), the analysis considers two trajectory scenarios; 1) a trajectory played from the closest batting crease, and 2) a trajectory played from the furthest batting crease. The type of cricket batting shots required to hit the ball from closest stumps are ‘late cut’ and ‘late glance’ shots and these do not achieve the same velocity as a ‘straight drive’ from the furthest batting crease. A greater emphasis is therefore placed on trajectories from the furthest batting crease.

Previous Work

Labosport Ltd have undertaken this type of boundary risk assessment for a great many other cricket grounds over the past 5 years when there have been perceived problems with cricket balls exceeding the boundary, or the potential influence of a new adjacent development to an existing club. Through this work, Labosport Ltd have developed significant expertise that supports our judgements in these matters.

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Section 3 – Site Specifics

Playing Standard of Cricket on the Site
Labosport have investigated the level of cricket that is played on this site. We have been advised that recreational cricket is played on this site. For recreational level cricket the basis of the shot velocity is 40 m/s. For recreational level cricket the basis of the 'late cut' or 'late glance' type shots is 30 m/s. It is on this basis that the recommendations in this report have been made.

Existing Mitigation
This report does not account for any existing, or planned planting (trees, hedges etc). It is our informed opinion that planting cannot be relied upon to provide protection against ball trajectories. The planting may not be sufficiently dense to stop the ball, nor homogeneous across the length. The planting may change during the seasons, or indeed be cut back or removed.

Site Measurements and Topography

Orientation of Risk
At the instruction of the client, this boundary risk assessment only evaluate possible ball trajectories in a Western direction towards the proposed development to The Cottage. The focus on the analysis is based on the shortest distances from the closest cricket pitches to the potential area of risk.

Section 4 – Site Measurements

Site Measurements

The above diagram illustrates the minimum distances from the cricket square to the site boundaries. Note as this is a risk assessment of the worst-case scenarios are considered; consequently, the shortest measured (and calculated) distance is used for the study. The following distances have been used to calculate the projected height of the ball for different shot conditions as specified below:

Measured Distance	Shortest Boundary (m)
West – Closest stump to site boundary	Circa 60.8 m
West** – Furthest stump to site boundary	Circa 80.55 m

Section 5 – Estimated Ball Height

Estimated Ball Height (Using the Projection Modelling Tool)

West Orientation

Estimated Ball Height @ 60.8 m		Angle (degrees)						
		20	25	30	35	40	45	50
Velocity (m/s)	20	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0
	40	0	0	1.7	3.7	4.9	4.2	0
	45	0	4.8	8.1	11.5	14.2	14.9	13.2
	50	4.6	9.1	13.3	17.3	20.7	23.0	23.0
Estimated Ball Height @ 80.55 m		Angle (degrees)						
		20	25	30	35	40	45	50
Velocity (m/s)	20	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0
	40	0	0	0	0	0	0	0
	45	0	0	0	0	0	0	0
	50	0	0	0	0	0	0	0

See Appendix A for example trajectories.

Section 6 – Risk Assessment Discussion

Risk Assessment Discussion
This report has been prepared to assess the potential risk of cricket balls surpassing the boundaries of a cricket ground at Gledhow Sports & Social Club and to advise on the height and location of mitigation recommended to provide a suitable level of protection.

Mitigation Recommendations – West Orientation

Distance	Distance to boundary	Mitigation height (majority of risk removed)	Mitigation height (vast majority removed)	Overall mitigation height recommendation
Closest stump to site boundary @ 30 m/s	60.8 m	0 m high	0 m high	**No mitigation required**
Furthest stump to site boundary @ 40 m/s	80.55 m	0 m high	0 m high	

Please Note: This may not stop all shots from landing beyond the site boundary, but it is believed from the assessment of ball trajectory it will significantly reduce their frequency.

Further Notes

This report does not recommend the specific design of a mitigation system, however options could include;

- Ball stop netting
- Rigid panel fencing
- Permanent or temporary fencing structures

It is recommended the client discuss design options with the relevant stakeholders including the LPA, the ECB and the cricket club.

In addition, the client may wish to consider alternative mitigation options such as the location and orientation of the cricket square, controlling the level of cricket played on the site, or defining the location of junior and senior cricket pitches. It is recommended that the client discusses any such plans with the ECB and other relevant organisations along with the club to ensure that plans are suitable in mitigating the risk but also practicable for the cricket club's day to day use.

Section 7 – Conclusions

Conclusions

This report has been prepared to assess the potential risk of cricket balls surpassing the boundaries of a cricket pitch at Gledhow Sports & Social Club and advise on the height and location of mitigation recommended to provide a suitable level of protection.

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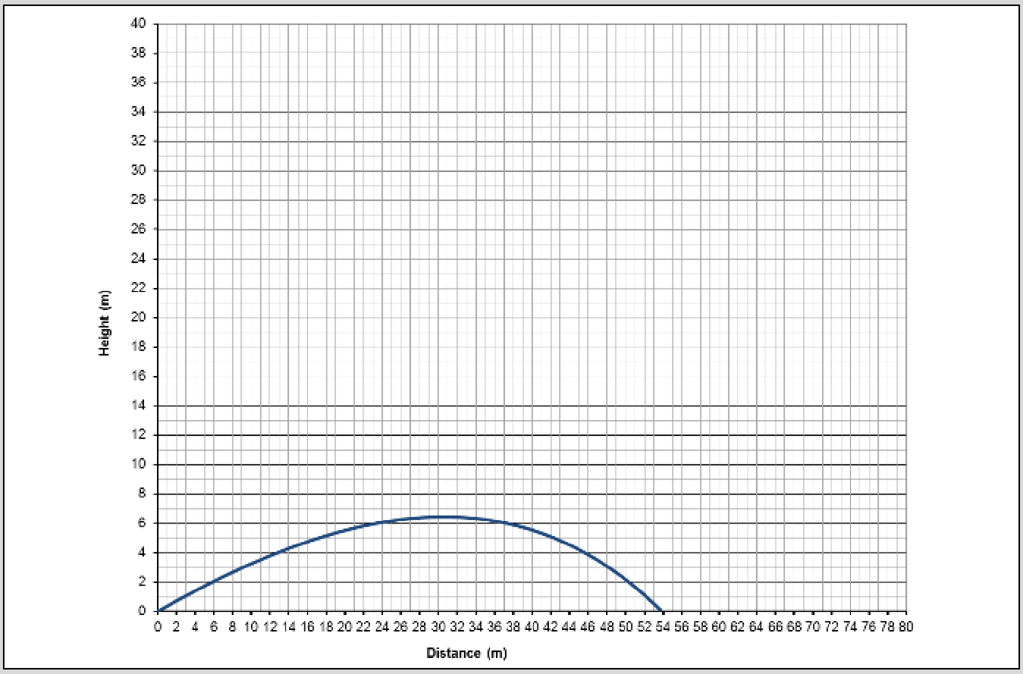
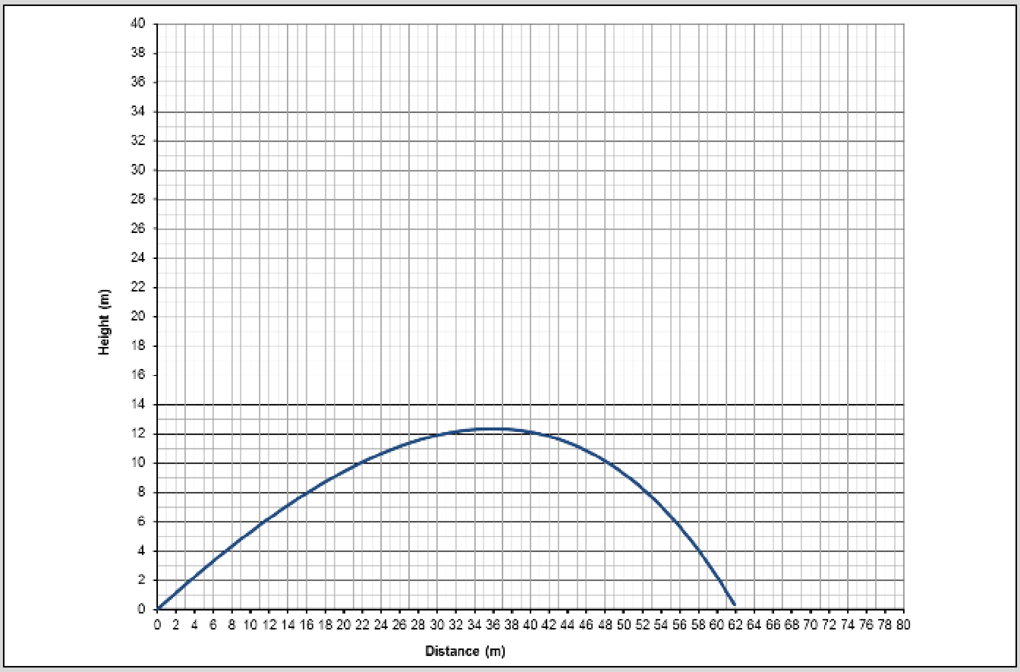
Appendix A – Typical Example Trajectories

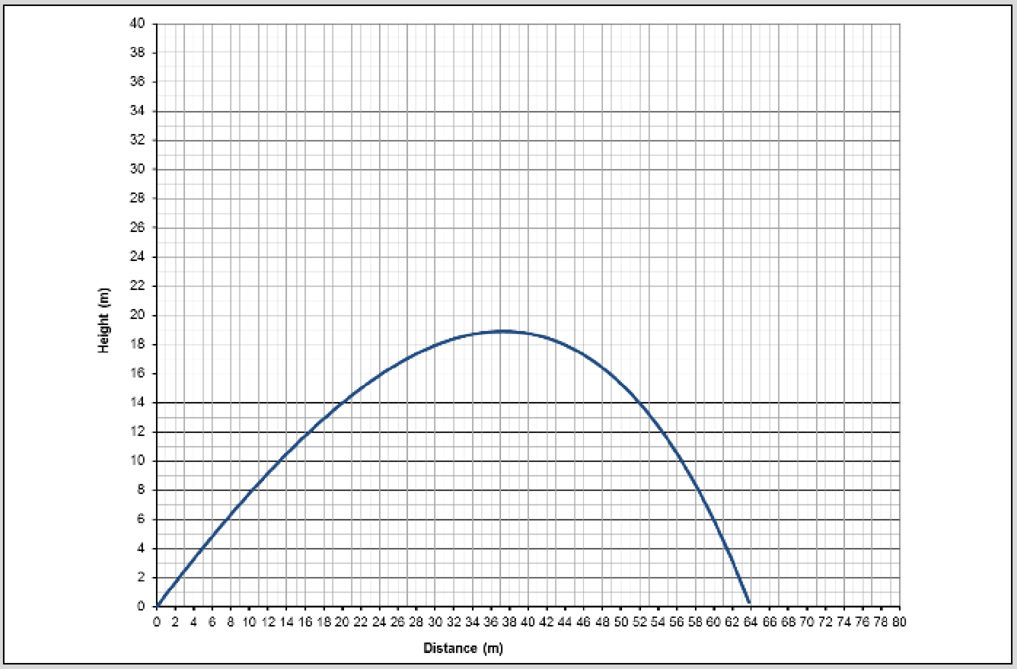
20 ° @ 40 m/s



30 ° @ 40 m/s



40 ° @ 40 m/s


Height (m)
Distance (m)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40