Statement by experts (M. Hilton, G. La Cock, M. Shepherd) in relation to the proposed FRP Block development.

FRP Block (on-site)

A. Geomorphology

1. We agree on the nature and history of the dunes on the FRP Block. The 1979 and 1995 aerial photos depict the dune forms prior to pine planting and can be used to locate dunes and dune boundaries now largely obscured by the pines. In 1995 a number of dunes were still active in the northernmost third of the block. Currently there are two active sites, both near the western boundary, but whether they are the result of more recent disturbance or mobilisation is unclear.

2. We agree that Dr. Hilton's map showing dune topography on the FRP site provides a clear depiction of the areas with higher dunes (attached). Some low- to moderate-height dunes may have been omitted from the map but this is unlikely to affect the overall interpretation of dune forms. A more detailed topographic survey will be necessary if development proceeds, to identify the exact location of less conspicuous dunes.

B. Hazards

3. We agree that the higher dunes on the site could become unstable if their vegetation cover is disturbed or removed or if the lower slopes of the dunes are removed during the development on the site. If development proceeds the vegetation cover of these dunes should be retained and protected, albeit we support progressive replacement of pine trees with appropriate native species

4. We agree that a forested buffer zone be retained within the FRP site along its western boundary. This would reduce the likelihood of dunes, migrating from the west, penetrating very far into the FRP Block and by slowing migration rates would buy time for measures to be taken to arrest the encroachment.

5. We differ with respect to the width of the zone (attached map). Whereas Dr. Hilton suggests a 20-30 m width may be sufficient, except in the northwest where active dunes currently affect the reserve and FRP land. M.S. and G.L.C. consider that a width of 100 m would be more prudent and that a buffer zone should also extend along the northern boundary of the FRP Block. This is because actively encroaching dunes are capable of passing over pine forest, as is currently happening to one section of large HDC pines on the boundary. A further reason for this precautionary approach is that one of the deflation basins currently stretches 75 m into the FRP land, albeit in the northwest. Dr Hilton argues that a 100m wide buffer is unnecessary because (i) appropriate management of the HDC Reserve would greatly reduce the likelihood of transgressive dune development; (ii) were such dune development to occur it could be intercepted at the FRP block boundary; (iii) future subdivision could be designed to avoid or mitigate this hazard; and (iv) a 100m wide buffer would unnecessarily restrict development options. GLC and MS suggest a narrower zone along the southern half of the western boundary may be appropriate if pines on the HDC Reserve adjacent to the FRP Block are retained so as to provide a minimum 100 m wide buffer.

6. MS and GLC question whether dune movement could be successfully intercepted at the FRP boundary. MH argues that any future RMA consents could include conditions that require monitoring of dunes in the HDC Reserve. Any dune movement could, therefore, be anticipated and managed while the dunes were still within the HDC reserve.

7. We agree that any replacement of trees in the buffer zone, with either pines or other vegetation cover, should be carried out carefully and progressively.

Risk to the FRP site from natural dune processes to the west of the site

8. The FRP site is unlikely to be *directly* affected by processes of wave erosion, storm surge or river mouth migration, although there would be a very small risk of tsunami waves reaching the site within the next 100 years.

9. All of the above processes could cause foredune erosion and initiate blowout/parabolic dune migration that may affect the FRP Block. Dune migration was not incorporated into Shand's (2008) methodology when he mapped Foxton Beach erosion hazard zones.

10. Owing to a combination of coastal orientation and exposure, windy climate, good sediment supply, wide beach and fine sand size, this coast is subject to high rates of aeolian sand transport from the beach and episodic dune migration which has been occurring on a large scale for thousands of years. Sand supply may increase following major earthquake or volcanic events, resulting in increased dune activity.

11. The risk of dunes migrating westward on to the FRP site in future cannot be assessed without consideration of both natural processes and management practices on the HDC Reserve.

12. The risk related to natural processes is difficult to quantify because of a limited data set with a short time-span, and the irregular occurrence of both medium-frequency phenomena, such as storm cycles and strong El Nino events, and lower frequency events such as tsunamis and large earthquakes. However, there is a chance that at least one event with a magnitude sufficient to initiate parabolic dune migration will occur within the next 100 years, while based on past history, smaller episodes of blowout and parabolic lobe development are likely to occur more frequently (i.e. every ten years). Whether such dune migration impacts the FRP Block depends, in part, upon management of the HDC Reserve (see below).

13. The indigenous vegetation and areas with bare sand have been replaced over a large area of the HDC reserve by marram grass, which can be an effective sand binder and dune stabiliser. However, it is accepted that a marram grass cover does not guarantee dune stability.

14. In recent decades dunes in the HDC reserve have generally become increasingly stabilised, following marram and pine planting programs. However, individual parabolic dunes along the coast adjoining the FRP block to the north have migrated inland at rates that are very high by global standards.

15. Any human activities, including vehicular activity, that destroy even small areas of vegetation, particularly on the foredune and higher dunes within the HDC Reserve, will

increase the risk of dune reactivation and migration towards and possibly on to the FRP block. It is not clear whether human activities were responsible for the reported formation of new mobile parabolic dunes in the Foxton-Himatangi dunefield in the 1990s, but they probably contributed.

Potential avoidance and mitigation options

The FRP site

16. Avoidance of dune encroachment is most likely if the HDC Reserve to the west is well managed, with respect to both hazard management and biodiversity objectives. With respect to mitigation, a forested buffer zone, as discussed previously, should prevent most migrating dunes from encroaching very far into the FRP Block, and would slow migration rates so that measures to block the sand source and/or to stabilise or remove the sand, would have a greater chance of success. Although large migrating dunes can pass over forest, the wider the buffer zone the greater the probability that dune migration would be arrested within the zone.

The HDC Reserve

17. We recognise that various subdivision design and construction methods could be employed to mitigate the adverse effects of sand dune migration *on* the FRP block, but the imperative is to first avoid hazards. We agree that any development of the FRP block should occur in conjunction with effective management of the HDC Reserve, in order that possible future coastal hazards can be avoided or mitigated on the FRP block.

18. In order to reduce the risk of renewed dune activity it will be necessary to maintain an effective vegetation cover within the reserve, and particularly with respect to the foredune and the depositional lobes of now stable parabolic dunes. This would require strict control of the activities of people and their vehicles. Any development of the FRP Block is likely to increase the impact of people and vehicles in the reserve to an extent proportional to the density of the subdivision. The construction of raised walkways across the dunes, fencing off of vulnerable areas, such as the foredune and higher dunes to landward, and restricted vehicle access are mitigation measures that have been successfully implemented elsewhere.

19. One of us (M.S.) is concerned that if the shoreline position remains stable for several decades, as appears to be occurring at present near Foxton Beach, sand continuously blown from the beach may nourish a well vegetated and maintained foredune to the extent that it builds up into a larger, higher structure, exposed to greater wind-shear at its crest, and therefore more prone to major blowouts and parabolic dune development.

20. In the event of natural events or human activity destabilising the foredune, it would be necessary to act quickly to prevent blowouts enlarging into larger parabolic dunes that migrate inland. Such practices are already carried out along parts of the Manawatu coast with a degree of success.

Appropriate vegetation

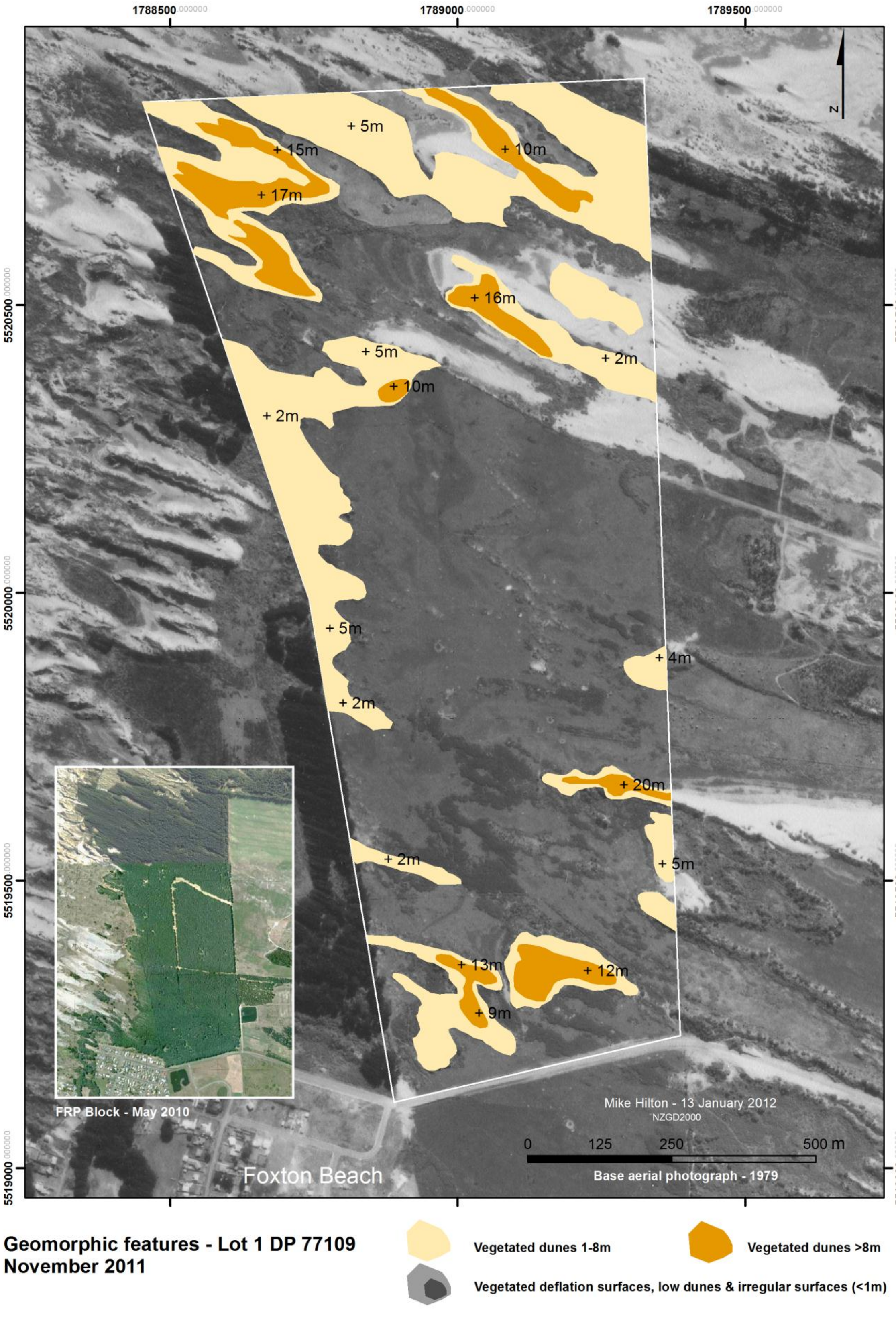
21. The pines on the FRP and HDC sites will not survive 100 years, and will need to be harvested or allowed to die a natural death within this time. In either case, careful management of the process is required to prevent the mobilisation of current dunes under the pines. Replacement with native trees and shrubs is preferred.

22. Ideally marram in the rear dunes should be replaced by appropriate indigenous rear dune vegetation.

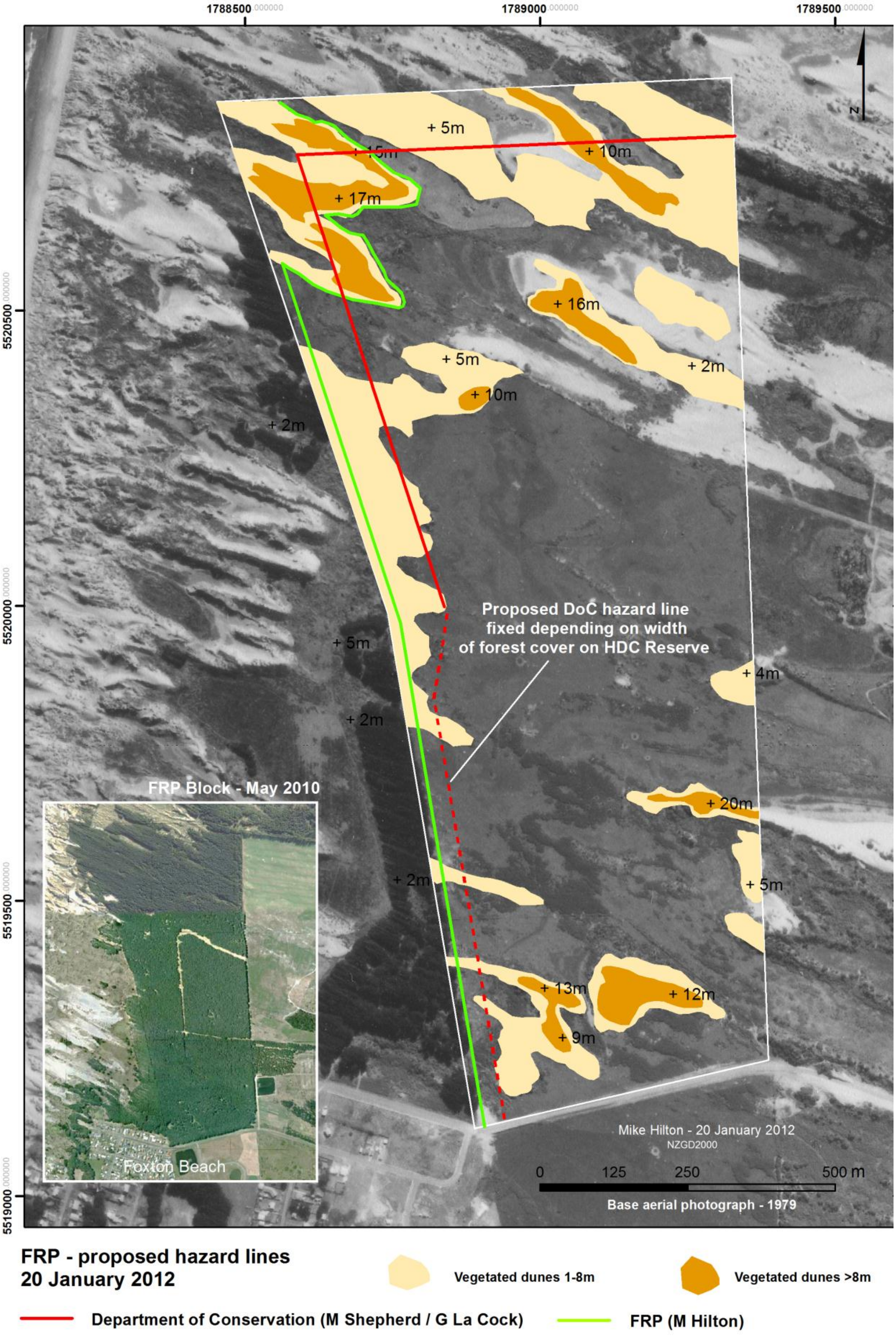
Agreed:

M. Hilton (for FRP)
M Shepherd & G La Cock (for DoC)

20th January 2012



Geomorphic features - Lot 1 DP 77109
November 2011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+ 5m
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+ 10m
+ 17m
+ 16m
+ 5m
+ 2m
+ 10m
+ 2m
Proposed DoC hazard line fixed depending on width of forest cover on HDC Reserve
+ 5m
+ 4m
+ 2m
FRP Block - May 2010
+ 20m
+ 2m
+ 5m
+ 13m
+ 12m
+ 9m
Foxton Beach
Mike Hilton - 20 January 2012
NZGD2000
0 125 250 500 m
Base aerial photograph - 1979
FRP - proposed hazard lines
20 January 2012
Vegetated dunes 1-8m
Vegetated dunes >8m
Department of Conservation (M Shepherd / G La Cock)
FRP (M Hilton)