



Working to restore & enhance our rivers

DORNOCH BURN, SCOTTISH HIGHLANDS

Options for reducing flood risk and improving habitats in the lower Dornoch Burn



For
NatureScot

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1	First Draft	24/04/2023
2	Final Report	26/07/2023

Disclaimer

This report has been compiled on the basis of the River Restoration Centre's (RRC) expertise and site visits 9th and 10th February 2023. RRC seeks to provide advice and suggestions to facilitate river restoration progress, but is careful not to produce detailed design drawings. In this way the Centre limits its liability. Liability for any restoration designs should be with the consultants tasked with the detailed technical feasibility and design work which will be necessary to take forward any options identified in this document.

RRC is a national centre for information and advice and holds a dataset of river restoration and best practice management works. To inform this inventory please let us know of any progress with this project and also other projects which are carried planned in the future. Please send any information to the RRC (rrc@therrc.co.uk).

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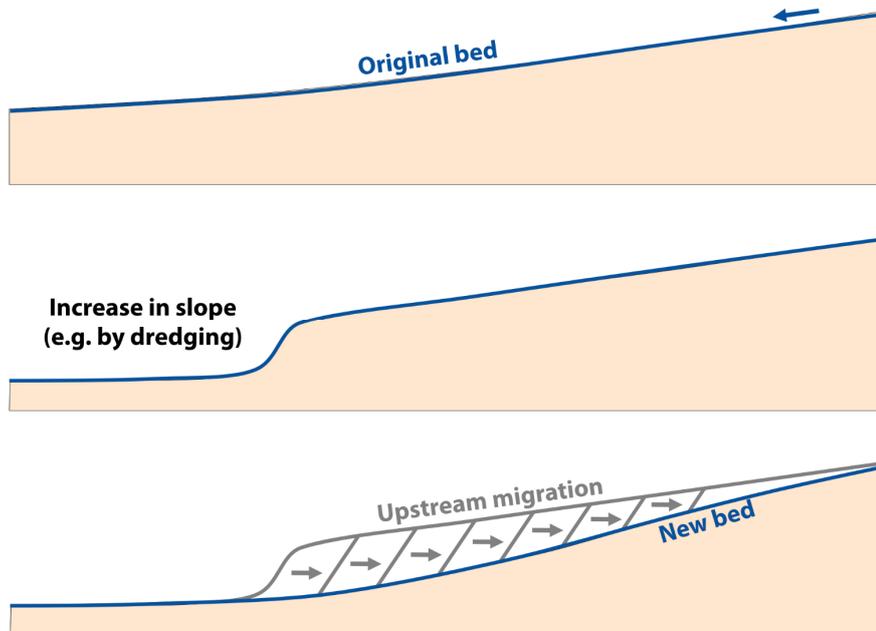
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Glossary

Knick-point erosion

refers to a river's natural response to an increase in the channel slope, usually following the over-deepening of a section of the river. The local increase in slope means the river has more energy and erodes upstream until the slope is lowered back to a more stable gradient. Depending on the level of over-deepening this migration upstream can extend for hundreds of metres.



River Restoration

refers to strategies and techniques applied to enhance the natural state and functioning of rivers and catchments. Several terms are used to describe works aiming to improve the riverine environment - such as rehabilitation, re-naturalisation, enhancement, re-creation and mitigation - and river restoration is used as an umbrella term for these.

Resectioning

refers to the re-profiling of the dimensions of a river. Bed resectioning refers to the over-deepening or over-widening of the river, whilst bank re-sectioning refers to the re-profiling of the river banks, usually at a uniform 45 degree angle.

Executive summary

Dornoch beach has been accreting sand and changing the landscape around the lower 500m of Dornoch Burn and diverting it to the south along the top of the beach. The impounded flow has flooded previously dry dune habitats, creating dune slack and wetland habitats, as well as creating flooding issues in the caravan site.

RRC has undertaken a River Habitat Survey assessment of the site and assessed options to improve local habitats and reduce flood risk in the caravan site. Findings from the surveys revealed very poor habitat quality along Dornoch Burn and Black Burn in the golf course and caravan sites, both within the bottom 10% and 40% of similar sites respectively. The part of Dornoch Burn that flows through the sand dunes has more valuable habitats, scoring in the top 40% of similar sites.

Four options have been assessed:

- Option A: Do nothing
- Option B: Dredge the beach accretion
- Option C: Lose small number of overnight camping slots and make minor habitat improvements
- Option D: Divert portion of flow to Black Burn and create wetland habitats

Option A will not solve the flooding issue or improve habitats. Option B is not suggested because it is not a sustainable solution to flooding as it will require periodic dredging, and it could de-stabilise the channel bed and drain valuable wetland dune habitats.

The suggested options are:

- **Short term:** Re-locate the flooded camping areas and create small wetland habitats in their place.
- **Long term:** Work with community stakeholders to develop a transformative project that would divert a portion of flow to Black Burn and create wetland habitats that would improve biodiversity and create a valuable public amenity for people to enjoy.

Introduction

Dornoch Burn is a small stream in the Scottish Highlands, which enters the sea at Dornoch Firth. Due to relative sea levels falling in this area over much of the last few hundred years, and a large long-shore drift component, the beach has been accreting sand at a rate of 14m per year (www.DynamicCoast.com). This has resulted in substantial changes to the landscape around the lower 500m of the burn before it enters the sea. The foreshore accretion and expanded dunes have blocked the burn, diverting it to the south along the top of the beach and further reduced the previously shallow gradient of the channel. The impounded flow has flooded previously dry dune habitats, creating dune slack and wetland habitats.

Figure 1 shows the changing position of Mean High Water Springs (MHWS) between 1905, 1979, 1997 and 2011. Such seaward accretion has made the river channel shallower than it was in 1905. Figure 1 also shows the altitude of the water surface within the burn on 8th February 2023. The burn has a very shallow gradient through the golf course, however as it enters the caravan park the water surface elevation actually increases. This may be related to the strong wind during the survey, but the burn's water surface falls very little in the caravan park. South of the wetlands the channel starts to fall, but it isn't until the open beach that the slope increases.

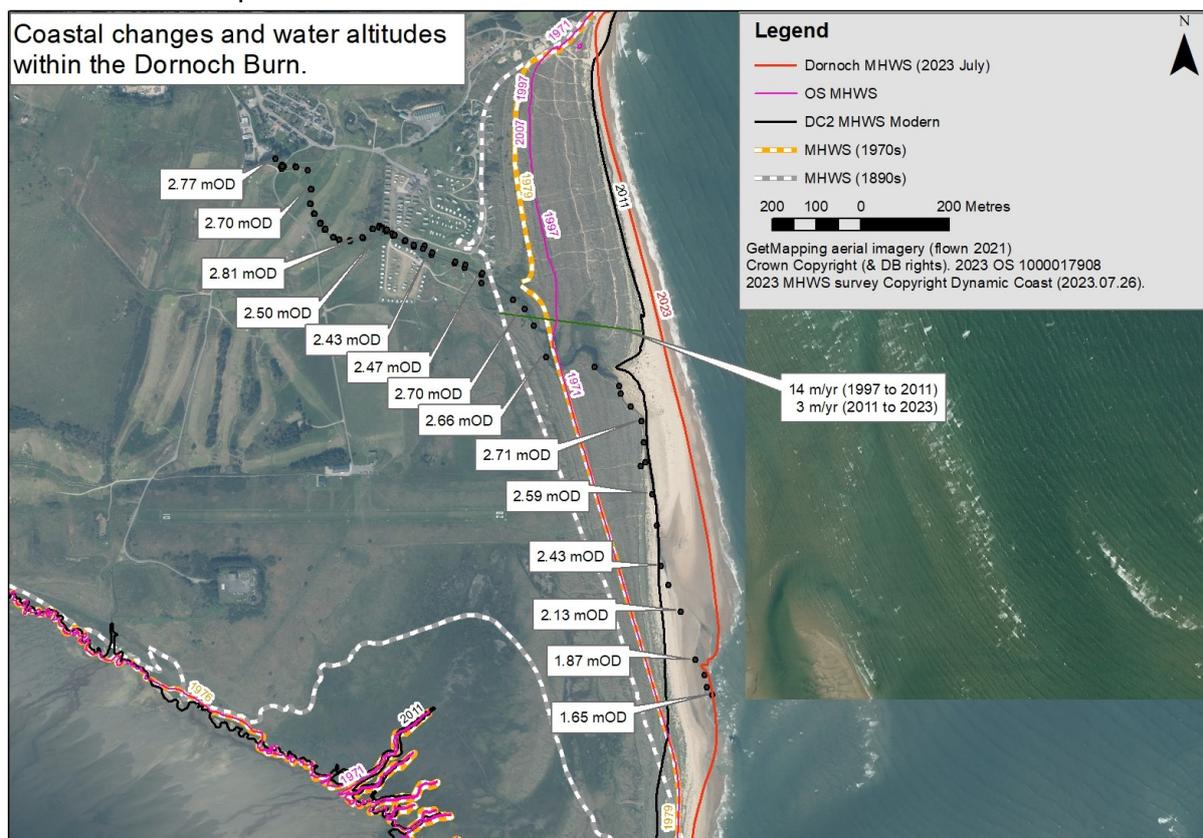


Figure 1: Map showing coastal changes adjacent to the Dornoch Burn, and water surface elevations within the burn.

Such instances where rapid coastal accretion has led to a substantial shallowing of coastal gradients are rare, but not unique, in Scotland. The dunes at Tentmuir have a similar

situation, where the coastal hinterland is occupied by forestry, although Forest Land Scotland are reporting similar issues with water retention.

The raised water level of the Dornoch burn is resulting in larger areas of standing water for longer periods of the year in the caravan park and golf course. The Highland Council (THC) manage the Dornoch Common Good land and the subject was discussed between THC and Dynamic Coast / NatureScot. NatureScot asked the RRC to visit the site to recommend options for addressing this problem and improving river habitat quality in the area.

RRC visited the site on 9th February 2023, completing 3 River Habitat Surveys and taking 238 360° photos across Dornoch and Black Burn. This report contains the outputs from the River Habitat Surveys, maps and indicative drawings of potential options, and some notes on RRC's suggestions.

Reach assessments

Dornoch Burn Reach 1

Upstream limit: NH 79973 89209

Downstream limit: NH 80266 88996

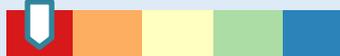
Land use: Improved grassland

Bedrock geology: Sandstone

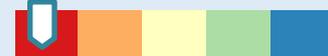
Dimensions: W: 1.8m; D: 0.8m

RHS survey date: 09/02/2023

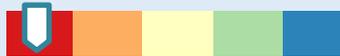
River Habitat Quality



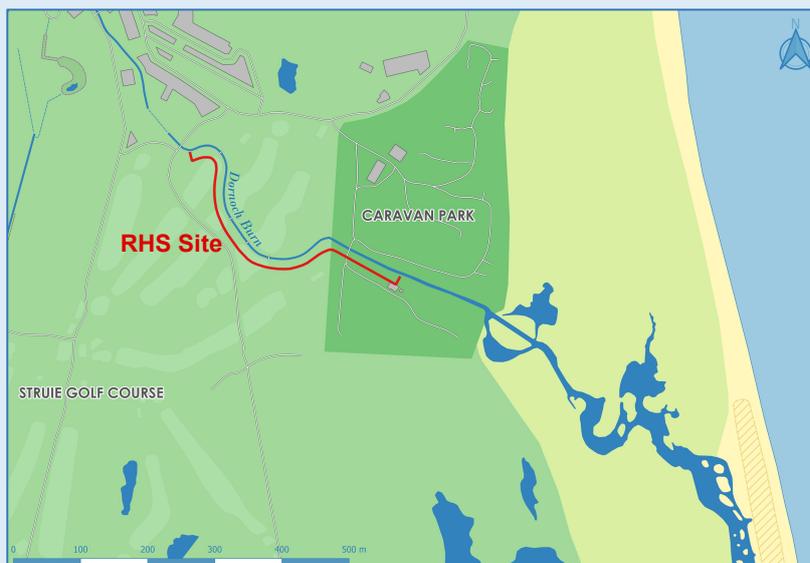
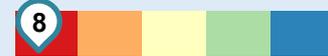
Riparian Quality



Habitat Modification



Vs. similar sites percentile



Pressures

Realignment
Bed resectioning
Bank resectioning
Bridges
Bank mowing
Bank reinforcements

Impacts on

Floodplain connectivity
Natural in-channel forms
Natural bank forms
Native riparian vegetation

Condition

- At the upstream end, the channel emerges from a culvert under the sewage pumping station.
- The channel is resectioned throughout with uniform channel forms and flow types.
- Toeboards line both banks throughout the golf course.
- The banks are mowed resulting in uniform bank and riparian vegetation structures.
- The golf course is low lying with large areas of standing water present in winter. According to the course manager this is a result of saturated soils rather than river flooding.

Photos



Dornoch Burn Reach 2

Upstream limit: NH 80561 88826

Downstream limit: NH 80722 88686

Land use: Dunes

Bedrock geology: Sandstone

Dimensions: W: 35.0m; D: 0.35m

RHS survey date: 09/02/2023

River Habitat Quality



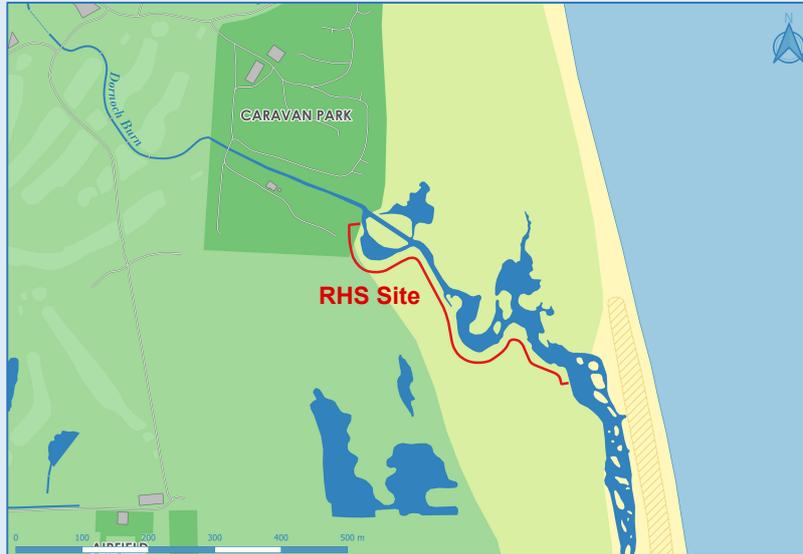
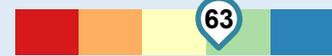
Riparian Quality



Habitat Modification



Vs. similar sites percentile



Pressures

Realignment
Bed resectioning

Impacts on

Floodplain connectivity
Natural in-channel forms

Condition

- Beach accretion has impounded the burn through the dunes and created wet habitats in areas that were previously dry.
- There are high quality habitat features here, including natural berms, islands and cut-off meander loops.
- Immediately downstream of the caravan site, the burn has been dredged and straightened to try and drain water away from the caravan site.

Photos



Black Burn Reach 1

Upstream limit: NH 79712 89150

Downstream limit: NH 79603 88744

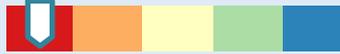
Land use: Scrub/Pasture/Turf

Bedrock geology: Sandstone

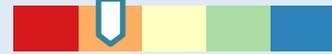
Dimensions: W: 6.0m; D: 1.5m

RHS survey date: 09/02/2023

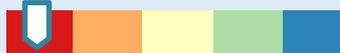
River Habitat Quality



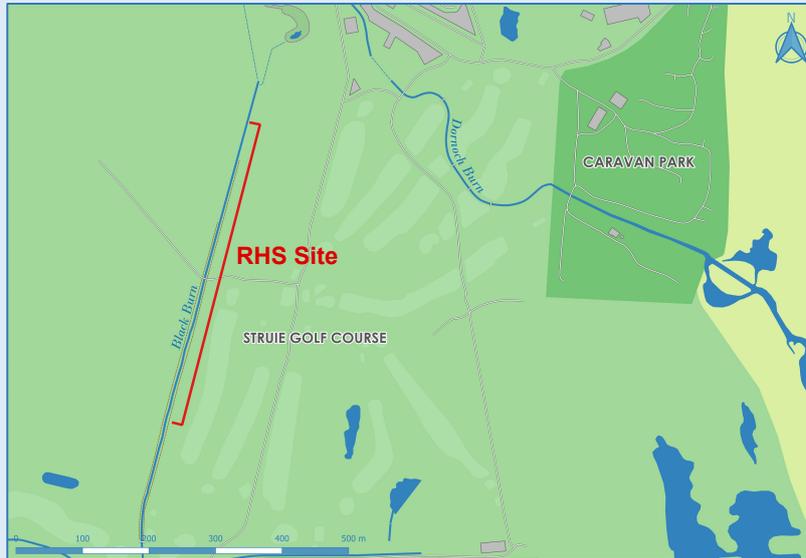
Riparian Quality



Habitat Modification



Vs. similar sites percentile



Pressures

*Realignment
Bed resectioning
Bank resectioning
Embankments
Bridges
Outfalls
Bank reinforcements*

Impacts on

*Floodplain connectivity
Natural in-channel forms
Natural bank forms
Water quality
Native riparian vegetation*

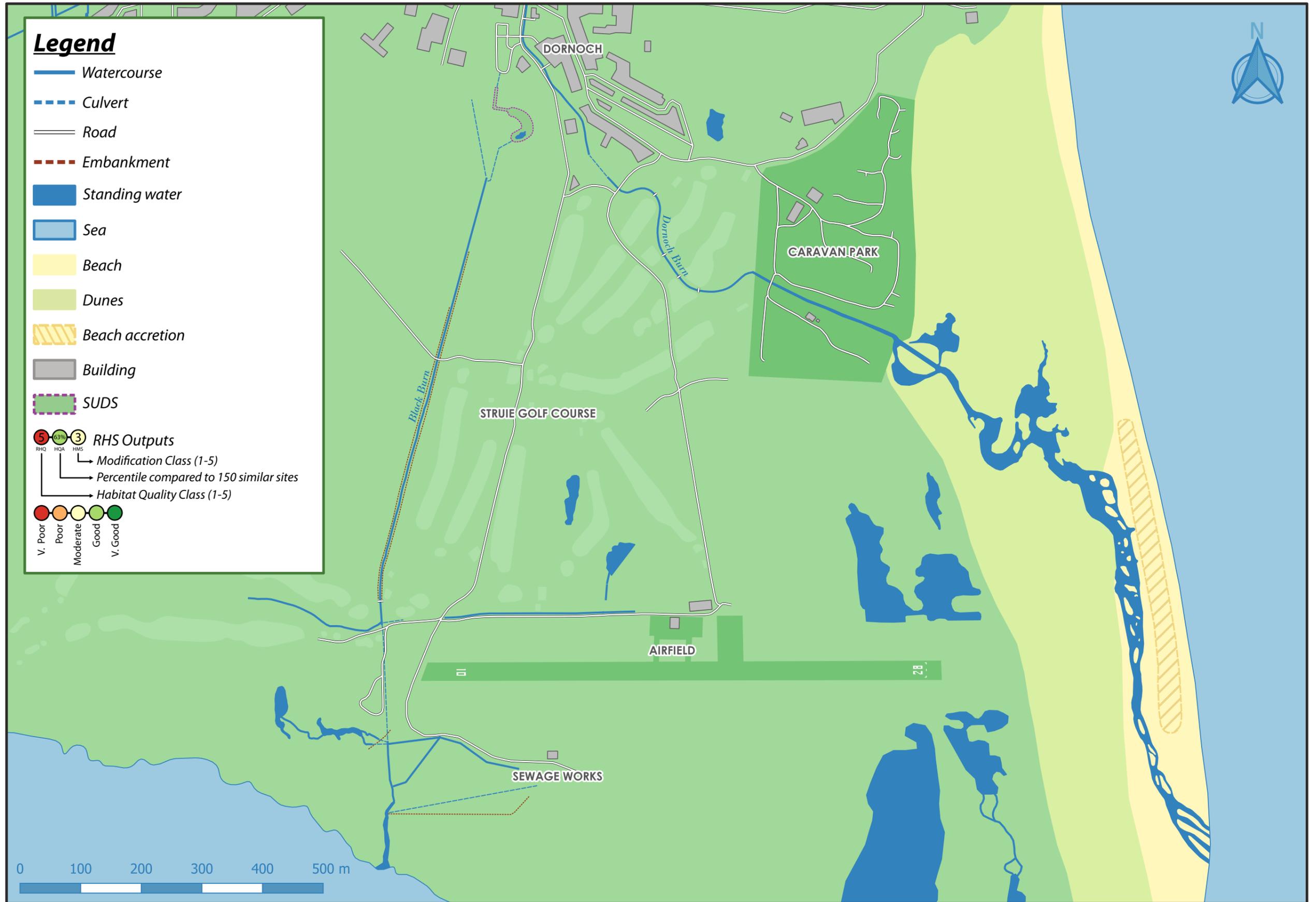
Condition

- The burn has been realigned with an over-deep and uniform channel profile.
- There is pollution coming from one of the upstream culverts, resulting in an ochre coloured sediment for the first 100m
- The channel is choked with vegetation in the upper half of the reach.
- Flow types are slow moving and non-perceptible in places
- Riparian and floodplain vegetation is uniform and the floodplain is completely disconnected as a result of over-deepening and large embankments.

Photos



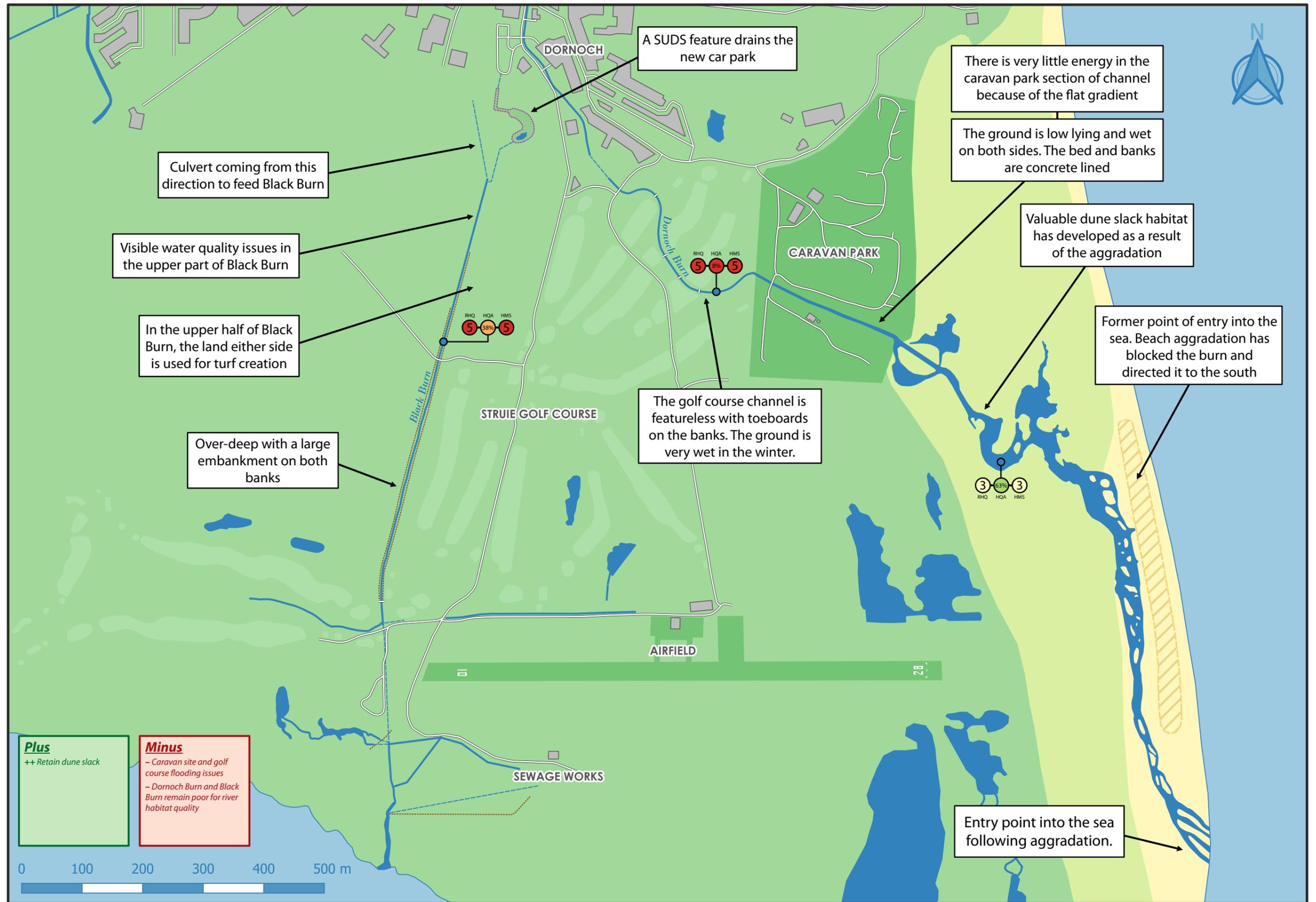
Legend



These are indicative drawings that should not be used as detailed designs

March 2023

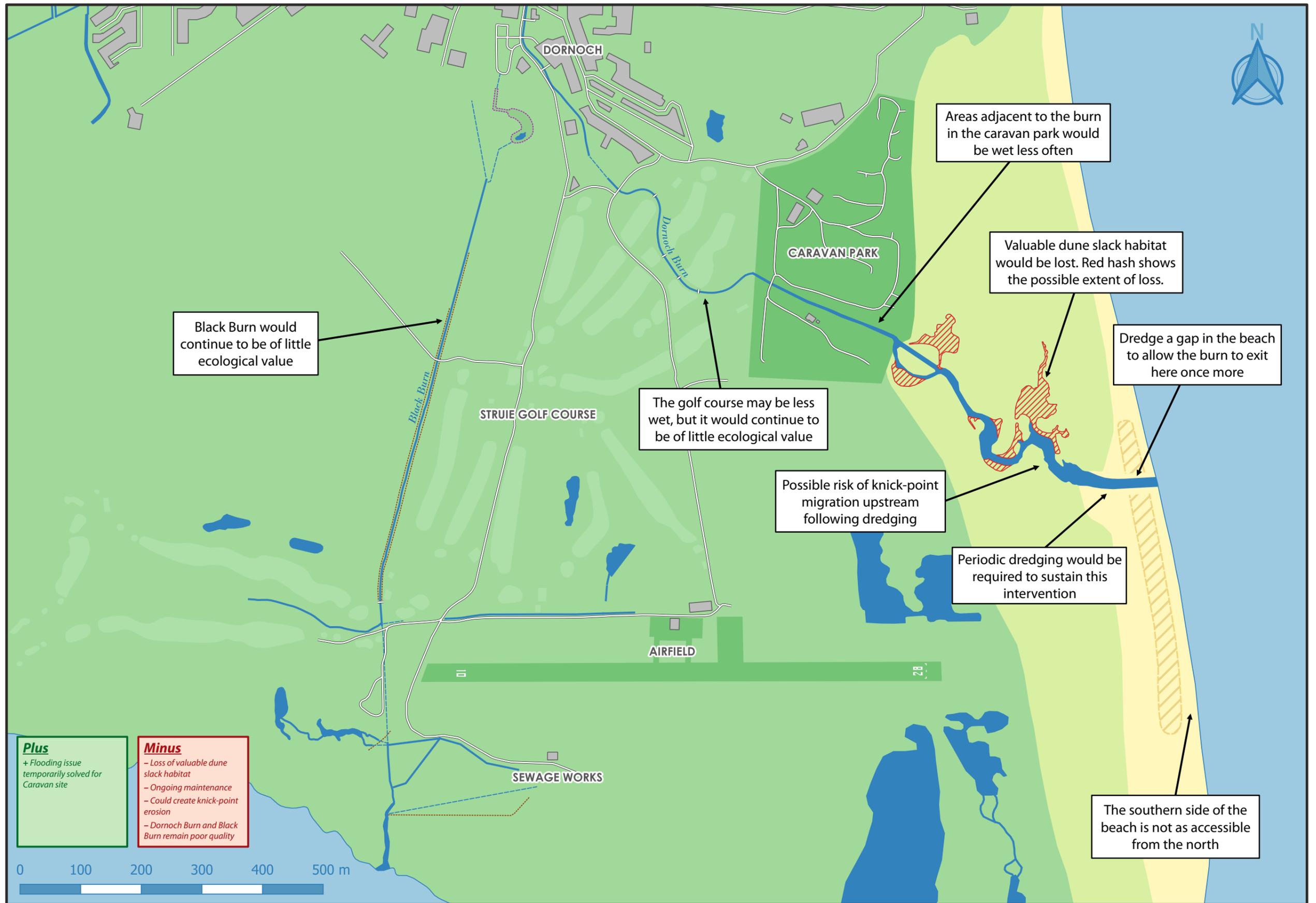
A: Current condition



These are indicative drawings that should not be used as detailed designs

March 2023

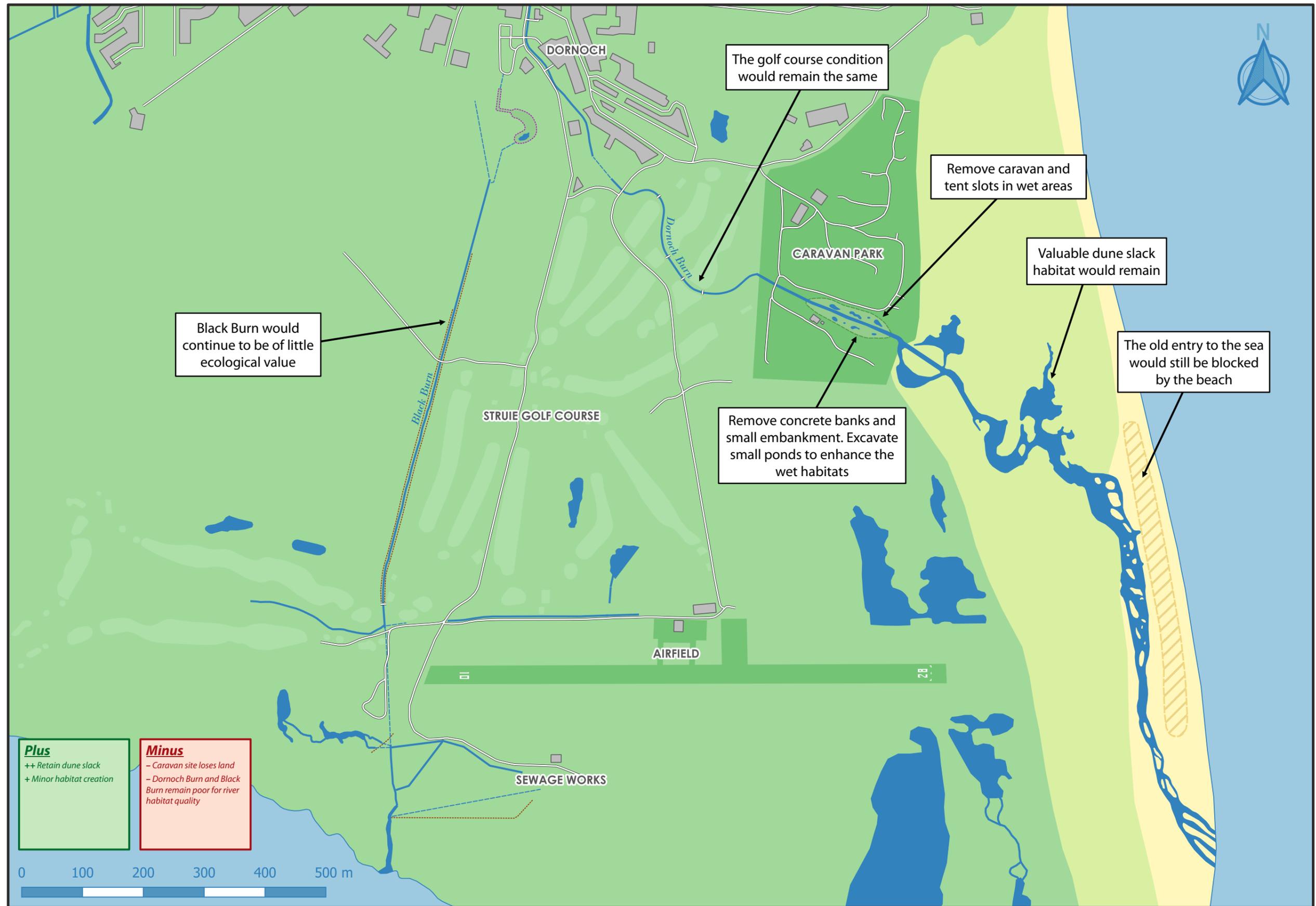
B: Dredge the beach accretion



These are indicative drawings that should not be used as detailed designs

March 2023

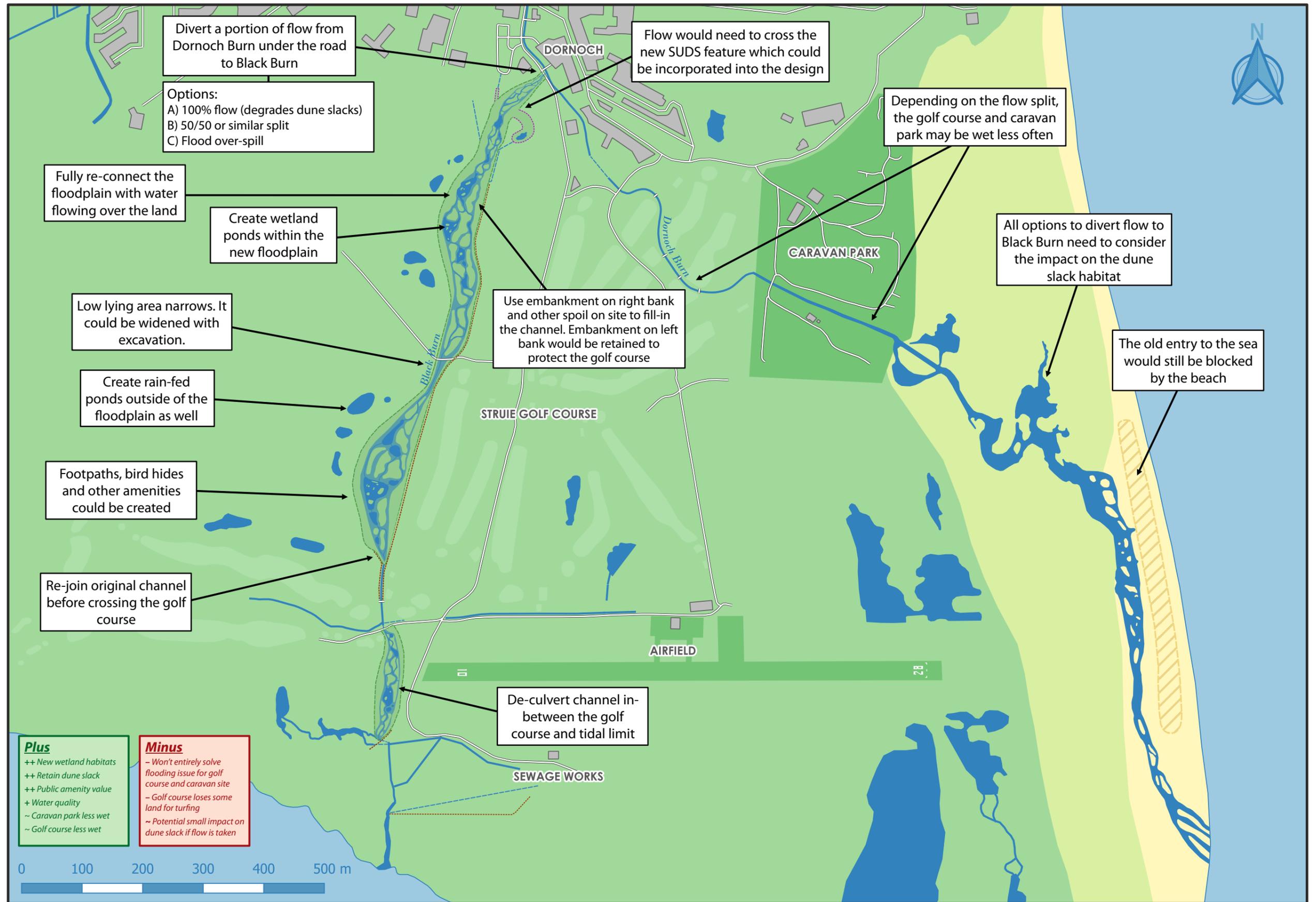
C: Lose small number of overnight camping slots and make minor habitat improvements



These are indicative drawings that should not be used as detailed designs

March 2023

D: Divert portion of flow to Black Burn and create wetland habitats



These are indicative drawings that should not be used as detailed designs

March 2023

Options appraisal table

Following discussions with local partner organisations, the options for Dornoch Burn will be assessed against the following criteria:



Reduction of the flooding risk, particularly around the caravan site



Conservation and improvement of biodiversity and habitat quality in the area



Public goods and amenities that are provided



Ongoing maintenance requirements



Cost of planning and delivery

					
A – Do nothing				M	L
B – Dredge beach accretion				H	H
C – Move camping slots + minor habitat creation				L	M
D – Divert some flow to Black Burn with wetland				M	H



Positive change



Negative change

**H, M, L are indications of the scale of complexity and cost of each option derived from RRC's experience and costings database.*

Options not suggested

Do nothing

Maintaining current management practices is not going to solve the caravan site's flooding issue or improve biodiversity, and it's even possible that habitats could degrade further and flooding could get worse without a change in how the area is managed.

Dredge the beach accretion

Dredging the beach is not suggested because it works against natural processes to provide a short term solution to a problem that will continue to persist. Where Dornoch Burn enters the sea is a naturally depositional environment, so a dredged channel will require periodic dredging to remain open. Furthermore, there is a risk that the shift in energy resulting from change in bed level will lead to knick-point erosion travelling upstream and threatening the stability of surrounding dunes and the caravan site. In addition to this it is likely that dredging will drain large areas of valuable wetland habitat in the dunes which has developed over the last two decades.

In summary, this is a high cost, high risk and high maintenance option that will only provide a temporary solution to flooding in the caravan site at the cost of quality wetland habitats in the dunes.

Suggested options

The suggested approach is to combine options C and D to achieve benefits for both the flood risk and biodiversity criteria. The options could be delivered simultaneously or in stages depending on the funding available. A description of how the overall project could be delivered in stages is provided below:

Short term: Lose small number of overnight camping slots & make minor habitat improvements

As the appraisal table shows, the only solution that will completely remove the flooding risk in the caravan site around Dornoch Burn is to remove the tent pitches and caravan slots from that area. Even if the beach is dredged, or if high flows are diverted away to Black Burn instead, this is a low-lying area that is likely to be under standing water at some periods of the year.

The caravan site could turn it into a positive by creating wetland habitats such as ponds to improve biodiversity, with seating areas and paths for people to enjoy.

This is a low risk option that will solve the flooding issue and provide minor local habitat improvement.

Long term: Divert portion of flow to Black Burn and create wetland habitats

A transformative project to restore wetland and river habitats is possible at Black Burn by bifurcating some of the flow from Dornoch Burn into Black Burn. This could be a high flow spillway which reduces the amount of flood water reaching the golf course and caravan site

downstream. Full diversion of the Dornoch Burn to Black Burn should be avoided because it would result in the loss of valuable wetland dune habitats highlighted in the dredging option.

There is a planning proposal for a distillery at the upstream end of Black Burn adjacent to the car park. This site, as well as its sustainable urban drainage systems should be designed to complement a plan to re-connect the Black Burn to its floodplain and create wetland habitats.

This option has the potential to create valuable habitats for wildlife, as well as amenity areas for residents and tourists. The scale that this option is applied at, both in terms of the percentage of flow taken off, and the area of wetland created, will depend on local constraints and engagement with stakeholders to design a project that delivers benefits for all.

Our suggestion is that the re-location of the flooded overnight camping area should be delivered in the short-term, whilst the transformative project on the Black Burn is developed with community stakeholders.