Designing effective mitigation including monitoring and adaptive management for a national significant infrastructure project: lessons from Queensferry Crossing.

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Queensferry Crossing

FORTH REPLACEMENT CROSSING

Bridging the Forth Safely

Forth Crossing Bridge Constructors

HOCHTIEF Solutions
American Bridge International
DRAGADOS
Morrison Construction

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Introduction

- The Queensferry Crossing was completed and open for traffic in September 2017.
- The name of the bridge was selected by the local community the original project was consented under the name Forth Replacement Crossing (FRC).

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- This paper will present the mitigation developed for the Queensferry Crossing for impacts to St Margaret's Marsh SSSI.
- It presents the decision process and considerations needed for developing a mitigation strategy.
- The role of pre- and post- mitigation monitoring.
- Adaptive management to support the increased likelihood of success.

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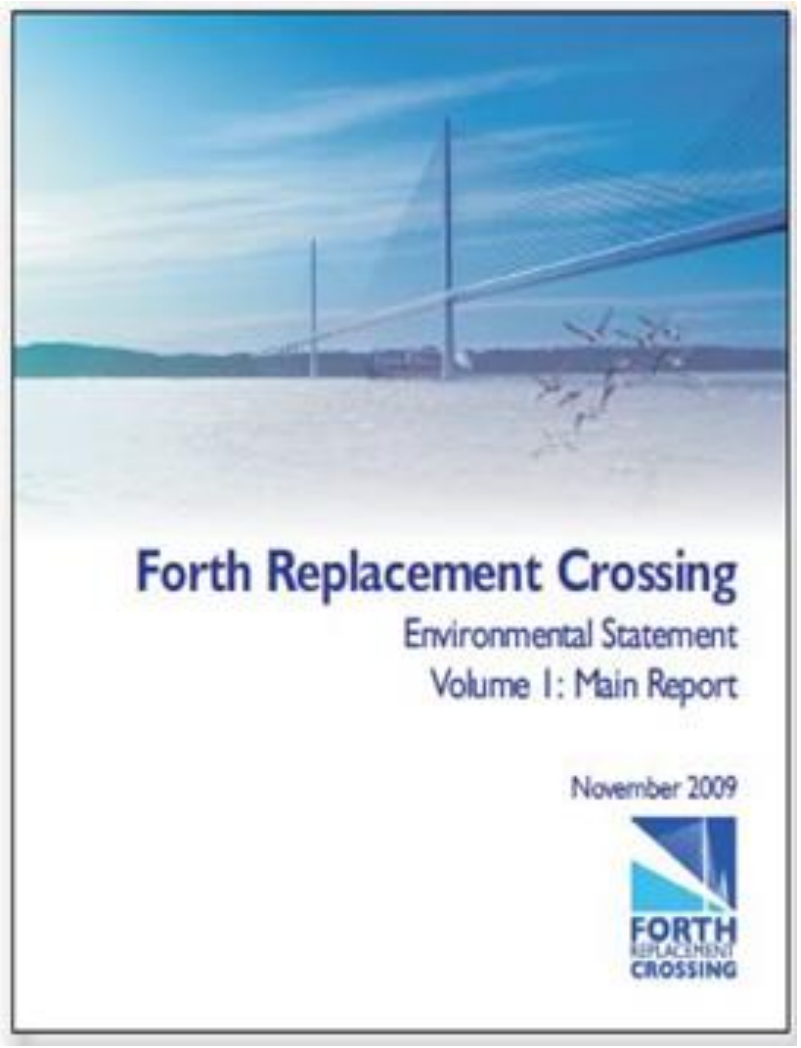
Forth Replacement Crossing: a challenging project

- Consent process was through a hybrid bill.
- Study area included many ecological features protected by legislation including:
- Protected species.
- Special Protection Areas (SPAs) for migratory and rare birds.
- Special Areas of Conservation (SACs).
- Wetlands of international importance (RAMSAR).
- Site of Special Scientific Interest (SSSI).



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Extensive study area for EIA

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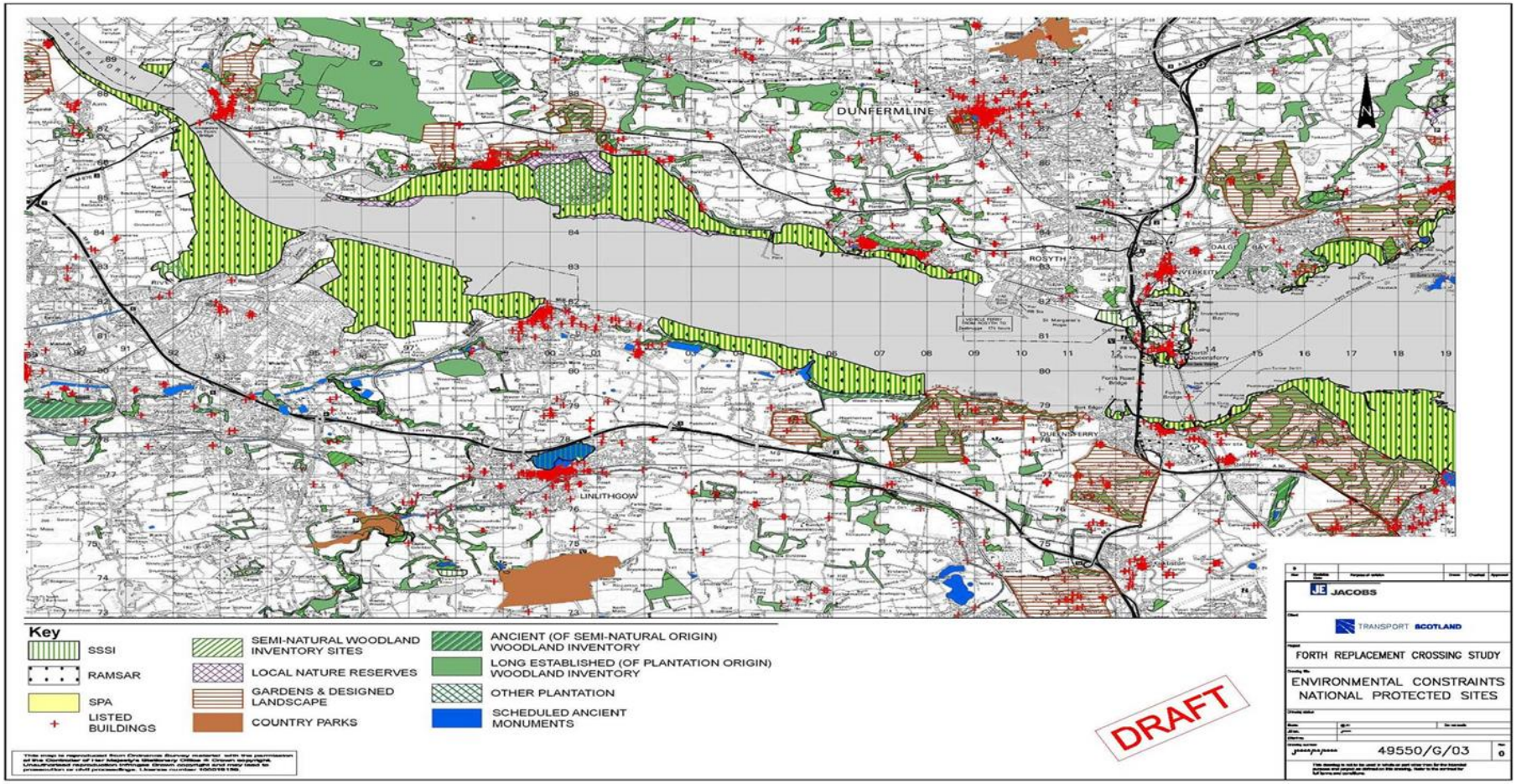
Environmental constraints



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Hierarchical mitigation approach: avoidance / protection/preventative measures. Reduction / minimisation / mitigation & new or net benefit / enhancement

During Planning, Assessment and Tender stages, environmental mitigation measures to Avoid, Reduce or Offset environmental impacts were developed and reported in the following documents:

- Environmental Statement
- Habitats Regulations Assessment/Natura 2000 (RIAA)
- CoCP
- Employer's Requirements

During Construction

- Additional and more detailed environmental controls and constraints were developed
- Contractor's Environmental Management Plan (EMP) (live document)
- Appendix R Reports (ERs, Part A1) process for ensuring changes to design or method of construction has:
- no worse residual impact than that identified in the ES
- no adverse impact on the integrity of Natura 2000 sites

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Delivering the mitigation Code of Construction Practice (CoCP)

- Legal and contractual environmental controls to ensure least practicable adverse impact on communities and the environment:
- Dust and air pollution
- Noise and vibration levels
- Land use and soils
- Water quality
- Ecology
- Landscape
- Local vehicle and pedestrian/cyclist access -maintained at all times

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St. Margaret's Marsh SSSI the challenges

- The SSSI is made land: 24 ha formed by dredgings deposited in mid-20th on north shore of Firth of Forth contained by rock sea wall.
- The site is notified for two habitat features; transition saltmarsh (reedbed) and saltmarsh.
- Part of the SSSI already de-designated because of the state of designated features.

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Mitigation context

- Direct loss of land within the SSSI boundary.
- Vegetation to be lost was not part of the reason for designation.
- Design lifespan of the bridge 120 years.

Scottish Natural Heritage's (SNH) proposed mitigation objectives for the FRC:

- improve 'unfavourable' status for reedbed and saltmarsh habitats by enabling sea water to flood marsh.
- improve access to increase amenity value.

Date	Feature Category	Feature Description	Condition
09/10/00	Saltmarsh	Littoral sediment (Coast)	Unfavourable, No change
19/12/02	Transition saltmarsh	Fen, marsh and swamp (Wetland)	Unfavourable, No change

Results of condition assessments for habitats in St Margaret's Marsh (information taken from SNH SiteLink website, August 2010).

Mitigation strategy

- In consultation with SNH and stakeholders a mitigation strategy was developed. It included:
- The development of a management plan for the site.
- Identification of a management team with responsibility for owning the management of the site.
- Mechanisms for ensuring the mitigation delivery.

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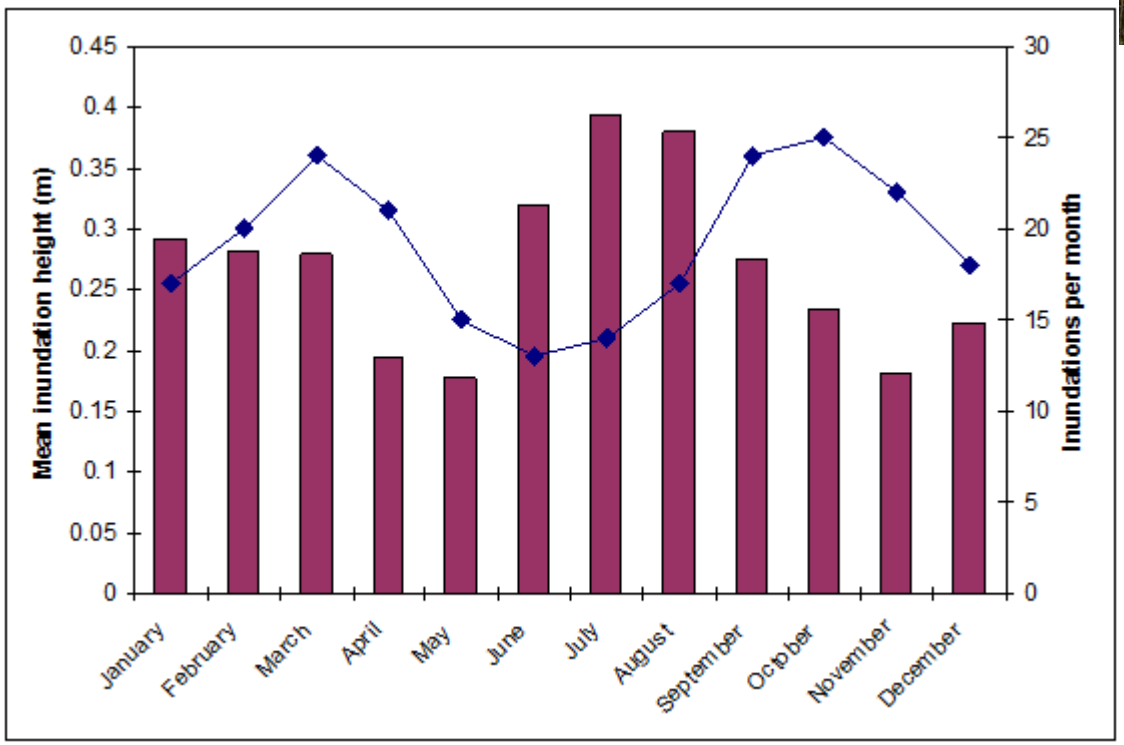
Understanding the marsh

- Research into the reasons why the marsh was in decline and in unfavourable condition to inform the mitigation strategy and the feasibility of different restoration approaches.



Number of potential inundations per month (bars) and their mean height (m) (line) in 2009.14

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Key findings to resolve

- Lack of salt water inundation
- Invasive species
- Eutrophication
- Vegetation previously classified as saltmarsh had been replaced by a combination of saltmarsh strand (with *Elytrigia repens* dominant) and *Arrhenatherum* grassland.
- Vegetation previously classified as both mid and upper saltmarsh was now indicated, from the combination of species, to be only mid-saltmarsh.
- The mid-saltmarsh was species-poor, particularly when compared to the species list noted during the previous cycle of monitoring.

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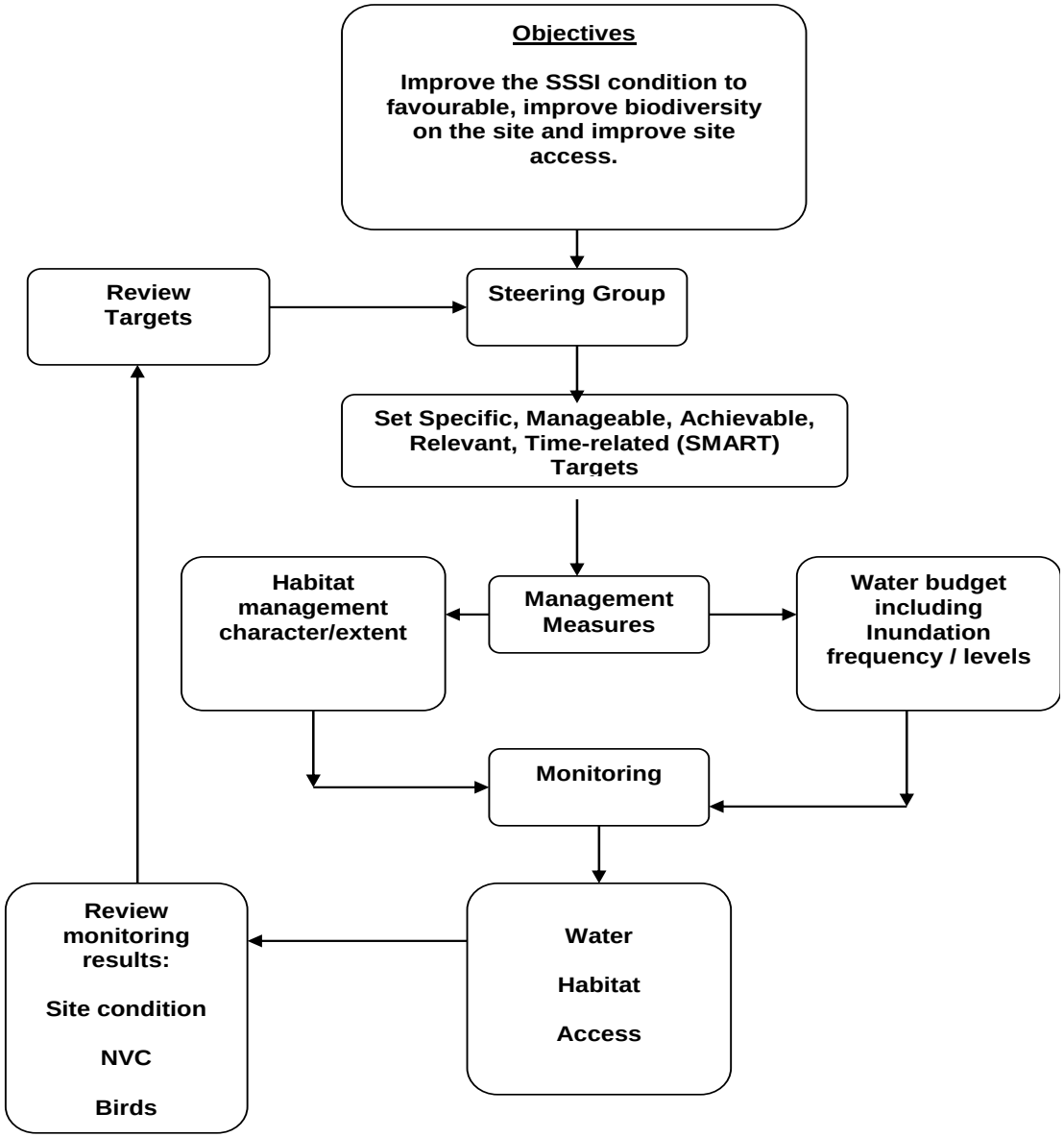
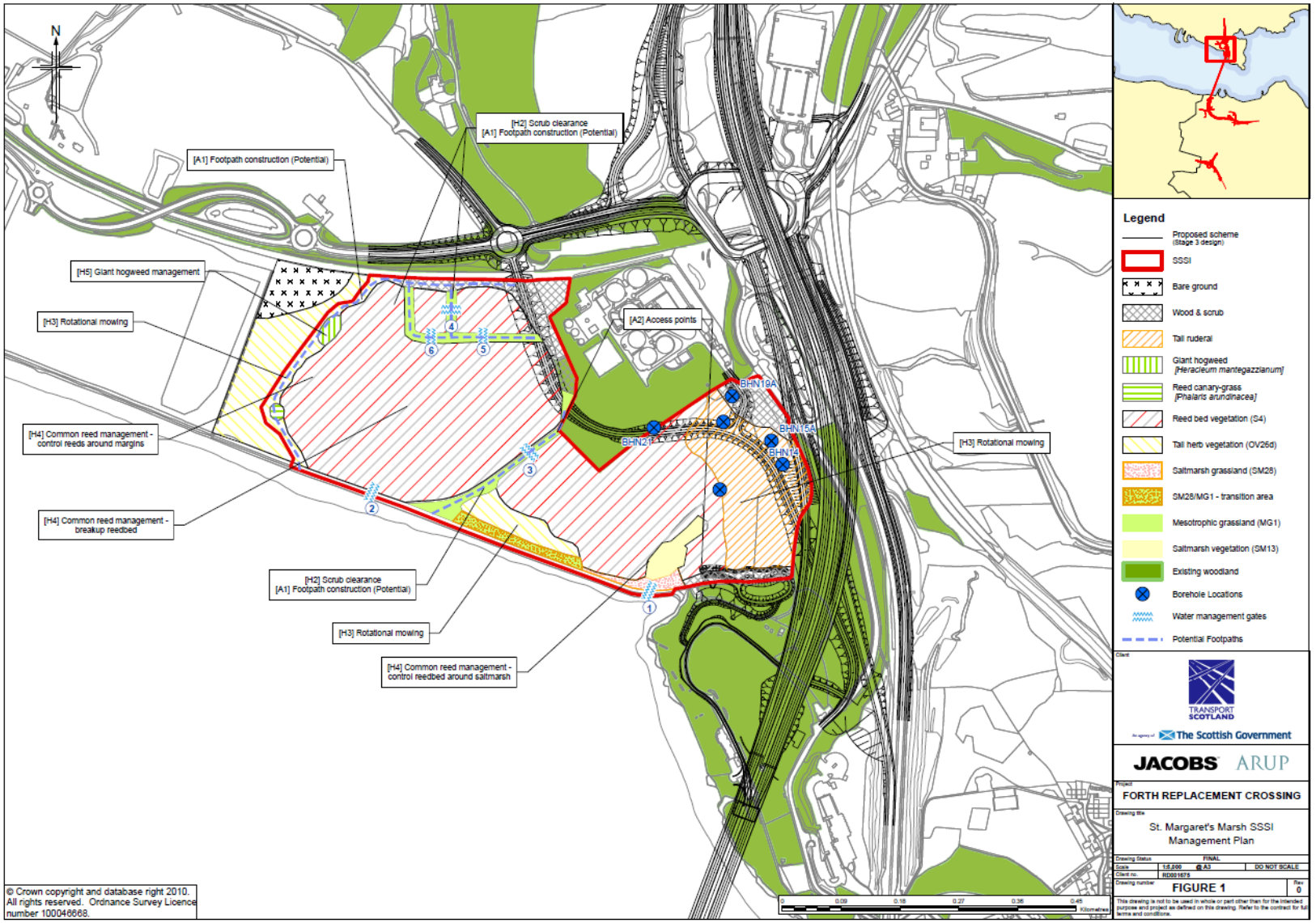


Diagram 1: Flowchart showing St Margaret's Marsh SSSI management plan decision and activity process

St Margret's Marsh SSSI Management Plan



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Programme of works and activities associated with enhancement of St Margaret's Marsh SSSI

Management Item	2011 (year 1)					2012-2016 (years 2-5)											
Water Management	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[W1] Construction of gates/sluices																	
Habitats Management																	
[H2] Scrub clearance																	
[H3] Rotational mowing																	
[H4] Common reed management																	
(a) Cutting/mowing																	
(b) Herbicide																	
[H5] Invasive plant management																	
(a) Giant hogweed																	
(b) Japanese knotweed																	
Access Management																	
[A1-A2] To be carried out taking into account FRC main programme of works]																	
Monitoring																	
Steering Group meeting																	
CSM[1] monitoring																	
NVC assessments (as required)																	
Bird monitoring (as required)																	

[1] CSM = Common Standards Monitoring

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Implementing the management interventions

- The mitigation required hard engineering for improving the water balance on the marsh to increase the inundation by sea water on the salt marsh vegetation to direct the recovery of the designated features.

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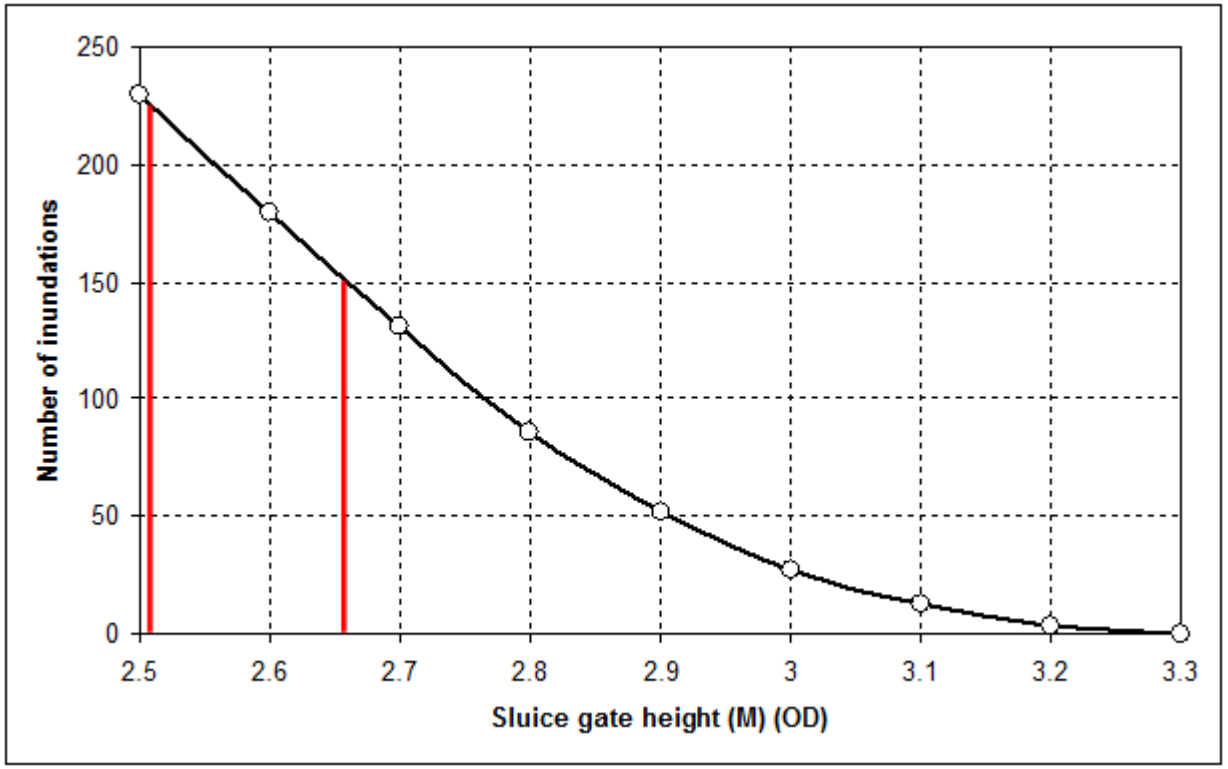
Water budget

Below the number of potential inundations at St Margaret's marsh based on a saltmarsh height of 2.5 m OD. Red lines show the sluice gate height required to obtain inundations of 150 or 225 per year.



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The engineering

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Salt water inundation

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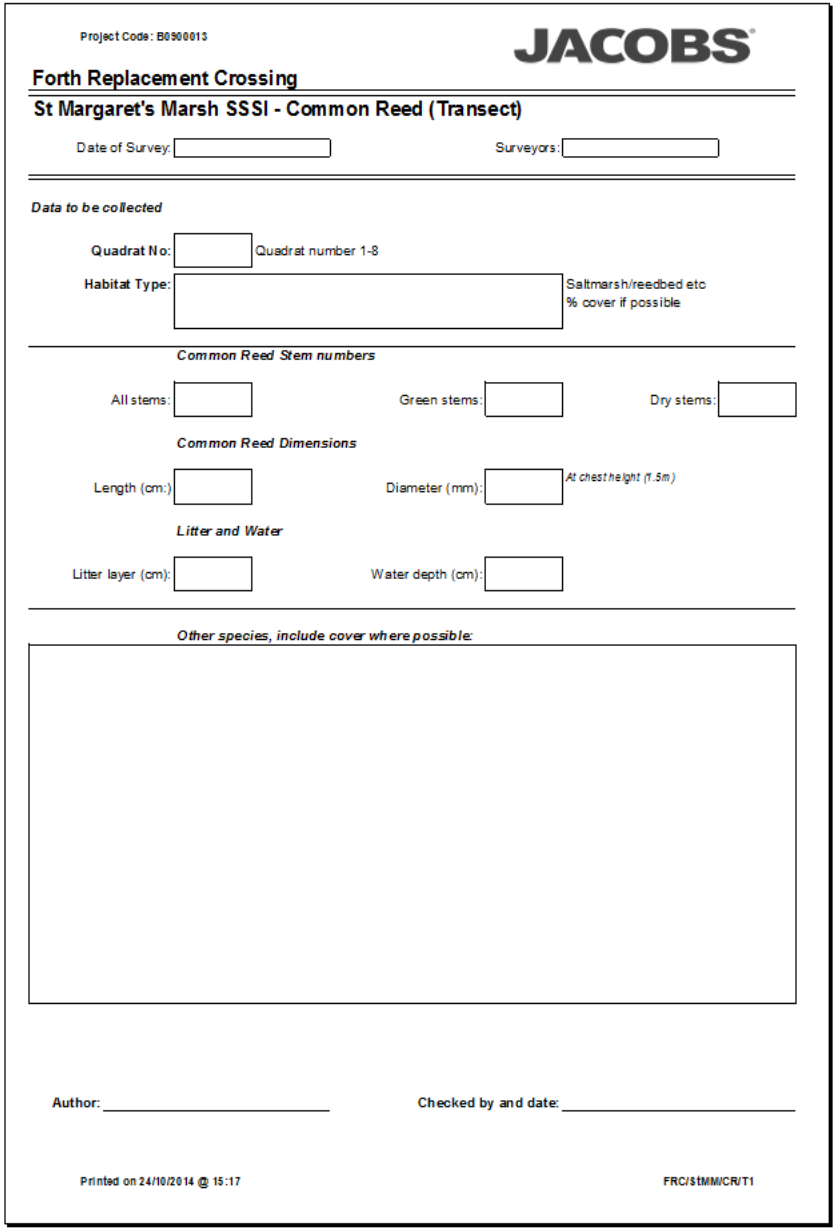
Adaptive management

- The success of the mitigation could be measured in terms of returning the site to conservation status and the use of Common Standards Monitoring Guidance for Saltmarsh Habitats (http://www.jncc.gov.uk/page-3520#download).
- However, it was recognised that the effectiveness of the inundation strategy and the direction the desired vegetation developed had to have an adaptive management and iterative approach to ensure success.



Project Code: B0900013

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Forth Replacement Crossing

St Margaret's Marsh SSSI - Common Reed (Transect)

Date of Survey: _____ Surveyors: _____

Data to be collected

Quadrat No: _____ Quadrat number 1-8

Habitat Type: _____ Saltmarsh/reedbed etc % cover if possible

Common Reed Stem numbers

All stems: _____ Green stems: _____ Dry stems: _____

Common Reed Dimensions

Length (cm:) _____ Diameter (mm): _____ *At chest height (1.5m)*

Litter and Water

Litter layer (cm): _____ Water depth (cm): _____

Other species, include cover where possible:

Author: _____ Checked by and date: _____

Printed on 24/10/2014 @ 15:17 FRC/StMM/CR/T1

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In summary

Issue	Effect	solution	monitoring
Lack of salt water inundation	Salt marsh community and diversity simplifying	Hard engineering to increase salt water inundation	Water levels and inundation frequency and extent Fixed quadrats and transect vegetation monitoring
Invasive species	Displacement of natural vegetation and safety issues for site workers and visitors	Eradication strategy	Aerial remote sensing and survey
Eutrophication	Reedbed structure and diversity reduced	Increased salt water inundation and reed bed management	Reed productivity/structure and diversity
Access	No safe access to parts of the site other than the sea wall	Scrub clearance and marked path post construction hand over	To be determined

Unmanned Aerial Vehicle for remote monitoring of giant hogweed

Photograph 10: Western side of St Margaret's Marsh, 23 June 2014. Scattered giant hogweed is evident in the reedbed habitat in the SSSI (blue circles, and elsewhere) and in a patch on adjacent land (yellow circle).

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Reed management

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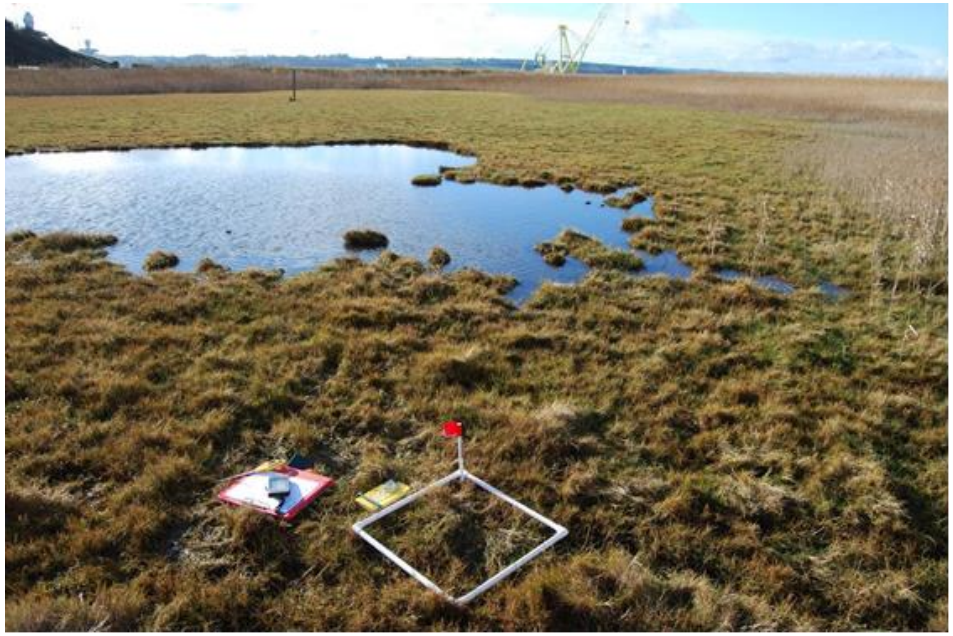
- The effectiveness of the monitoring of the site and ability for the hard engineering and management plan to adapt to the changing conditions on the site is essential
- The management team and mechanism for directing resource is essential for the continued success of the mitigation.
- Their decisions have to be based on good data from the monitoring.



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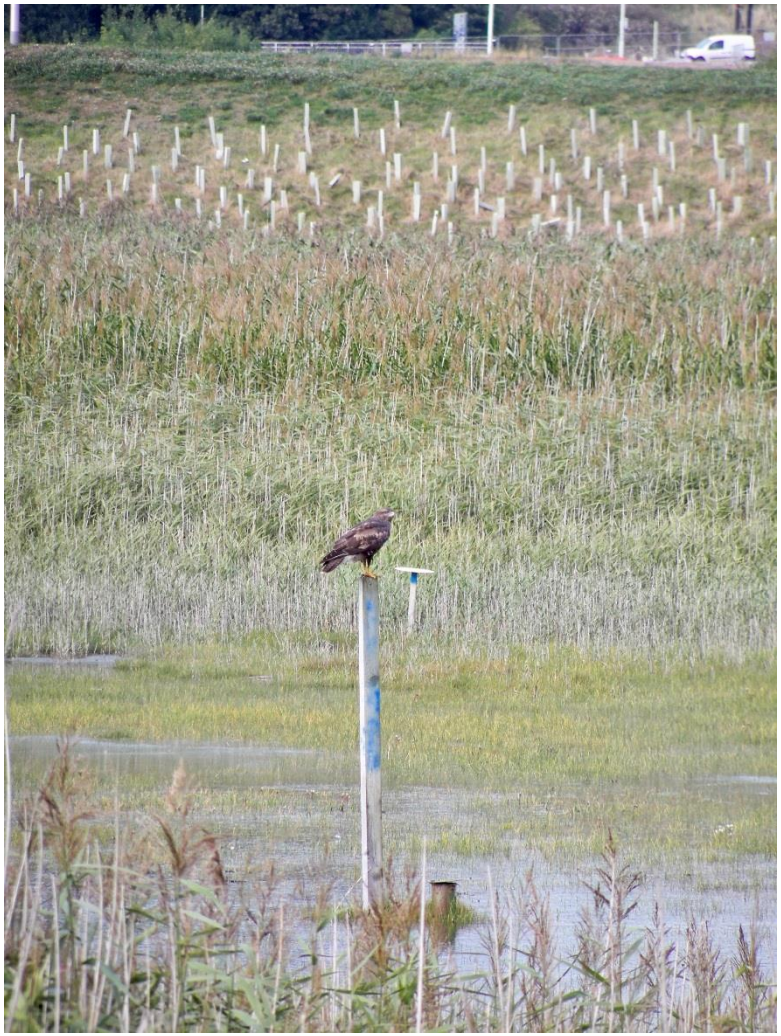
Conclusions

- Understand the impact and the feature affected: data, data, data!
- Develop a mitigation strategy
- Ensure buy in from stakeholders
- Develop a delivery mechanism with identified owners…and resource to deliver
- Ensure the owners understand the mitigation objectives
- Monitor progress against the objectives
- Build in adaptive management to ensure objectives are met and sustained.



Thank you for listening

Any Questions?

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