REPORT OF BUILDING PROJECTS OFFICER

SUBJECT : CAREW MILL & CAUSEWAY – RESERVOIRS ACT STATUTORY REPAIRS

Purpose of Report

To request approval for capital funding to proceed with urgent repair works work at Carew Mill & Causeway as per the recommendations of the report following statutory annual inspection (2016).

Historic Value

Carew Mill and Causeway are Grade II* listed buildings, the mill being the only tidal mill in Wales. First mentioned in 1541 the present building dates from c.1840. The three floors retain the complete set of machinery to a remarkable degree of preservation, comprising the bin, stone and meal floors from top to bottom. The mill ceased production in 1937, by which time structural damage had occurred due to the vibration caused by producing bone meal.

Various restorations have taken place, including in 1972 when the Carew Estate repaired the machinery and inserted tie-bars. Further repairs were undertaken by this Authority after it took the lease of the mill in 1983, including replacement of all the windows and various structural works. More recently the roof covering has been replaced (2015/16) with Natural Welsh slate.

The Causeway has undergone many phases of major and minor repair works to prevent / minimise water leakage through the structure from the mill pond which is accepted as an ongoing and permanent issue. Repairs are programmed in line with the recommendations of the Reservoirs Engineer.

Carew Mill and Causeway for part of the Carew Castle site, the Authority holds a full repairing lease with c. 70 years remaining.

Background

Carew Mill pond is designated as a high-risk reservoir as defined by the Reservoirs Act 1975, section 2C (1), where an uncontrolled release of water from the reservoir could endanger life. It is the duty of this Authority to appoint a Supervising Engineer and arrange for annual inspections to be carried out.

On 22nd August 2016 Carew Mill Pond, Causeway & Mill was inspected and the annual report was issued on 28 November 2016. Within the report, measures in the interests of safety under Section 10(3) (c) or maintenance under 10(3) (b) of the Act

were recommended to be carried out within 1 year of the report (These recommendations are enforceable by Natural Resources Wales) in the interest of safety. Other measures to be taken in respect of maintenance under Section 11 of the Act were also recommended and carried out as part of the maintenance programme.

Proposed Repairs

A summary of the required works are as follows :-

Indicative costs for the purpose of budget planning are included shown below. The costs will be subject to further refinements and revision following the design / construction process.

Measures	**Contractor / PCNPA**	**Estimated Cost**	**Priority**
Section 10(3)(b) repairs			
(i) the tidal sluice gates be repaired. (includes the provision of stoplogs which will be retained for future use)	Contractor	£9,000	High
(ii) the leakage into the wheel house be stemmed/stopped.	Contractor	£64,000 (Option 2)	High
(iii) a plan be written which outlines future work to ensure the integrity of the structure in the long term	Consultant	£1,500	High
Section 10(3)(c) Repairs			
(i) remedial works are required to the stonework around the letter box.	PCNPA	£1,500	High
Section 11 Maintenance (Ongoing)			
(i) all significant and 'woody' plant growth on the causeway walls should be removed and any damage caused made good from time to time.	PCNPA	£3k every 5 years	Continue to monitor
(ii) erosion to the toe beam be repaired – say every 5 years.	Contractor	£3k every 5 years	Continue to monitor
(iii) the reservoir be emptied of water, the flap valves, sluice paddles and adjacent structure (channel base and walls) be inspected and suitable repairs put in place, and that the sluice gate operating gears be cleaned and re-greased periodically, say every 5 years.	Contractor	£5,000 (Repeat every 5 years)	Carry out immediately in conjunction with major repairs
(v) the walls of the main spillway be pointed.	PCNPA	£5,000	High
(vi) the gate/paddle in the mill should continue to be operated monthly.	PCNPA	£0	High
(vii)the operating mechanisms be refurbished as and when required.	PCNPA	£1,000 (Repeat annually)	Carry out immediately in conjunction with major repairs

Summary of Estimated Costs

Total Works	c.£87,000
Fees & Consents	c.£30,000
Estimated Contract Total	**c.£117,000**

Note : Although the investment into this structure is maintaining its condition there is continual deterioration which will inevitably lead to more major repairs in the future. Therefore it is likely that there will be the need for further significant repairs in the medium term.

The works required to prevent leakage into the wheelhouse form the most substantial element of the repairs required. Works to prevent leakage within an old masonry dam structure with limited space for the works is challenging and requires specialist geotechnical engineering techniques to remediate. A particular difficulty is the use of concrete grouting where high flow velocities through leaking sections of wall as a result in variations in water levels between the upstream and downstream side of the dam. This can result in washout of grout materials before they can set. This problem can partly be mitigated by draining down the (upstream) pond to reduce the flow of water through the dam structure, however it is not anticipated that measures would be taken to prevent the natural variation of tidal levels on the downstream side of the dam.

Limited grouting repairs were carried out in 2002, using cementitious grout to infill voids around the sluice tunnels for both the north and south mill wheels and to the seaward facing dam wall immediately to the west of the Mill House. These repairs have been successful in reducing leaks, but due to the limited extent of the repairs and the passage of time, seepage between the flap channel and the mill building has increased in recent years and there is a need to undertake a further phase of work in the vicinity of the mill.

In 2006, works comprised grouting between the Mill House and the tidal sluice gate channel, and at the auxiliary spillway. They were partially effective, with reduction in seepage achieved, particularly to the north of the flap channel.

Atkins has investigated a number of options to reduce the leakage within the causeway, based on a range of construction techniques. This includes an option for resin grouting which has been successfully used to repair old dock walls at Milford Docks even whilst the docks remain in operation. In addition, conventional grouting of the ground has been considered as well as removal and replacement of the impermeable clay core material. The design of the repairs has had to consider sub-surface flows of water which continue to cause erosion as well as repointing repairs to wall masonry. All the options proposed have been costed and compared and will be selected to deliver both an economic solution and one which utilises construction methods sympathetic to the conservation value of the Causeway.

Photos showing leakage into the Wheelhouse (Basement)

Procurement

Under the Authority's Standing orders relating to Major Contract (£25,000+) standing order 13 allows, under certain conditions, for the suspension of the normal procurement rules. Due to the extremely tight timescale to complete the repairs before the end of November 2017, this paper therefore also requests consent from Members to apply standing order 13. The quotations will however be returned on a date to be agreed and in accordance with the Authority's Financial Procedure No 8 which governs contract procurement up to £25,000. It is proposed to contact 3 reputable contractors as recommended by our Consultants in order to obtain 3 quotations for the works.

Consents

- Marine Licence (pending approval)
- SSSI consent
- Public Right of Way – Temporary closure

This works are classed as repairs therefore do not require formal Planning or Listed building consent.

Biodiversity implications/Sustainability appraisal

To enable inspections and safe access, there is a need to allow the Mill Pond (which is a Saline Lagoon) to drain down at low tide(s). This is a temporary change to the normal operating regime, where currently sluice gates on the Mill Pond impound water upstream of the causeway. Early consultation on this aspect has been undertaken with NRW & Sarah Mellor – PCNPA Ecologist (at a site meeting on 25/7/17) because it is anticipated that this will have an impact on marine ecology within the pond, specifically the tentacled lagoon worm (Alkmaria Romijni).

Working methods and proposed works within the Mill Pond have been provisionally agreed and a method statement for the works has been included in the Marine Licence which is pending approval. (Appendix 1 – Method Statement & Plans)

Financial, Risk & Compliance Considerations

It is anticipated that the cost of the repairs will be funded from the Authority's General Reserves which at as 31st March 2017 stood at £938k.

Human Rights / Equality Issues

No Issues

Welsh language Statement

The proposal complies with the requirements of the Compliance Notice served upon the Authority under Section 44 of the Welsh Language (Wales) Measure 2011. During the works public procurement documents, signage, public notices will be bilingual.

Wider implications

Various stakeholders and colleagues have been consulted including:

- Carew Community Council
- Natural Resources Wales
- Cadw
- Sarah Mellor – Biodiversity Officer
- Daisy Hughes – Site manager
- Anthony Richards – Rights of Way Officer

RECOMMENDATION

Members are asked to approve:-

- Funding for these repairs / works from the Authority's General Reserves
- Variation to the Authority's Standing Orders on major contracts for contractor selection.

(For further information, please contact Andrew Muskett - Building Projects Officer on 01646 624891)

CAREW MILL AND CAUSEWAY REPAIRS

Outline Method Statement

Note:
This method statement is provided in outline - for discussion only - in preparation for a marine licence for marine works. This method statement does not fully detail Health and Safety risks which need to be considered separately.

Purpose:
The purpose of the project is to undertake small scale repairs to the historic causeway structure at Carew Mill. Some of the works will be undertaken from the surface of the causeway around the perimeter of the Mill House and the remainder of the works will be to the vertical walls of the causeway alongside the Mill Pond.

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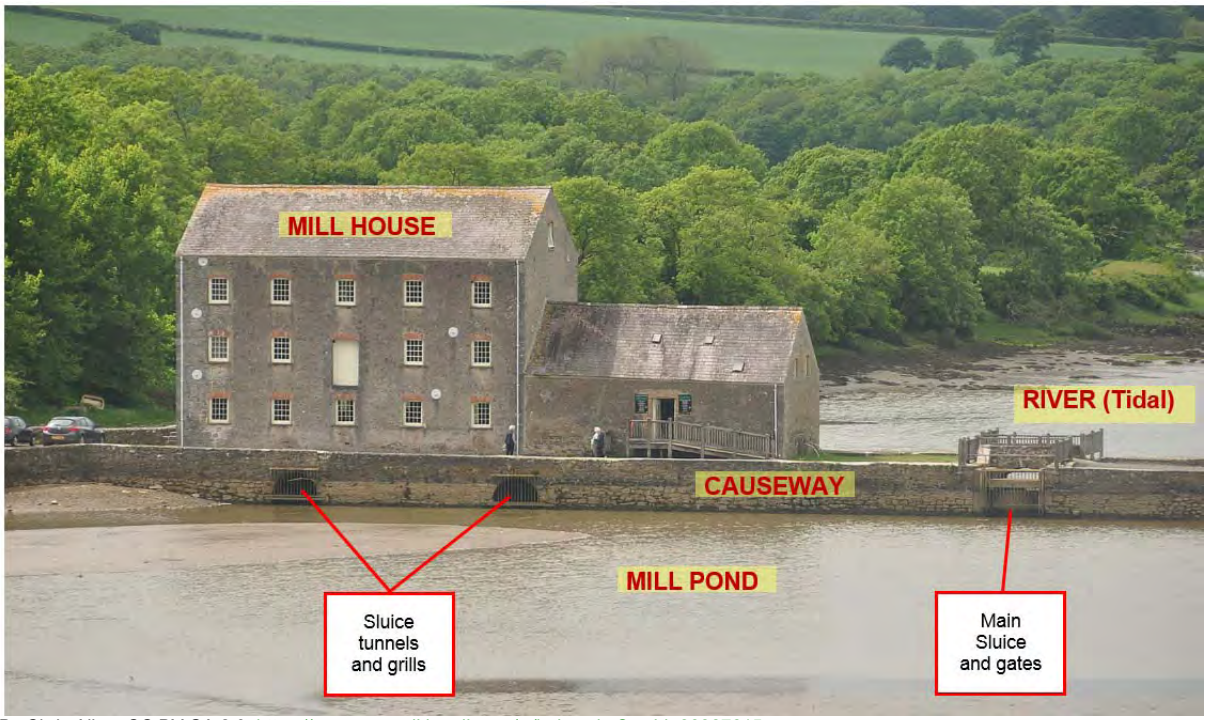


Primary Risks:

- Pollution incidents from spills of fuel,
- Plant or equipment working in the Mill Pond below MHWS,
- Ecological impacts to the Tentacled Lagoon Worm,
- Working in and adjacent to a SAC/SSSI (Within: Pembrokeshire Marine SAC, Milford Haven Waterway SSSI, Carew Mill Pond - Saline Lagoon Feature; Adjacent to: Carew Castle SSSI – 250m, Pembrokeshire Bat Sites and Bosherton Lakes SAC – 50m
- Incoming Tides,
- Risk of slipping, falling into sluice tunnels,
- Risk of drowning.

Other issues reviewed:

- Unlikely risk of transportation of fine sediments into the water body leading to reduction in water quality, since the Mill Pond will be drained during construction.
- Disruption to wider ecology is unlikely i.e. bats and birds, as works are small scale and do not transmit much noise.

Method:

The proposal is to repair the walls of the historic masonry causeway. These repairs will require a marine licence for (i) work to repair the walls of the causeway adjacent to the Mill Pond and (ii) temporary works required to block the entrances to the sluice tunnels and the (iii) undertaking of trial holes near the base of the wall. Also, the aforementioned works are reliant on draining down the Mill Pond. This is a temporary change to the normal operating regime, where currently sluice gates on the Mill Pond impound water upstream of the causeway.

Separate repairs to the ground around the Mill House, accessed by working atop of the causeway, will also take place.

The project will be achieved by utilising medium or small sized construction equipment comprising of mini-excavators, excavators and tipper-dumpers, in addition to manual labour for handling materials, repointing works and fixing steel plates, grills or sluice gates.

All works will be undertaken in the 'dry' i.e. at low tide and are expected to take up to 8 weeks.

Phase 1 – Arrange for the pond to be drawing down and removal of sluice gates for repair.

The sluice gates currently in place are mitre gates and this arrangement allows the water to flow in one direction i.e. it allows water from the river to 'top up' the pond on a high tide. Once the tide falls, the gates self-close and allows the water to be retained within the Pond. By removing the gates, water is able to flow freely in both directions, both filling and emptying the pond as the tide rises and falls. It is being considered whether to create a weir by using stoplog boards adjacent to the gate position. In this way:

- Using these stoplog boards it is possible to prevent the incoming tide entering the pond, keeping it dry for the period of the works.
- Or – the stoplog boards will be removed over the weekend to allow the pond to fill and allow the pond mud to regain some moisture and protect the worm habitat.
- Or – the stoplog boards will only remain in place during concreting or pointing operations for maximum periods of 3-5 days at a time and then removed to allow the pond to fill and allow the pond mud to regain some moisture and protect the worm habitat.

Photo 1- View of sluice gates within the sluice channel (sited below the concrete beams)

Photo 2- View of sluice channel looking upstream towards the sluice gates

The sequence of works is as follows:

1. Remove temporary disabled access ramp to the Mill Shop.
2. Access the gate location, via the causeway with a small excavator, Hiab (road going crane-lorry).
3. Remove the fixings retaining the gate in place **(see photo 1)**
4. Lift out the gates with the excavator or Hiab and place on transport.
5. Install stoplog retaining channels (steel rails fixed to walls).
6. Install stoplogs.

Phase 2 – Inspection of causeway masonry walls

The walls (over a 50m length and 4m height) will be scraped clean of heavier marine growth so that the joints in the masonry can be inspected and any voids identified for infilling. Vegetation will be loaded into skips for off-site disposal. The base of the walls will be inspected by taking trial pit excavations or carry out probing works from a mini-excavator our similar small tracked machine. The machines will be limited to an access route close to the causeway. Work will be constrained within at 50m length extend and a 5m wide working corridor.

The sequence of works is as follows:

1. Construct tower scaffold to provide safe-man access into the Mill Pond from the causeway.
2. Clean the walls where heavy growth exists (typically the lower part of the walls).
3. Collect marine growth and hoist onto the causeway for subsequent loading into a skip and then off-site disposal.
4. Carry out a walkover survey/visual inspection.
5. Hoist excavator/tracked machine into Pond from small portable crane set on land. (from southern side of causeway) – see **photo 3.**
6. Dig trial pits in mud, down face of causeway wall. Materials arising are temporarily set aside and then replaced. – see **photo 4.**
7. Carry out probing works. No material will arise. No drilling mud to be used. – see **photo 5.**
8. Lift out excavator/tracked machine.
9. Remove scaffolding (following completion of other phases below).

Photo 3 - Lorry mounted Hiab and mini-excavator

Photo 4 - Excavator working alongside causeway walls (river side)

Photo 5 - Tracked probing rig – (photo:Dando Drilling)

<u>Phase 3 – Temporarily block up the sluice gates with steel plates.</u>

The existing steel grillages (3m square approx.) will be removed from the face of the masonry wall, lifted and set aside for storage. Steel plates (3m square approx.) will be placed over the entrance of the sluice tunnels and will be sealed against the masonry stonework. In addition, sand bags will be temporarily placed behind the steel plates for additional stability. The plates and the sand bags will remain in place for most of the period of the works.

The sequence of works is as follows:

1. Unbolt grills from face of walls, lift and store for reuse.
2. Transport steel plates into position – lifted in from the causeway above via Hiab or excavator.
3. Secure steel plates to wall through drilled fixings into wall.
4. Place sand bags at base of wall/against steel plates for additional support. A variation may be to use 1T sand or gravel bags instead of smaller sand bags.

Phase 4 – Carry out pointing repairs to masonry walls.

Voids identified during inspection will be hand repaired with like for like lime-mortar material.

The sequence of works is as follows:

1. Mix lime mortar materials on the causeway in small quantities.
2. Hoist mortar materials to operatives.
3. Place thin strip of plastic sheeting to catch falling mortar materials used in repointing.
4. Repoint the walls.

Phase 5 – Following completion of repairs around the Mill, remove steel plates and reinstate original grills.

The sequence of works is the reverse of Phase 3, as follows:

1. Remove sand bags at base of wall/against steel plates.
2. Remove steel plates by removing fixings.
3. Lift out steel plates - lifted out from the causeway above via Hiab or excavator.
4. Lift in grills from the causeway above via Hiab or excavator.

Phase 6 – Reinstall sluice gates (2no. 2.3m high and 1.7m wide) and allow pond to fill naturally on incoming tides.

The sequence of works is the reverse of Phase 1, as follows:

1. Remove stoplogs and set aside for future maintenance/emergency use.
2. Lift in the gates with the excavator or Hiab.
3. Reinstall the fixings retaining the gate in place.
4. Reinstall temporary disabled access ramp to the Mill Shop.

Works around the perimeter for the Mill (non-marine works)
Will involve placing concrete or grout within the core of the causeway itself. All the works will be below ground and carried out from the causeway itself. All surfacing material will be reinstated in completion – see **photo 6.**

The sequence of works is the reverse of Phase 1, as follows:

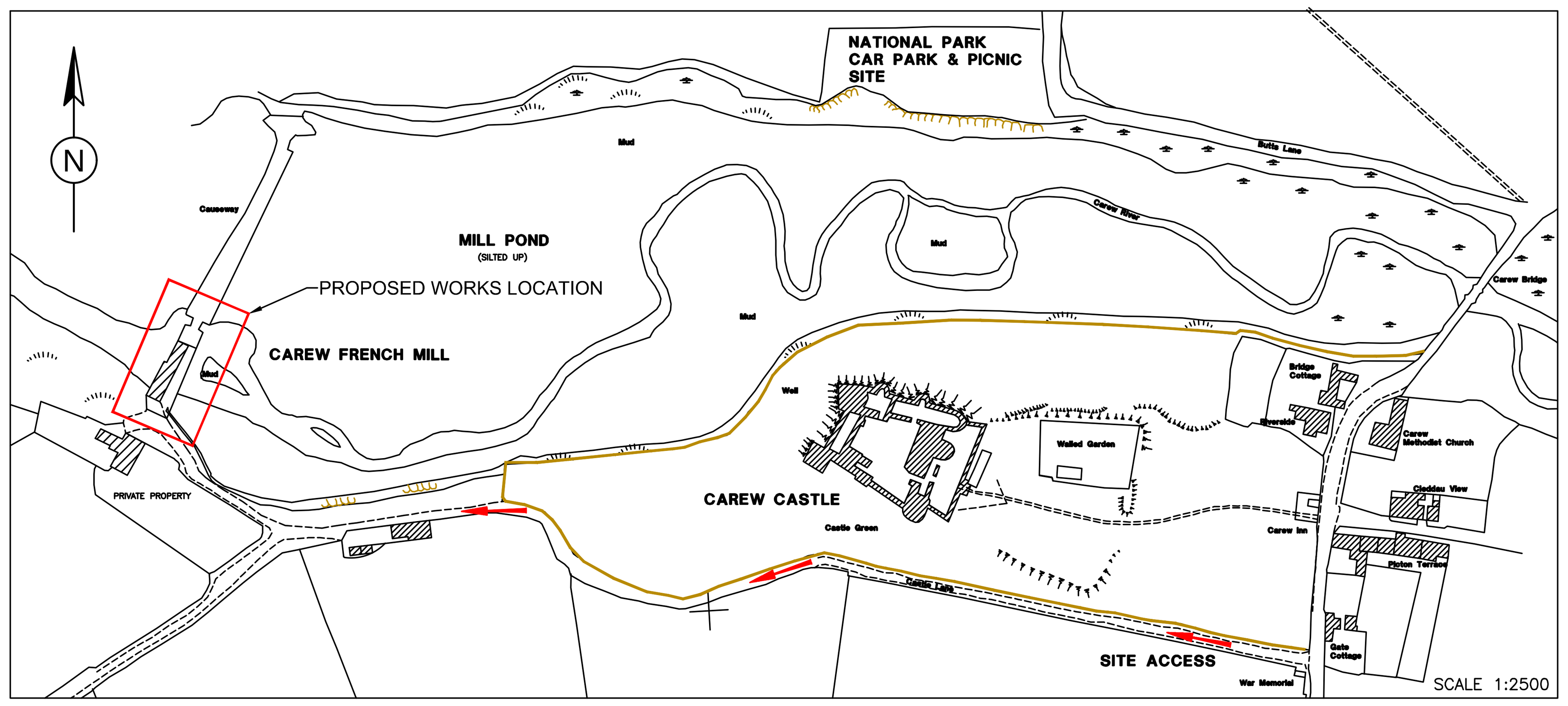
1. Mobilise excavator plant and grouting rig.
2. Set up in works location and carry out excavations, followed by grouting or concreting.
3. Demobilise plant.
4. Reinstate surfacing.

Photo 6 – View of causeway, footpath and Mill House (with disabled ramp in background)

Controls

- A toolbox talk will be given to contractors prior to the start date in order to inform contractors of the sensitive habitat and the limitations on access and working areas within the Mill Pond.
- All vehicles will use bio-degradable fuels.
- Spill kits will be provided at several locations in the event of oil or fuel leak.
- No fuelling will be allowed alongside the Mill Pond, river or on the causeway.
- No materials to be stored in the intertidal area.
- Observance of the tidal regime and flood warnings.
    - The contractor shall sequence works to work with neap and spring tides. Repair work shall be undertaken during the neap tide cycle.
- Comply with MHPA harbourmaster requirements.
- Comply with MHPA marine licence requirements.
- Comply with NRW marine licence requirements.
- Comply with the Panel Engineer or Supervising Engineer or NRW requirements under Reservoir Act 1975.
- Risk assessments for personnel.
- Provision of Emergency Exits.
- Agreement of Access points.
- Appropriate PPE for staff.
- Day-time working hours only.

DO NOT SCALE



WORKS EXTENT FOR MARINE LICENCE (OSGB36)		
REF.	EASTING	NORTHING
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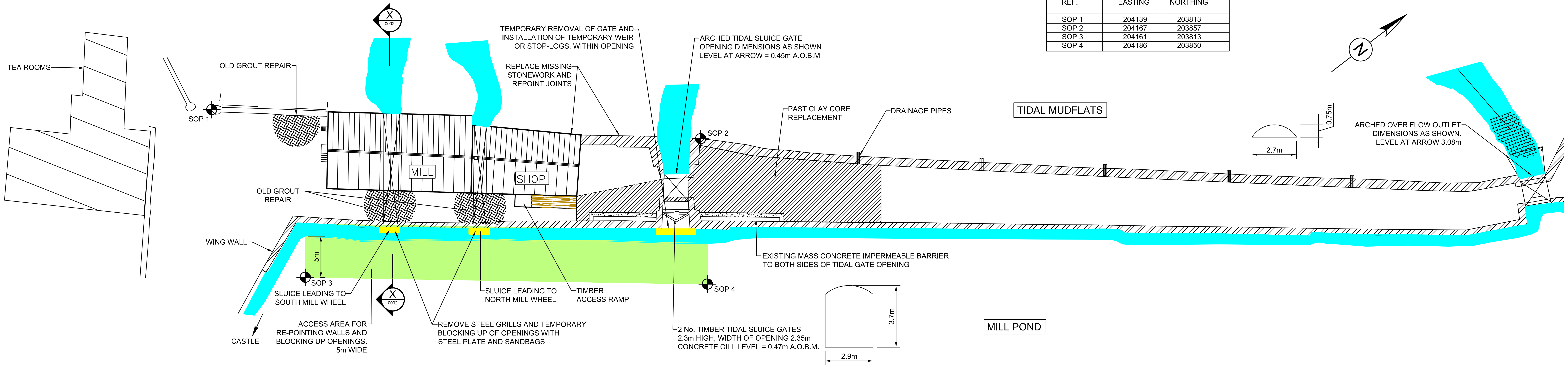
SOP 2	204167	203857
SOP 3	204161	203813
SOP 4	204186	203850



PLAN OF CAUSEWAY SHOWING REPAIR ITEMS

1:250

Rev.	Date	Description	By	Chk'd	App'd
P2	26/07/2017	MINOR AMENDMENTS, SETTING OUT POINTS ADDED	MJE	RM	DF
P1	19/07/2017	FIRST ISSUE	MJE	RM	DF

Drawing Status: INFORMATION
Suitability: S2

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Project Title: CAREW MILL AND CAUSEWAY 2017 REPAIRS

Drawing Title: WORKS TO CAUSEWAY

Scale	Designed	Drawn	Checked	Authorised
AS SHOWN	RM	MJE	RM	DF
Original Size: A1	Date: 18/07/17	Date: 18/07/17	Date: 19/07/17	Date: 19/07/17

Drawing Number: 5129589.008-ATK-ZZ-ZZ-DR-D-0001
Revision: P2

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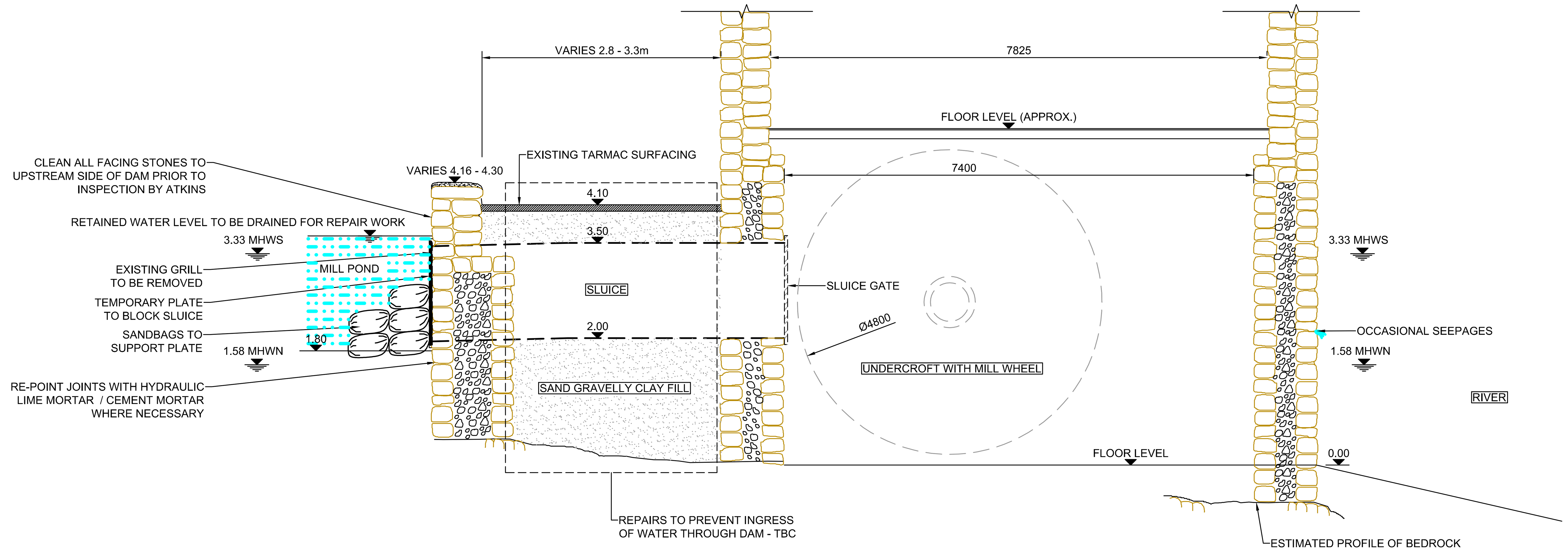

X 0001 TYPICAL DETAIL OF CAUSEWAY STRENGTHENING X-X
1:50

Rev.	Date	Description	By	Chk'd	App'd
P2	26/07/2017	MINOR AMENDMENTS	MJE	RM	DF
P1	19/07/2017	FIRST ISSUE	MJE	RM	DF

Drawing Status: INFORMATION — Suitability: S2

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Project Title: CAREW MILL AND CAUSEWAY 2017 REPAIRS

Drawing Title: SECTION X-X

Scale	Designed	Drawn	Checked	Authorised
AS SHOWN	RM	MJE	RM	DF
Original Size: A1	Date: 18/07/17	Date: 18/07/17	Date: 19/07/17	Date: 19/07/17

Drawing Number: 5129589.008-ATK-ZZ-ZZ-DR-D-0002 — Revision: P2