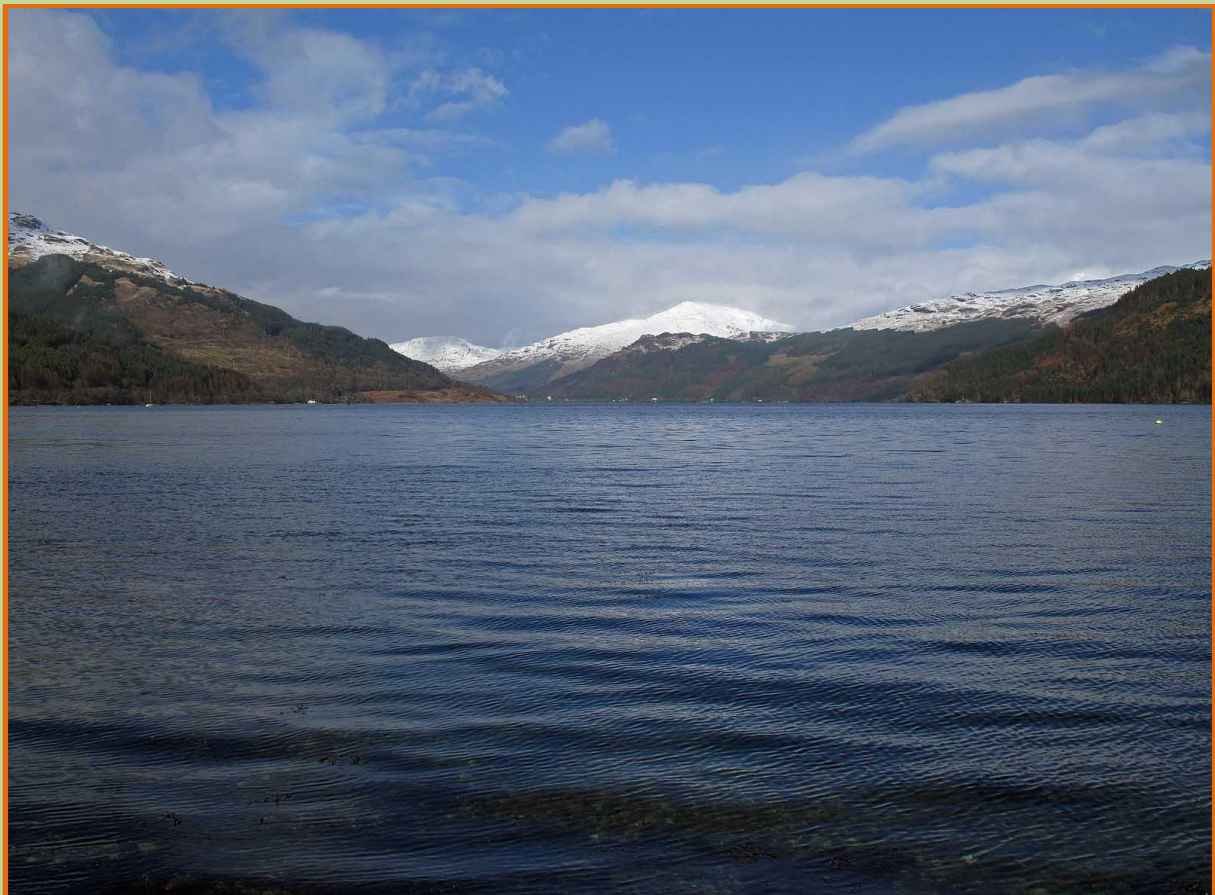




A Littoral and sublittoral benthic survey of the construction footprint for the Carrick landing craft/bund facility, Loch Goil



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Table of Contents

Introduction	1
Methods	2
Results	4
1. Diving Survey	4
2. Littoral Visual Survey	6
Conclusion	8
References	8
Appendix 1. Starting position of survey transects	10
Appendix 2. Photograph and video log	11
Appendix 3. Video transect analysis results	13
Appendix 4. Diving Log Sheets	14

A Littoral and sublittoral benthic survey of the construction footprint for the Carrick landing craft/bund facility, Loch Goil

Introduction

The installation of a landing craft/bund facility has been proposed for the shore adjacent to Carrick Farm in Loch Goil with the aim of providing landing craft access to productive woodland where road transport is limited and impractical. The facility would consist of a permanent stone and rock structure forming a short causeway and a hard stand to stack timber.

The landing craft will arrive for loading at high tide, bottoming to allow the use of a Volvo self-load as the tide ebbs and floods. The craft is expected to depart on the following high tide. The number of loads transported from the site is estimated to be around 25 and it is anticipated that the site will be in operation for up to twelve months.

The proposed location at Carrick lies within the Upper Loch Fyne and Loch Goil Nature Conservation Marine Protected Area (NC MPA), which has been selected for the following Proposed Protected Features (PPFs):

- Burrowed mud
- Flame shell (*Limaria hians*) beds
- Horse mussel (*Modiolus modiolus*) beds
- Ocean quahog (*Arctica islandica*) aggregations
- Sublittoral mud and specific mixed sediment communities

The site's status means that the requirements of the Marine (Scotland) Act 2010 apply. Consequently, the Loch Lomond & the Trossachs National Park Authority is required to consider the effect of the proposal on the NC MPA before it can be consented.

The main focus of the work is therefore to (1) establish whether the listed PPF's are present within the impact footprint of the proposed landing craft/bund facility and (2) if PPFs are present, to identify what adverse impacts (if any) may result from the development activity.

Historical records for Loch Goil are sparse, and nearly all records are concentrated in water substantially deeper than the planned development. However, records do exist for the presence of *Modiolus modiolus* and burrowed mud features within a mile of the proposed development (Holt and Davies, 1991; Moore, 2013).

It is known that all of the identified PPFs are susceptible to abrasion, siltation, and smothering pressures from human activities to varying degrees, while also being vulnerable to modified current regimes that sometimes result from the construction of coastal structures (Holt et al., 1998). For this reason a simple transect-based diving survey protocol was utilised to quickly establish the presence of PPFs, both within and outside of the construction footprint, but within a possible zone of influence.

Methods

A transect approach was used to establish whether any PPF's were present within and outside the construction footprint. This 'video transect' method is consistent with SNH's own protocols for collecting visual data and is commonly employed to gather semi-quantitative data on species and habitats of conservation importance.

Each transect began at the shoreward high water mark on the shore and extended seaward for 120m. Transect 1 was placed through the centre of the proposed jetty structure, using GPS positions provided by the project engineers. A further four transects peripheral to Transect 1 were undertaken, two each on either side, spaced at 20m intervals (i.e. 20m and 40m from Transect 1). All transects extended offshore on a bearing of 60°. The selected 120m length of the transects ensured the search included an area well-beyond the jetty and chain-and-anchor array. The GPS position for the start position of each transect was recorded (Appendix 1) and these are plotted in **Figure 1**.

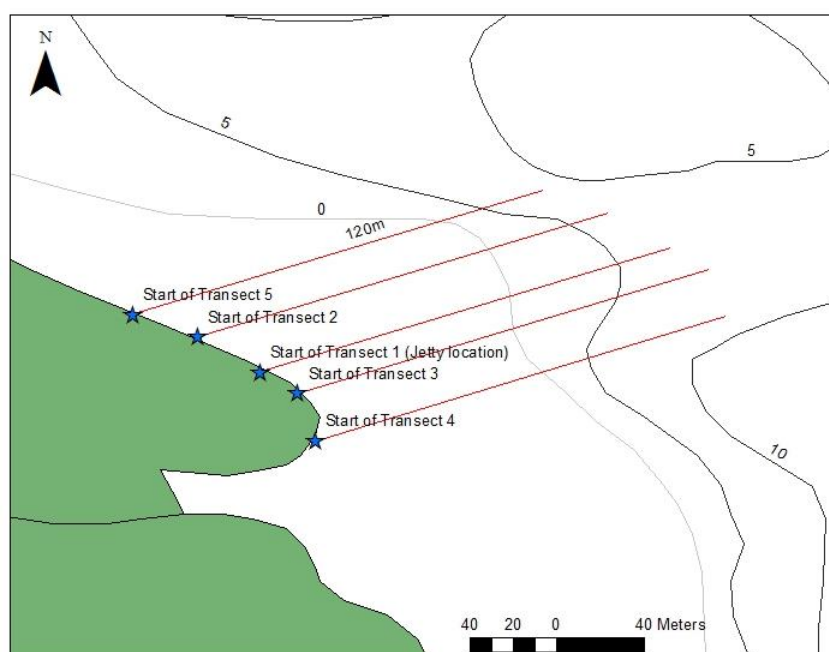


Figure 1. Positions and direction of the 5 transects used to assess the presence of PPF's in the proposed jetty and bund development.

For each transect the diver swam out on the surface from the shore on a bearing of 60° carrying a survey line which was tensioned and paid out from a reel by a member of the survey team on the shore. The diver's direction was additionally guided and corrected by instructions from the shore support, equipped with a sighting compass. On reaching a distance of 120m, confirmed by a signal from the shore support, the diver descended and started the survey. The diver swam back along the survey line at a steady speed, videoing the seabed at an approximate 45° angle (oblique angle aids subsequent species identification). If the diver encountered a PPF or a species that is indicative of a PPF he was required to stop and record the depth and/or distance along the survey line, and pause

to obtain clear footage. The diver continued along the transect line until reaching a depth of less than one metre. An additional photographic dive was also conducted along Transect 1, to obtain high quality stills images of the different habitats present.

The first two peripheral transects (Transects 2 and 3) passed approximately 1m outside of the anchor points for the tyre and chain array, ensuring that a visual assessment of the habitat in which these elements will be placed was possible.

All of the PPFs for the Upper Loch Fyne and Loch Goil NC MPA are found only in the subtidal, usually deeper than 5m. Consequently, only a small amount of time was expended on carrying out a littoral visual survey. The proposed jetty footprint itself, the mooring pin locations and the drag embedment anchor mooring points were the focus of the littoral assessment. Note, however, that the day of the survey corresponded to an unusually high tide occurring around the middle of the available survey period and so the shallow portion of the diving transects effectively included a substantial intertidal element.

Results

1. Diving Survey

All survey transects recorded three broad habitat types within the survey area, none of which could be categorised as PPFs. The distribution of these three habitats is shown in **Figure 2**. Moving shoreward, the first habitat extended from 120m distance limit to between 75 and 45m from the shore, with the depth ranging from 9.9 to 5.1m below chart datum. This habitat was broadly classified as SS.SMx.IMx (Infralittoral mixed sediment) (Connor et al., 2004). This habitat did contain occasional individual *Modiolus modiolus* and a single live *Arctica islandica* was observed, but these occurrences are common for this area and the density is not sufficient to be classified as a “bed” and therefore cannot be considered a PPF.

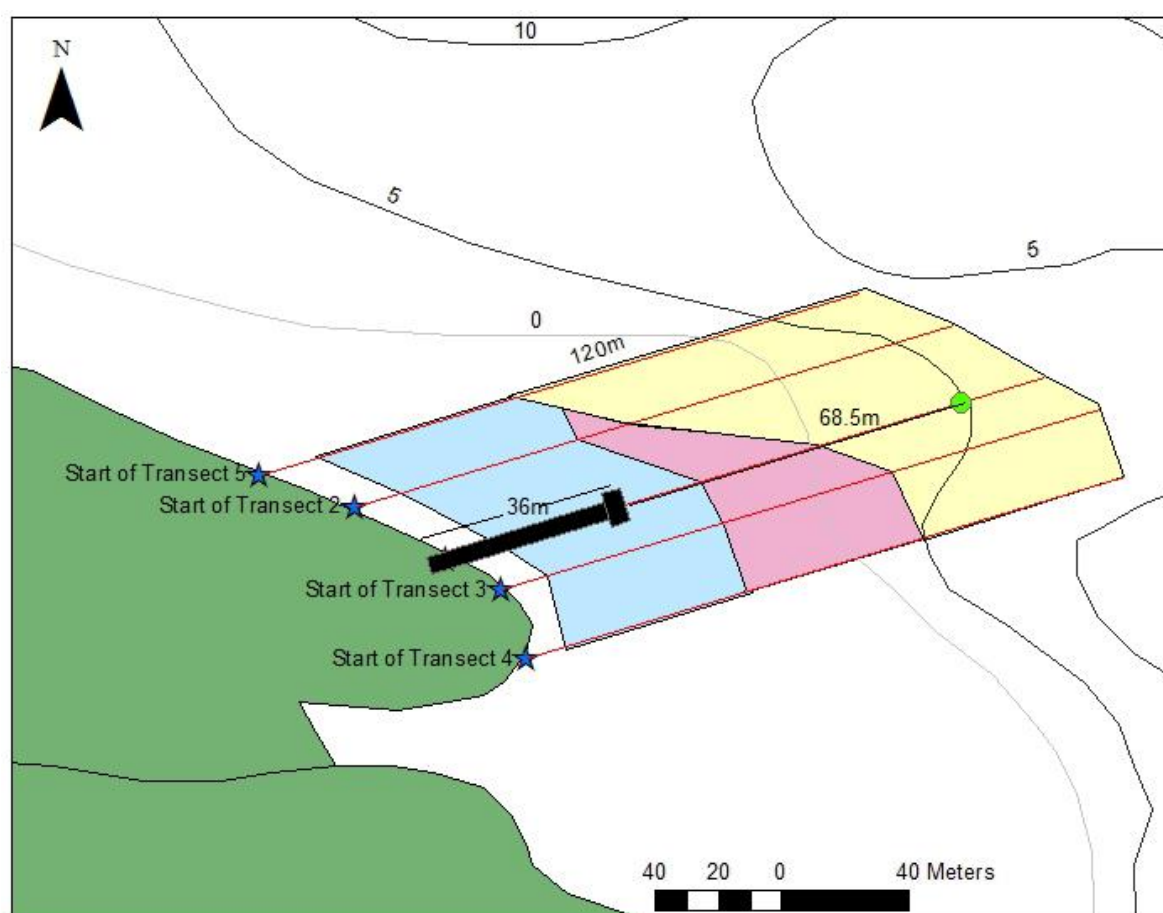


Figure 2. Map of the study site, showing the approximate positions of the three habitats recorded, blue = LL.LLR.FVS, pink = IR.LIR.KVS, yellow = SS.SMx.IMx. The black rectangle represents the approximate size and position of the jetty, and the green circle donates the maximum extent of the anchoring chains and tyres.

The second habitat encountered was a relatively steep muddy cobble and boulder slope, with sometimes dense sugar kelp *Saccharina latissima*. The slope rises some 4m from the deeper habitat,

and was classified as IR.LIR.KVS (Kelp in variable or reduced salinity) (Connor et al., 2004). This habitat was absent on transect 5, but ranged from 75m to 45m from the shore on the other transects, this related to approximately 5m to 0m below chart datum.

The third habitat started between 45 and 40m from the shore, the deeper end approximately corresponding to chart datum and therefore exhibiting a typical intertidal seaweed succession pattern. This habitat was broadly classified as LL.LLR.FVS (Fucoïds in variable salinity) (Connor et al., 2004).

Representative images of each of the habitats are provided below.



Image 1. Habitat SS.SMx.IMx. Example image from transect 1 showing a live *Modiolus modiolus*.



Image 2. Habitat IR.LIR.KVS. Example image from transect 1.



Image 3. Habitat LL.LLR.FVS. Example image from transect 1.

2. Littoral Visual Survey

The visual littoral surveys undertaken at the mooring pin locations (locations determined from the supplied plans) recorded 3 zones approximately 4m wide running down the shore. The upper zone consisted of large stones and mixed sediments, topped with a strandline composed of mixed drift furoid seaweed. The midshore zone comprised cobbles on mixed sediment, with scattered *Fucus vesiculosus* (15%), *Pelvetia canaliculata* occasional (5%) and *Semibalanus balanoides* (5%). The lower mid shore was very similar to the mid shore but with 80% cover of furoids. The lower shore was not accessible by foot during the survey period, but diver observation confirmed the presence of *Fucus vesiculosus* and *Ascophyllum nodosum*. This littoral community pattern, typical for Scottish sea lochs, was broadly consistent across the full survey area.

Representative images of these communities are shown below.



Image 4. Top of transect 1, looking offshore on a bearing of 60°. The three recorded littoral zones are visible down the shore.



Image 5. Midshore zone, showing patchy *Fucus vesiculosus* cover and occasional barnacles *Semibalanus balanoides*.

Conclusion

The survey results indicate that there are no features that correspond to Proposed Protected Features (PPFs) for the Loch Goil Nature Conservation Marine Protected Area (NC MPA) present within the vicinity of the proposed jetty and bund development. The survey was of sufficient resolution and coverage to be confident that any PPFs within the possible impact zone of the proposed development would have been observed and recorded. Both *Modiolus modiolus* and *Arctica islandica*, potential components of PPFs, were present within the survey area, but were sparse and did not occur in sufficient densities to be classified as features of concern¹. All species and habitats observed during the survey are common for the location and their status is highly unlikely to be adversely affected by the proposed development.

References

- Connor, D.W., Allen, J.H., Golding, N., Howell, K.R., Lieberknecht, L.M., Northern, K.O., Reker, J.B., 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 JNCC. Peterborough.
- Holt, R.H.F., Davies, M., 1991. Marine Nature Conservation Review Surveys of Scottish Sealochs - Sealochs in the northern Firth of Clyde.
- Holt, T.J., Rees, E.I.S., Hawkins, S.J., Seed, R., 1998. Biogenic reefs: an overview of dynamic and sensitivity characteristics for conservation management of marine SACs IX, 1–169.
- Moore, C.G., 2013. Biological analyses of underwater video from research cruises in the Clyde Sea (Loch Goil and the south of Arran) and in Orkney (Rousay Sound and Stronsay Firth). Scottish Nat. Herit. Comm. Rep. No. 631.

¹ For *Modiolus modiolus* to be classified as a PMF they would need to occur in densities of 1-9 per 0.1m² or greater (Connor et al., 2004; Holt et al., 1998)

Appendices

Appendix 1. Starting position of survey transects.

Positions derived using WGS84 datum

Transect	Latitude	Longitude
Start of Transect 1 (Jetty location)	N56°06.4240'	W004°54.2090'
Start of Transect 2	N56°06.4328'	W004°54.2245'
Start of Transect 3	N56°06.4187'	W004°54.1997'
Start of Transect 4	N56°06.4070'	W004°54.1953'
Start of Transect 5	N56°06.4383'	W004°54.2407'

Appendix 2. Photograph and video log.


File Name	Date	Transect	Description	Photo/Video	Credit
DSC_7629	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7632	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7636	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7637	21.02.2015	1	SS.SMx.IMx + <i>M. modiolus</i>	Photo	RC
DSC_7642	21.02.2015	1	SS.SMx.IMx + <i>M. modiolus</i>	Photo	RC
DSC_7645	21.02.2015	1	SS.SMx.IMx + <i>M. modiolus</i>	Photo	RC
DSC_7648	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7649	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7650	21.02.2015	1	SS.SMx.IMx + <i>M. modiolus</i>	Photo	RC
DSC_7652	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7654	21.02.2015	1	SS.SMx.IMx	Photo	RC
DSC_7655	21.02.2015	1	SS.SMx.IMx + <i>M. modiolus</i>	Photo	RC
DSC_7658	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7659	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7660	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7661	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7663	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7664	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7666	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7668	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7670	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7671	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7672	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7673	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7675	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7676	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7677	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7678	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7679	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7680	21.02.2015	1	IR.LIR.KVS	Photo	RC
DSC_7681	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7682	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7683	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7684	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7685	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7686	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7687	21.02.2015	1	LL.LLR.FVS	Photo	RC
DSC_7688	21.02.2015	1	LL.LLR.FVS	Photo	RC
Transect 1	21.02.2015	1	Video of Transect 1	Video	RC
Transect 2	21.02.2015	2	Video of Transect 2	Video	ID
Transect 3	21.02.2015	3	Video of Transect 3	Video	GS
Transect 4	21.02.2015	4	Video of Transect 4	Video	GS
Transect 5	21.02.2015	5	Video of Transect 5	Video	ID
IMG_7906	21.02.2015	5	Upper shore area looking North	Photo	ID

IMG_7907	21.02.2015	NA	Upper shore strand line	Photo	ID
IMG_7908	21.02.2015	NA	Northern mooring pin location	Photo	ID
IMG_7909	21.02.2015	NA	Mid shore zone with <i>S. balanoides</i>	Photo	ID
IMG_7910	21.02.2015	NA	Mid shore zone with <i>F. vesiculosus</i>	Photo	ID
IMG_7911	21.02.2015	NA	Mid shore zone with <i>S. balanoides</i>	Photo	ID
IMG_7912	21.02.2015	NA	Mid shore zone with <i>F. vesiculosus</i>	Photo	ID
IMG_7913	21.02.2015	NA	Mid shore zone with <i>F. vesiculosus</i>	Photo	ID
IMG_7914	21.02.2015	5	Sewerage pipe running offshore from public toilet block	Photo	ID
IMG_7915	21.02.2015	5	Sewerage pipe running offshore from public toilet block	Photo	ID
IMG_7916	21.02.2015	1	Transect 1 starting location	Photo	ID

Appendix 3. Video transect analysis results

Transect (M)	Transect 1		Transect 2		Transect 3		Transect 4		Transect 5	
	Habitat	Notes, Depth, Time	Habitat	Notes, Depth, Time	Habitat	Notes, Depth, Time	Habitat	Notes, Depth, Time	Habitat	Notes, Depth, Time
110									LR.LLR.FVS	<i>F. vesiculosus</i>
105			LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS	<i>F. vesiculosus</i>
100			LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS	<i>F. vesiculosus</i>
95			LR.LLR.FVS	<i>F. vesiculosus</i> ,6:36 mins	LR.LLR.FVS	<i>F. vesiculosus</i> ,13:02 mins	LR.LLR.FVS	<i>F. vesiculosus</i> ,11:46mins	LR.LLR.FVS	
90	LR.LLR.FVS	<i>F. vesiculosus</i>	LR.LLR.FVS		LR.LLR.FVS		LR.LLR.FVS		LR.LLR.FVS	Sewerage Pipe, 8:01 mins
85	LR.LLR.FVS	<i>F. serratus / vesiculosus</i>	LR.LLR.FVS	<i>F. serratus</i>	LR.LLR.FVS		LR.LLR.FVS		LR.LLR.FVS	
80	LR.LLR.FVS	0.3m	LR.LLR.FVS	<i>F. serratus</i>	LR.LLR.FVS		LR.LLR.FVS	<i>F. serratus</i> , 11:03 mins	LR.LLR.FVS	
75	LR.LLR.FVS	9:21 mins, <i>F. serratus</i>	IR.LLR.KVS		LR.LLR.FVS	<i>F. serratus</i> , 11:58 mins	IR.LLR.KVS	1.1m	LR.LLR.FVS	<i>F. serratus</i> , 07:14 mins
70	IR.LLR.KVS		IR.LLR.KVS	Dense <i>S. latissima</i>	IR.LLR.KVS		IR.LLR.KVS		SS.SMx.IMx	
65	IR.LLR.KVS		SS.SMx.IMx		IR.LLR.KVS	<i>S. latissima</i>	IR.LLR.KVS		SS.SMx.IMx	
60	IR.LLR.KVS		SS.SMx.IMx		IR.LLR.KVS		IR.LLR.KVS		SS.SMx.IMx	
55	IR.LLR.KVS	2m, 7:40 mins	SS.SMx.IMx		IR.LLR.KVS	3.9m, 10:10 mins	IR.LLR.KVS		SS.SMx.IMx	
50	IR.LLR.KVS	6:42 mins, <i>S. latissima</i>	SS.SMx.IMx		IR.LLR.KVS		IR.LLR.KVS	<i>S. latissima</i>	SS.SMx.IMx	Softer sediment
45	SS.SMx.IMx	<i>M. modiolus</i> , 5.1m, 5:23 mins	SS.SMx.IMx		IR.LLR.KVS	5.2m, 7:19 mins, <i>S. latissima</i>	IR.LLR.KVS	5m. 7:41 mins	SS.SMx.IMx	
40	SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx	
35	SS.SMx.IMx	6.6m	SS.SMx.IMx		SS.SMx.IMx	7.7m	SS.SMx.IMx	<i>M. modiolus</i> , 3:46 mins	SS.SMx.IMx	
30	SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx	<i>M. modiolus</i> , 5:41 mins	SS.SMx.IMx	<i>M. modiolus</i> x 2, 3:15 mins	SS.SMx.IMx	Wreckage, 3:38 mins
25	SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx	<i>M. modiolus</i> , 4:57 mins	SS.SMx.IMx	<i>M. modiolus</i> , 3:05 mins	SS.SMx.IMx	
20	SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx	<i>M. modiolus</i> , 4:16 mins	SS.SMx.IMx		SS.SMx.IMx	
15	SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx	<i>M. modiolus</i> , 2:22 mins	SS.SMx.IMx	
10	SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx		SS.SMx.IMx	<i>M. modiolus</i> , 2:15 mins	SS.SMx.IMx	<i>M. edulis</i> , 01:58 mins
5	SS.SMx.IMx	<i>A. islandica</i> , 3:05 mins	SS.SMx.IMx	<i>Mya truncata</i>	SS.SMx.IMx	<i>M. modiolus</i> , 2:06 mins	SS.SMx.IMx	Wreckage, 1:50 mins	SS.SMx.IMx	
0	SS.SMx.IMx	<i>A. islandica</i> shells, 6.6m	SS.SMx.IMx		SS.SMx.IMx	7.9m, mooring chain	SS.SMx.IMx	9.9m	SS.SMx.IMx	

Appendix 4. Diving Log Sheets



Graham Saunders Marine Ecology

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United Kingdom

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Mob: 07808 137932
Email: info@saunders-marine.co.uk

Daily Project Log

Diving Contractor – Graham Saunders/GS Marine Ecology
Tel: 07808 137932; graham.saunders@saunders-marine.co.uk

A separate sheet must be completed for each day of a diving project. Each Diving Supervisor must complete the dive details for the diving operation under their control and sign the appropriate section to verify the information and state that they carried out all pre-dive equipment checks. The Senior Diving Supervisor must complete the first section of this form prior to the day's operations commencing and sign the appropriate section to verify that a pre-dive briefing has taken place. All completed forms must be returned the Graham Saunders as soon as is practically possible.

Date of Project: 21/2/15	Period of Project: 21/2/15
Location: S. of Carrick Castle, Loch Goil	Work site/Vessel: Shore
Senior Diving Supervisor: G. Saunders	Project Leader: G. Saunders
Other Diving Supervisors: Rob Cook, Iain Dixon	ACOP Used: Scientific and Archaeological
Divers: Rob Cook Iain Dixon Graham Saunders	Other Persons involved (State duties): None
	Type of Equipment: Scuba
	Decompression Tables/computer: Computers
	Tide
	Weather Conditions Sun + Snow showers, NW 3
	LW: 0701+1929 HW: 14.19
	Air Temp: 4°C Sea Temp: 8°C
Type of Diving Project: Contract	Underwater visibility: 4-5m

Verification Of Pre-Dive Briefing – All divers present	
Senior Diving Supervisor Signature: <i>G. Saunders</i>	Date and time: 21/2/15, 10:30
Particulars of any equipment faults:	N/A
Particulars of any decompression illness:	N/A
Particulars of any other medical problems:	N/A
Particulars of any emergency and action taken:	N/A

Diving Log Sheets cont...

Before Dive											After Dive					Task/ Purpose	
Name of Diver	Dive Team	SBD	Tank Size	Reserve pressure & Size	% O ₂	Air in	Air & Manifold checked	Buoyancy checked	Tools checked	Computer Set	Left Surface	Arrived surface	Total Time	Max Depth	Air out		Stops S or D
Rob	\	Graham	24L	/	21	215	✓	✓	✓	✓	11:24	11:47	23	9.4	180	/	T1
Graham	\	Iain	12L	3L 220	21	210	✓	/	✓	/	12:14	12:32	17	11.6	138	/	T3
Iain	\	Graham	12L	3L 220	21	190	✓	✓	✓	/	12:57	13:06	9	9.3	150	/	T2
Rob	\	Iain	24L	/	21	180	✓	/	/	/	13:44	14:05	24	11.6	150	/	T1
Graham	\	Rob	12L	3L 220	21	130	✓	/	/	/	14:30	14:48	18	14.1	72	/	T4
Iain	\	Graham	12L	3L 220	21	150	✓	✓	/	/	15:21	15:35	14	10.0	110	/	T5

Diving Supervisor(s)	Name	Signature	Time on	Time off/ Desaturation Time
	Iain	<i>[Signature]</i>	11:10	11:50
	Rob	<i>[Signature]</i>	11:50	13:15
	Graham	<i>[Signature]</i>	13:15	14:15
	Iain	<i>[Signature]</i>	14:15	15:10
Rob	<i>[Signature]</i>	15:10	→ + 24hrs	

NOTES: SBD = Standby diver; Stops S or D = Safety or Decompression stops