# A SURVEY OF HABITAT CONDITION FOR THE FRESHWATER PEARL MUSSEL *MARGARITIFERA MARGARITIFERA* IN THE RIVER SLANEY AT ENNISCORTHY, COUNTY WEXFORD

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## 1.0 Background & Introduction

1.1 The European Union Directive on the Conservation of Natural and Semi-Natural Habitats and of Wild Fauna and Flora (Habitats Directive) lists the freshwater pearl mussel *Margaritifera margaritifera* under Annex II (species whose conservation requires the designation of special conservation areas) and Annex V (species whose taking in the wild and exploitation may be subject to management measures). Article 17 of the directive requires each member state to make 6 year reports on the status of the species both inside and outside of the SAC network.

1.2 The freshwater pearl mussels is protected under the Wildlife Act, thus protecting the species and its habitat throughout the country.

1.3 The freshwater pearl mussel has declined throughout its range. It has been estimated that there was a decline in *Margaritifera margaritifera* of more than 90% of individuals in European populations during the 20th Century and that the decline is continuing in the 21st Century (Bauer, 1988; Geist, 2010).

1.4 *Margaritifera margaritifera* is listed as "critically endangered" in Europe by IUCN, and in the Irish Red Data List (Moorkens, 2011; Byrne et al., 2009).

1.5 The duck mussel *Anodonta anatina* is listed as "vulnerable" in the Irish Red Data List (Byrne et al., 2009). Habitat destruction and the spread of alien species have led to its decline (Moorkens, 2006).

1.6 The Slaney River Valley SAC (000781) lists *Margaritifera margaritifera* as a qualifying interest, but with the Conservation Objectives for the species within the SAC currently under review (NPWS website). The *Margaritifera* regulations 2009 do not list the Slaney River, but the Derreen River was included, and a sub-basin plan was drafted for the Derreen to the confluence of the Slaney main channel and not further downstream.

1.7 The current considerations for the Flood Defence Scheme for the Enniscorthy area include a new bridge spanning the Slaney River and the Dublin to Rosslare railway, to replace Seamus Rafter Bridge (to be demolished), lowering of high points on the river bed and removal of sediment build-up through dredging, and management of the flow regime of the side channel at the Island area that exits close to the railway bridge.

1.8 A freshwater mussel survey was undertaken by Ecofact (2016), which found 51 live *Margaritifera* and 4 live *Anodonta* within the stretch of river that is proposed to be affected by the scheme.

1.9 In the assessment of affects of the scheme on *Margaritifera* and *Anodonta*, an understanding of the importance of the habitat for these species must be taken into consideration in order to understand how the individuals present may be contributing to the overall Slaney River populations of these species, and in the case of *Margaritifera*, to the function of the Derreen River population that is the subject of the *Margaritifera* regulations 2009.

1.10 A survey of river bed habitat in the vicinity of current and potential *Margaritifera* and *Anodonta* presence was undertaken on 28th October 2016, under licence from NPWS, and to whom licence returns must be made. This study has been carried out on behalf of Scott Cawley.

**2.0 Methodology and Survey Locations**

2.1 A survey for the presence of freshwater pearl mussels has already been undertaken by Ecofact (2016). The purpose of this survey was to visit a sample of locations where mussels were found within the study stretch of river, and assess the habitat quality present.

2.2 The condition of the habitat was assessed using redox potential, and a visual assessment was made of the living and decaying organic matter on the river bed, the presence of surface and infiltrated silt and whether the habitat was scoured, compacted or lithified.

2.3 The Redox equipment comprises a 0.7m long probe fitted with a platinum tipped electrode, a reference Ag/AgCl electrode and a meter with a millivolt display. A reading is obtained by holding both electrodes in the water column until a stable reading is obtained (typically this would be 450-580mV). With the Ag/AgCl electrode remaining in the water column, the platinum electrode is then inserted into a depth of 5cm in the substrate and a reading taken immediately.

**Figure 1 Using a redox meter**

2.4 Two areas were assessed for habitat condition (Figure 2). Area 1 was the area of habitat downstream of the centre channel island, and Area 2 was where mussels were found upstream of the centre channel island.

2.5 One mussel in area 1 was checked for stress using tongs using the method of Moorkens (2005). The mussel was gently checked for muscular resistance under light pressure. Unstressed mussels clam shut and cannot be opened with light presure.

2.6 The side channel on the left bank was walked to assess its potential as a habitat refuge, and how changes to this channel might affect the main Slaney River.

2.7 The potential habitat at Scarawalsh Bridge was also considered in a brief site visit.

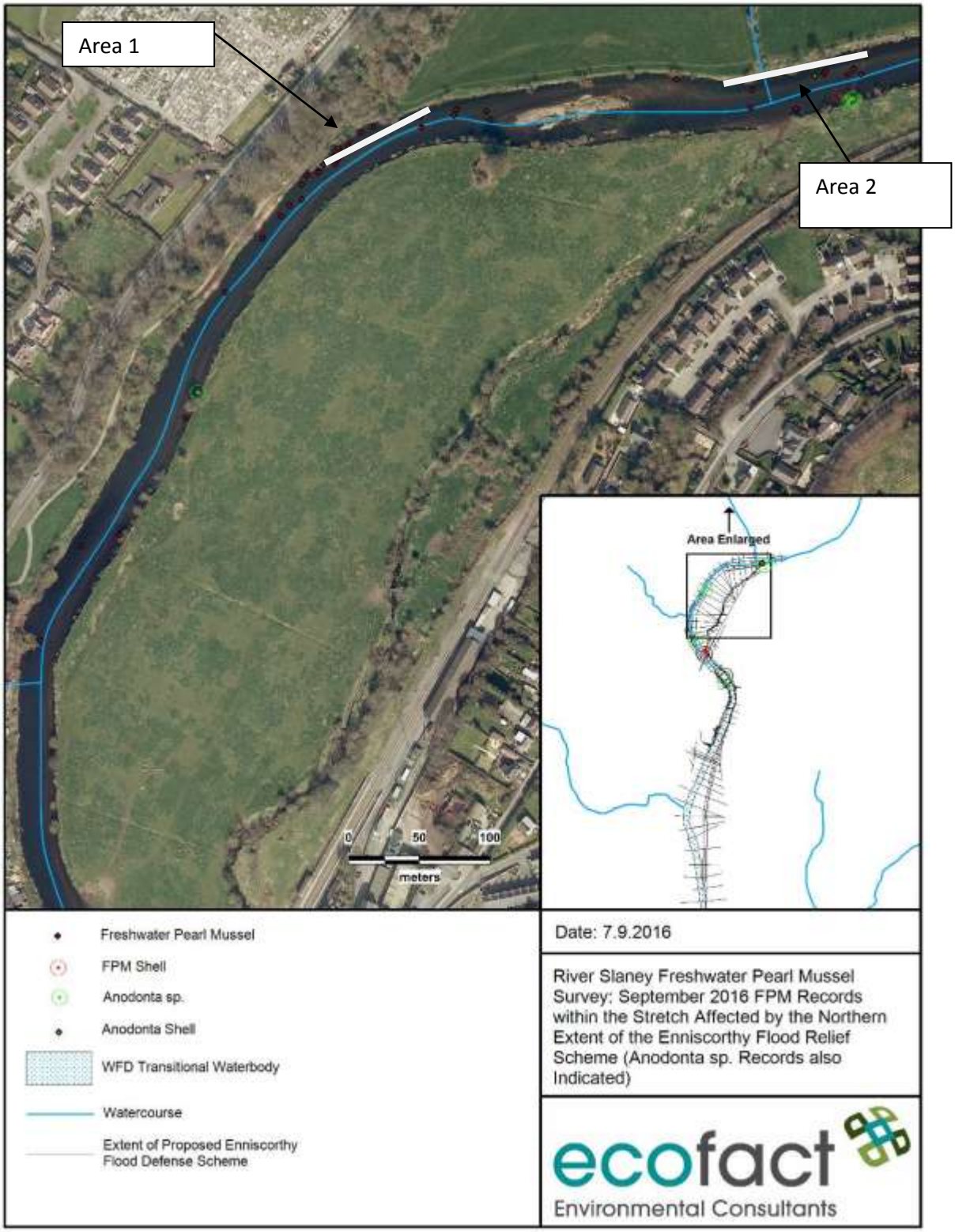



**Figure 2. Areas assessed with reference to the mussel locations identified by Ecofact (2016).**

**3.0 Results**

**3.1 Redox potential results**

Three sets of redox potential measurements were taken with a total of 30 measurements, where depth permitted, as the equipment requires a water depth of 70cm or less. Ten readings were taken in each set (Table 1). A reduction of 20% or less from open water levels demonstrates oxygenated conditions at 5cm depth, which is required for juvenile mussel survival (Geist & Auerswald, 2007). The redox readings were compatible with juvenile mussel survival in 40% of the area upstream of the island, while the conditions downstream of the island were not compatible with juvenile survival.

Table 1. Redox potential measurements where mussels were found.

| Site (N=10 in each) | Grid reference | Min loss | Max loss | Average loss | Percentage suitable | Potential juvenile habitat |
|---|---|---|---|---|---|---|
| 1 (Area 1 downstream) | S 9740 4065 | 23% | >49% | 29% | 0% | Not in current condition |
| 2 (Area 1 upstream) | S9732 4071 | 21% | 28% | 24% | 0% | Not in current condition |
| 3 (Area 2) | S 9767 4079 | 17% | 23% | 20% | 40% | Good potential habitat |

**3.2 Visual assessment**

The visual assessment was based on 15 parameters as noted in Table 2. There was considerable difference in quality between the poorer downstream area and the area upstream of the island, which had some conditions suitable for adult and juvenile mussel survival. Photography was difficult due to the depth and poor light (Table 3).

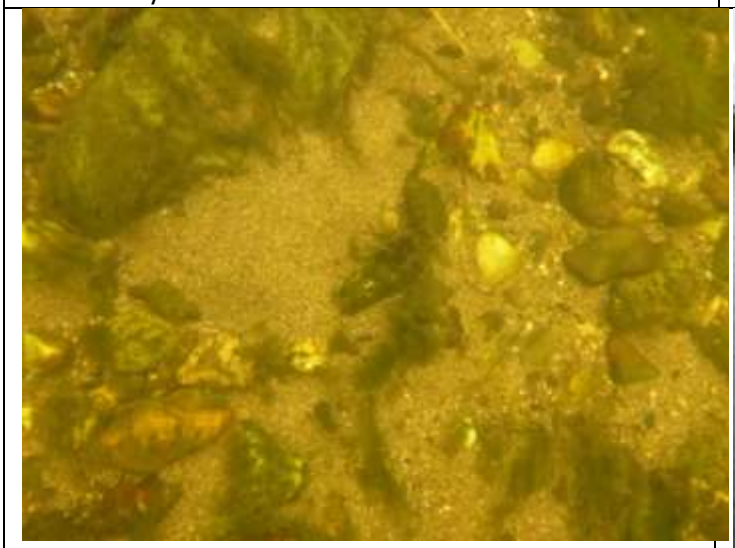
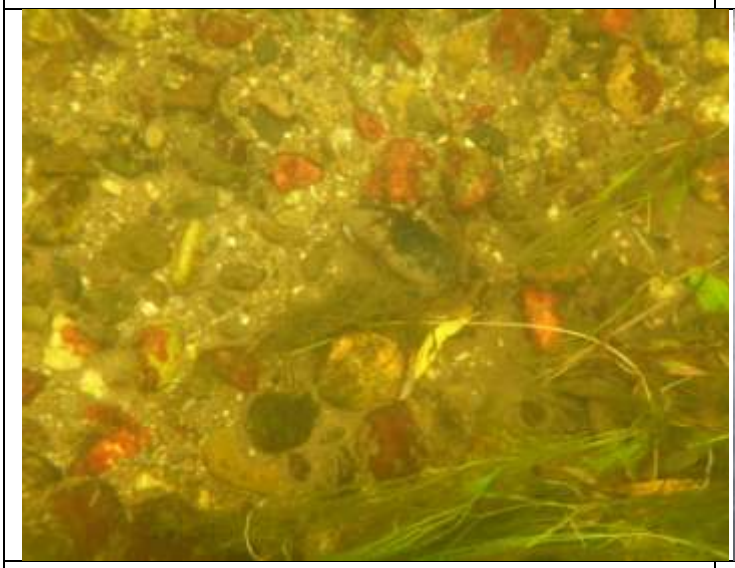
**3.3 Stress assessment**

Only one mussel (in Area 1) could be checked for stress using tongs (Moorkens, 2005). The other mussels seen were too deep to be able to safely remove and replace them. The mussel opened slightly under light pressure, showing evidence of slight stress. This mussel did not have any severe scarring, thus is unlikely to have travelled far from where it was born. Some dead shells seen and two of the 3 dead shells presented in the Ecofact (2016) report from Enniscorthy were highly scarred and are likely to have been washed downstream for a considerable distance either before or after death. One dead mussel was found in Area 2. It had died within the week or two before the survey and still had dead flesh within. It had no evidence of scarring and is likely to have been born and lived its life in close proximity to where it was found.

Table 2. Parameters, requirements for appropriate FPM habitat, and results from Areas 1 and 2.

| Parameter surveyed | Requirement | Area 1 Downstream of Island | Area 2 Upstream of Island |
|---|---|---|---|
| **Adult Mussel location** | Well buried, in stable situation | No | Yes |
| **Substrate mix** | Wide range of sizes | Larger boulders and mud prevalent | Yes |
| **Sand to fine gravel amongst larger stones** | The presence of coarse sand and fine gravels is needed for juvenile mussels to bury into | Yes | Yes |
| **Compaction** | Substrate should move easily when pressed with penetrometer or metal rod | No, highly compacted in places | Yes |
| **Silt cover** | Fine sediment or mud should not cover habitat surface | No, covered in most places | Yes, most of the suitable habitat was clean |
| **Silt infiltration** | Fine sediment or mud should not infiltrate river bed substrate, redox should not be >20% compared with open water reading | Severe silt plumes and redox reduction in river bed | Some areas of faster flow relatively clean with 40% good redox results |
| **Flow** | Near bed velocity should be sufficient to prevent stress to adults and juveniles | No, poor velocities near edge, centre channel areas could not be surveyed | Some good preferential flow areas |
| **Scour** | River bed habitat should not be unstable or disturbed, as evidenced by bright coloured stones | Mostly stable but away from the bank some areas were more disturbed and scoured | Less stable areas were scoured, but considerable stable habitat present |
| **Detritis** | Accumulations of leaf litter and natural or unnatural debris should not occur | Only at edges | Very little detritus even at edges |
| **Filamentous algal cover** | <5% and sparse, not luxurient | No algae (October) | No algae (October) |
| **Decaying organic matter** | Substrate should be clean with no organic decay | Fine flocculating decayed matter present and severe in places | Light fine flocculating decayed matter present in places with poorer flow |
| **Macrophytes** | Rooted macrophytes should be <5% in mussel habitat | <5% | <5% |
| **Bryophytes** | The presence of *Fontinalis* in mussel habitat is positive and indicates good flow | Not observed in area surveyed | Present in better flow areas |
| **Juvenile habitat physical attributes present** | The presence of suitable FPM juvenile habitat is present regardless of condition | Very little potential juvenile habitat | Some good areas of potential juvenile habitat |
| **Juvenile habitat conditions** | Where present, suitable FPM juvenile habitat is present in good condition | Even where some potential habitat present, condition was poor | Mixed condition, with preferential flow areas with some good condition |

**Table 3: Photographs of habitat**

| | |
|---|---|
|  |  |
| Very silted substrate downstream of island | Dark conditions prevented photography in deeper areas |
|  |  |
| Good juvenile habitat with adult mussel in clean gravel in the lee of boulder upstream of the island | Looking downstream towards island from area of good mussel habitat |
|  |  |
| Recently dead shell on river bed in Area 2 | Dead mussel still had flesh inside and had no scar marks |

### 3.4 The left bank and side channel

The side channel on the left bank was walked from its entry area to its return to the Slaney. The inflow area may be considered for reprofiling. The main channel here was highly silted toward the edge, but *Anodonta anatina* was seen and some shell fragments of both *Margaritifera* and *Anodonta* were found on the bank. The small channel entry was not connected at the time of the survey, and is likely to only be connected during high flow, providing a stable ponded habitat outside of high flow times. There is consequently some good wetland and transitional habitat present, as well as a valuable tree line, well used by birds during the visit. A flock of long-tailed tits were making their way up the tree line, demonstrating its value as a corridor to and from the town.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Current bank rising from the Slaney above which flooding has to occur to reach the side channel</td><td>Overgrown side channel close to the north end</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Standing water with Lemna further downstream in channel</td><td>Wider area of standing water at southern end of channel</td></tr>
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**3.5 Scarawalsh Bridge area**

A short visit was made to the Scarawalsh Bridge area. Here shallow areas of preferential flow with potential juvenile mussel areas were seen. This area has the potential to act as a translocation receptor site if needed.

**4.0 Discussion**

4.1 The conditions for habitat condition assessment were limited by flow and by cloud cover /light availability, and the deeper and downstream areas where mussels were found by Ecofact could not be reached.

4.2 From the areas accessed, there appears to be a difference in habitat quality for *Margaritifera*, with better habitat located upstream of the island area. As *Anodonta anatina* lives in river bed habitats with finer silts, the potential for this species is wider.

4.3 The freshwater pearl mussel is acknowledged to be one of the most demanding species of high water quality and high river bed quality in the world. However, where preferential flows occur that prevent the negative manifestations of lower water quality and sedimentation from suppressing river bed quality, mussels including juveniles may persist.

4.4 The Slaney River population of *Margaritifera* was likely to have been as high as 10 million individuals around 100 years ago. It is unlikely that a dense population in the main channel can be restored, but low densities over a large distance can be maintained where there is sufficient pockets of juvenile habitats available to continue the population.

4.5 The protection of the red data species *Anodonta* should be undertaken by translocating all individuals that would be placed in danger from dredging or bridge works upstream within their existing range.

4.6 The protection of the protected and critically endangered species *Margaritifera* should be undertaken in a number of ways:

a) By safeguarding the habitat areas with good juvenile potential upstream of the island

b) By translocating the downstream mussels that would be negatively affected by dredging to the vicinity of Scarawalsh Bridge, if an appropriate licence was issued to do so.

c) Any translocation receptor sites would need to be chosen and carefully documented using the methodology of Killeen & Moorkens (In press), including clear labelling of each mussel.

d) A monitoring programme to include 6 month, 1 year and annual monitoring thereafter for 5 years would be needed to include habitat assessment, stress testing and a recommendation for removal if the receptor site is found to be or becomes unsuitable.

e) A monitoring programme for the habitat area upstream of the island to assess its quality over time after the proposed flood defence works are undertaken.

4.7 In order to assess the potential effects of the proposed works, the following considerations need to be included:

a) Consideration of potential effects on *Margaritifera* within the area listed under the 2009 *Margaritifera* regulations (i.e. the Derreen population):

- *Changes in River Flow:* Activities such as land drainage, major land use changes, water abstraction, physical changes to the river and its tributaries by dredging or straightening can *all* affect the quantity of water in the river, and the speed and direction of river flow. The cumulative effects of many small individual changes in land drainage can be the source of the loss of juvenile habitat once the tipping point for near bed velocity over that habitat has been reached. Reversal of prior drainage and a subsequent increase in the permeability of the wider catchment can restore habitat function through reduction in high flow or flood events, and the slow release of water during periods of base flow or drought. Restoration of more natural flood plain conditions and buffer zones that hold water provides better movement of groundwater through to river bed gravels during low flows.

- *Addition of Chemicals and Nutrients:* A range of substances cause harm to mussels when they enter the river. Industrial pollutants, nutrients (phosphorus and nitrogen which may come from forestry, agriculture, agri-based industries, waste management facilities and sewage inputs), and pesticides (particularly sheep dip) all negatively affect the FPM population. Measures to abolish pollutants and reduce nutrients to oligotrophic levels at a catchment level have a positive effect on FPM recovery.

- *Inputs or movements of Sediment:* In-stream works, land drainage, construction works, tillage and animal poaching are among the many activities that can result in the movement of fine sediment from the land to water. Over time this eroded sediment makes its way through ditches and streams into the river and onto pearl mussel populations. Once in a river system, fine sediment goes through periods of settlement and remobilization, and thus can do much harm over a long period of time, and a long distance. Measures taken to eliminate artificial sediment sources and return to natural conditions can slowly improve the entire river habitat, with eventual sustainable conditions for juvenile FPM establishing, along with other benefits such as the maintenance or return to Water Framework directive (WFD) High Status.

- *Biotic factors:* Where any actions both within or outside the FPM habitat area negatively affect the salmonid host of the FPM, damage to mussel populations will also result due to failure of FPM larvae to find host fish. Reduction in fish host numbers can result in a subsequent decrease in FPM numbers and the distribution extent (range) of FPM, resulting in damage to the resilience of FPM through genetic loss. Fish barriers will result in a loss of FPM range. Where FPM exists outside the population but within connectivity of the population via encysting on fish that can subsequently move into the population area, there should be no reduction in the range of either the FPM or the fish that are contributing to that population.

The issues to be considered in this case would be the biotic factors.

b) Consideration of potential effects on *Margaritifera* outside the area listed under the 2009 *Margaritifera* regulations, under the Wildlife Act and the Environmental Liability Directive.

Where good *Margaritifera* habitat exists (upstream of the island), care must be taken not to affect flows, water chemistry, fine sediment or biotic factors. Where poor *Margaritifera* habitat exists (downstream of the island) without conservation objectives to improve condition, there is only a limited loss, as juveniles are unlikely to survive and adult mussel contribution would only be through the production of glochidia and the encystment of fish moving upstream. Any loss of host fish or their spawning habitat would also be negative.

4.8 Finally, it should be noted that the River Basin District Plans under the Water Framework Directive, and the draft sub-basin plan for the Derreen *Margaritifera* population should be taken into consideration in the design and assessment of the proposed works. In particular, the requirement to reduce fine sediment loss from the catchment into the river channels should be referenced. As the need for the dredging proposed arises from catchment problems that must be legally addressed under the WFD and the *Margaritifera* regulations (through the sub-basin plans), ongoing management of flood risks should be compatible with these plans and support them where possible. Ongoing dredging may be more difficult to assess positively than a once-off proposal, so management of sediment inputs in the future would need to be part of the assessment of any ongoing dredging maintenance.

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