Nitrate Vulnerable Zone (NVZ) designation, 2017 Eutrophication (lakes)

Publication Date: June 2016

NVZ Name: Betley Mere
NVZ ID: EL128
Evidence of eutrophication 2017

This document provides a summary of the evidence used in proposing an area of land as one which should be, or should continue to be, designated as a Nitrate Vulnerable Zone (NVZ) for the purposes of the Nitrate Pollution Prevention Regulations 2015.

A full description of the methods used in developing the NVZ proposals is set out in the detailed methodology for eutrophication-related NVZs, available via http://apps.environment-agency.gov.uk/wiyby/141443.aspx. These methods were developed under the guidance of a review group convened by the Defra for the last NVZ review (2011-2013), which included representatives from the farming and water industries as well as independent academic experts. Minor refinements to the methods have been made for the current review.

NVZs are areas of land that drain to polluted waters and which contribute to the pollution of those waters. Polluted waters include those which are eutrophic or may in the near future become so if the Regulations were not to apply there.

Eutrophication is defined as “the enrichment of water by nitrogen compounds, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned”.

For both freshwaters and saline waters, a weight-of-evidence based approach to assessing the risks and impacts of eutrophication was employed. The evidence for individual water bodies was assessed against a national suite of criteria for eutrophication in the different categories/types of water for review. The criteria are both quantitative and qualitative and reflect scientific understanding of the process and effects of eutrophication. They are broken down in the same way for each water category as follows:-

- Nutrients
- Plants/algae
- Secondary and other effects

For each designated or candidate water body which might meet the criteria for eutrophication, a datasheet such as this one was completed, bringing together information about the water body, its catchment, its uses, evidence of eutrophication and the sources of nitrogen input.

This document is a record of the evidence used in the designation process, including results from national monitoring and assessment programmes, and further information supplied by Area staff. The proposals for NVZ designation are made as a result of close working between Area and national Environment Agency teams, with further quality assurance for the eutrophication designations through the use of a national expert panel.

An accompanying guide to these datasheets is available, which provides an explanation of the contents, acronyms and technical terms.

Some features of the maps within this report are based on digital spatial data licensed from the Centre for Ecology and Hydrology, ©.

Please note that any maps shown here have not used detailed field boundaries and therefore represent the indicative 'soft' boundary only. The definitive NVZ area can be seen on the "What's in Your Backyard" (WIYBY) website ((http://apps.environment-agency.gov.uk/wiyby/141443.aspx).

NVZ Name: Betley Mere
NVZ ID: EL128
Section 1. Lake and catchment characteristics

| WB ID: 34330 | 2013 NVZ status: Not Designated |

### Lake attributes

<table>
<thead>
<tr>
<th>EA Area</th>
<th>Greater Manchester Merseyside and Cheshire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake grid co-ordinates (Easting/Northing)</td>
<td>374871 / 347944</td>
</tr>
<tr>
<td>Lake waterbody area (ha)</td>
<td>8.8</td>
</tr>
<tr>
<td>WFD Lake Typology</td>
<td>Organic, very shallow, very small, lowland</td>
</tr>
<tr>
<td>Lake Alkalinity (ueq/L)</td>
<td>4224</td>
</tr>
<tr>
<td>Mean lake depth (m)</td>
<td>0.7</td>
</tr>
<tr>
<td>Is the lake heavily modified according to WFD?</td>
<td>Yes</td>
</tr>
<tr>
<td>Does stratification occur?</td>
<td>Well mixed</td>
</tr>
<tr>
<td>Is this waterbody a reservoir?</td>
<td>No</td>
</tr>
</tbody>
</table>

Natural or artificial lake:
Natural

Type of artificial lake:
n/a

Lake perimeter (% artificial):
Natural

Significant changes in lake level due to seasonal drawdown:
N

Pumped storage or other reservoir:
n/a

Information on abstraction (if available)
### Lake catchment attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake catchment area (ha)</td>
<td>1155</td>
</tr>
<tr>
<td>If pumped, pumped catchment area (ha)</td>
<td></td>
</tr>
</tbody>
</table>

#### Hydrological character

Primarily surface water

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Please note that the map above has not used the detailed field boundaries and is the indicative 'soft' boundary. The definitive NVZ area can be seen on the Environment Agency website (www.environment-agency.gov.uk)

**Comments on accuracy of lake catchment:**

**Is the map representative of the natural catchment?**

No --- The catchment boundary on the above map has been altered to match the boundary provided by Environment Agency area staff in 2015.

**Is the map representative of the artificial catchment?**

n/a --- Hydrology

---

**NVZ Name:** Betley Mere  
**NVZ ID:** EL128
Section II - Waterbody uses

Water Supply:
Controlled water (Section 104 of Water Resources Act):
Yes
Public Water Supply:
No
Drinking Water Protected Area:
No
UWWTD designation
No
Used for hydropower or flow regulation:
n/a

Recreational use:
Accessiblity to public:
Not easily accessible, few visits --- Angling syndicate for fishing the lake
Recreational fishing:
Little activity --- Small angling syndicate for fishing the lake
Contact watersports
No activity
Nature of watersports (if applicable):
---
Other public benefit visits:
Little activity

Conservation status:
Conservation value of lake:
National ---
Habitats Directive site:
Not SPA or SAC --- Ramsar, SSSI
SPA or SAC for aquatic interest features
---

SSSI or local conservation designation:
SSSI --- and RAMSAR

Description of Aquatic interest features:
--- Eutrophic standing open water: A8 Nuphar lutea community.Submerged aquatic vegetation mostly of Canadian waterweed Elodea canadensis but including the nationally rare autumnal water-starwort Callitriche hermaphrodita and regionally scarce blunt-fruitd water-starwort C. obtusangula. The site attracts many birds throughout the year and more than 50 species breed including little and great crested grebes Tachybaptus ruficollis and Podiceps cristatus, grey wagtail Motacilla cinerea and seven species of warbler. There is a representative and diverse aquatic invertebrate fauna associated with the Mere including the rare water flea Daphnia magna. Caddis flies Trichoptera, mayflies Ephemeroptera, snails Mollusca and water bugs Hemiptera are prominent groups

NVZ Name: Betley Mere
NVZ ID: EL128
### Total oxidised nitrogen (TON) data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean summer TON (mg/l)</td>
<td>0.5</td>
</tr>
<tr>
<td>Total number of summer TON samples</td>
<td>9</td>
</tr>
<tr>
<td>75th percentile annual TON (mg/l)</td>
<td>2.5</td>
</tr>
<tr>
<td>Total number of TON samples</td>
<td>18</td>
</tr>
<tr>
<td>Confidence of annual 75th %ile TON exceeding 1 mg/l</td>
<td>Low</td>
</tr>
<tr>
<td>Confidence of annual 75th %ile TON exceeding 2 mg/l</td>
<td>Low</td>
</tr>
<tr>
<td>Date range of TON samples</td>
<td>2010 - 2014</td>
</tr>
</tbody>
</table>

### TON monitoring data

![TON Monitoring Data Graph](image)

- **NVZ Name:** Betley Mere
- **NVZ ID:** EL128
Total nitrogen (TN) data

<table>
<thead>
<tr>
<th>Mean annual TN (mg/l)</th>
<th>2.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of TN samples</td>
<td>18</td>
</tr>
<tr>
<td>Confidence of annual mean TN exceeding 1 mg/l</td>
<td>High</td>
</tr>
<tr>
<td>Confidence of annual mean TN exceeding 2 mg/l</td>
<td>High</td>
</tr>
<tr>
<td>Date range of TN samples</td>
<td>2010 - 2014</td>
</tr>
</tbody>
</table>

TN monitoring data

Does any other (e.g. EA non-WFD, or third party) monitoring data for the lake provide improved evidence of significantly elevated nutrient nitrogen?

--- Only routine WFD monitoring undertaken at Betley Mere by the EA. Field dets MR added to this site from November 2015 under LOQWQ driver. Third party data (limited spot sample) available for the surface water inputs to Betley Mere (catchment walkover report.) 10 sites sampled in Jan 15 for the catchment walkover conducted by AECOM for the Meres and Mosses Partnership. No concerns regarding DO results (all sites in range 8-10mg/l). Total N above 2mg/l at all 10 5 sites (range min 2.3mg/l to max 10.6mg/l). Ortho P above 0.12 mg/l at 9 of the 11 sites (max 0.51mg/l). Ref : Betley Mere SSSI – Catchment Walkover Survey AECOM Report for: The Meres and Mosses Partnership (April 2015). Link N:\Water\GMMC WFD\Weaver Gowy\3rd party data
## Total phosphorus (TP) data

<table>
<thead>
<tr>
<th>Annual geometric mean TP (ug/l)</th>
<th>432</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFD face value TP class</td>
<td>Bad</td>
</tr>
<tr>
<td>Confidence of moderate or worse TP status</td>
<td>100%</td>
</tr>
<tr>
<td>Date range of TP samples</td>
<td>2010 - 2014</td>
</tr>
</tbody>
</table>

### TP monitoring data

![TP monitoring data graph]

--- Only routine WFD monitoring undertaken at Betley Mere by the EA. No field readings (DO or pH) have been taken therefore no assessment of any eutrophic effect can be made on these parameters. Third party data (limited spot sample) available for the surface water inputs to Betley Mere (catchment walkover report.).
Nutrient sources

Nitrogen loading estimates based on catchment map area

<table>
<thead>
<tr>
<th>Source</th>
<th>Leached N (kgN/yr)</th>
<th>Conc. (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From all agricultural sources</td>
<td>23926</td>
<td>12.8</td>
</tr>
<tr>
<td>From agricultural sources minus atmospheric deposition</td>
<td>22617</td>
<td>No data</td>
</tr>
<tr>
<td>From urban sources</td>
<td>747</td>
<td>0.6</td>
</tr>
<tr>
<td>From all sources</td>
<td>25983</td>
<td>20.2</td>
</tr>
<tr>
<td>From all sources (minus atmospheric deposition)</td>
<td>24674</td>
<td>19.2</td>
</tr>
</tbody>
</table>

Local assessment 2015

Significance of loading from agricultural sources to the catchment of the lake

Principal source --- From Diffuse Water Pollution Plan and 'AECOM SSSI Catchment Walkover Study' of the mere - This document states "The largest single annual sources of phosphorous were agriculture (combined 51%) and septic tanks (25%), although potential releases of phosphorus from lake bed sediments and backflow of treated effluent from the WwTW via the Mere Gutter were not included in the study. The principle source of nitrogen was also agriculture (74%), with 14% from septic tanks and 11% from groundwater, respectively. The results should be considered in the context of the limitations of the study."

Significance of loading from human habitation to the catchment of the lake

Minor source --- From Diffuse Water Pollution Plan and 'AECOM SSSI Catchment Walkover Study' of the mere - comments as per Q3.4. After relocation of the outfall from Betley Sewage Treatment Works, out of the mere, the ongoing inputs of phosphorous from human sources have been reduced. However there is still likely to be some ongoing impacts from phosphorous deposited in the sediment from when the discharge was occurring.

Significance of any other sources of nutrient loading to the lake or its catchment

--- Sediment for phosphorous as described in Q3.5

NVZ Name: Betley Mere
NVZ ID: EL128
### Chlorophyll data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual mean Chlorophyll (ug/l)</td>
<td>42</td>
</tr>
<tr>
<td>total number of Chlorophyll samples</td>
<td>18</td>
</tr>
<tr>
<td>WFD face value Chlorophyll class</td>
<td>Poor</td>
</tr>
<tr>
<td>Confidence of moderate or worse status</td>
<td>100%</td>
</tr>
<tr>
<td>Chlorophyll Good/Moderate boundary value</td>
<td>20</td>
</tr>
<tr>
<td>Date range of Chlorophyll samples</td>
<td>2010-2014</td>
</tr>
</tbody>
</table>

#### Chlorophyll monitoring data

![Chlorophyll monitoring data chart](chart.png)

- **Date range of Chlorophyll samples**: 2010-2014
- **Sample date**: Jul-10, Oct-10, Jan-11, Apr-11, Jul-11, Oct-11, Jan-12, Apr-12, Jul-12, Oct-12, Jan-13, Apr-13, Jul-13, Oct-13, Jan-14, Apr-14, Jul-14, Oct-14

**NVZ Name:** Betley Mere  
**NVZ ID:** EL128
### Other responses

<table>
<thead>
<tr>
<th>Phytoplankton (Pluto EQR)</th>
<th>Macrophytes (EQR)</th>
<th>Diatoms (EQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQR</td>
<td>0.14</td>
<td>No data</td>
</tr>
<tr>
<td>Total number of samples/surveys</td>
<td>12</td>
<td>No data</td>
</tr>
<tr>
<td>WFD face value class</td>
<td>Poor</td>
<td>No data</td>
</tr>
<tr>
<td>Confidence of moderate or worse status</td>
<td>100%</td>
<td>No data</td>
</tr>
<tr>
<td>Date range of samples</td>
<td>2011 - 2013</td>
<td>-</td>
</tr>
<tr>
<td>Number of years when algal blooms were observed based on reactive monitoring 2010-2015:</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

### Change as Square Chord Distance

| Change in Diatom community | No data |

### Evidence that designated aquatic interest features associated with the lake show evidence of eutrophic disturbance? (local judgement)

Affected- The main water body unit of the SSSI is in an unfavourable condition and the mere has gradually been declining in conservation value in terms of the diversity and cover of aquatic macrophytes. Phosphorous has been identified as a key pollutant of Betley Mere. Although a significant amount of the loading may be released seasonally from sediments already deposited in the lake, additional sources likely come from the wider catchment. The detrimental ecological effect of high phosphorous concentrations includes algal and macrophyte growth and die back affecting dissolved oxygen levels and impacting on species composition. Persistent phosphorous in the Mere means that nitrogen loading is also a potential issue, despite phosphorus typically being the limiting factor in freshwater environments. Like phosphorus, nitrates can contribute to the enrichment of water bodies leading to eutrophic conditions including poor water quality, the excessive growth of macrophytes and low biodiversity - AECOM 'Betley Mere SSSI - Catchment Walkover Survey' - 2015

### Strength of evidence (local judgement)

Strong evidence ---

### Other responses

**NVZ Name:** Betley Mere  
**NVZ ID:** EL128
**Review of evidence and recommendations**

**Comments and decisions**

**WFD Weight of evidence for eutrophication:**

<table>
<thead>
<tr>
<th>Certainty of eutrophication problem based on core WFD tools:</th>
<th>Very certain eutrophication problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certainty of eutrophication problem based on overall weight of evidence:</td>
<td>Very certain eutrophication problem</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WFD overall ecological status :</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence in WFD status :</td>
<td>Uncertain</td>
</tr>
</tbody>
</table>

**Current assessment of weight of evidence supporting designation in 2017**

**First national panel**

**Recommended action :** Needs further investigation

**Comments from first panel:**

N is significantly elevated (>2mg/l) and ecological evidence indicates eutrophic impact. Appears a strong candidate for designation

**Second national panel**

**Comments from second national panel :**

Evidence of summer N limitation. CEH review imminent but possibly not in time for the designation process. Natural England macrophyte survey 2015 provides more recent evidence (NE to provide). Panel support designation.

**Recommendation:** Designate

**Local summary and recommendation:**

There is good evidence for eutrophication from the unfavourable condition of the SSSI and chlorophyll and phytoplankton WFD data. There is high confidence of elevated nutrient levels supporting this, both phosphorous and to a lesser extent nitrogen. The 2015 source apportionment assessment estimated 74% of the nitrogen to come from agricultural sources. The effects of the sewage treatment works that has now been relocated is apparent in phosphorous levels to date and will remain apparent in sediment levels.

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**NVZ Name:** Betley Mere  
**NVZ ID:** EL128
Lake Description:
Betley Mere like other meres is thought to have developed from a natural depression in the glacial drift left by the ice sheets in the last ice age. It is a small lake at 8.8 Ha and very shallow with a mean depth of around 0.7m.

Why the lake should be designated as a Polluted Water (eutrophic):
The proposed eutrophic NVZ for Betley Mere is within an existing surface water NVZ. Agriculture contributes significantly to the nitrogen load in Betley Mere. Nitrogen concentrations are above the 1-2 mg/l threshold range.

Nitrogen:
The 75th percentile TON is 2.5 mg/l and annual mean TN is 2.6 mg/l both above the 2mg/l threshold. There is evidence of N limitation occurring with significant reductions in TON concentrations in the summer months, suggesting that reduction in nitrogen inputs would lead to further limitation in productivity in the lake.

Phosphorus:
The WFD total phosphorus classification is Bad status.

Ecological response:
WFD Chlorophyll status is Poor, as is the overall phytoplankton status, indicating a eutrophic impact on the ecology.

Supplementary evidence:
Meres and Mosses Partnership data also records high nitrogen levels, their results range between 2.3 and 10.6 mg/l. Their plant survey found few macrophytes, all nutrient tolerant species and they commented that it appeared to be a decline from previous surveys.
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