

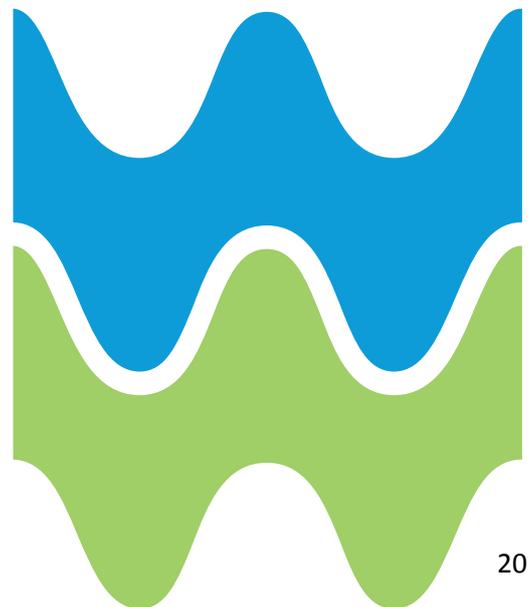
Draft

Drought Plan 2020:

Annex 1b – Clwyd

Coastal WRZ

March 2019



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# 1. Clwyd Coastal – WRZ Reference no. 8012

## 1.1. Clwyd Coastal Water Resources Overview

The Clwyd Coastal Water Resource Zone covers the coastal region from Prestatyn to Colwyn Bay and then further inland to St. Asaph (see Figure 1).

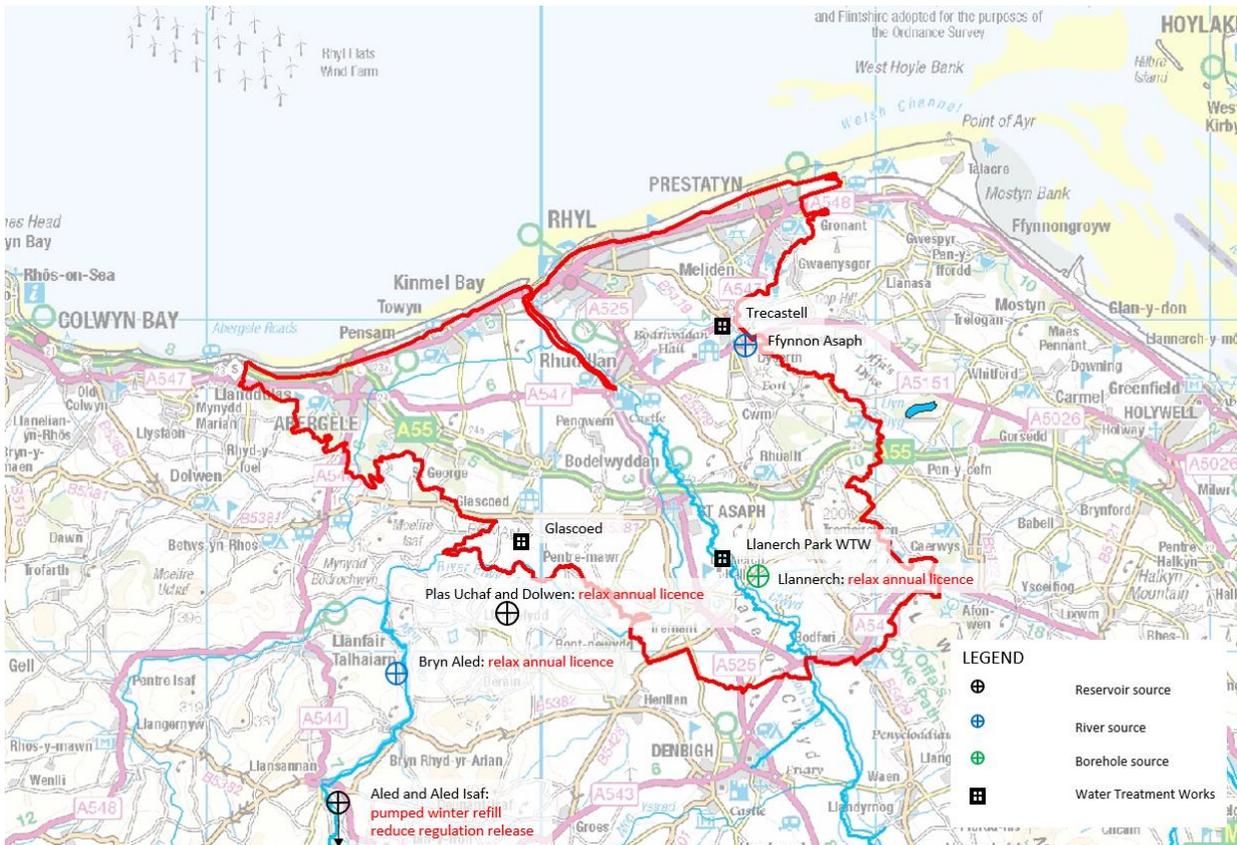


Figure 1 - Map of the Clwyd Coastal WRZ

The water resources within the zone consist of four impounding reservoirs (Llyn Aled, Aled Isaf, Plas Uchaf and Dolwen), a regulated river intake at Bryn Aled, a groundwater abstraction (Llannerch Park) and a spring abstraction (Ffynnon Asaph). A list of our raw water sources for the zone is presented in Table 1.

Site Name	Licence No.	Source Type	Status
Llyn Aled	N/A	River Regulating Reservoir	Operational
Llyn Aled Isaf	N/A	River Regulating Reservoir	Operational
Plas Uchaf	24/66/6/0007	Impounding Reservoir	Operational
Dolwen	24/66/6/0007	Impounding Reservoir	Operational
Llannerch Park	24/66/3/0048	Groundwater	Operational

Ffynnon Asaph spring	24/66/7/0034	Spring Source	Operational
Bryn Aled	24/66/5/0007	Regulated River Intake	Operational
Aled (Llyn) catchwaters A1 and A2	24/66/5/0006	Transfer	Operational

*Table 1 - Licensed sources in the Clwyd Coastal WRZ*

The zone is supplied by three water treatment works (WTW); Glascoed, Llannerch and Trecastell. Treated water from Llannerch is pumped up to Glascoed where it is blended with Glascoed water in the final water tank before it goes into supply. Glascoed is the largest of all the works and can supply the whole zone if necessary.

The Glascoed WTW receives its water from the Aled system. We do not abstract directly from Llyn Aled and Aled Isaf but release the water from these reservoirs into the Afon Aled and abstract the water further downstream at our Bryn Aled intake. The water then pumped from here up into Plas Uchaf reservoir where it is stored before being re-abstracted and treated at Glascoed WTW. Dolwen reservoir releases its water downstream into Plas Uchaf thus augmenting the volumes available for treatment. The amount of water we are required to release into the Afon Aled is prescribed under the Aled Section 20 Operating Agreement between ourselves and Natural Resources Wales (NRW). Releases are also made for environmental and fisheries benefit as well as water supply.

Llannerch works is supplied by 3 boreholes which abstract from the sandstone aquifer in the Vale of Clwyd. As well as abstracting water from the sandstone, the boreholes are known to draw water through the drift deposits and reduce flows in the nearby Afon Clwyd. To mitigate this, when flows in the river are naturally low, we release water from a set of artesian boreholes (Llanynys, Glanywern, Ruthin, Plas yr Esgob, Llwyn Isaf and Efail Newydd) further up the Vale to augment the flow. This is known as the Clwyd augmentation scheme and is also covered under a S20 Operating Agreement between ourselves and NRW.

Trecastell works is supplied solely from a spring source at Ffynnon Asaph; however, during heavy rainfall the spring can be affected by turbidity and the works is unable to treat the water. During such times the Prestatyn area is supplied from Glascoed works.

There are no exports or imports of water in the Clwyd Coastal zone.

## 1.2.Drought Triggers

The drought status of the zone is assessed by the reservoir storage position at any time in relation to the Drought Action Zones (DAZs), defined for the combined storage of Aled Isaf and Llyn Aled, as shown in Figure 2. The use of the DAZs are described in more detail in Section 2 of the main report.

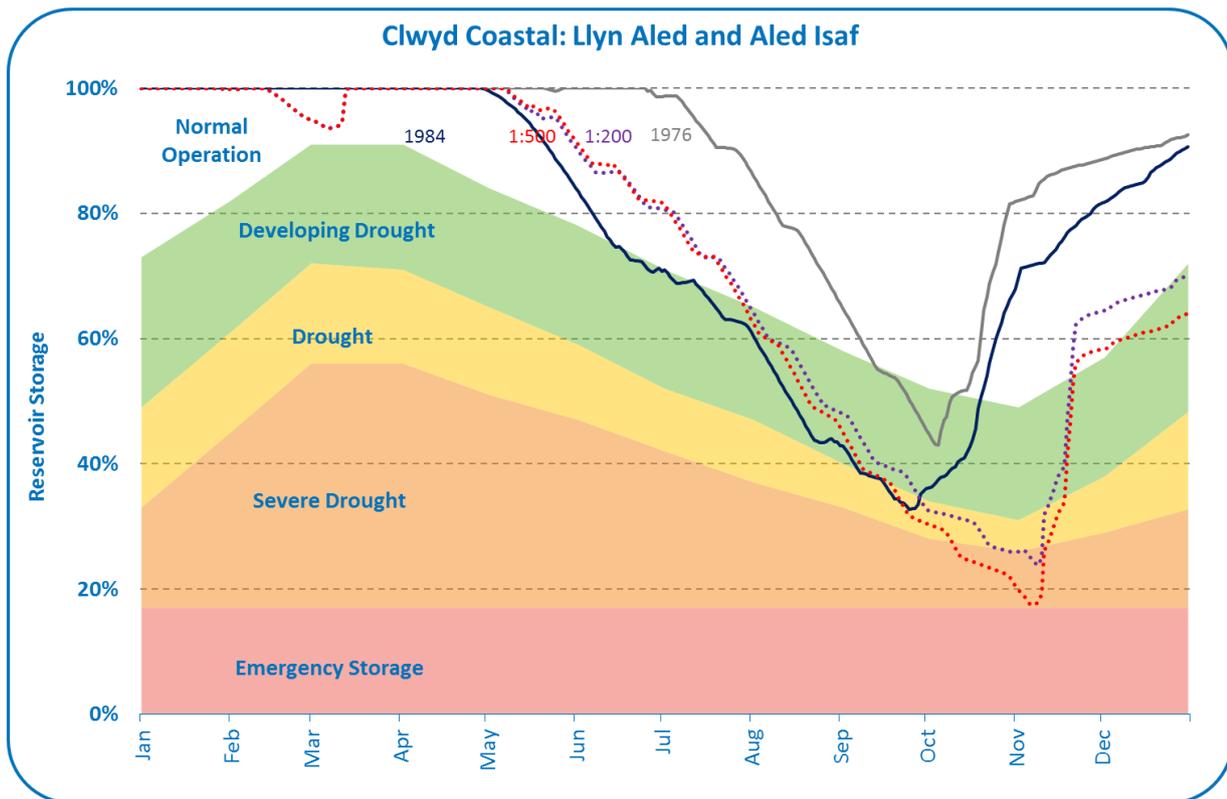


Figure 2 - Llyn Aled and Aled Isaf Drought Action Zones showing the results of scenario testing

### 1.3. Assessment of Drought Risk

Using a stochastically generated timeseries, we've looked at the performance of our reservoirs against the most severe events in our historic record. Figure 2 shows a sample of results from the drought library scenario testing together with output from our baseline scenario testing. The plots show that the zone is resilient to historic events such as 1976 and 1984, but there is a slight risk that we may need a hosepipe ban to help preserve resource. The testing also shows that even under more extreme events such as a 1:500 year return period drought (i.e. a drought that has a 0.2% chance of occurring in any year) that we would not need to impose wide spread pressure management and local water rationing on our customers.

Overall, our scenario testing tells us that the risk of needing to implement extreme supply side measures (i.e. widespread pressure management or water rationing) is low but that during these severe drought events, we need to ensure careful management of our water resources as reservoir storages will fall to levels we have not experienced before. Based on this information we have therefore chosen to retain four drought permit options to provide additional support, should these ever be required. Section 1.5 provides details of these.

### 1.4. Drought Management of the WRZ

As the identified drought risk in the zone is low then our management philosophy is to ensure we operate our water resources in line with our control curves and take all necessary actions in good time, in order to maintain this high level of drought resilience.

The following sections describe the operation of the zone as we move into a drought period and the actions that we will take to ensure that we minimise the impact on our customers. In the event of extreme drought, options to increase the quantity of water resource available for public water supply may be required – these are also outlined, with supporting summary information on the requirements of those options.

#### 1.4.1. Normal Operating Zone

During normal weather conditions we optimise our sources to minimise the cost of operations. In the Clwyd Coastal zone this means that we make maximum use of Glascoed treatment works. However, when the natural flows in the River Aled are low we have to commence regulation releases from Aled Isaf to support our abstraction at Bryn Aled. Therefore, to conserve stocks in the Aled reservoirs and ensure we would have enough water if the summer was unusually dry, we maximise the use of Trecastell and Llannerch treatment works during the spring and summer.

#### 1.4.2. Developing Drought Action Zone

As reservoir storages move into the developing drought action zone, we are more likely to have to carry out operations which are not usually undertaken and as a result increase the risk of impacting our customers. To authorise these activities, the 'Gold' command centre may convene.

Once in the developing drought action zone we will have already made significant changes to our water supply network in order to maximise the use of the Trecastell and Llannerch treatment works. This reduces Glascoed treatment works to its minimum operating levels and accordingly lowers the demand on Aled Isaf, Llyn Aled, Plas Uchaf and Dolwen reservoirs. We also have the option of making local network changes to transfer small volumes of treated water from the neighbouring Dyffryn Conwy and Alwen Dee water resource zones to help reduce the demand at Glascoed WTW. These network changes are not routinely undertaken and so would require approval from our Gold centre. To supplement these changes we will increase our leakage efforts to minimise losses in the network.

The Aled and Clwyd Consultative Groups (which is made up of members from NRW and Welsh Water) will also meet to review the water resource position and to discuss any actions that are needed.

#### 1.4.3. Drought Action Zone

Once all changes to our water supply systems have been made, the operation of the zone will be fully optimised to balance the available water resource across the zone. In the event that dry weather continues, and our forecasts indicate that storage may continue to decline, we will look to implement temporary use bans (e.g. hosepipe bans) and submit applications to request our drought permits. These permissions from NRW would enable us to increase our licensed abstraction, pump water back into Llyn Aled and/ or reduce our regulation releases into the Afon Aled. To support these requests, we will commence environmental monitoring in line with our Environmental Assessment Reports (Appendix 9 to 12) and submit our applications for the options identified in Section 1.5.

#### 1.4.4. Severe Drought Action Zone

As reservoir storage enters the Severe Drought Action zone we will consider implementing non-essential use bans and, subject to receiving the necessary permissions from NRW, we will look to implement one or more of our four drought permit schemes. As set out in Section 1.5, the options available to us are: 1) relaxation of the Bryn Aled and Plas Uchaf and Dolwen annual licence volumes, 2) relaxation of the Llannerch annual licence volume, 3) pump (winter) refill of Llyn Aled from Aled Isaf, and 4) reduce the regulation release from Aled Isaf.

## 1.5. Supply-side drought management action

The following tables (Table 2, Table 3, Table 4 and Table 5) provide the information required by Appendix G of NRW's Water Company Drought Plan Technical Guideline (Dec 2017). The tables summarise the key information from within the associated Environment Assessment Reports (EARs) including any potential environmental impacts, risks to the scheme implementation and any necessary mitigation that may be required.

Action Implementation Assessment	<b>Name:</b>	<b>Reduction of the regulation release from Aled Isaf and modification of the Hands Off Flow value at Bryn Aled</b>
	<b>Trigger(s)</b>	Combined storage of Aled Isaf and Llyn Aled crosses into Severe Drought Action Zone.
	<b>Deployable Output or yield of the action</b>	1 Ml/d
	<b>Location</b>	Aled Isaf Reservoir and the Afon Aled
	<b>Implementation timetable</b>	<p><b>Preparation time:</b> We assume a decision from NRW within 14 days of submitting the Drought Permit application. The practical implementation of the option could be effected immediately.</p> <p><b>Time of year effective:</b> The option is most likely to be implemented during September to January.</p> <p><b>Duration:</b> Drought permits are valid for up to six months, but the permit would be surrendered earlier than this if the water situation in Clwyd Coastal WRZ had improved.</p>
	<b>Risks associated with action</b>	The application, as applied for, is not approved. Reduction in regulation releases have potential environmental impacts. These will be assessed through the EAR submitted with the application.
	<b>Other considerations</b>	N/A
Environmental Assessment: alone & in-combination	<b>Risk to the Environment</b>	Reduced flow in the Afon Aled.
	<b>Summary of likely environmental impacts</b>	<p>The EAR has concluded that there is potential for moderate hydrological impact on river flows and medium risk to the physical environment of the river, including water quality.</p> <p>This could lead to moderate environmental impact on aquatic ecology, due to potential moderate impacts on fish and minor impacts on macroinvertebrates, macrophytes and phytobenthos.</p>
	<b>Baseline information used</b>	<p><b>Hydrological data:</b></p> <ul style="list-style-type: none"> <li>• Daily Llyn Aled Reservoir water level data</li> <li>• Daily Aled Isaf Reservoir water level data</li> <li>• Daily controlled outflow data from Aled Isaf Reservoir (compensation releases, regulation releases, freshet releases and flood mitigation releases combined)</li> <li>• Daily abstraction data from Bryn Aled intake</li> <li>• Bryn Aled flow gauge; daily river flow data</li> <li>• NRW Pont Gwyddel flow gauge data</li> </ul> <p><b>Ecological data:</b></p> <ul style="list-style-type: none"> <li>• NRW, APEM and Ricardo macrophyte and macroinvertebrate sampling data from the Afon Aled.</li> <li>• NRW and APEM fish survey data from the Afon Aled</li> <li>• Ricardo phytobenthos monitoring data from the Afon Aled</li> </ul>

	<b>Summary of additional monitoring requirements</b>	<ul style="list-style-type: none"> <li>• Spot flow gauging surveys</li> <li>• Biochemical water sampling</li> <li>• Fish surveys (including salmon, brown trout, lamprey and eel)</li> </ul>
	<b>Mitigation &amp; Compensation measures</b>	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> <li>• Temporary reduction or cessation of the terms of the Drought Order/Permit</li> <li>• Fish distress monitoring with triggers and response plan</li> <li>• Protection of 'spate flows'</li> <li>• Reduction of fish predation</li> <li>• Physical in-river works</li> <li>• Provision of alternative compensation flows</li> <li>• Provision of alternative water supplies if other water users are at risk of derogation.</li> </ul> <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	<b>Impact on other activities</b>	A small reduction in flows on the Afon Aled is expected to have negligible impact on the landscape, visual amenity and recreational activities of the Afon Aled.
	<b>Any permissions or approvals required and constraints that apply</b>	N/A

*Table 2 - Option 8012-2 Reduction of the regulation release from Aled Isaf and modification of the Hands Off Flow value at Bryn Aled*

Action Implementation Assessment	<b>Name:</b>	<b>Relaxation of the annual licences on Afon Aled and the Plas Uchaf and Dolwen Reservoirs</b>
	<b>Trigger(s)</b>	Combined storage of Aled Isaf and Llyn Aled crosses into Severe Drought Action Zone.
	<b>Deployable Output or yield of the action</b>	5 MI/d
	<b>Location</b>	The Afon Aled catchments and the Afon Aled.
	<b>Implementation timetable</b>	<p><b>Preparation time:</b> We assume a decision from NRW within 14 days of submitting the Drought Permit application. The practical implementation of the option could be effected immediately.</p> <p><b>Time of year effective:</b> The option is most likely to be implemented during November to March.</p> <p><b>Duration:</b> Drought permits are valid for up to six months, but the permit would be surrendered earlier than this if the water situation in Clwyd Coastal WRZ had improved.</p>
	<b>Risks associated with action</b>	The application, as applied for, is not approved.
<b>Other considerations</b>	N/A	
Environmental Assessment: alone & in-combination	<b>Risk to the Environment</b>	Increased abstraction on the Afon Aled could impact flows, water quality and ecology in the river.
	<b>Summary of likely environmental impacts</b>	<p>The assessment has concluded that there is a minor impact on flows in the Afon Aled as a result of implementing the drought permit. Impacts on the Dolwen Reservoir and Plas Uchaf Reservoir have been assessed as major, and impacts on Aled Isaf and Llyn Aled are assessed as minor. These hydrological impacts are assessed as leading to major impacts on the physical environment of the river, including water quality.</p> <p>The assessment has concluded that there are minor to moderate impacts on fish, macroinvertebrates, and macrophytes and negligible impacts on phytoplankton in the Plas Uchaf and Dolwen Reservoirs.</p>
	<b>Baseline information used</b>	<p><b>Hydrological data:</b></p> <ul style="list-style-type: none"> <li>• Daily Llyn Aled Reservoir water level data 2001-present;</li> <li>• Daily Aled Isaf Reservoir water level data 1989-present;</li> <li>• Daily Plas Uchaf Reservoir water level data 2000-present;</li> <li>• Daily Dolwen Reservoir water level data 2000-present;</li> <li>• Daily controlled outflow data from Aled Isaf Reservoir (compensation releases, regulation releases, freshet releases and flood mitigation releases combined) 1995-present;</li> <li>• Daily abstraction data from Bryn Aled intake 1989-2015;</li> <li>• Daily flows to Glascoed WTW 2005-2015;</li> <li>• Bryn Aled flow gauge; daily river flow data 1990-present.</li> </ul> <p>In addition, Natural Resources Wales (NRW) operate a flow gauge on the Afon Elwy, 300m downstream of the confluence with the Afon Aled:</p> <ul style="list-style-type: none"> <li>• Pont Gwyddel flow gauge; daily river flow data 1973-present.</li> </ul>
	<b>Summary of additional monitoring requirements</b>	<ul style="list-style-type: none"> <li>• Spot flow gauging on surveys</li> <li>• Biochemical water sampling</li> <li>• Macrophyte, macroinvertebrate and fish surveys at Llyn Aled, Plas Uchaf, Aled Isaf and Dolwen Reservoir</li> <li>• Fish surveys (including salmon, brown trout, and other species) on the Afon Aled downstream of the Bryn Aled intake.</li> </ul>

	<b>Mitigation &amp; Compensation measures</b>	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> <li>• Temporary reduction or cessation of the terms of the Drought Order/Permit</li> <li>• Fish distress monitoring with triggers and response plan</li> <li>• Protection of 'spate flows'</li> <li>• Reduction of fish predation</li> <li>• Physical in-river works</li> <li>• Provision of alternative compensation flows</li> <li>• Provision of alternative water supplies if other water users are at risk of derogation.</li> </ul> <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	<b>Impact on other activities</b>	The EAR has identified a negligible impact on the landscape, visual amenity and recreational value of the area.
	<b>Any permissions or approvals required and constraints that apply</b>	N/A

*Table 3 - Option 8012-4 Relaxation of the annual licences on Afon Aled and the Plas Uchaf and Dolwen Reservoirs*

Action Implementation Assessment	<b>Name:</b>	<b>Relaxation of the Llannerch boreholes annual licence</b>
	<b>Trigger(s)</b>	Combined storage of Aled Isaf and Llyn Aled crosses into Severe Drought Action Zone.
	<b>Deployable Output or yield of the action</b>	1 MI/d
	<b>Location</b>	Llannerch boreholes, with potential impacts on the Afon Padrig and Afon Clwyd.
	<b>Implementation timetable</b>	<p><b>Preparation time:</b> We assume a decision from NRW within 14 days of submitting the Drought Permit application. The practical implementation of the option could be effected immediately.</p> <p><b>Time of year effective:</b> The option is most likely to be implemented during November to March.</p> <p><b>Duration:</b> Drought permits are valid for up to six months. This drought permit affects the annual licence, so the duration of the permit will need to extend until the end of the licence year, which is 31<sup>st</sup> March.</p>
	<b>Risks associated with action</b>	The application, as applied for, is not approved.
	<b>Other considerations</b>	N/A
Environmental Assessment: alone & in-combination	<b>Risk to the Environment</b>	Increased abstraction from Llannerch boreholes has potential to impact flows in nearby rivers (Afon Padrig and Afon Clwyd), nearby groundwater dependant ecosystems and/or other groundwater users.
	<b>Summary of likely environmental impacts</b>	<p>The assessment has concluded that there is a major impact on flows in the Nant Padrig as a result of implementing the drought permit. These hydrological impacts are assessed as leading to minor impacts on the physical environment of the river, including water quality. Impacts on flow in the Afon Clwyd have been assessed as negligible.</p> <p>The assessment has concluded that there are moderate impacts on fish, minor impacts on macroinvertebrates and negligible impacts on macrophytes and phytobenthos in Nant Padrig.</p>
	<b>Baseline information used</b>	<p><b>Hydrological data:</b></p> <ul style="list-style-type: none"> <li>• Pont y Cambwll flow gauge and spot flow gaugings, Afon Clwyd upstream of Llannerch boreholes</li> <li>• Pont Dafydd flow gauge and spot flow gaugings, Afon Clwyd downstream of Llannerch boreholes</li> <li>• Bodfari flow gauge and spot flow gaugings, Afon Wheeler, tributary of Afon Clwyd 5km upstream of Llannerch boreholes</li> <li>• Abstraction borehole level data for Llannerch boreholes</li> <li>• Observation borehole data for boreholes around Llannerch boreholes</li> <li>• Daily abstraction returns for Llannerch boreholes</li> </ul> <p><b>Ecological data:</b></p> <ul style="list-style-type: none"> <li>• NRW macrophyte, macroinvertebrate, fish and phytobenthos survey data</li> </ul>
	<b>Summary of additional monitoring requirements</b>	<ul style="list-style-type: none"> <li>• Groundwater abstraction and level data monitoring</li> <li>• Biochemical water quality sampling</li> <li>• Macroinvertebrate surveys</li> <li>• Fish surveys (including salmon, brown trout, lamprey, bullhead, eel, shad)</li> </ul>

	<b>Mitigation &amp; Compensation measures</b>	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> <li>• Temporary reduction or cessation of the terms of the Drought Order/Permit</li> <li>• Fish distress monitoring with triggers and response plan</li> <li>• Protection of 'spate flows'</li> <li>• Reduction of fish predation</li> <li>• Physical in-river works</li> <li>• Provision of alternative compensation flows</li> <li>• Provision of alternative water supplies if other water users are at risk of derogation.</li> </ul> <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	<b>Impact on other activities</b>	The EAR has identified potential negligible impacts on landscape, recreation and archaeology.
	<b>Any permissions or approvals required and constraints that apply</b>	N/A

*Table 4 - Option 8012-5 Relaxation of the Llannerch boreholes annual licence*

<b>ction Implementation Assessment</b>	<b>Name:</b>	<b>Pumped (winter) refill from Aled Isaf to Llyn Aled</b>
	<b>Trigger(s)</b>	Combined storage of Aled Isaf and Llyn Aled crosses into Severe Drought Action Zone.
	<b>Deployable Output or yield of the action</b>	N/A
	<b>Location</b>	Aled Isaf and Aled Reservoirs and the Afon Aled
	<b>Implementation timetable</b>	<b>Preparation time:</b> We assume a decision from NRW within 14 days of submitting the Drought Permit application. The practical implementation of the option could be effected immediately. <b>Time of year effective:</b> The option is most likely to be implemented during November to February. <b>Duration:</b> Drought orders are valid for up to six months, but is most likely to be three months.
	<b>Risks associated with action</b>	The application, as applied for, is not approved.
	<b>Other considerations</b>	N/A
<b>Environmental Assessment: alone &amp; in-combination</b>	<b>Risk to the Environment</b>	Reduced flows on the Afon Aled due to less frequent winter spills in the winter from Aled Isaf.
	<b>Summary of likely environmental impacts</b>	The hydrological assessment has concluded that there is a moderate to minor impact on river flows as a result of implementing the drought permit. There are also low risks to the physical environment of the river, including water quality. The environmental assessment has concluded that there are moderate impacts on aquatic ecology, specifically: moderate impacts on spawning and juvenile salmon habitat; minor impacts on macroinvertebrates, negligible impacts on Coed Llys-Aled SSSI, Coed Nant Y Merddyn Uchaf SSSI, Mnydd Hiraethog SSSI, macrophytes and phytobenthos.
	<b>Baseline information used</b>	Continuous monitoring is undertaken by Welsh Water to monitor its operations in the Afon Aled catchment namely: <ul style="list-style-type: none"> <li>• Daily Llyn Aled Reservoir water level data 2001-present (in addition to some manual level readings for the period 1995-1996).</li> <li>• Daily Aled Isaf Reservoir water level data 1989-present.</li> <li>• Daily controlled outflow data from Aled Isaf Reservoir (compensation releases, regulation releases, freshet releases and flood mitigation releases combined) 1995-present.</li> <li>• Daily abstraction data from Bryn Aled intake 1989-present.</li> <li>• Bryn Aled flow gauge; daily river flow data 1990-present.</li> </ul> In addition, Natural Resources Wales (NRW) operate a high flow gauge for flood warning on the Afon Elwy, 300m downstream of the confluence with the Afon Aled: <ul style="list-style-type: none"> <li>• Pont Gwyddel flow gauge; daily river flow data 1973-present.</li> </ul> <b>Ecological data:</b> Afon Aled: <ul style="list-style-type: none"> <li>• NRW fish survey data.</li> <li>• APEM &amp; Ricardo macroinvertebrate sampling.</li> </ul>
	<b>Summary of additional monitoring requirements</b>	<ul style="list-style-type: none"> <li>• Spot flow gaugings</li> <li>• Biochemical water sampling</li> <li>• Fish surveys (including salmon, sea trout, eel)</li> </ul>

	<b>Mitigation &amp; Compensation measures</b>	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> <li>• Temporary reduction or cessation of the terms of the Drought Order/Permit</li> <li>• Fish distress monitoring with triggers and response plan</li> <li>• Protection of 'spate flows'</li> <li>• Reduction of fish predation</li> <li>• Physical in-river works</li> <li>• Provision of alternative compensation flows</li> <li>• Provision of alternative water supplies if other water users are at risk of derogation.</li> </ul> <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	<b>Impact on other activities</b>	<p>A reduction in flows on the River Aled has potential temporary and uncertain impact to visual amenity and recreation. Because flows would be naturally high at the time of the drought permit, it is uncertain how significant reduction in flows would be on the visual appeal of the rivers, and recreational activities in the area include angling, riding, cycling, walking and canoeing.</p> <p>Aled Isaf is located in the Conwy Uplands Cultural landscape area. It is uncertain how a reduction in water levels over winter would affect landscape and visual amenity in the area.</p>
	<b>Any permissions or approvals required and constraints that apply</b>	N/A

*Table 5 - Option 8012-6 Pumped (winter) refill from Aled Isaf to Llyn Aled*