The river basin management plan for the Solway Tweed river basin district

Chapter 2 Appendix C

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Appendix C: Methodology for setting water body objectives in England

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Selecting and appraising measures

Appraising the measures currently acting on, or available to, a water body is central to setting an appropriate objective to achieve good ecological status or potential. The process includes considering whether:

- it is technically feasible to implement measures to achieve a desired objective,
- doing so would be disproportionately expensive (by comparing the costs of the measures with the benefits and other impacts implementing the measure will deliver), and
- whether natural conditions affect the ability or the timing of the achievement of an objective.

The process in principle can be summarised in a number of steps, shown below and diagrammatically in figure 1:

Step one – Identify current or planned measures and assess how far these go to meeting default objectives.

Step two – If default objectives are not achieved after step 1, identify potential additional measures.

Step three - Identify cost-effective options for these additional measures.

Step four - Appraise cost-effective option(s) for additional measures to see whether they are currently technically feasible and proportionately costly (by comparing the costs of the measures with the benefits and other impacts implementing the measure will deliver) and identify how much further these take us to meeting default objectives.

Step five - If default objectives are not achieved after steps 2-4, identify and appraise additional local measures and evaluate how much further these take us to meeting default objectives.

Step six - Identify and report final water body objectives (default or alternative objectives) and any justifications for alternative objectives.

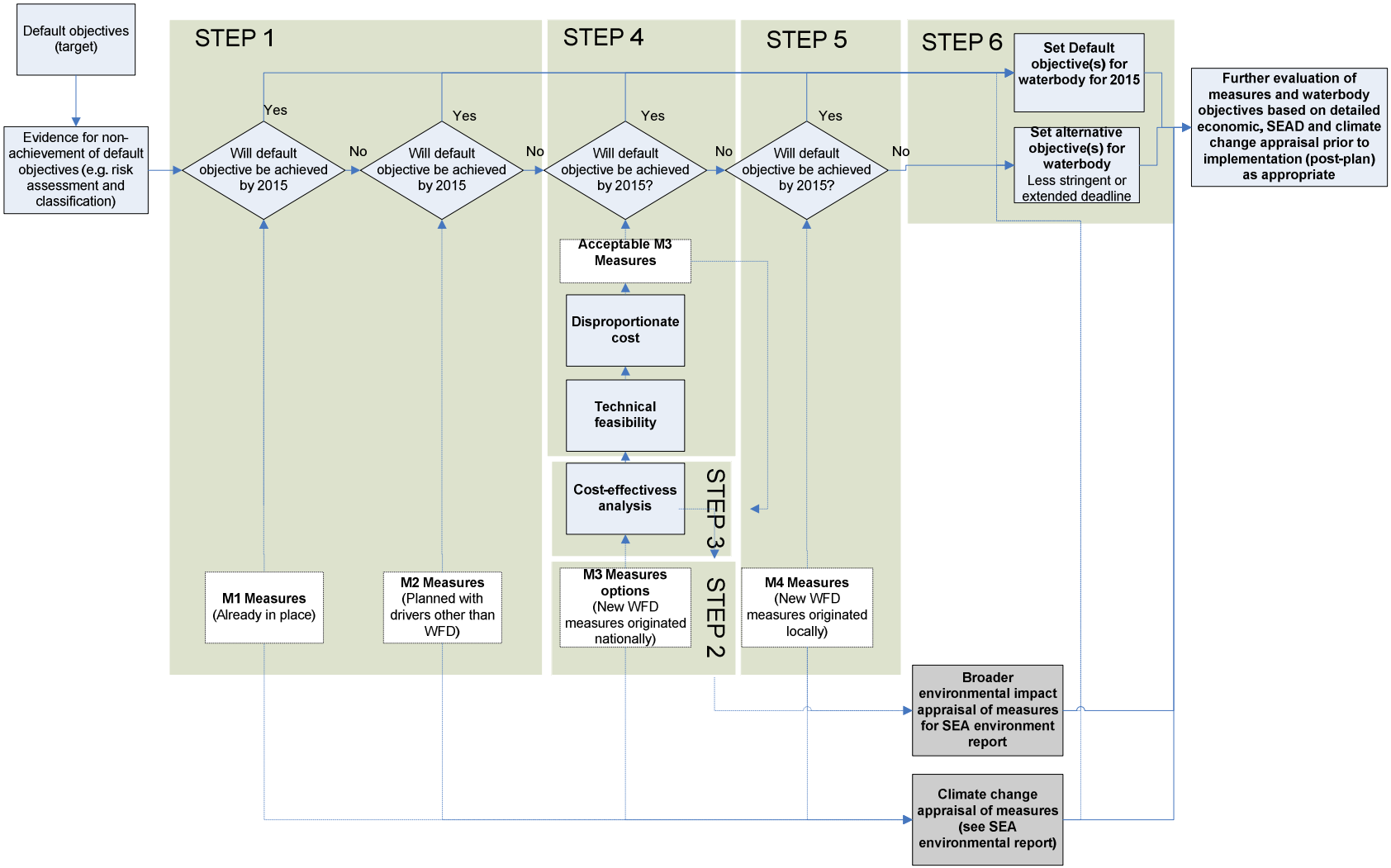


Figure 1: **Summary of measures appraisal and objectives setting process**

Identifying Objectives

The measures appraisal process enabled the Environment Agency to identify the expected outcomes for each of the elements that together define the status of a water body, based on implementing a challenging but realistic set of measures. These expected outcomes have been used to propose default or alternative objectives for each water body.

In carrying out these processes, the programme of measures was reviewed and:

- for each water body it was predicted (using modelling and/or expert judgement) the status that each non-biological element will achieve (and by when) when the measures are implemented;
- it was checked that the measures proposed for different pressures are compatible in terms of timing and benefits - they should not work against each other and ideally should complement each other;
- the status for the biological elements that we would expect to be achieved was predicted by a panel of Environment Agency officers with local, expert knowledge supported by decision rules and a variety of data sets;
- the predicted outcomes were translated to a set of overall objectives for each water body using the same 'one out all out rules' used in classification. Where any of the predicted outcomes for the elements of status are not 'good status by 2015' an alternative objective was set.

For water bodies adversely affected by multiple pressures (e.g. physical modifications to the bed and banks; over abstraction; etc), the timescale needed to tackle each impact was assessed separately. These assessments were then combined to identify the earliest date by which all the conditions needed for good status can be achieved (e.g. for surface waters, the right water quality; flows and levels; structure and condition of the bed, banks, shores; etc).

Improvements in some of the characteristics of these water bodies can be made, and are proportionate to make, earlier than others. This means that water bodies whose overall objective is good status by 2021 or 2027, may nevertheless be subject to significant improvements in the interim.

In identifying objectives, the best information currently available to the Environment Agency was used. The initial focus was on gathering information on water bodies that can be improved by 2015.

Detailed information on actions appraisal for individual pressures and justification of alternative objectives

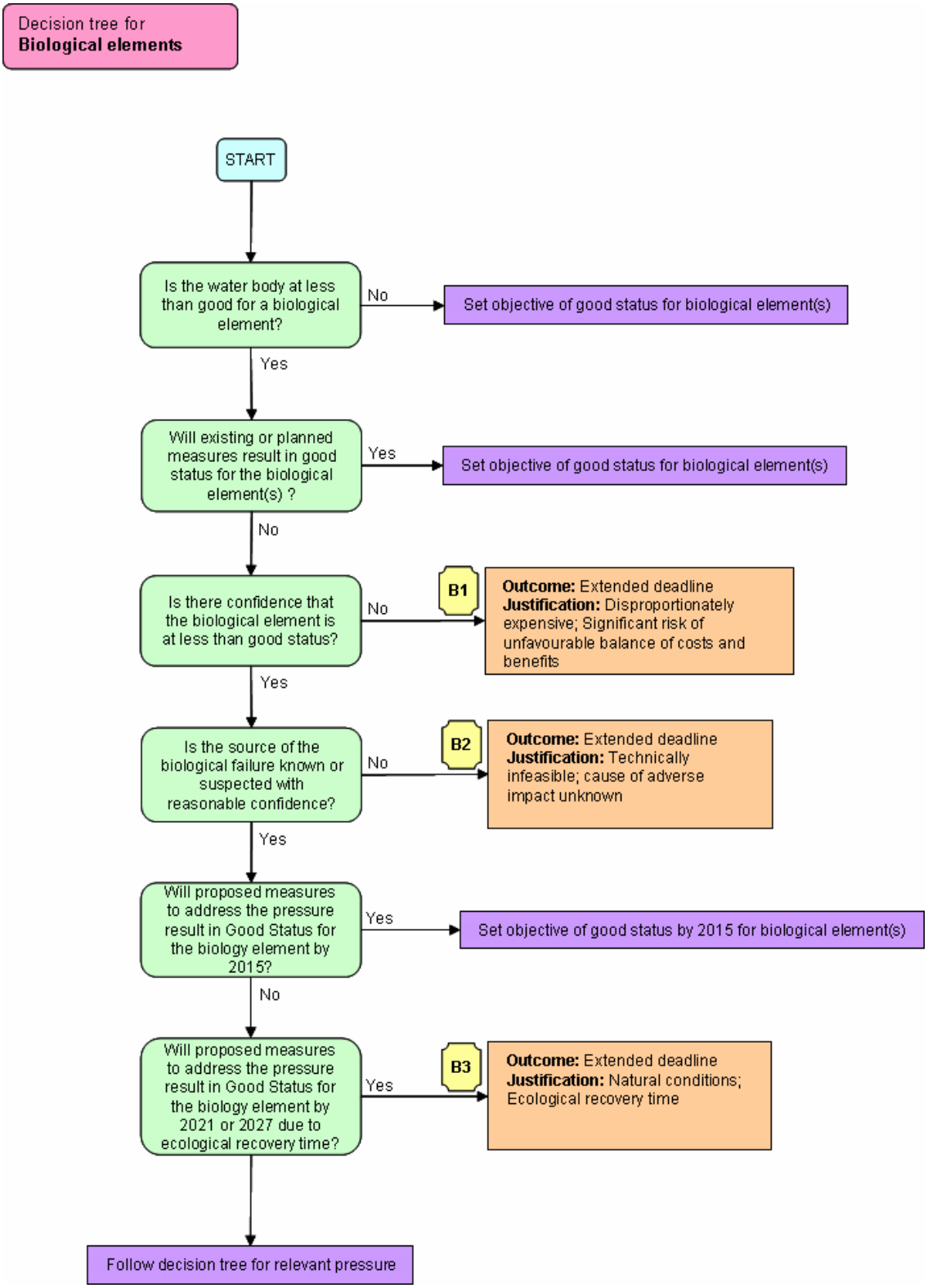
The following sections set out detailed information on actions appraisal for individual pressures and biological elements which are relevant to English water bodies in the Solway Tweed River Basin District. The sections include more information on the justification for setting alternative objectives.

Each of these sections includes one or more decision trees. These decision trees show the main steps taken in appraising the potential measures to address a pressure and set out which of those decisions can lead to the setting of an alternative objective.
Each branch of a tree leading to an alternative objective has a 'decision code'. These codes are unique to a particular decision tree (e.g. S1 is from Sediments tree, P1 from the Phosphorus tree).

For any branch on the decision tree, the information supporting the decision to set an alternative objective may vary. For example, if the source of the pressure varies then the other supporting information (such as possible future measures to address the pressure) may vary too. Therefore the decision code for a particular branch in the tree may have sub-divisions e.g. S1a, S1b.

The decision codes also appear in the water body data sheets which can be accessed through the SEPA interactive map <link>.

Decision codes B1a, B2a, B2j, B2p and B2r



Reference	B1a
Element predicted not to achieve good by 2015	Biological elements
Reason for failure	Unknown – uncertain there is a failure/impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive - significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

There is not high confidence that the biology elements have failed

In these cases the biological elements do not achieve the good status boundary values but with low confidence of failure. Without confidence in a biological failure we cannot reliably consider the pressures and measures. To do so would mean a significant risk of wasted investment on additional measures in already compliant water bodies. It is therefore disproportionately expensive to achieve good status by 2015.

An extended deadline for achieving good ecological status is therefore required. This will to allow time to undertake investigations to confirm any failure with certainty, identify the pressures causing the failure and appraise additional measures. Where possible additional measures will be implemented within the first cycle.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Additional monitoring or specifically tailored investigations to improve certainty that there is an impact on the biological elements. Supplementary data could also be used to build sufficient weight of evidence to show that biological populations are impacted.

Possible future measures

If the biological populations are impacted then possible future measures will depend on the significance and/or extent of the failure, the identification of the pressure(s) causing the failure and the source of the pressure(s).

Possible measures are described in the tables of supporting information for individual pressures.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Not possible to identify these at this stage

Reference	B2a
Element predicted not to achieve good by 2015	Biological elements
Reason for failure	Unknown – reasons for failure unknown
Alternative objective	Extended deadline
Reason for alternative objective	Technically infeasible - cause of adverse impact unknown

Justification for alternative objective

The pressure causing the failure is unknown

Although the biological element is known to be at less than good status, the pressure causing the impact is not known. It is therefore technically infeasible to identify and appraise appropriate measures, and achieve good status by 2015.

Where the failure of good status for a biological element is not also supported by a failure of a standard for a physio-chemical element or priority hazardous substance, it is often not easy to identify the pressure causing the biological failure. In the time available we have not been able to identify the specific pressure(s) causing the impact on biology.

An extended deadline for achieving good ecological status is therefore required. This will to allow time to undertake investigations to identify the pressure(s) causing the failure and appraise additional measures. Where possible additional measures will be implemented within the first cycle

Investigation type

Investigate cause of failure

Example of investigation

Additional monitoring or specifically tailored investigations to identify the pressure(s) causing the impact and the source(s) of the pressure(s). Supplementary data could also be used to build sufficient weight of evidence to identify the pressure and/or source or more detailed analysis of the biological data may help to indicate the likely pressure. For example, by more detailed analysis of the invertebrate data or looking at the diagnostic data associated with the fish classification outputs.

Possible future measures

Possible future measures will depend on the identification of the pressure(s) causing the failure and the source of the pressure(s). Possible measures are described in the tables of supporting information for individual pressures.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Not possible to identify these at this stage

Reference	B2j, B2p and B2r
Element predicted not to achieve good by 2015	Biological elements
Reason for failure	Various pressures and reasons: B2j = suspected hydrology (flows) B2p = suspected morphology B2r = suspected phosphate
Alternative objective	Extended deadline
Reason for alternative objective	Technically infeasible - cause of adverse impact unknown

Justification for alternative objective

The pressure causing the failure is not known with certainty

Although a pressure responsible for the impact on the biological element has been suggested, there is low confidence that the pressure has been correctly identified. For example, the pressure may also be an element of classification (such as ammonia) which is currently classified at good status. Further work is therefore needed to confirm that the correct pressure has been identified before work can begin to identify and appraise appropriate measures. It is therefore technically infeasible to achieve good status by 2015.

An extended deadline for achieving good ecological status is therefore required. This will to allow time to undertake investigations to confirm the pressure(s) causing the failure and appraise additional measures. Where possible additional measures will be implemented within the first cycle.

Investigation type

Investigate cause of failure

Example of investigation

Additional monitoring or specifically tailored investigations to identify the pressure(s) causing the impact and the source(s) of the pressure(s). Supplementary data could also be used to build sufficient weight of evidence to identify the pressure and/or source or more detailed analysis of the biological data may help to indicate the likely pressure.

Possible future measures

Possible future measures will depend on the identification of the pressure(s) causing the failure and the source of the pressure(s). Possible measures are described in the tables of supporting information for individual pressures.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Not possible to identify these at this stage

Reference	B3a
Element predicted not to achieve good by 2015	Biological elements
Reason for failure	Various pressures and sources
Alternative objective	Extended deadline
Reason for alternative objective	Natural conditions - ecological recovery time

Justification for alternative objective

The biology will not recover to good status until after 2015

All necessary measure have or will be put in place to mitigate the pressure causing the biological failure. However, there is expected to be a delay before the biology returns to good status. This may be due to the biological populations taking time to re-colonise or re-establish once the hydromorphological, chemical or physicochemical conditions have been restored to good or the time taken for the habitat conditions to stabilise after improvement works. For example, once a barrier to fish migration has been removed it will take time for fish to migrate into the now accessible area and re-establish populations and therefore good status is not expected to be achieved by 2015.

An extended deadline for achieving good ecological status is therefore required. This will to allow time for the biology to recover.

Investigation type
Monitoring of ecological recovery
Example of investigation
Monitoring of biological elements to confirm that populations recover to good status
Possible future measures
Not applicable at this stage
Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive
None

Reference	MS (Morphology Sensitive)
Element predicted not to achieve good by 2015	Biological elements
Reason for failure	Various pressures and sources
Alternative objective	Not applicable
Reason for alternative objective	Not required

Why a justification for alternative objective is not required

Biological element not included in classification

Some biological elements are agreed to be sensitive to morphological pressures. The specific elements vary depending on the water body type:

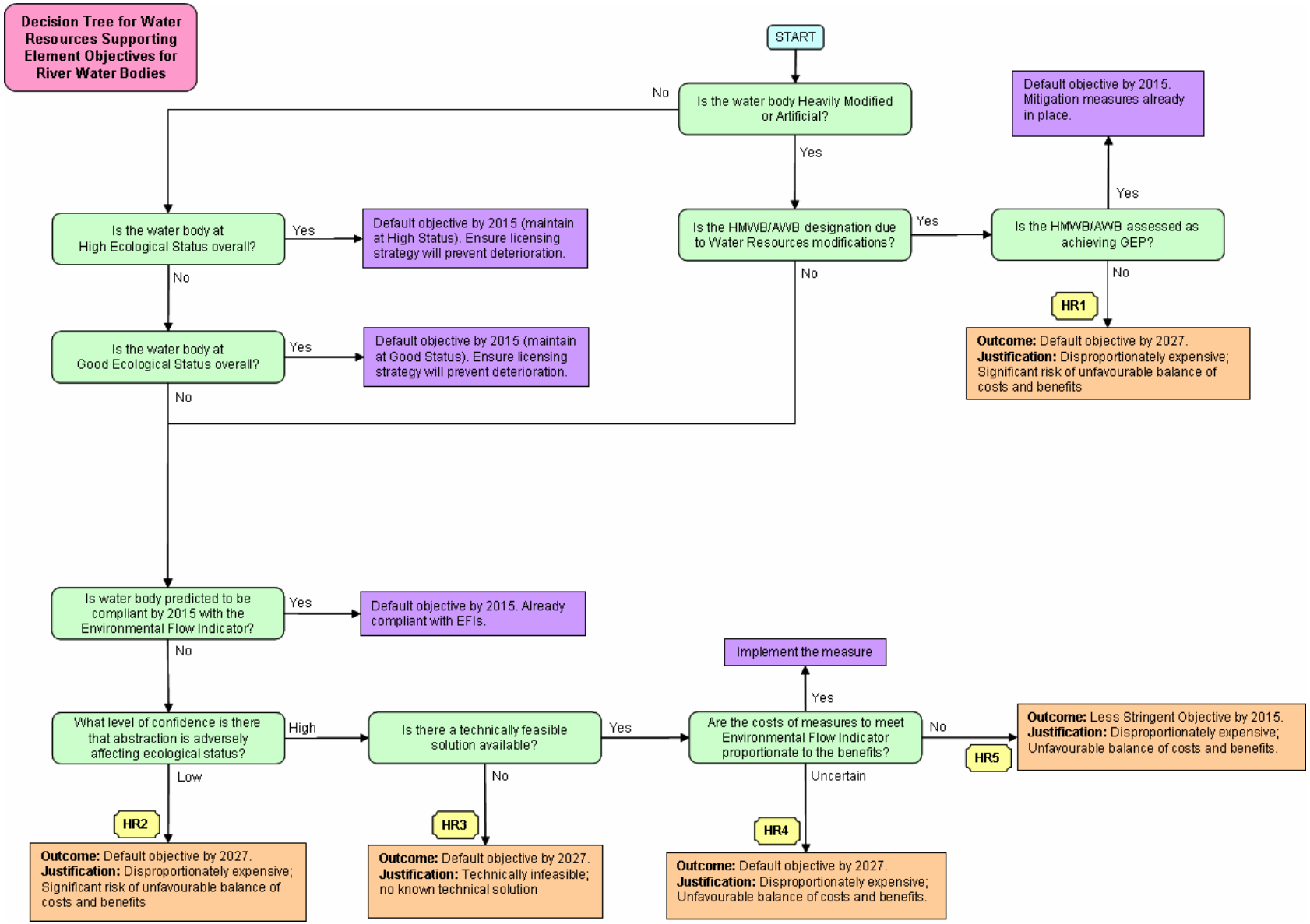
- rivers = fish, macroinvertebrates and macrophytes
- lakes = macrophytes
- estuaries/coasts = seagrass, fish and benthic invertebrates

As these elements are sensitive to morphological pressures, it is difficult to determine whether these biological elements in Artificial and Heavily Modified Water Bodies are at less than good status due to the effects of morphological changes alone or also the impacts from other pressures.

These elements are therefore not included in the classification or objective setting processes for Artificial and Heavily Modified Water Bodies. The status of a morphology-sensitive biological element can therefore not lead to an alternative objective being set in A/HMWBs.

Investigation type
Not applicable
Example of investigation
Not applicable
Possible future measures
If these morphology-sensitive biological elements are at less than good status in an Artificial or Heavily Modified water body, other drivers may well require action to be taken to improve their status. For example if the water body has a protected area designation.
Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive
Not applicable

Decision codes HR2a and HR4a



Reference	HR2a
Element predicted not to achieve good by 2015	Hydrology
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

Low confidence that abstraction is adversely affecting ecological status

It is disproportionately expensive to require changes to the current abstraction regime at this time because our risk assessment (Environmental Flow Indicator threshold compliance) shows that there is only low confidence that abstraction pressure is adversely affecting ecological status.

The flow regime is a supporting element in classification. Environmental Flow Indicators have been developed as a screening tool to indicate the level of flow below which Good Ecological Status may not be supported. Where we have low confidence that abstraction pressure is adversely affecting ecology, further studies are required to understand the relationship between flow and ecological status before we can attribute the failure in ecological status to abstraction pressures. Until this link is sufficiently established for a water body, there is a significant risk that there will be either no or low benefits from taking remedial action to improve flows.

In such cases these low expected benefits contrast to potential very high costs of remedial measures. Water is abstracted from the environment to provide drinking water supplies and for use by industry. Where abstractions need to be reduced to improve the flow regime in the environment, alternative abstraction sources need to be developed. Developing new abstractions is very expensive; costing from £1.5m to £7m to provide a single mega-litre of water each day.

The only practicable lower-cost actions to reduce the impact of abstraction are those that promote efficient and sustainable water use. In catchments subject to significant abstraction pressures, these are either already in place or will be put in place under this RBMP.

Investigation type

investigate to confirm failure and/or impacts

Example of investigation

Monitoring and modelling to assess the impacts of abstraction pressures on ecological status. This work will include investigation of the hydrological impacts of abstraction and review of the flow requirements to support Good Ecological Status.

Possible future measures

Possible future measures include reduction in abstraction licence quantities, restrictions on abstraction during particular months, and the imposition of conditions on licences, such as Hands-Off flow constraints. The costs and benefits of measures will however need to be considered, and other measures such as river restoration schemes may prove to be a more cost beneficial way of achieving ecological status improvements.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

It is likely that reduction or ending of abstractions to meet Environmental Flow Indicator thresholds in all water bodies will be disproportionately expensive, due to the potential impacts on public water supply and other water users.

The preliminary cost effectiveness analysis undertaken by Defra estimated the cost of achieving EFIs by 2027 as between £3,200 million and £20,000 million for England and £65 million to £980 million for Wales. In regions where demand for water is high relative to resources, it may not be feasible to locate alternative sources for drinking water without causing deterioration in other water bodies.

Reference	HR4a
Element predicted not to achieve good by 2015	Hydrology
Reason for failure	Confirmed - Abstraction
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: unfavourable balance of costs and benefits

Justification for alternative objective

Likely unfavourable balance of costs and benefits of achieving good ecological status

An extended deadline is required for all water bodies that are failing to achieve Good Ecological Status, do not meet Environmental Flow Indicator thresholds and where there is a high confidence that abstraction pressure is adversely affecting ecological status. In these water bodies, flows are unlikely to support Good Ecological Status and the costs and benefits of possible remedial measures must be considered

At this stage, direct measures to reduce abstraction sufficiently to support Good Ecological Status are considered likely to be disproportionately expensive. Costs to reduce or relocate abstractions are typically high, ranging from £1.5m to £7m per Ml/d of abstraction. This leads to considerable uncertainty in the costs of measures in the light of uncertainty in the scale of flow improvement required to support Good Ecological Status. On the benefits side there is also considerable uncertainty. Low flow is rarely the only cause of failure of ecological status and the benefits of improving flow will depend on whether actions to reduce other pressures are taken.

Further investigation is required to identify proportionately costly solutions.

Investigation type

investigate feasible measures

Example of investigation

Monitoring and modelling to assess the water body specific impacts of abstraction pressures on ecological status. Investigation will be focussed on assessing the costs and potential benefits of measures in order to identify proportionately costly solutions. Part of this will also involve hydroecological investigation to establish the conditions required to support good ecological status and the scale of measures required in order to achieve this.

Possible future measures

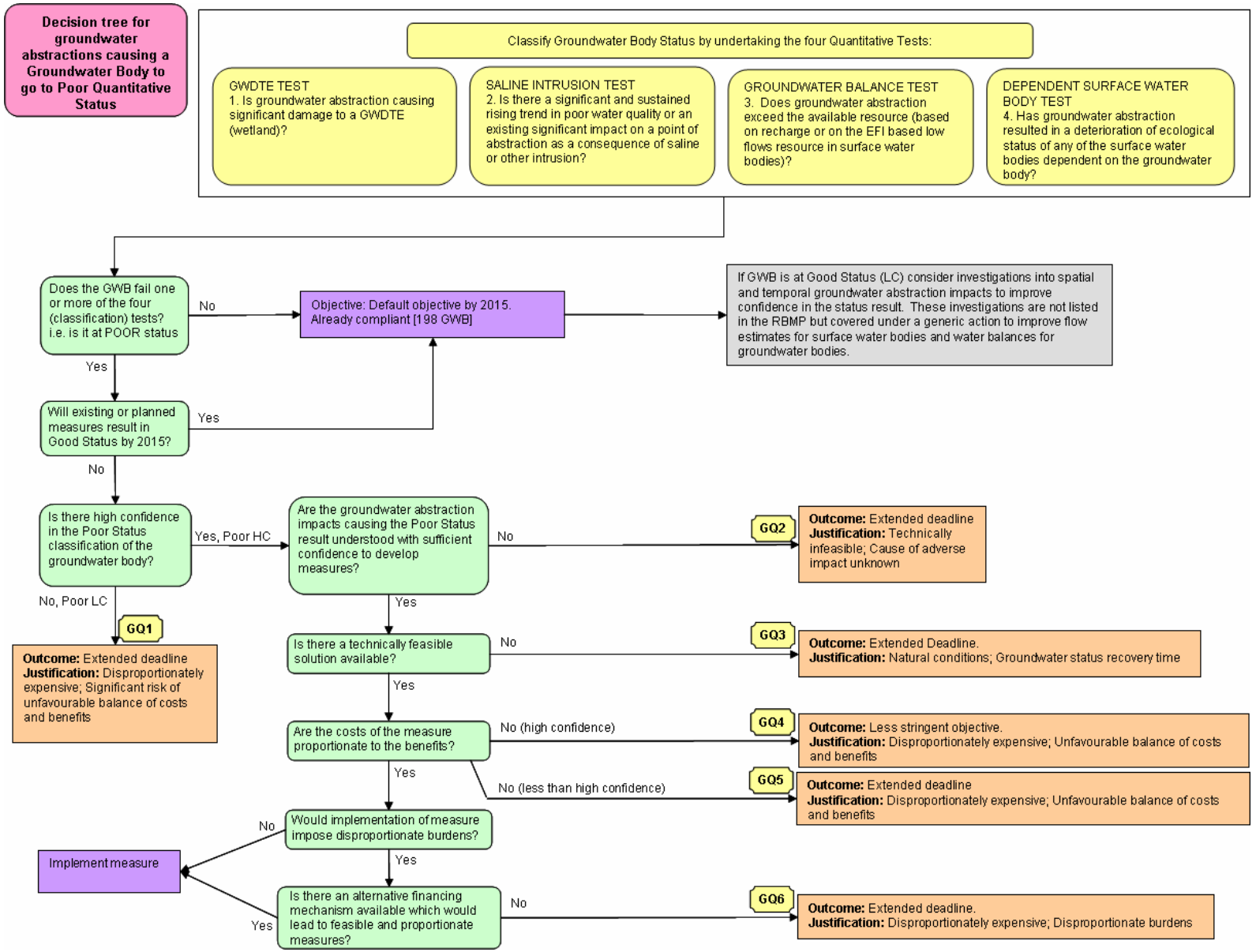
Possible future measures include reduction in abstraction licence quantities, restrictions on abstraction during particular months, and the imposition of conditions on licences, such as Hands-Off flow constraints. The costs and benefits will however need to be considered, and other measures such as river restoration schemes may prove to be a more cost beneficial way of achieving ecological status improvements.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

It is likely that reduction or ending of abstractions to meet Environmental Flow Indicator thresholds in all water bodies will be disproportionately expensive, due to the potential impacts on public water supply and other water users.

The preliminary cost effectiveness analysis identified that costs to reduce or relocate abstraction may be in the order of £1.5m - £7m per Ml/d of abstraction. The same analysis estimated the cost of achieving EFIs by 2027 as between £3,200 million and £20,000 million for England and £65 million to £980 million for Wales. In regions where demand for water is high relative to resources, it may not be feasible to locate alternative sources for drinking water without causing deterioration in other water bodies.

Decision codes GQ1b and GQ1c



Reference	GQ1b
Element predicted not to achieve good by 2015	Impact On Surface Water Ecological Status
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

Low confidence that there is a failure in this element of groundwater status: It is disproportionately expensive to require changes to the current abstraction regime at this time because there is only low confidence that there is a failure of the surface water ecological status as a result of groundwater abstraction pressure.

For many principal aquifer groundwater bodies (and a few secondary aquifers), high rates of groundwater abstraction are locally or more generally associated with predicted impacts on dependent surface water body flows which are estimated to fall below the Environmental Flow Indicators considered to support Good Ecological Status. However, the spatial and temporal distribution of these flow impacts and their severity are not yet understood with confidence and more work is thereafter required to evaluate the benefits on river ecology of any abstraction reduction.

Until these factors are understood sufficiently for a water body, there is a significant risk that there will be either no or low benefits from taking action to reduce groundwater abstractions.

In such cases these low expected benefits contrast to potential very high costs of remedial measures. Water is abstracted from the environment to provide drinking water supplies and for use by industry. Where groundwater abstractions need to be reduced to improve the flow regime in dependent rivers, alternative abstraction sources need to be developed. Developing new abstractions is very expensive; costing from £1.5m to £7m to provide a single mega-litre of water each day.

The only practicable lower-cost actions to reduce the impact of abstraction are those that promote efficient and sustainable water use. In catchments subject to significant abstraction pressures, these are either already in place or will be put in place under this RBMP.

Investigation type

investigate to confirm failure and/or impacts

Example of investigation

In view of the number of groundwater bodies in this category the investigations are likely to be tiered with at least basic level of investigation in the first cycle. Investigations will improve the spatial and temporal characterisation of groundwater abstraction impacts; refine understanding of the likely costs and benefits of abstraction rate reductions in helping to restore flows and thereby achieve ecological status targets; may be integrated alongside consideration of other pollution and habitat pressures to determine the optimum way forward.

Possible future measures

Any future measures need to be based on a better characterised balance between costs and benefits carried out for each water body incorporating all the pressures. Measures may include reductions in abstraction licences, but other measures such as river restoration schemes may prove to be a more cost beneficial way of achieving ecological status improvements.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Large reduction or relocation of groundwater abstractions may be disproportionately expensive because replacement abstractions are very expensive; costing from £1.5m to £7m to provide a single mega-litre of water each day. Even if progressed, some of the higher storage sandstone aquifers respond slowly to changes in abstraction and recovery may not be realised by the desired deadline. In regions where demand for water is high relative to resources, it may not be feasible to locate alternative sources for drinking water without causing deterioration in other water bodies

Reference	GQ1c
Element predicted not to achieve good by 2015	Water Balance
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

Low confidence that there is a failure in this element of groundwater status

It is disproportionately expensive to require changes to the current abstraction regime at this time because there is only low confidence that there is a failure of the water balance element of groundwater status as a result of groundwater abstraction pressure.

For many principal aquifer groundwater bodies (and a few secondary aquifers), high rates of groundwater abstraction is estimated to reduce the natural outflow from the groundwater body as a whole by more than the aggregated available low flow resource. This resource is estimated from the Environmental Flow Indicators considered to support Good Ecological Status in all the surface water bodies draining each groundwater body. However, an adequate characterisation of the flow impacts has not yet been achieved and more work is thereafter required to evaluate the benefits on river ecology of any abstraction reduction.

Until these factors are understood sufficiently for a water body, there is a significant risk that there will be either no or low benefits from taking action to reduce groundwater abstractions

In such cases these low expected benefits contrast to potential very high costs of remedial measures. Water is abstracted from the environment to provide drinking water supplies and for use by industry. Where groundwater abstractions need to be reduced to improve the flow regime in dependent rivers, alternative abstraction sources need to be developed. Developing new abstractions is very expensive; costing from £1.5m to £7m to provide a single mega-litre of water each day.

The only practicable lower-cost actions to reduce the impact of abstraction are those that promote efficient and sustainable water use. In catchments subject to significant abstraction pressures, these are either already in place or will be put in place under this RBMP.

Investigation type

investigate to confirm failure and/or impacts

Example of investigation

In view of the number of groundwater bodies in this category the investigations are likely to be tiered with at least basic level of investigation in the first cycle. Investigations will improve the spatial and temporal characterisation of groundwater abstraction impacts; refine understanding of the likely costs and benefits of abstraction rate reductions in helping to restore flows and thereby achieve ecological status targets; may be integrated alongside consideration of other pollution and habitat pressures to determine the optimum way forward. Any future measures need to be based on a better characterised balance between costs and benefits carried out for each water body incorporating all the pressures.

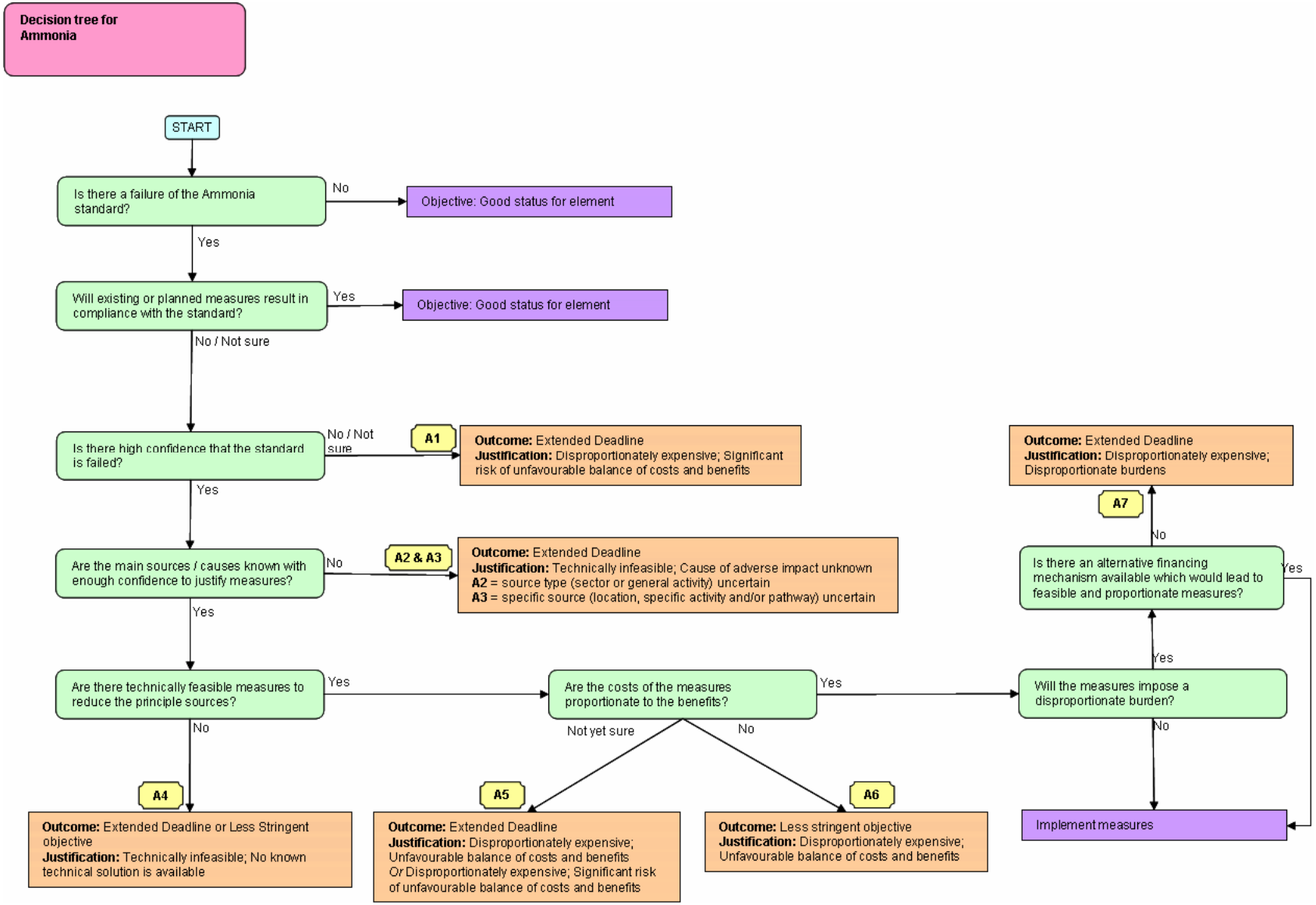
Possible future measures

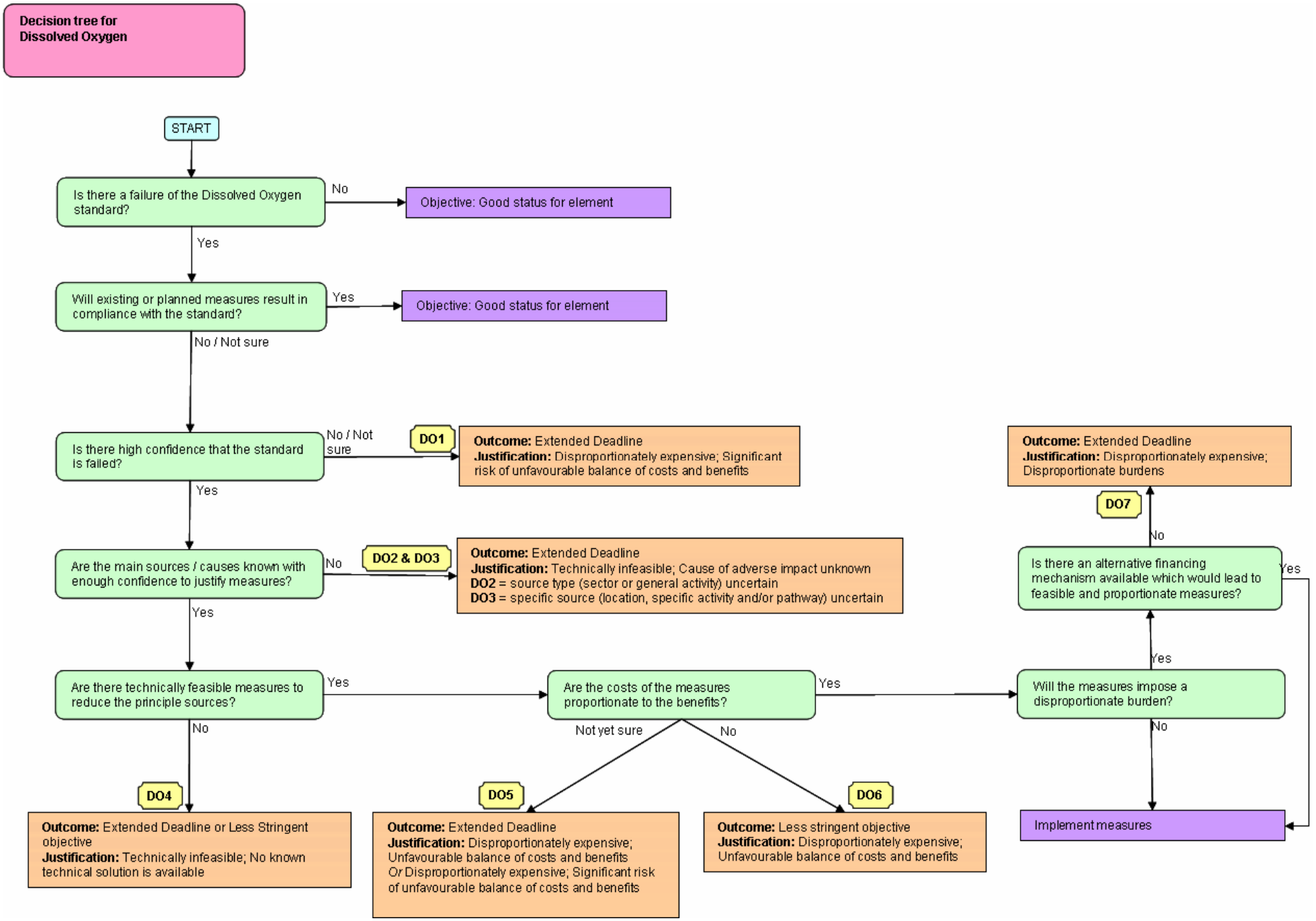
Measures may include reductions in groundwater abstraction licences.

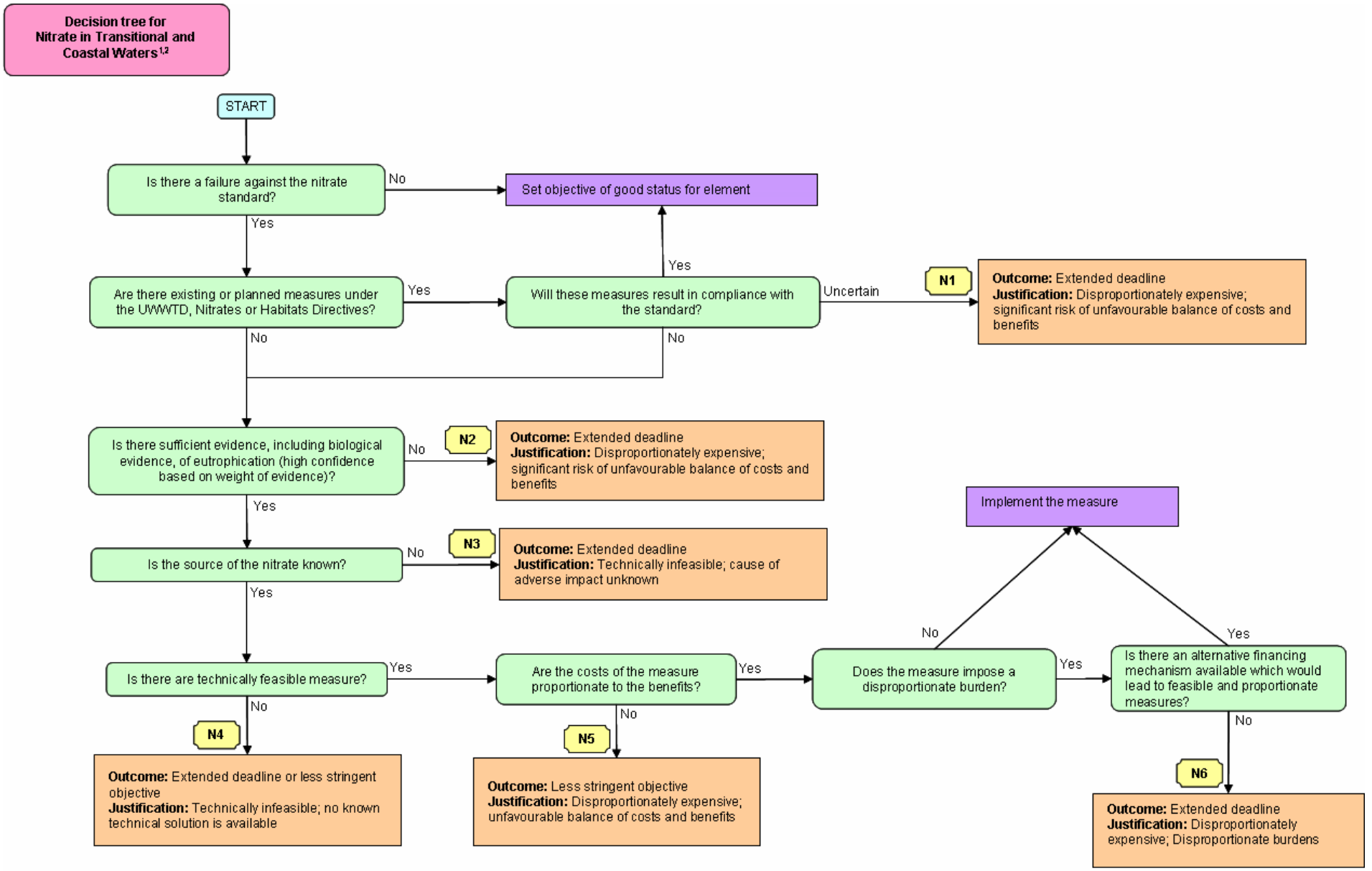
Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Large reductions or relocation of groundwater abstraction may be disproportionately expensive because replacement abstractions are very expensive; costing from £1.5m to £7m to provide a single mega-litre of water each day. Even if progressed, some of the higher storage sandstone aquifers respond slowly to changes in abstraction and recovery may not be realised by the desired deadline. In regions where demand for water is high relative to resources, it may not be feasible to locate alternative sources for drinking water without causing deterioration in other water bodies

Decision Codes A1a and A2a, DO1a and DO3a, N1o, PH1a and PH2a, P1a and P1b, and T1a

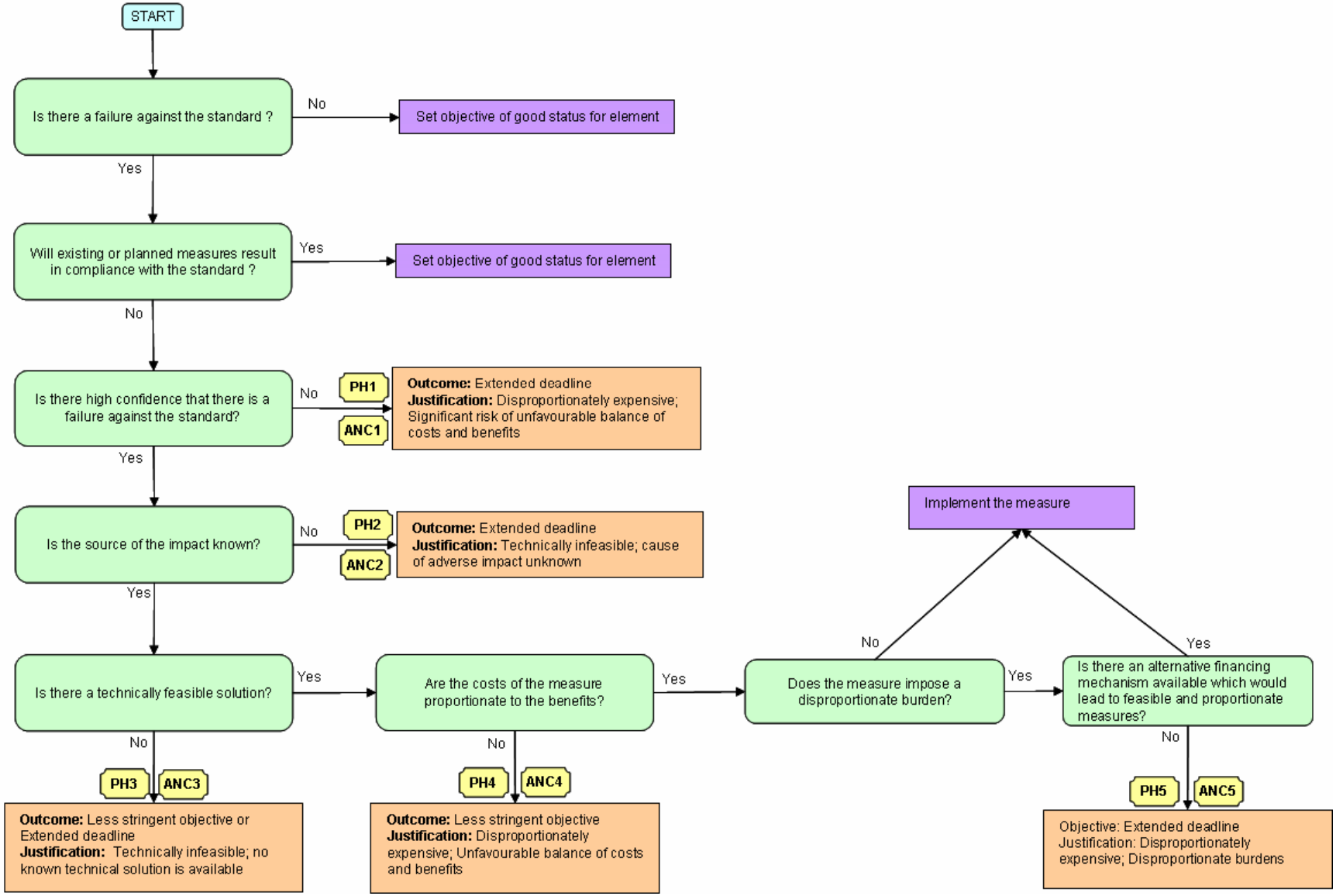


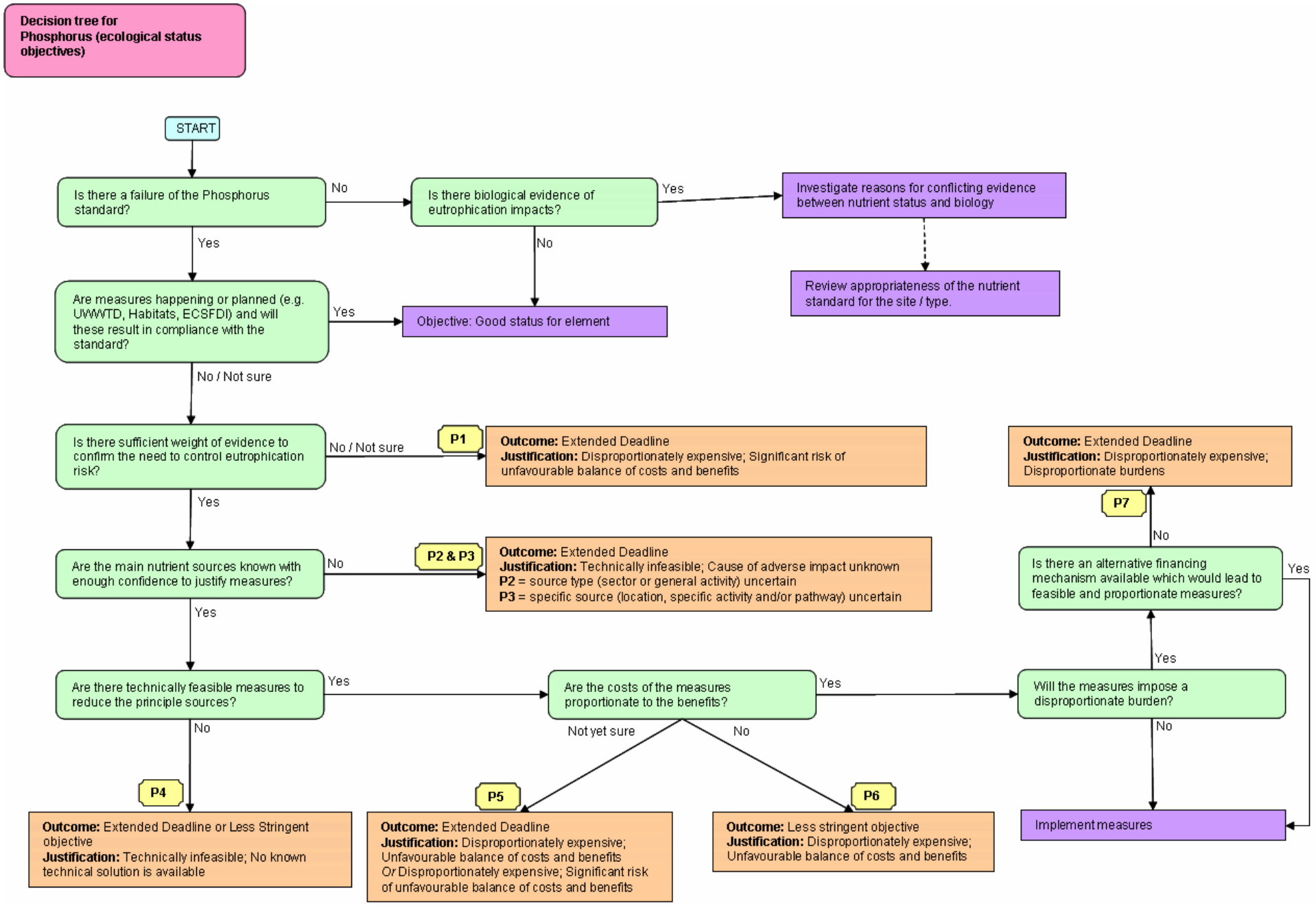

Decision tree for Dissolved Oxygen
START
Is there a failure of the Dissolved Oxygen standard?
No
Objective: Good status for element
Yes
Will existing or planned measures result in compliance with the standard?
Yes
Objective: Good status for element
No / Not sure
Is there high confidence that the standard is failed?
No / Not sure
DO1
Outcome: Extended Deadline
Justification: Disproportionately expensive; Significant risk of unfavourable balance of costs and benefits
Yes
Are the main sources / causes known with enough confidence to justify measures?
No
DO2 & DO3
Outcome: Extended Deadline
Justification: Technically infeasible; Cause of adverse impact unknown
DO2 = source type (sector or general activity) uncertain
DO3 = specific source (location, specific activity and/or pathway) uncertain
Yes
Are there technically feasible measures to reduce the principle sources?
Yes
Are the costs of the measures proportionate to the benefits?
Yes
Will the measures impose a disproportionate burden?
No
DO4
Outcome: Extended Deadline or Less Stringent objective
Justification: Technically infeasible; No known technical solution is available
Not yet sure
No
DO5
Outcome: Extended Deadline
Justification: Disproportionately expensive; Unfavourable balance of costs and benefits
Or Disproportionately expensive; Significant risk of unfavourable balance of costs and benefits
DO6
Outcome: Less stringent objective
Justification: Disproportionately expensive; Unfavourable balance of costs and benefits
Implement measures
Yes
Is there an alternative financing mechanism available which would lead to feasible and proportionate measures?
Yes
No
DO7
Outcome: Extended Deadline
Justification: Disproportionately expensive; Disproportionate burdens

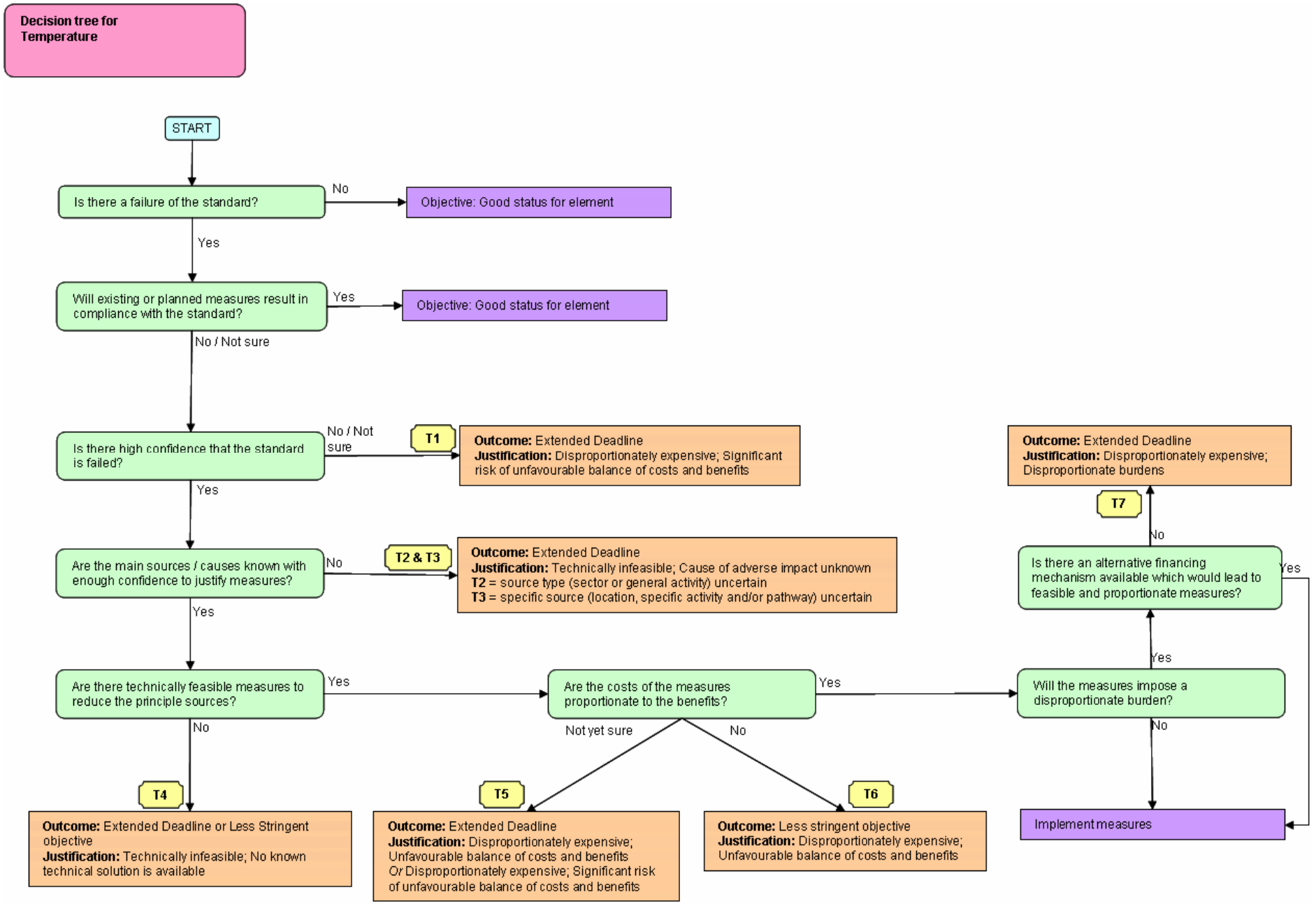


[1] A Water Framework Directive standard for nitrate in rivers and lakes has yet to be established
[2] Measures to address nitrate will also be carried out in certain Protected Areas (Nutrient Sensitive Areas designated under the Nitrates and Urban Waste Water Treatment Directives and Natura 2000 sites designated under the Habitats and Birds Directives)

Decision tree for pH and Acid Neutralising Capacity




Decision tree for Phosphorus (ecological status objectives)
START
Is there a failure of the Phosphorus standard?
No
Is there biological evidence of eutrophication impacts?
Yes
Investigate reasons for conflicting evidence between nutrient status and biology
Review appropriateness of the nutrient standard for the site / type.
No
Yes
Are measures happening or planned (e.g. UWWTD, Habitats, ECSFDI) and will these result in compliance with the standard?
Yes
Objective: Good status for element
No / Not sure
Is there sufficient weight of evidence to confirm the need to control eutrophication risk?
No / Not sure
P1
Outcome: Extended Deadline
Justification: Disproportionately expensive; Significant risk of unfavourable balance of costs and benefits
Yes
Are the main nutrient sources known with enough confidence to justify measures?
No
P2 & P3
Outcome: Extended Deadline
Justification: Technically infeasible; Cause of adverse impact unknown
P2 = source type (sector or general activity) uncertain
P3 = specific source (location, specific activity and/or pathway) uncertain
Yes
Are there technically feasible measures to reduce the principle sources?
Yes
Are the costs of the measures proportionate to the benefits?
Yes
Will the measures impose a disproportionate burden?
No
Yes
Is there an alternative financing mechanism available which would lead to feasible and proportionate measures?
Yes
No
P7
Outcome: Extended Deadline
Justification: Disproportionately expensive; Disproportionate burdens
Implement measures
No
P4
Outcome: Extended Deadline or Less Stringent objective
Justification: Technically infeasible; No known technical solution is available
Not yet sure
P5
Outcome: Extended Deadline
Justification: Disproportionately expensive; Unfavourable balance of costs and benefits
Or Disproportionately expensive; Significant risk of unfavourable balance of costs and benefits
No
P6
Outcome: Less stringent objective
Justification: Disproportionately expensive; Unfavourable balance of costs and benefits


Decision tree for Temperature
START
Is there a failure of the standard?
No
Objective: Good status for element
Yes
Will existing or planned measures result in compliance with the standard?
Yes
Objective: Good status for element
No / Not sure
Is there high confidence that the standard is failed?
No / Not sure
T1
Outcome: Extended Deadline
Justification: Disproportionately expensive; Significant risk of unfavourable balance of costs and benefits
Yes
Are the main sources / causes known with enough confidence to justify measures?
No
T2 & T3
Outcome: Extended Deadline
Justification: Technically infeasible; Cause of adverse impact unknown
T2 = source type (sector or general activity) uncertain
T3 = specific source (location, specific activity and/or pathway) uncertain
Yes
Are there technically feasible measures to reduce the principle sources?
Yes
Are the costs of the measures proportionate to the benefits?
Yes
Will the measures impose a disproportionate burden?
No
Implement measures
Yes
Is there an alternative financing mechanism available which would lead to feasible and proportionate measures?
Yes
No
T7
Outcome: Extended Deadline
Justification: Disproportionately expensive; Disproportionate burdens
No
T4
Outcome: Extended Deadline or Less Stringent objective
Justification: Technically infeasible; No known technical solution is available
Not yet sure
T5
Outcome: Extended Deadline
Justification: Disproportionately expensive; Unfavourable balance of costs and benefits
Or Disproportionately expensive; Significant risk of unfavourable balance of costs and benefits
No
T6
Outcome: Less stringent objective
Justification: Disproportionately expensive; Unfavourable balance of costs and benefits

Reference	A1a, DO1a, PH1a, T1a
Element predicted not to achieve good by 2015	A1a = Ammonia DO1a = Dissolved Oxygen PH1a = pH T1a = Temperature
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

There is not high confidence that the standard is failed

For these water bodies we do not have the statistical confidence that the standard is failed; the water body may be compliant. Without confidence in a failure we cannot reliably consider sources and measures. To do so would mean a significant risk of wasted investment on measures in already compliant water bodies. In the first cycle we will carry out further investigations to confirm any failure with certainty, identify sources and appraise additional measures. Where possible additional measures will be implemented.

It is disproportionately expensive to implement further measures at this time. An extended deadline for achieving good ecological status is therefore required. One of the main sources of ammonia is discharges from municipal sewage treatment works. These works can also discharge significant loads of organic material that can result in a reduction in dissolved oxygen levels in receiving water bodies. Removing ammonia and organic material from sewage is expensive requiring structural changes to the works and ongoing operational costs for energy, maintenance and the disposal of sludge. The preliminary cost effectiveness analysis estimated that to put additional treatment capacity on all sewage treatment works for water bodies at risk of not achieving WFD standards would cost £304 to £848 million/year depending on how much ammonia was removed. Even where the need to control ammonia is confirmed, there is still a significant risk that removing ammonia from sewage treatment works is disproportionately expensive because of the balance of costs and benefits (see tables reference A5c). Of the 34 cases assessed, 21 were assessed as being not justified because of the unfavourable balance of costs, benefits and other impacts. Actions are in most instances expensive and need to be justified in terms of addressing real failures.

As part of the recent review of water prices for the water industry (PR09), we looked for cases where, irrespective of compliance with established environmental standards, further improvements to the quality of discharges would deliver local benefits sufficient to justify the costs of improvement. One case was found. This is in the Thames RBD where 5 sewage works will be improved for the benefit of the Thames Estuary.

There are no ongoing actions in or upstream of the water body that are estimated to bring improvements in the status in this water body.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Additional monitoring to confirm status and the need to take additional action.

Monitoring and modelling work to identify the relative sources of ammonia, dissolved oxygen, pH or temperature in the catchment.

If the need for additional action is confirmed, identification of the most cost effective combination of measures necessary to achieve good ecological status.

Possible future measures

Possible future measures will depend on confirmation of being at less than good status and the identification of sources that contribute to this status. If the need to take additional action and the sources are confirmed, further measures (subject to further assessment of cost, benefits and other impacts) will be implemented. These measures may include additional regulatory controls on point sources, including sewage treatment works and storm sewage discharges; actions to address diffuse sources, e.g. extension of schemes such as Catchment Sensitive Farming, better targeting of agri-environment schemes, pollution prevention (through the adoption of best practice methodologies, local education campaigns and voluntary initiatives); control at source (e.g. through additional use restrictions).

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

It will be disproportionately expensive to install ammonia removal technology on all municipal sewage treatment works in England and Wales.

It is likely that installing additional ammonia removal technology on many works will be disproportionately expensive. To reduce ammonia to 1 mg/l at all works where this may be necessary would cost £848 million/year across England and Wales.

Reference	A2a, PH2a
Element predicted not to achieve good by 2015	A2a = Ammonia PH2a = pH
Reason for failure	Unknown - reasons for failure unknown
Alternative objective	Extended deadline
Reason for alternative objective	Technically Infeasible: cause of adverse impact unknown

Justification for alternative objective

The cause of the failure (sector or general activity) is unknown

Ammonia, substances affecting dissolved oxygen, pH and acid neutralising capacity (ANC) are released into the environment from a wide range of sources including urban and agricultural land use, industry and domestic release to sewers. For water bodies where the sources of the pollution is not known, or not known in sufficient detail to be able to identify and appraise measures (including identification of the person who is responsible for causing the pollution), it is technically infeasible to identify and implement additional measures, and achieve the objective by 2015. An extended deadline for achieving good ecological status is therefore required.

For over 20 years we have routinely (usually annually) assessed compliance with water quality standards (such those for the freshwater fisheries directive and river quality objectives) and tried to identify the activities releasing the substances and causing the failure of the standards. We use a number of different approaches to do this including routine and investigative monitoring, modelling, and site inspections. Despite this, the sources of some of these old failures remains unknown.

In 2008 and 2009 (as part of the classification work for the draft and first river basin management plans) we assessed compliance with the new standards for ammonia, dissolved oxygen, pH and ANC. Where these substances did not have standards under the old compliance schemes, or where the standards for the water framework directive are tighter than before, we have identified new failures. In the time available, we have not been able to identify the sources and their relative contributions for each of the new failures.

Investigation type

Investigate reason for failure.

Example of investigation

The significance of locally relevant sources will be assessed through additional monitoring, site visits, desktop studies and modelling (e.g. using SIMCAT models) to identify and apportion causes of failure. The most cost effective combination of measures necessary to achieve good ecological status will be identified. Investigations will include local studies as well as using information and understanding from national source apportionment projects and ongoing work to improve our understanding of the effectiveness of measures. Modelling will also be used to assess the likely outcome from the actions in order to appraise the costs, benefits and other impacts. This will allow appropriate measures to be identified for implementation in this or subsequent river basin planning cycles.

Possible future measures

Possible future measures will depend on the sources that contribute to the failure. Measures may include additional regulatory controls on point sources, including sewage treatment works and storm sewage discharges; actions to address diffuse sources, e.g. extension of schemes such as Catchment Sensitive Farming, better targeting of agri-environment schemes, pollution prevention (through the adoption of best practice methodologies, local education campaigns and voluntary initiatives); control at source (e.g. through additional use restrictions).

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Uncertain until the sectors or general activities causing the failure is known.

Reference	DO3a
Element predicted not to achieve good by 2015	DO3a = Dissolved Oxygen
Reason for failure	Confirmed - diffuse source agricultural
Alternative objective	Extended deadline
Reason for alternative objective	Technically infeasible: cause of adverse impact unknown

Justification for alternative objective

The specific agricultural source (location, specific activity and/or pathway) of the failure is unknown

Although agriculture is known to be causing the problem, until the specific source(s) is known in sufficient detail to be able to identify and appraise measures (including identification of the person who is responsible for causing the pollution), it is technically infeasible to identify and implement additional measures, and achieve the objective by 2015. An extended deadline for achieving good ecological status is therefore required.

For over 20 years we have routinely (usually annually) assessed compliance with water quality standards (such those for the freshwater fisheries directive and river quality objectives) and tried to identify the activities releasing the substances and causing the failure of the standards. We use a number of different approaches to do this including routine and investigative monitoring, modelling, and site inspections. Because of this work we know agriculture is causing the problem but the specific source is yet to be identified.

In 2008 and 2009 (as part of the classification work for the draft and first river basin management plans) we assessed compliance with the new standards for ammonia, dissolved oxygen, pH and ANC. Where these substances did not have standards under the old compliance schemes, or where the standards for the water framework directive are tighter than before, we have identified new failures. In the time available, we have been able to identify agriculture as the source but have yet to identify the specific source.

Investigation type

Investigate source of failure.

Example of investigation

The significance of locally relevant agricultural diffuse sources will be assessed through additional monitoring, site visits (including tracing studies), desktop studies and modelling to identify and apportion the sources of failure. The most cost effective combination of measures necessary to achieve good ecological status will be identified. Investigations will include local studies as well as using information and understanding from national source apportionment projects and ongoing work to improve our understanding of the effectiveness of agricultural measures. There are a number of national projects being planned to do further testing and evaluation (including field trials) of feasible and cost effective means of reducing agricultural pollution, including ongoing work within the Catchment Sensitive Farming catchments in England and Demonstration Catchment work in Wales. Modelling will also be used to assess the likely outcome from the actions in order to appraise the costs, benefits and other impacts. This will allow appropriately targeted measures to be identified for implementation in this or subsequent river basin planning cycles.

Possible future measures

Possible future measures will depend on the more detailed identification of source contributions and investigations into the feasibility and relative effectiveness of measures.

Measures might include for example:

• More local partnership projects to support farmers to change practice

• Increased roll-out (in terms of duration and geographic extent) of Catchment Sensitive Farming advisory initiatives in England, and in Wales expansion of the Environment Agency's Catchment Co-ordinator Initiative

• Widen the measures and activities included in agri-environment initiatives (e.g. rural sustainable drainage systems)

• Widen the measures and activities that are included in the Common Agricultural Policy funded initiatives (e.g. increase soil resource protection measures in current approach to cross-compliance, or whatever may follow in future)

• Establish and or extend existing national partnerships that provide advice and support to land managers to improve practice

• Increased Environment Agency-led pollution enforcement campaigns (including use of anti-pollution works notices)

• where appropriate designation of Water Protection Zones

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

• Wide scale reversion of arable land to low intensity pasture over large parts of England and Wales

• Wide scale reversion of agricultural land to woodland over large parts of England and Wales

• Wide scale reduction in livestock densities (cattle, sheep and pigs) over large parts of England and Wales

Reference	P1a
Element predicted not to achieve good by 2015	P1a = Phosphate or Total Phosphorus
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

There is not sufficient weight of evidence to confirm the need to control eutrophication risk

Guidance on river basin planning issued by Defra and Welsh Assembly Government requires that for failures of nutrient standards that the biology is truly impacted when considering the case for improvement actions. For these water bodies there is no or insufficient biological data or other evidence to justify taking additional measures to control the risk of eutrophication.

Guidance on river basin planning issued by Defra and Welsh Assembly Government requires that for failures of nutrient standards that the biology is truly impacted when considering the case for improvement actions. For these water bodies there is no or insufficient biological data or other evidence to justify taking additional measures to control the risk of eutrophication. From the monitoring undertaken for this plan it is now clear that there is a link between high levels of phosphate in surface waters and biological failures in the main river type (lowland alkaline rivers). We are already collecting additional biological data in locations where the phosphate standard is exceeded. This includes monitoring started in 2008 to gather additional biological evidence downstream of sewage treatment works where additional treatment to remove phosphorus would be justified if we were confident there is a risk of damage.

For these water bodies the sources of nutrient are not yet confirmed.

It is disproportionately expensive to implement further measures at this time. An extended deadline for achieving good ecological status is therefore required. The major source of phosphorus is discharges from municipal sewage treatment works. Removing phosphorus from sewage is expensive (8 to 7408 £/kg of P removed depending on the size of the works and the treatment technology used) requiring structural changes to the works and ongoing operational costs for chemicals, energy and sludge disposal. Even where the need to control the risk of eutrophication is confirmed, there is still a significant risk that removing phosphorus from sewage treatment works is disproportionately expensive because of the balance of costs and benefits (see tables reference P5c). Of the 51 cases assessed, 15 were assessed as being not justified because of the unfavourable balance of costs, benefits and other impacts.

As part of the recent review of water prices for the water industry (PR09), we looked for cases where, irrespective of compliance with established environmental standards, further improvements to the quality of discharges would deliver local benefits sufficient to justify the costs of improvement. None were found.

There are no ongoing actions in or upstream of the water body that are estimated to bring improvements in the status in this water body.

The results of the new (from 2007) WFD monitoring programme will be reviewed to improve our understanding of the relationship between failure of nutrient standards and biological impact. If this shows that there is a strong correlation, we need not wait for direct biological evidence to start work to define the sources of the problem and their solution. This will mean that following further consideration of technical feasibility and disproportionate costs, further measures may be implemented in the first cycle.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Additional biological monitoring to confirm status. This has already started. For example, in 2008 we started monitoring downstream of some sewage treatment works to gather additional biological evidence to potentially justify additional treatment to remove phosphorus.

Monitoring and modelling work to identify the relative sources of nutrients in the catchment.

If the need for additional action is confirmed, identification of the most cost effective combination of measures necessary to achieve good ecological status.

Possible future measures

Ban on phosphorus in detergents.

The major sources of nutrients are discharges from sewage treatment works and agricultural activities. If the need to take additional action and the sources of the nutrient are confirmed, further measures (subject to further assessment of cost, benefits and other impacts) will be implemented.

Examples of such measures include additional regulatory controls on point sources, including sewage treatment works and storm sewage discharges; actions to address diffuse sources, e.g. extension of schemes such as Catchment Sensitive Farming, better targeting of agri-environment schemes, pollution prevention (through the adoption of best practice methodologies, local education campaigns and voluntary initiatives); control at source (e.g. through additional use restrictions).

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Sewage treatment works discharges:

It will be disproportionately expensive to install phosphorus removal technology on all municipal sewage treatment works in England and Wales. To do so would cost up to £6billion and result in benefits of approximately £2billion. Removing phosphorus requires more energy and so has a carbon impact. Depending on the size of the works and the treatment technology used it is estimated that 16-1426 tonnes of additional carbon are produced per tonne of phosphorus removed.

It is likely that installing phosphorus removal technology on many of the works serving less than 250 people will be disproportionately expensive. It cost between 157-7408 £/kg to remove phosphorus from these size works.

Agricultural activities:

• Wide scale reversion of arable land to low intensity pasture over large parts of England and Wales

• Wide scale reversion of agricultural land to woodland over large parts of England and Wales

• Wide scale reduction in livestock densities (cattle, sheep and pigs) over large parts of England and Wales

Reference	P1b
Element predicted not to achieve good by 2015	P1b = Phosphate or Total Phosphorus
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

There is not sufficient weight of evidence to confirm the need to control eutrophication risk

Guidance on river basin planning issued by Defra and Welsh Assembly Government requires that for failures of nutrient standards that the biology is truly impacted when considering the case for improvement actions. For these water bodies there is no or insufficient biological data or other evidence to justify taking additional measures to control the risk of eutrophication. From the monitoring undertaken for this plan it is now clear that there is a link between high levels of phosphate in surface waters and biological failures in the main river type (lowland alkaline rivers). We are already collecting additional biological data in locations where the phosphate standard is exceeded. This includes monitoring started in 2008 to gather additional biological evidence downstream of sewage treatment works where additional treatment to remove phosphorus would be justified if we were confident there is a risk of damage.

For these water bodies all or some of the nutrient sources are known.

It is disproportionately expensive to implement further measures at this time. An extended deadline for achieving good ecological status is therefore required. The major source of phosphorus is discharges from municipal sewage treatment works. Removing phosphorus from sewage is expensive (8 to 7408 £/kg of P removed depending on the size of the works and the treatment technology used) requiring structural changes to the works and ongoing operational costs for chemicals, energy and sludge disposal. Even where the need to control the risk of eutrophication is confirmed, there is still a significant risk that removing phosphorus from sewage treatment works is disproportionately expensive because of the balance of costs and benefits (see tables reference P5c). Of the 51 cases assessed, 15 were assessed as being not justified because of the unfavourable balance of costs, benefits and other impacts.

As part of the recent review of water prices for the water industry (PR09), we looked for cases where, irrespective of compliance with established environmental standards, further improvements to the quality of discharges would deliver local benefits sufficient to justify the costs of improvement. None were found.

There are no ongoing actions in or upstream of the water body that are estimated to bring improvements in the status in this water body.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Additional biological monitoring to confirm status. This has already started. For example, in 2008 we started monitoring downstream of some sewage treatment works to gather additional biological evidence to potentially justify additional treatment to remove phosphorus.

Monitoring and modelling work to review the relative sources of nutrients in the catchment.

If the need for additional action is confirmed, identification of the most cost effective combination of measures necessary to achieve good ecological status.

Possible future measures

Ban on phosphorus in detergents.

The major sources of nutrients are discharges from sewage treatment works and agricultural activities. If the need to take additional action and the sources of the nutrient are confirmed, further measures (subject to further assessment of cost, benefits and other impacts) will be implemented.

Examples of such measures include additional regulatory controls on point sources, including sewage treatment works and storm sewage discharges; actions to address diffuse sources, e.g. extension of schemes such as Catchment Sensitive Farming, better targeting of agri-environment schemes, pollution prevention (through the adoption of best practice methodologies, local education campaigns and voluntary initiatives); control at source (e.g. through additional use restrictions).

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Sewage treatment works discharges:

It will be disproportionately expensive to install phosphorus removal technology on all municipal sewage treatment works in England and Wales. To do so would cost up to £6billion and result in benefits of approximately £2billion. Removing phosphorus requires more energy and so has a carbon impact. Depending on the size of the works and the treatment technology used it is estimated that 16-1426 tonnes of additional carbon are produced per tonne of phosphorus removed.

It is likely that installing phosphorus removal technology on many of the works serving less than 250 people will be disproportionately expensive. It cost between 157-7408 £/kg to remove phosphorus from these size works.

Agricultural activities:

• Wide scale reversion of arable land to low intensity pasture over large parts of England and Wales

• Wide scale reversion of agricultural land to woodland over large parts of England and Wales

• Wide scale reduction in livestock densities (cattle, sheep and pigs) over large parts of England and Wales

Reference	P1c, N1c
Element predicted not to achieve good by 2015	P1c = Phosphate or Total Phosphorus N1c = Dissolved Inorganic Nitrogen
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

There is not sufficient weight of evidence to confirm the need to control eutrophication risk and there are ongoing or planned improvement actions

Guidance on river basin planning issued by Defra and Welsh Assembly Government requires that for failures of nutrient standards that the biology is truly impacted when considering the case for improvement actions. For these water bodies there is no or insufficient biological data or other evidence to justify taking additional measures to control the risk of eutrophication. From the monitoring undertaken for this plan it is now clear that there is a link between high levels of phosphate in surface waters and biological failures in the main river type (lowland alkaline rivers). We are already collecting additional biological data in locations where the phosphate standard is exceeded. This includes monitoring started in 2008 to gather additional biological evidence downstream of sewage treatment

works where additional treatment to remove phosphorus would be justified if we were confident there is a risk of damage.

There are ongoing actions within or upstream of the water body (either at sewage treatment works and / or through actions on agriculture in the catchment). Some of these actions are driven by eutrophic designations under the Urban Waste Water Treatment Directive and / or the Nitrates Directive. The ongoing actions will reduce nutrient levels and lead to some improvement in status. We are uncertain of the extent of the improvement and further action would not be pursued until the outcome was established through future monitoring. This is because we have low confidence that future quality would fail the standard. Without confidence in a failure we cannot reliably consider further measures. To do so would mean a significant risk of wasted investment on measures in already compliant water bodies. Our priority in the first cycle will be to carry out further investigation to confirm any failure with certainty, identify sources and additional potential measures. This will also need to consider biological response times.

It is disproportionately expensive to implement further measures at this time. An extended deadline for achieving good ecological status is therefore required. The major source of phosphorus is discharges from municipal sewage treatment works. Removing phosphorus from sewage is expensive (8 to 7408 £/kg of P removed depending on the size of the works and the treatment technology used) requiring structural changes to the works and ongoing operational costs for chemicals, energy and sludge disposal. Even where the need to control the risk of eutrophication is confirmed, there is still a significant risk that removing phosphorus from sewage treatment works is disproportionately expensive because of the balance of costs and benefits (see tables reference P5c). Of the 51 cases assessed, 15 were assessed as being not justified because of the unfavourable balance of costs, benefits and other impacts.

As part of the recent review of water prices for the water industry (PR09), we looked for cases where, irrespective of compliance with established environmental standards, further improvements to the quality of discharges would deliver local benefits sufficient to justify the costs of improvement. None were found.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Additional biological monitoring to confirm status. This has already started. For example, in 2008 we started monitoring downstream of some sewage treatment works to gather additional biological evidence to potentially justify additional treatment to remove phosphorus.

Monitoring and modelling work to review the relative sources of nutrients in the catchment.

If the need for additional action is confirmed, identification of the most cost effective combination of measures necessary to achieve good ecological status.

Possible future measures

Ban on phosphorus in detergents.

The major sources of nutrients are discharges from sewage treatment works and agricultural activities. If the need to take additional action and the sources of the nutrient are confirmed, further measures (subject to further assessment of cost, benefits and other impacts) will be implemented.

Examples of such measures include additional regulatory controls on point sources, including sewage treatment works and storm sewage discharges; actions to address diffuse sources, e.g. extension of schemes such as Catchment Sensitive Farming, better targeting of agri-environment schemes, pollution prevention (through the adoption of best practice methodologies, local education campaigns and voluntary initiatives); control at source (e.g. through additional use restrictions).

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Sewage treatment works discharges:

It will be disproportionately expensive to install phosphorus removal technology on all municipal sewage treatment works in England and Wales. To do so would cost up to £6billion and result in benefits of approximately £2billion. Removing phosphorus requires more energy and so has a carbon impact. Depending on the size of the works and the treatment technology used it is estimated that 16-1426 tonnes of additional carbon are produced per tonne of phosphorus removed.

It is likely that installing phosphorus removal technology on many of the works serving less than 250 people will be disproportionately expensive. It cost between 157-7408 £/kg to remove phosphorus from these size works.

Agricultural activities:

• Wide scale reversion of arable land to low intensity pasture over large parts of England and Wales

• Wide scale reversion of agricultural land to woodland over large parts of England and Wales

• Wide scale reduction in livestock densities (cattle, sheep and pigs) over large parts of England and Wales

Reference	N1o
Element predicted not to achieve good by 2015	N1o = Dissolved Inorganic Nitrogen
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

There is not sufficient weight of evidence to confirm the need to control eutrophication risk

Guidance on river basin planning issued by Defra and Welsh Assembly Government requires that for failures of nutrient standards that the biology is truly impacted when considering the case for improvement actions. For these water bodies biological data for nutrient sensitive elements is suggesting good or better status so there is low certainty that there is a risk of eutrophication even though nutrients are exceeding the standard. Where we are not confident of failing good status we would not use regulatory powers to pursue costly site specific measures on the grounds that we would only anticipate low or uncertain benefits which would not be proportionate to the costs.

It is disproportionately expensive to implement further measures at this time. An extended deadline for achieving good ecological status is therefore required. The major source of phosphorus is discharges from municipal sewage treatment works. Removing phosphorus from sewage is expensive (8 to 7408 £/kg of P removed depending on the size of the works and the treatment technology used) requiring structural changes to the works and ongoing operational costs for chemicals, energy and sludge disposal. Even where the need to control the risk of eutrophication is confirmed, there is still a significant risk that removing phosphorus from sewage treatment works is disproportionately expensive because of the balance of costs and benefits (see tables reference P5c). Of the 51 cases assessed, 15 were assessed as being not justified because of the unfavourable balance of costs, benefits and other impacts.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Investigate reasons for conflicting evidence between nutrient status and biology. This could lead to a review of the appropriateness of the nutrient standard for the site / type. Site would also be kept under review against risk of deterioration.

Possible future measures

Ban on phosphorus in detergents.

The major sources of nutrients are discharges from sewage treatment works and agricultural activities. If the need to take additional action and the sources of the nutrient are confirmed, further measures (subject to further assessment of cost, benefits and other impacts) will be implemented.

Examples of such measures include additional regulatory controls on point sources, including sewage treatment works and storm sewage discharges; actions to address diffuse sources, e.g. extension of schemes such as Catchment Sensitive Farming, pollution prevention (through the adoption of best practice methodologies, local education campaigns and voluntary initiatives); control at source (e.g. through additional use restrictions).

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Sewage treatment works discharges:

It will be disproportionately expensive to install phosphorus removal technology on all municipal sewage treatment works in England and Wales. To do so would cost up to £6billion and result in benefits of approximately £2billion. Removing phosphorus requires more energy and so has a carbon impact. Depending on the size of the works and the treatment technology used it is estimated that 16-1426 tonnes of additional carbon are produced per tonne of phosphorus removed.

It is likely that installing phosphorus removal technology on many of the works serving less than 250 people will be disproportionately expensive. It cost between 157-7408 £/kg to remove phosphorus from these size works.

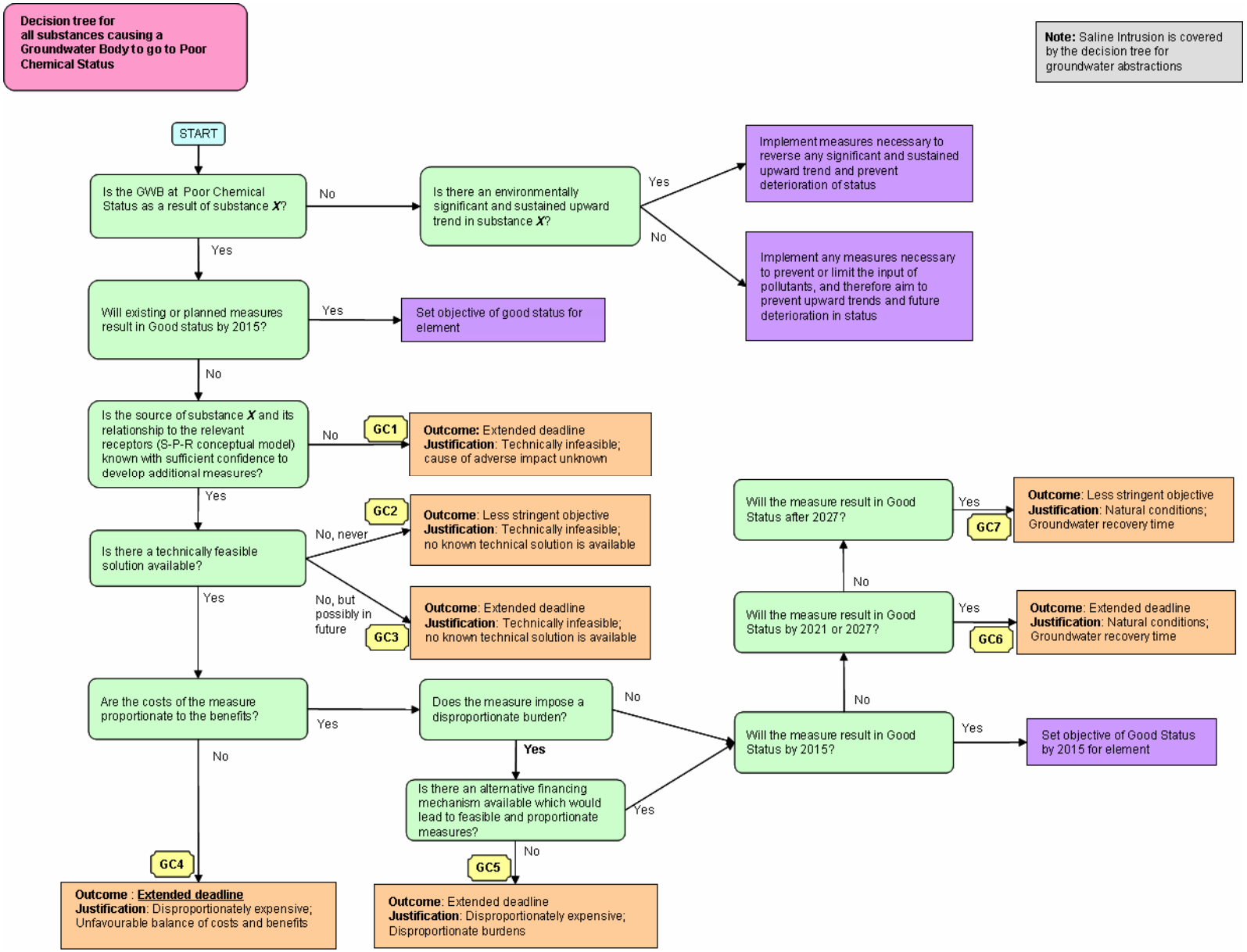
Agricultural activities:

• Wide scale reversion of arable land to low intensity pasture over large parts of England and Wales

• Wide scale reversion of agricultural land to woodland over large parts of England and Wales

• Wide scale reduction in livestock densities (cattle, sheep and pigs) over large parts of England and Wales

Decision code GC5a



Reference	GC5a
Element predicted not to achieve good by 2015	Surface water test General quality test
Reason for failure	Confirmed - Disused mines point and/or diffuse source The failures were mainly caused by metals (e.g. Iron)
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive: disproportionate burdens

Justification for alternative objective

The costs of the measures are proportionate to the benefits but would impose a disproportionate burden if implemented by 2015

A phased Coal Authority scheme is being implemented in this groundwater body to restore the body to good status. Treasury has agreed that the funding for these schemes will be phased over three river basin cycles to 2027 due to affordability issues. To bring forward the implementation date of all these minewater remediation schemes would also cause considerable practical difficulties, for example gaining permission for, and undertaking the necessary works. This phased approach will allow time to investigate and implement the most cost effective solution in each case, and it will also allow learning to take place. Our PCEA study has shown that a phased approach is likely to significantly reduce the overall cost of the whole programme. It would therefore impose a disproportionately burden to meet good status by 2015. Achieving good status by 2027, with the highest priority sites tackled by 2015, is a proportionate and cost effective response to the problem.

Affordability is one area where there is limited guidance available at a European level and hence additional care must be taken in justifying exemptions to ensure that they follow the spirit of the Directive and its objectives. Although the adoption of the WFD entails obligations for member states to make available the necessary means for implementation, this needs to be moderated by the option available to member states to phase the implementation (through extended deadlines) of measures to spread the costs of implementation (while taking clear and demonstrable action in the first cycle).

To apply a time extension on grounds of affordability consideration should be given to the availability of alternative financing mechanisms, the consequences of non-action and steps taken to resolve affordability in the future. We have considered all of these factors as part of justifying this alternative objective.

Investigation type

Further investigate feasible measures and their applicability at individual sites

Example of investigation

Investigation and prioritisation of minewater remediation schemes to achieve maximum environmental benefit.

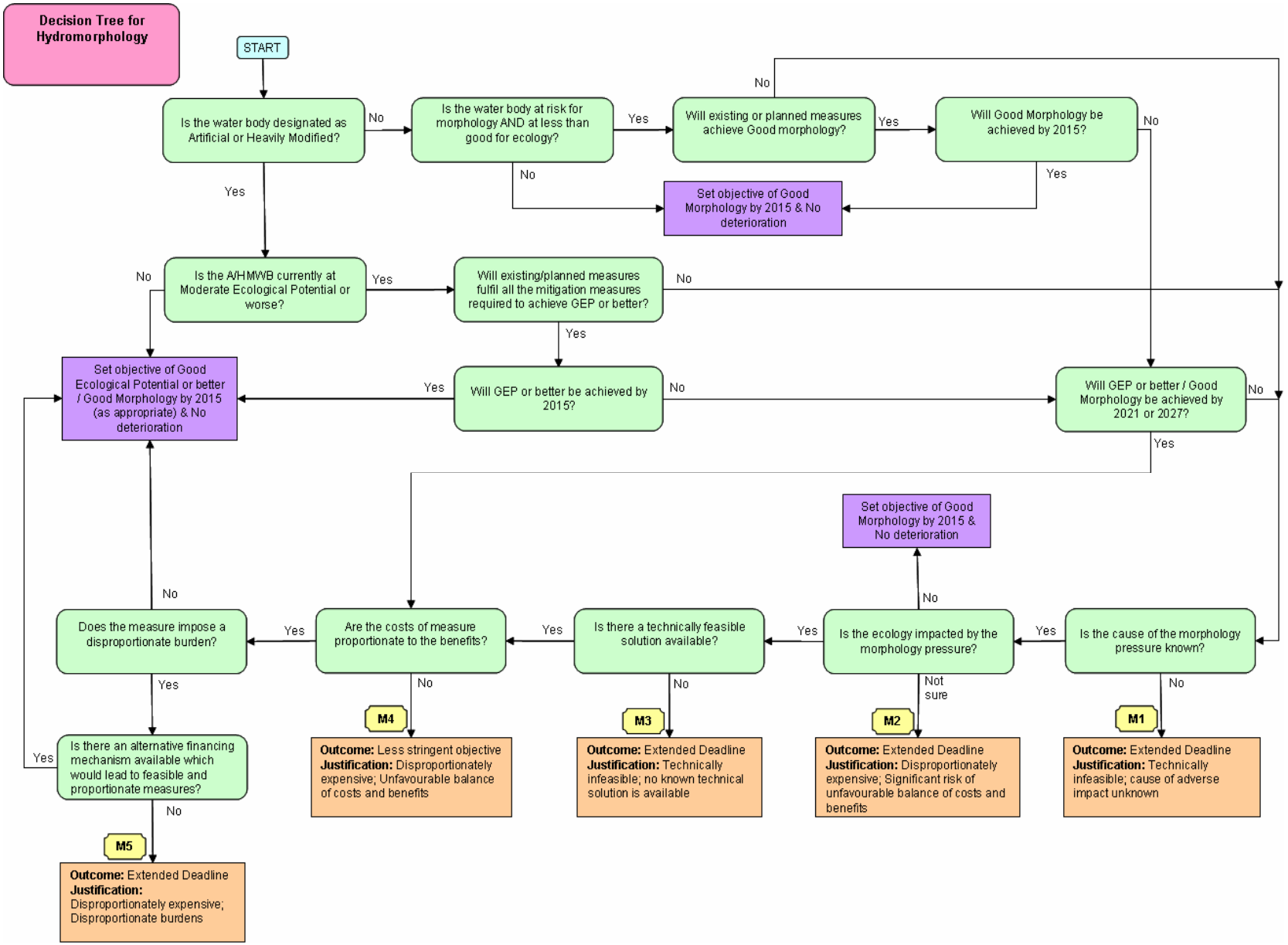
Possible future measures

Minewater remediation schemes

Measures required to achieve 100% Good Chemical Status by 2027 that are likely to be technically infeasible or disproportionately expensive

Immediate implementation of minewater remediation schemes for all discharges.

Decision codes M3a, M3b, M3c, M3d and M5a



Reference	M3a to M3d
Element predicted not to achieve good by 2015	Morphology
Reason for failure	M3a = Confirmed - physical modification flood protection M3b = Confirmed - physical modification urbanisation M3c = Confirmed - physical modification land drainage M3d = Confirmed - physical modification water storage and supply (including for power generation)
Alternative objective	Extended deadline
Reason for alternative objective	Technically infeasible: no known technical solution

Justification for alternative objective

Technical solutions to address the ecological impact caused by the physical modification are under development and their effectiveness is not yet known

There is a known morphological pressure (a physical modification) and an observed biological impact but uncertainty surrounds the effectiveness of the measure(s) available to reduce that impact.

There are a range of morphological improvement measures available to mitigate and reduce biological impacts from physical modification. However, we do not always have a high level of confidence in the outcome and effectiveness of these improvement measures in relation to the specific biological quality elements. Many of the morphological improvement measures are yet to be proven in terms of their effect on biology at the water body scale. Similarly, the effectiveness of morphological improvement measures across differing environmental conditions, for example, different river types, remains unknown.

A programme of research is underway to improve our confidence in the applicability, feasibility and success of a range of morphological improvement measures. Extending the deadline for achieving objectives will allow time to complete these investigations to confirm the effectiveness of morphological improvement measures.

For artificial and heavily modified water bodies, mitigation measures have been identified as necessary in order to achieve GEP. The feasibility of these measures requires further examination. Mitigation measures defined from the ecological potential classification process are derived from a generic list that deals with pressures and impacts on a broad scale. To ensure that the measures are technically feasible in each individual water body, local conditions and requirements must be considered. Mitigation measures must also be looked at in combination to identify their effect where there are multiple pressures and impacts present in the water body.

Investigation type

Investigate feasibility of measures

Example of investigation

Where we have low confidence in how effective the morphological improvement measures are in bringing biological improvements, further investigations are underway. Investigations are taking the form of catchment trials, testing of measures and monitoring the success of measures in bringing biological improvements.

The biological improvement brought about by morphological improvement measures in some water bodies may be different where different physical conditions prevail. Certain measures may be effective in some water bodies and not others. The above trials and investigations will help determine situations in which specific measures are likely to be applicable and suitable.

Possible future measures

Once investigations have established the effect of morphological improvement measures this will inform the choice of measure to be implemented in order to meet WFD objectives. Some possible measures are listed below:

- Removal of barriers to fish passage.
- River enhancement/restoration schemes
- Restoration of natural flows through habitat management & removal of impediments to flow.
- Revised sediment management strategies
- More widespread use of Sustainable Drainage Systems.
- Codes of Practice / General Binding Rules for operational activities/boat traffic.
- Opportunistic habitat enhancements on the back of capital and maintenance works

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

- Wholesale restoration or removal of flood and coastal defences, and other engineered or reinforced channels.
- Removal of major infrastructure, bridges and culverts under buildings.
- Hull design or other modifications to vessels.
- Measures which are not proven to be technically successful or applicable at the scale or under the conditions of particular water bodies
- Removal of all barriers to migration

Reference	M5a
Element predicted not to achieve good by 2015	Fish
Reason for failure	Confirmed - physical modification barriers to fish migration
Alternative objective	Extended deadline
Reason for alternative objective	Disproportionately expensive - Disproportionate burdens

Justification for alternative objective

If implemented before 2015, the required measure would impose a disproportionate burden. We are considering possible relevant alternative financing mechanisms.

We are confident that the fish classification is at less than good status and that barriers to fish migration are the only or contributory factor in the observed impact. A technically feasible solution is available. The results of the national impact assessment have shown that there is a favourable cost/benefit ratio associated with remedies to deal with barriers to fish migration. This will be supported by the introduction of the fish passage regulations, expected in 2011. Further investigation of alternative financing mechanisms will take place in order to introduce these measures, or identification of the “polluter” if this is possible. We will follow the Common Implementation Strategy Guidance Document No. 20, where it states that when affordability arguments are used to extend the deadline, the possibility to use relevant alternative financing mechanisms should be fully considered, which could include distribution of costs along polluters and users, use of the public budget (at different levels), private investment, EU and international funds etc. EA, Defra and other EU partners are currently preparing an EU Life bid, for example, on developing expertise and sharing best practice on catchment restoration funds.

Affordability is one area where there is limited guidance available at a European level and hence additional care must be taken in justifying exemptions to ensure that they follow the spirit of the Directive and its objectives. Additional care has been taken in explaining why these exemptions are being used and in making this transparent.

Although the adoption of the WFD entails obligations for member state to make available the necessary means for implementation, this needs to be moderated by the option available to member state to phase the implementation (through extended deadlines) of measures to spread the costs of implementation (while taking clear and demonstrable action in the first cycle).

To apply a time extension on grounds of affordability consideration should be given to the availability of alternative financing mechanisms, the consequences of non-action and steps taken to resolve affordability in the future.

Government is generally involved in financing fish passes because of the nature of the problem. There are no "polluters" in the normal sense of the word and the benefits are typically to the general public rather than identifiable individuals or organisation. Where fish passes can be financed by other means this is generally done. In particular to reduce costs care is taken to make sure that fish passes are installed where other changes to the water body (e.g. for flood defence) are taking place. This means that a large number of necessary fish passes are installed at low or no cost, but this is not sufficient to cover all cases where there is a positive benefits to cost ration.

The polluter pays principle is the central tenet of the Directive and where benefits are produced of similar importance is the beneficiary pays principle. Only when action is not financeable through these principles should resort be made to public budgets.

In the main the fish passes have no identifiable "polluter" and the beneficiaries are impossible to target because these are generally non use benefits (i.e. not individual or organisation like fisheries). If "polluters" or beneficiaries could be uniquely identified they would be chased for a contribution to the cost which may make them affordable depending upon the scale of the cost.

In terms of the consequences of the time extension for fish passes these are mainly the delayed benefits of achieving good ecological status in the relevant water bodies.

Defra is actively engaged in identifying alternative sources of financing for fish passes and in securing available funds through the process of allocating government funds. Defra sought an additional £10 million as part of business planning (25% to be spent on fish passes) and is currently establishing a business case for further expenditure as part of the Comprehensive Spending Review. Both the processes consider the costs and the benefits of the action in a similar way to that required by the Directive, to ensure that public budgets are spent on the most value for money interventions. As a consequence additional expenditure over and above that identified in the spending review process would not be considered value for money, in the sense that using the money to finance a greater number of fish passes would produce a net cost because the benefits of the passes are less than the benefits of alternative ways of spending the governments budget. This process of setting public budgets is kept under constant review as is the question of alternative sources of finance including taxes and changes and should changes arise in the future these will be reflected in later plans.

Investigation type

Investigate feasible measures

Example of investigation

Investigate cheaper measures and alternative financing mechanisms.

Possible future measures

The introduction of the new fish passage regulations will give additional powers to help address this pressure. Where the EA owns the barriers it will be our responsibility to address fish passage issues. For those owned by third parties, the responsibility will lie with them. Encourage local groups e.g. Rivers Trusts, angling associations, to install fish passes, which can often be more cost effective.

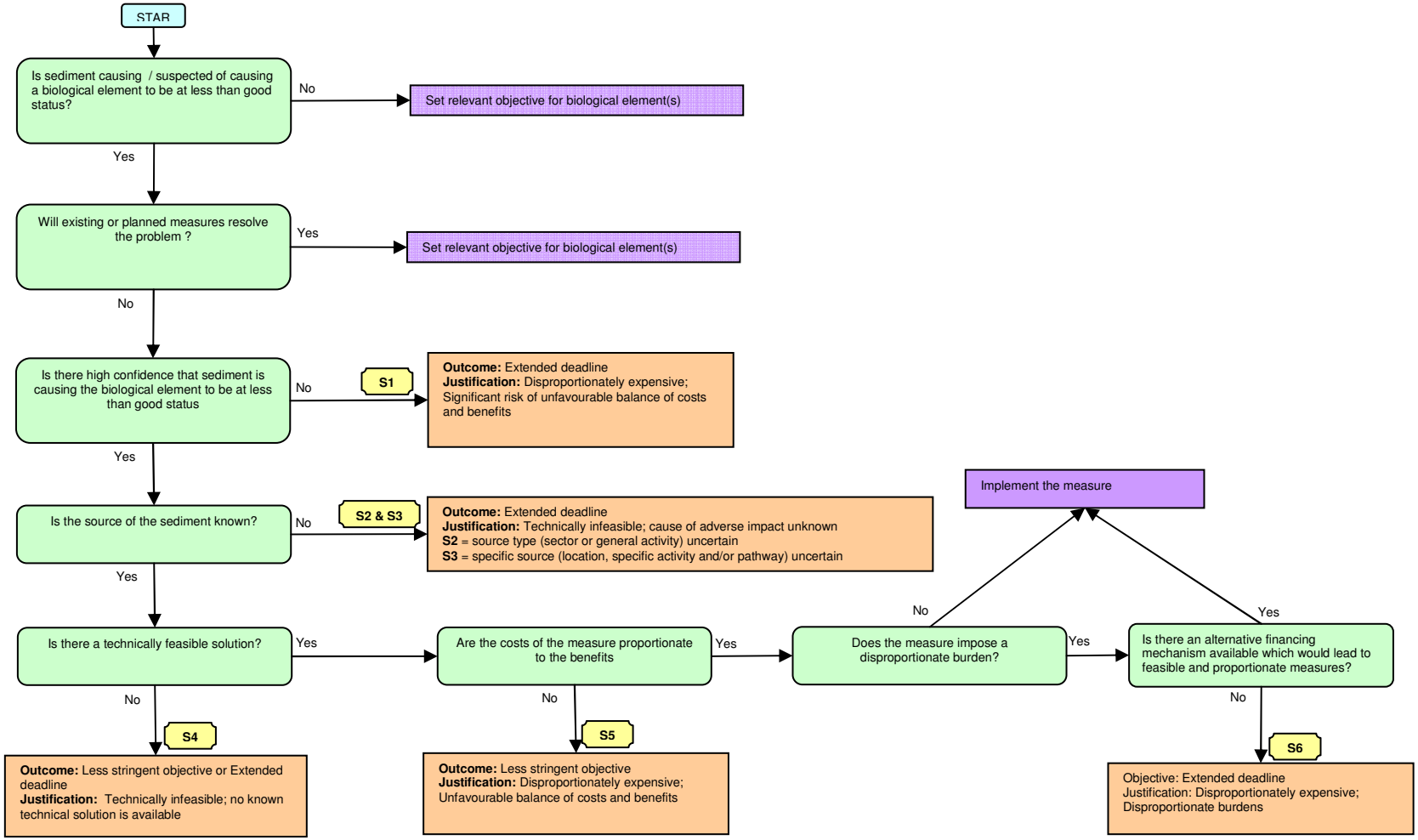
Explore Axis 4 Leader options in funding action at local catchment level.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Removal of all barriers to fish migration. In most cases we will have to introduce fish passes rather than removing the obstruction.

Decision codes S2b and S3b

Decision tree for sediment



Reference	S2b
Element predicted not to achieve good by 2015	Biological element
Reason for failure	Suspected – sediment from diffuse source agricultural
Alternative objective	Extended deadline
Reason for alternative objective	Technically Infeasible - cause of adverse impact unknown

Justification for alternative objective

The source (sector or general activity) of the sediment impacting on biology is not yet confirmed

Agriculture is the suspected source of the sediment. However, until this is confirmed with reasonable confidence, the identification and application of measures (including who needs to implement them) tailored to local circumstances is not possible. It is therefore not technically feasible to achieve good status by 2015.

Projects have been initiated that will develop methodologies for reviewing and gathering evidence to help identify the sources and pathways of sediment that is contributing to biological failure and inform the identification of appropriate measures.

An extended deadline for achieving good ecological status is therefore required. This will allow time to undertake investigations to confirm that agricultural sources are causing the failure and to identify and implement appropriate measures.

Investigation type

Investigate source of failure

Example of investigation

Investigations to confirm the source of sediment and the pathways by which the sediments are entering water bodies (e.g. field run-off, field drains, road/track drains, bank-side erosion and livestock poaching etc.). The investigation may include site visits, monitoring, and desk study modelling.

Possible future measures

If agriculture is confirmed as the source of the problem:

- More local partnership projects to support farmers to change practice, or stabilise bank-side habitat
- Increased roll-out (in terms of duration and geographic extent) of Catchment Sensitive Farming type advisory initiatives in England and Wales
- Increased Environment Agency-led pollution enforcement campaigns (including use of anti-pollution works notices)
- Where appropriate designation of Water Protection Zones
- Widen the measures and activities included in agri-environment initiatives (e.g. rural sustainable drainage systems) as well as securing more effective targeting and enhanced funding
- Widen the measures and activities that are incorporated in to Common Agricultural Policy funded initiatives (e.g. increase soil resource protection measures in current approach to cross-compliance, or whatever may follow in future)
- Establish and or extend existing national partnerships that provide advice and support to land managers to improve practice
- Targeted land use change (e.g. afforestation or reversion of arable land to low intensity pasture) in priority areas

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

- Wide scale reversion of arable land to low intensity pasture over large parts of England and key areas in Wales
- Wide scale reversion of agricultural land to woodland over large parts of England and Wales
- Wide scale reduction in livestock densities (cattle, sheep and pigs) over large parts of England and Wales

Reference	S3b
Element predicted not to achieve good by 2015	Biological element
Reason for failure	Confirmed – sediment from agricultural diffuse source
Alternative objective	Extended deadline
Reason for alternative objective	Technically infeasible - cause of adverse impact unknown

Justification for alternative objective

The specific agricultural source (location, specific activity and/or pathway) of the sediment that is impacting on the biology is not known

Until the specific source(s) of the sediment is known with reasonable confidence, the identification and application of additional measures (including who needs to implement them) tailored to local circumstances is not possible. It is therefore not technically feasible to achieve good status by 2015.

Projects have been initiated that will develop methodologies for reviewing and gathering evidence to help identify the sources and pathways of sediment that is contributing to biological failure and inform the identification of appropriate measures

Projects have also been initiated that will review the effectiveness of measures to control diffuse pollution, including sediment, that will improve the identification of appropriate cost effective solutions to reduce sources of agricultural sediment.

An extended deadline for achieving good ecological status is therefore required. This will allow time to undertake investigations to confirm the agricultural source and pathways of sediment causing the failure and to identify and develop appropriate measures (e.g. source protection measures to stop diffuse pollution occurring in the first place or mitigation measures to stop sediment getting into water bodies).

Investigation type

Investigate source of failure

Example of investigation

Investigations to identify the relative importance of the specific activities and locations giving rise to unacceptable quantities of sediment in a river system. This may include site visits, monitoring, desk study modelling and stakeholder (e.g. farmer) liaison.

Possible future measures

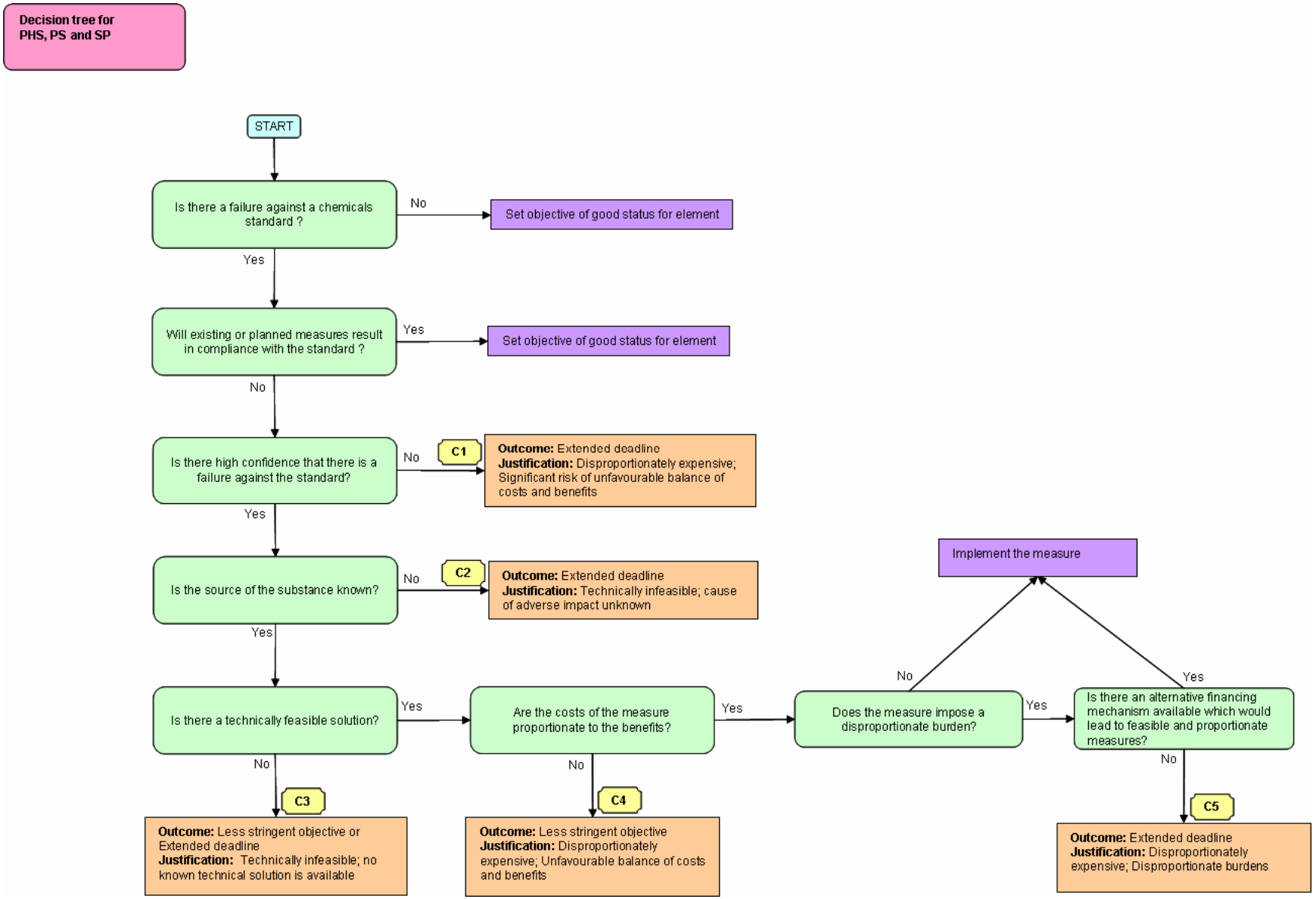
When specific source identified:

- More local partnership projects to support farmers to change practice, or stabilise bank-side habitat
- Increased roll-out (in terms of duration and geographic extent) of Catchment Sensitive Farming type advisory initiatives in England and Wales
- Increased Environment Agency-led pollution enforcement campaigns (including use of anti-pollution works notices)
- Where appropriate designation of Water Protection Zones
- Widen the measures and activities included in agri-environment initiatives (e.g. rural sustainable drainage systems) as well as securing more effective targeting and enhanced funding
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Decision codes C1a and C2a



Reference	C1a
Element predicted not to achieve good by 2015	Priority substances, priority hazardous substances and specific pollutants
Reason for failure	Unknown - uncertain there is a failure / impact
Alternative objective	Extended Deadline
Reason for alternative objective	Disproportionately expensive: significant risk of unfavourable balance of costs and benefits

Justification for alternative objective

The water body is currently non-compliant with the EQS, but with low confidence of failure

For over 20 years we have routinely monitored surface waters for chemical parameters listed in a range of national and European legislation (including for example, those chemicals specified in the Dangerous Substances and Freshwater Fish Directives). The Environmental Quality Standards Directive (2008/105/EC) introduces new or more stringent standards for many substances. In some cases where a new standard has been introduced, we have not previously monitored surface waters for these substances – our monitoring programme is targeted where risk is considered to be highest. Similarly where a more stringent standard has been introduced our analysis may have been at a higher limit of detection than would now be required to assess compliance with the increasingly stringent standards. While we have adapted our monitoring programme to take account of the new standards, there is sometimes insufficient monitoring data to assess compliance with high confidence. This will be addressed as additional monitoring data becomes available.

For water bodies which are currently non-compliant with low confidence of failure, our priority in the first cycle will be to carry out further investigation to confirm the situation and identify sources and additional potential measures. To identify measures until the failure is confirmed would mean that there is a significant risk of wasted investment. This is considered disproportionately costly given the high possibility that such measures would not confer any additional environmental benefit.

Investigation type

Investigate to confirm failure and/or impact

Example of investigation

Additional monitoring or modelling (e.g. using SIMCAT models) to confirm failure against the standard with high confidence. Where an EQS failure is confirmed with high confidence, the significance of various sources can then be assessed in order to identify and apportion causes of failure. This will allow appropriate measures to be targeted for implementation in this or subsequent river basin planning cycles.

Possible future measures

Possible future measures will depend on the substance in question, confirmation of failure against the standard and identification of sources that contribute to the failure. Measures which could be appropriate for individual substances are set out in national pollution reduction plans (PRPs) for all the priority and priority hazardous substances and 6 specific pollutants. Measures may include control at source (e.g. through additional marketing and use restrictions); additional regulatory controls on point sources, including sewage treatment works, industrial emissions and action to address discharges from abandoned mines; actions to address diffuse sources, e.g. pollution prevention (through local education campaigns, voluntary initiatives and the adoption of best practice methodologies), extension of schemes such as Catchment Sensitive Farming and the Voluntary Initiative for pesticides, and additional controls on dredging to reduce releases of TBT from contaminated sediments.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

Measures that are likely to be technically infeasible or disproportionately expensive will depend on the substance in question and the source of that substance. The PRPs include an evaluation of the technical feasibility and costs associated with available and potential measures, which is based a range of supporting information, e.g. the preliminary cost effectiveness analysis (pCEA).

This illustrates that some measures will be more useful in the first river basin planning cycle than others. For example, it is feasible and relatively cost effective to investigate the concentration of lead in leachate from landfill sites and remediate where necessary (estimated at £5 million per tonne lead removed); it is neither feasible nor cost effective to replace all domestic lead pipes to prevent leaching into the sewerage system (£54 – 136 million per tonne lead removed). It should also be noted that some substances, e.g. cadmium are naturally occurring and complete elimination from all surface waters will not be possible. Furthermore, in some exceptional circumstances where water bodies are severely impacted by a legacy of metal mining, it may be technically infeasible or disproportionately expensive to restore metal concentrations to a level that approaches the standard due to the nature of the metal sources.

Reference	C2a
Element predicted not to achieve good by 2015	Priority substances, priority hazardous substances and specific pollutants
Reason for failure	Unknown - reasons for failure unknown
Alternative objective	Extended deadline
Reason for alternative objective	Technically infeasible: cause of adverse impact unknown

Justification for alternative objective

The source of the substance causing the failure is unknown

Chemicals are released into the environment from a wide range of sources including urban and agricultural land use, industry, domestic release to sewers, mines, ports and harbours. For water bodies where the sources of the pollution is not known, or not known in sufficient detail to be able to identify and appraise measures (including identification of the site or activity who is responsible for causing the pollution), it is technically infeasible to identify and implement additional measures, and achieve the objective by 2015.

For over 20 years we have routinely (usually annually) assessed compliance with water quality standards (such as those for the Dangerous Substances and Freshwater Fish Directives) and tried to identify the activities releasing the substances and causing the failure of the standards. We use a number of different approaches to do this including routine and investigative monitoring, modelling, and site inspections. Despite this, the sources of some of these old failures remains unknown.

In 2008 and 2009 we assessed compliance with the new standards for priority substances, priority hazardous substances and specific pollutants. Where these substances did not have standards under the old directives, or where the standards for the water framework directive are tighter than before, we have identified many new failures.

We have produced and consulted on (in conjunction with the draft river basin management plans) national pollution reduction plans for all the priority and priority hazardous substances and 6 specific pollutants. These identify potential point, diffuse and historical sources of these substances but their significance varies locally and in the time available, we have not been able to identify specific sources and their relative contributions for each of the new failures. An extended deadline for achieving good ecological and/or chemical status is therefore required.

Investigation type

Investigate cause of failure

Example of investigation

Potential point, diffuse and historical sources are set out in national pollution reduction plans (PRPs) for all the priority and priority hazardous substances and 6 specific pollutants. The significance of these and any locally relevant sources will be assessed through additional monitoring or modelling (e.g. using SIMCAT models) to identify and apportion causes of failure. This will allow appropriate measures to be targeted for implementation in this or subsequent river basin planning cycles.

Possible future measures

Possible future measures will depend on the substance in question and the sources that contribute to the failure. Measures which could be appropriate for individual substances are set out in the PRPs. Measures may include control at source (e.g. through additional marketing and use restrictions); additional regulatory controls on point sources, including sewage treatment works, industrial emissions and action to address discharges from abandoned mines; actions to address diffuse sources, e.g. pollution prevention (through local education campaigns, voluntary initiatives and the adoption of best practice methodologies), extension of schemes such as Catchment Sensitive Farming and the Voluntary Initiative for pesticides, and additional controls on dredging to reduce releases of TBT from contaminated sediments.

Measures required to achieve 100% GES/GEP by 2027 that are likely to be technically infeasible or disproportionately expensive

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