

Title: New Authorisations for water abstraction IA No: DEFRA0046 Lead department or agency: Department for Environment, Food and Rural Affairs Other departments or agencies: The Environment Agency, Welsh Government and, Natural Resources Wales	Impact Assessment		
	Date: 07/12/2015		
	Stage: Consultation		
	Source of intervention: EU		
	Type of measure: Secondary Legislation		
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Summary: Intervention and Options	RPC Opinion: GREEN
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Cost of Preferred (or more likely) Option

Total Net Present Value	Business Net Present Value	Net cost to business per year (EANCB on 2014 prices)	In scope of One-In, Two-Out?	Measure qualifies as
-£96.47m	-£96.47m	£4.32m	No	N/A

What is the problem under consideration? Why is government intervention necessary?

Water is a precious resource for a variety of human uses and for flora and fauna in the environment. Many areas of the country are already experiencing water stress as a result of competing demand for access to the water available. With population growth and climate change that pressure is expected to increase. Existing water abstractions (the process of extracting water from a particular source), whether these are licensed or unlicensed, are having a damaging effect on the environment. While an abstraction licensing regime has been in place for several decades, abstraction for a number of purposes has remained outside licensing control, allowing some groups to take water irrespective of the needs of other users of the environment. In 2000 the EU Water Framework Directive (WFD) was set up to help Member States manage their water resources effectively. A requirement of the WFD is to have prior authorisation and control of abstraction; subsequently the adoption of the WFD eventually led to the Water Act 2003, which includes provisions to end most abstraction exemptions in England and Wales by awarding them “**New Authorisations**”

What are the policy objectives and the intended effects? The objectives behind New Authorisations are:

- i) **Enable better future management of water resources:** to directly tackle the environmental damage caused by unlicensed abstractions and support the future reform of the licensing system;
- ii) **Meet European statutory obligations on the status of our water bodies:** all licensed abstractions would be managed through the existing legislative framework and considered part of the programme of measures intended to meet ‘Good’ water body status for the Water Framework Directive;
- iii) **To extend the licensing regime in a way that is cost effective, equitable and places minimum burden on abstractors.**

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

Option 0: Business as Usual: we do not bring licence exempt abstractors into licensing but rely on existing regulations surrounding environmental protection to meet our statutory requirements on water bodies.

Option 1: Commence new authorisations **without the inclusion of a transitional arrangement;**

Option 2: Commence new authorisations with **the inclusion of a transitional period** for pre-existing abstractions;

Option 3: Commence new authorisations with the inclusion of a transitional arrangement as under Option 2, yet also give provision to award **compensation for planned future increases in abstraction.** .

Option 2 is our preferred option as it meets our EU obligations on prior authorisation and control of water abstractions, but also treats exempt abstractions on an equal footing with those already licensed and gives an application period for new authorisations to submit and the regulator to process.

Will the policy be reviewed? It will not be reviewed. **If applicable, set review date:** N/A

Does implementation go beyond minimum EU requirements?			No		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	Micro Yes	< 20 No	Small Yes	Medium Yes	Large Yes
What is the CO ₂ equivalent change in greenhouse gas emissions? (Million tonnes CO ₂ equivalent)			Traded: 0		Non-traded: 0

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: _____ Date: _____

Summary: Analysis & Evidence

Policy Option 1

Description: Commence the licensing requirement for currently exempt abstractions **with no transitional period.**

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2015	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: -83.7	High: -295.2	Best Estimate: -126.2

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0.1	4.3	92.6
High	38.8	12.3	311.4
Best Estimate	7.9	6.0	138.7

Description and scale of key monetised costs by 'main affected groups' relative to the base line

- Compliance and Administration costs:** including one-off compliance costs, ongoing annual costs and costs incurred every 12 years for licence review. **Central NPV £26.0m low 15.3 high 123.7**
- Economic Output:** changes to output from either investing in mitigating technology; reduced profits due to reduced abstraction volume; having to switch location or activity or cease operating. **Central NPV £112.8m low 77.3 high 187.7**

Other key non-monetised costs by 'main affected groups'

- No transitional arrangements may limit applicants' time to gather information and adapt their businesses, leading to less than optimal responses. No significant impact anticipated as policy has been expected since 2003.
- Supply chain links: E.g. canal boat operators; cement works and; irrigation from drainage boards. These small impacts are not easily monetised and there is no evidence indicating the extent of dependence on abstraction.
- Logistical problems – unlikely EA can assess all New Authorisations within the usual determination period.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0	0.4	8.8
High	0	0.8	16.3
Best Estimate	0	0.6	12.5

Description and scale of key monetised benefits by 'main affected groups'

Monetised benefits from levelling the playing field in the form of increased output are reported for existing agriculture /horticulture licensed abstractors due to the increased volume /availability of water flows from the curtailment and restrictions placed on trickle irrigation farms. **Central NPV £12.5m low 8.8 high 16.3**

Other key non-monetised benefits by 'main affected groups'

- Environmental benefit*, prevention of environmental damage and more efficient water resource management. Greater site specific abstraction data is necessary to assess the environmental improvements.
- Levelling the playing field* through reducing unfairness arising from over consumption by exempt abstractors that depletes water stock for existing licenced abstractors who face regulated restrictions. Regulating exempt activities would benefit all existing license holders through the increased availability of water flows.

Key assumptions/sensitivities/risks

Discount rate (%) 3.5%

There is no transitional period available to those seeking New Authorisations. Abstractors take up cost effective/feasible mitigation options when faced with restrictions to their abstraction activities providing they are cost-beneficial. Regulator does not refuse a licence to any activity not causing at least serious environmental damage.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 6.2	Benefits: 0.6	Net: -5.6	No	N/A

Summary: Analysis & Evidence

Policy Option 2

Description: commence the licensing requirement with two years for **transitional arrangements**.

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2015	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)			
			Low: -63.3	High: -229.7	Best Estimate: -96.5	
COSTS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)		Total Cost (Present Value)	
Low	0.1		3.6		75.3	
High	38.8		9.7		251.7	
Best Estimate	7.9		5.0		113.6	
<p>Description and scale of key monetised costs by 'main affected groups'</p> <p>The main difference between Options 2 and 1 is a transitional period that allows for a further two years of exempt abstraction and so defers the impact on an applicant's economic output and compliance and administration costs. For the quarries and mining sector it allows two further years of extraction below the water table. <i>Compliance & Administrative costs: Central NPV 22.5 low 13.0 high 100.8</i> <i>Economic Output: Central NPV £91.1m low 62.3 high 150.9</i></p>						
<p>Other key non-monetised costs by 'main affected groups'</p> <p>These are as per Option 1, although we would anticipate fewer logistical problems for the Environment Agency and less reduction in efficiency from having a transitional period.</p>						
BENEFITS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)		Total Benefit (Present Value)	
Low	0		0.6		12.0	
High	0		1.1		22.2	
Best Estimate	0		0.9		17.1	
<p>Description and scale of key monetised benefits by 'main affected groups'</p> <p>The model indicates benefits are slightly higher in Option 2 vs Option 1. Although we might expect the level the playing field benefits to actually be lower under Option 2 relative to Option 1, due to the two year transitional period, we do not think the indicated disparity is significant. The modelling is insufficiently precise to identify the factors that explain the increase for Option 2 and it is considered that if more simulations were run, results should tend to an indicated net reduction in disparity with Option 1.</p>						
<p>Other key non-monetised benefits by 'main affected groups'</p> <p>As per option 1. In addition benefits from having a two-year transitional could:</p> <ul style="list-style-type: none"> • Provide greater time for the regulator to determine licence applications - but likely to be a negligible value. • Enable applicants to gather sufficient information for responding to New Authorisations and subsequently provide for more-efficient outcomes – but not likely to lead to significant change in the profile of benefits. <p>Environmental benefits; although, due to delay from transition, these are expected to be lower than for Option 1.</p>						
Key assumptions/sensitivities/risks					Discount rate (%)	3.5%
As per Option 1 yet there is a two year transitional period.						

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 5.1	Benefits: 0.8	Net: -4.3	No	N/A

Summary: Analysis & Evidence

Policy Option 3

Description: commence the licensing requirement with two years transitional arrangements and award **compensation for loss of planned increases to future abstraction.**

FULL ECONOMIC ASSESSMENT

Price Base Year 2014	PV Base Year 2015	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: -63.3	High: -229.7	Best Estimate: -96.5

COSTS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	0.1		3.6	75.3
High	38.8		9.8	254.5
Best Estimate	7.9		5.1	115.6

Description and scale of key monetised costs by 'main affected groups'

Monetised costs are identical to those set out in Option 2 but with inclusion of compensation claims from exempt abstractors for planned future abstractions. Indicative compensation costs - treated as transfer payments - to the regulator range from zero to £2.75 million NPV.

Other key non-monetised costs by 'main affected groups'

This option is considered to unduly favour certain groups of abstractors compared to those already licensed, who have no expectation or right to future water or compensation. Pressures from climate change mean abstractors newly licensed under these arrangements would be in a more favourable position. Rights to future water or compensation, both at cost to non-exempt abstractors, may delay investment in new sustainable sites and prolong the risk of environmental damage. This will reduce the effectiveness of the benefits of levelling the playing field.

BENEFITS (£m)	Total Transition (Constant Price) Years		Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		0.6	12.0
High	0		1.3	25.0
Best Estimate	0		1.0	19.1

Description and scale of key monetised benefits by 'main affected groups'

The monetised benefits are identical to those set out in Option 2. In addition, indicative benefits of compensation - treated as transfer payments - to licence exempt abstractors range from zero to £2.75 million NPV.

Other key non-monetised benefits by 'main affected groups'

As per Option 2. In addition, allowing compensation provisions for planned abstractions will give generous protection to those abstractors who plan to abstract at the expense of abstractors who are already licensed and may also have additional future needs. We would expect the Environment Agency would have to curtail current or future application for abstraction licences under this option and may have to make significant compensation payments.

Key assumptions/sensitivities/risks	Discount rate (%)	3.5%
As per Option 2. Compensation costs are spread evenly over the ten years in which exempt abstractors can apply.		

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 5.1	Benefits: 0.8	Net: -4.3	No	N/A

Evidence Base (for summary sheets)

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1 Overview

- 1.1 This Impact Assessment (IA) presents an appraisal of the lead options for extending the set of licensed water abstractions to cover the majority of currently unlicensed water abstraction activities within England and Wales. It supports the consultation on the secondary legislation required to commence these “New Authorisations”, and provides the analytical justification for our desired approach.
- 1.2 The initial policy proposal for ‘New Authorisations’ was included in the Water Act 2003 Impact Assessment (IA) ‘Water Bill-Regulatory Impact Assessment, Environmental and Equal Treatment Appraisals’, with supplements produced for the 2009 consultation; these IAs were not validated. This IA Defra0046 provides a more up to date analysis of the policy proposal by including data from consultations in 2009 and making use of new evidence where it has previously not existed.
- 1.3 The prior authorisation and control (i.e. licensing) of water abstraction, except for those abstractions that have no significant impact on water status, is a basic requirement of the European Union Water Framework Directive.
- 1.4 The monetised costs of our preferred option are £113 million NPV of which around 20% is due to the administration and compliance costs of licensing, while 80% is due to impact on economic output. Monetised benefits to existing licence holders from levelling the playing field are around £17 million NPV. While the monetised benefits are small, the stream of non-monetised environmental benefits that reduce the negative externalities associated with water abstraction and enhance natural capital may grow to be significant given the increasing pressures from climate change and population growth.

The Problem under Consideration

- 1.5 Water is a precious resource for a variety of human uses (public water supply, business or industrial processes, amenity and leisure) and for flora and fauna in the environment. Many areas of the country are already experiencing water stress as a result of competing demands for access to the water that is available. With climate change that pressure is expected to increase.
- 1.6 Water abstraction refers to the process of extracting water from a particular source. Existing water abstractions, whether these are licensed or unlicensed, are having a damaging effect on the environment.
- 1.7 An abstraction licensing management system has been in place for several decades. However, abstraction for a number of purposes has remained outside licensing control, allowing some groups to take water irrespective of the needs of other users or the environment.
- 1.8 Action is in hand through the regulator’s ‘Restoring Sustainable Abstraction Programme’ to vary or revoke licences where licensed abstractions are having a damaging effect.¹ However, with limited tools to manage and control the impacts of unlicensed abstractions, licensed abstractors are carrying a disproportionate share of the responsibilities and costs for protecting the environment.

Background

- 1.9 In 2000, the European Union **Water Framework Directive** (WFD) was set up to help Member States manage their water resources effectively. The WFD requires each Member State to have in place a programme of measures designed to deliver “Good” water body status.

¹ The Environment Agency is the regulator for managing water resources in England while in Wales it is Natural Resource Wales.

- 1.10 To meet the objectives of the WFD, Government goes through an iterative process of first identifying issues within each of the water bodies within England and Wales, and then drawing up a programme of measures designed to tackle the identified environmental issues within each water body. One of the basic requirements in the initial tranche of programme of measures is to have in place prior authorisation and control of water abstraction and impoundments, except for those that have no significant impact on water status.² This should have been operational by December 2012 with all water bodies expected to have Good status achieved by 2015.
- 1.11 After the adoption of the WFD at the end of 2000, a consultation on the improvements to the abstraction licensing system led to the **Water Act 2003** ('the Act'). The Act, which amends the Water Resources Act 1991, includes provisions to end most abstraction exemptions in England and Wales, whilst retaining or introducing new exemptions for low risk abstractions, e.g. abstractions of less than 20 cubic metres per day.
- 1.12 The Act allows transitional regulations to be developed on governing the creation and determination of licence applications designed to bring exempt abstractions under licence control. Secondary legislation is required to commence these 'New Authorisations', as well as to grant transitional arrangements and to create a small number of further low risk exemptions.
- 1.13 In 2009 we consulted on arrangements to commence the provisions of the Act and bring these New Authorisations under licensing control. A number of issues were raised through the consultation responses and through ongoing dialogue with the regulators, including in relation to access to water for planned abstractions; the balance of rights and responsibilities for creating a sustainable water abstraction regime; and the role compensation might have.³ As a result, the relevant provisions of the Act have not yet been commenced.
- 1.14 The Government's 2011 White Paper titled Water for Life set out its vision for reform of the abstraction licensing system to make it more responsive to future uncertainty and enable the management of England's water resources more effectively. The Government consulted on reform in December 2013 of the water abstraction licensing system.⁴ The reform aims to provide a more flexible and adaptive approach to managing water resources that are resilient to future pressures. In particular the new system will systematically link access to water with its availability and encourage abstractors to manage the risks from future pressure on water. While some abstractors remain outside of licensing control and are able to abstract quantities without regard to other licensed abstractors or the environment, a reformed system will not be able to maximise the use of available water through flexible and adaptable allocations.⁵

The Current Abstraction Licensing System

- 1.15 Water abstraction licensing in England and Wales has developed over many decades. The first licences of right were granted in the 1960s. These licences were without regard to the environment and set to last, in effect, in perpetuity. Over more recent years the licensing regime has evolved to provide greater environmental protection in a move to ensure water use is efficient and adequately valued to reflect water scarcity and competing demands.
- 1.16 The licensing system uses a range of tools to help maintain environmental protection, and also to protect the rights of downstream abstractors. These tools may include both daily and annual abstraction limits. New surface water abstraction licences also incorporate 'Hands-off-Flow' (HoF) restrictions on water use, whereby upon notice all licensed abstractors with a HoF within a given catchment are required to stop abstracting when the flow in a river drops below a defined

² http://ec.europa.eu/environment/water/water-framework/index_en.html

³ <http://webarchive.nationalarchives.gov.uk/20091205011114/http://www.defra.gov.uk/corporate/consult/water-act/index.htm>

⁴ <https://consult.defra.gov.uk/water/abstraction-reform>

⁵ The case for reforming the abstraction system was originally set out in the Water White Paper – Water for Life: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228861/8230.pdf

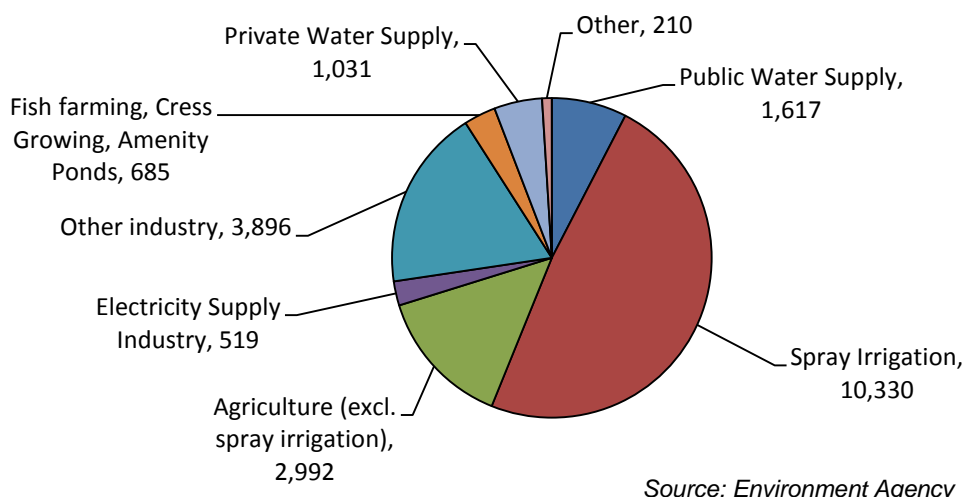
threshold. A similar condition applies to groundwater abstraction that instead refers to the levels of water - a 'Hands-off-Level' condition.

1.17 The majority of licensed abstractors pay an annual charge.⁶ this is comprised of two components: the first is an annual charge that accounts for the Environment Agency/Natural Resources Wales' (referred to as the regulator) cost of managing and regulating water abstraction; the second component is the cost of compensating abstractors associated with the revocation or variation of licences when the activity is causing harm to the environment (this is referred to as the Environmental Improvement Unit Charge or "EIUC"). Exempt abstractors do not incur any of these costs.

1.18 Licences can be varied or revoked if their associated abstraction activities are deemed unsustainable. In these circumstances, compensation is paid out of the communal EIUC pot unless the licence is revoked due to association with an activity causing serious environmental damage. Demonstrating that a licence is unsustainable (i.e. it gives provision to remove more water than the surrounding environment can cope with causing deterioration over time) requires investigation; the Water Resources Act 1991 allows for licences to be amended.

1.19 New licences and licence variations have been awarded on a time limited basis since 2001. These typically require renewal after 12 years. If a licensed abstractor requires more water it applies to the regulator to either get a new licence or to vary the terms of an existing licence.

Figure 1.1: Number of Abstraction Licences in force by type in England & Wales as at 2012



1.20 Finally there are two types of permanent licence, depending on whether or not water is to be consumed in the activity of use from abstraction. Activities which merely move water from one area to another qualify for a "Transfer" licence. Otherwise the abstractor will obtain a "Full" licence. A Transfer licence has a higher up front cost to the abstractor and does not face an annual charge from the regulator. A lot of the activities, but not all, associated with New Authorisations will require a Transfer Licence.

1.21 Licensing is the required means for Government to meet the objectives of the Water Framework Directive. As mentioned in paragraph 1.14, the current system is being reviewed as the Government works to reform abstraction management. However, the control of water resources across a catchment will be essential for reform of abstraction licensing to work effectively. The impact of future reform on currently exempt abstractors is covered in another IA out of the scope of this IA.⁷

⁶ Approximately 98% of current licensed abstractors pay annual charges. We expect approximately 80% of New Authorisation licences will be transfer licences, which do not attract annual charges.

⁷ The final Impact Assessment on the future reform of the Abstraction Licensing system is due to be published by early 2015.

The Regulator

The Environment Agency is the regulator for managing water resources in England while in Wales it is Natural Resources Wales. The regulator manages water resources through licensing most abstractions with regard to the water available in a catchment, the needs of the environment and the rights of existing abstractors. As well as volume limits, licences may have conditions attached to them to protect the environment and the rights of other abstractors. For example, licences may have a condition that requires them to stop abstracting when flows fall below a certain level or specify the season in which water may be taken.

Aim of New Authorisations

- 1.22 We aim to implement a light-touch, risk-based approach to implementation. Here we outline the New Authorisations proposal, having taken into account responses from previous consultation; the precise design of this is what we analyse in each option in this Impact Assessment.
- 1.23 The responses to the 2009 consultation have been used to refine our approach. Transitional Arrangements will help ensure that currently exempt abstractors are treated equitably as far as possible as with other abstractors that are already the subject of licence control. The Arrangements will also provide sufficient time in which to make an application to comply with these new requirements.
- 1.24 Because these abstractions are already taking place, our approach presumes them to be broadly neutral in environmental terms – they neither improve nor deteriorate the water body as a result of licensing. This would not alter the water situation or cause a water body to deteriorate or to improve. In circumstances where there is no risk of serious environmental damage taking place, we propose to license based on the volume of water abstracted in the previous four years with conditions to control abstraction at times of reduced water availability.⁸ This is intended to help minimise the impact on industry. Renewals would be considered by the regulator in the same way as other licensed abstractors.
- 1.25 Future or additional abstraction would be considered through the usual application process and judged by the regulator on their individual merits against the published criteria (water availability, environmental impact etc). Abstractions that are considered low-risk will remain exempt from licensing (for example, abstractions of less than 20 cubic meters per day). Deregulation measures in the Water Act 2003 removed around 24,000 abstractors from the abstraction licensing regime to their current levels of around 21,000 licensed abstractors. The introduction of further exemptions will keep further several thousand abstractions out of regulation.
- 1.26 Where it is considered that there is a risk of serious damage from an activity, the regulator will curtail the amount the user can abstract, such that the water body becomes no longer at risk of serious environmental damage. In the extreme a licence may be refused. The impact of an abstraction on the environment depends on a combination of factors that include the type/rarity of habitat or species affected the scale and longevity of the impact and how easily it can be undone.⁹
- 1.27 Currently where abstraction licences are modified (other than for reasons of serious environmental damage) compensation is paid from the EIUC charge fund. This fund is sourced from the annual abstraction charge and therefore the exempt abstractors do not contribute to this.

⁸ The four year period refers to the four years of abstraction prior to the policy commencement date (that is the four years up to the start of a transition period / appraisal year 0). This will help to reduce any risk of moral hazard. In addition, the regulator will scrutinise licence applications and will require evidence of abstraction activity to ensure a fair level of water is allocated.

⁹ The principles by which the regulator will assess serious damage are set out in guidance available at: <https://www.gov.uk/government/consultations/the-water-act-2003-withdrawal-of-compensation-on-the-grounds-of-serious-damage>

- 1.28 Under the proposed light-touch approach of the transitional measures, we anticipate that most exempt abstractors will receive licences. Only some abstractions would be restricted upon entering the licensing system, to protect the environment at low water flows and from causing serious environmental damage. Any applications refused or restricted due to serious environmental damage would not receive compensation. Only applications based on water use in the previous four years that are refused or restricted for reason less than serious damage would be able to apply for compensation.
- 1.29 Upon commencement, we propose that each applicant will have a sufficient window in which to gather, record and submit information to the regulator for their licence application. Afterwards there will be a further period of time for the regulator to assess and give verdict on each application. Up until the point a decision has been made on the application, each abstractor will be able to continue their abstraction activities without interruption, provided they have submitted an application.

Who does it apply to?

- 1.30 New authorisations will be granted to a range of activities but not every activity will warrant being brought into the licensing system.
- 1.31 The Water Act 2003 (as well as provision of the Environment Act 1995), once commenced, will end the majority of licence exemptions, while retaining or providing powers to introduce new exemptions for abstractions considered low risk. The current abstraction activities that will have their exempt status removed are:
- i) Dewatering of engineering-works, **quarries and mines**.
 - ii) **Trickle Irrigation**: All forms of irrigation other than spray irrigation (as already licensed).
 - iii) The use of land drainage systems in reverse to maintain field water systems and; abstraction of water containing silt for deposit onto agricultural land where the silt acts as fertiliser (process known as warping). Collectively the issues relate to **Managed Wetland Systems**.
 - iv) The transfer of water from one inland water system to another in the course of, or as the result of, operations carried out by conservancy authority, **navigation or ports**.
 - v) Abstraction of water into **Internal Drainage Districts**.
 - vi) The majority of abstractions covered by **Crown Estate** exemption.
 - vii) Abstractions within currently **exempt geographical areas**.
- 1.32 A breakdown of the estimated number of abstractors by activity that we expect to bring into the licensing regime is provided in *Table 5.1* (Section 5). The environmental and hydrological issues for each of these currently exempt activities are discussed in **Annex A** of this Impact Assessment.
- 1.33 However the Government intends to retain exemptions for low risk abstractions that will not be covered under New Authorisations. These activities relate to:
- The abstraction of saline water for ports and harbours, and in connection with dredging systems.
 - The abstraction of water with a high saline content from underground strata in the Cheshire basin. This is part of an existing exemption given to the former Mersey and Weaver River Authority in 1968.
 - The abstraction of water and impounding work solely for the management, operation or maintenance of water within managed wetland systems.
 - Impounding works constructed by or on behalf of Internal Drainage Board in exercise of their appointed area functions.

In addition, following consultation in 2009, further exemptions will be retained covering:

- Small scale dewatering used in construction activity.
- Third-party operated dry docks that transfer water within a navigation authority's system.
- Impounding works when needed to maintain safety or in an emergency.

2 Objectives

2.1 We aim to bring currently exempt abstractors¹⁰ into the water abstraction licensing system. The objectives behind this are to:

- i) Enable better future management of domestic water resources: to directly tackle the environmental damage caused by unlicensed abstractions and support the future reform of the abstraction licensing system;
- ii) Meet European statutory obligations on the status of our Water Bodies: Once licensed, all abstractions would be managed through the existing legislative framework and considered part of the programme of measures intended to meet 'Good' water body status for the Water Framework Directive;
- iii) To extend the licensing regime in a way that is cost effective, equitable and places minimum burden on the industry: for instance through allowing activities that pose a low-risk to the water environment to remain out of scope, ensuring all abstractions are managed on an equal footing, and giving sufficient transitional period for abstractors to assess their strategic options and calculate their required volumes;

2.2 Detail for how we intend to meet these objectives is in **Chapter 4**.

¹⁰ Abstraction activities currently exempt from licensing but covered by the scope of New Authorisations are listed in Section 1.31 of the Impact Assessment and also in detail in **Annex A**. In addition to activities considered low-risk to the environment, some abstractions will continue to remain exempt after the commencement of New Authorisations. These are covered in Section 1.33.

3 Rationale for Intervention

- 3.1 Water abstractions that are currently exempt from licensing can lead to the over-abstraction of water.¹¹ This could have a detrimental impact on the country's water resources and its environment.
- 3.2 This section explores the economic and wider political rationale for bringing exempt abstractions under licence control.

Future Pressures on Water

- 3.3 Over abstraction of water puts significant pressures on the **Environment**. These pressures will be exacerbated in the future by climate change and changing patterns in water use.
- 3.4 Water resources are already under pressure in many areas of the country. Water supply is characterised by seasonality and is inherently uncertain. In the future, emerging climate pressures and the effects of an increasing population's water needs will affect the volumes and certainty of water available at different times of the year. Short duration droughts (12-18 months) are likely to become more frequent, while by the 2030s, those areas already experiencing water stress¹² face a potentially increased population of over 40 per cent (particularly the River Basin Districts of Thames and South East England).¹³ This all leads to a risk of less resilient water resources and a need to be more effective at managing them.
- 3.5 The Government has recently consulted on reform of the abstraction management regime. This will create a system that is more flexible and resilient to future pressures, whilst being able to promote economic growth and protect the environment. Once completed, a reformed and more flexible system will bring benefits to abstractors by increasing the amount of water that can be used by systematically linking access to water availability. The transition to a new system is expected to take place from 2018 with the new system going live in the early 2020s.

Levelling the Playing Field

- 3.6 A key rationale for intervention is to seek **equity** amongst all water abstractors.
- 3.7 Abstractors exempt from licensing are able to remove unlimited amounts of water, irrespective of what is available and without regard to the environment or other abstractors. Where action is taken to balance the needs of abstractors and the environment, actions falls primarily on those that are regulated through the licensing regime. This leads to greater responsibility and costs being imposed on licensed abstractors as well as undermining efforts to manage water resources within a catchment area. The associated market failures are discussed further down in paragraph 3.16.
- 3.8 We intend to extend the licensing regime to all abstraction activities other than those posing low environmental risk (e.g. abstractions of less than 20 cubic metres per day). Licensing all abstractions will create a level playing field across abstractors whilst addressing abstractions that are causing serious environmental damage, and also meet the requirements of the WFD for a system of prior authorisation and control of abstractions and impoundments. It would also help enable delivery of one of the commitments in England's *Biodiversity 2020* strategy¹⁴. This impact

¹¹ See section 3.16 for the Economic Rationale behind this.

¹² Water stressed areas – final classification

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

¹³ Environment Agency's *The case for change – current and future water availability*

<http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/research/planning/135501.aspx>

¹⁴ Outcome 1C of England's *Biodiversity 2020* strategy: "By 2020, at least 17% of land and inland water, especially areas of particular importance for biodiversity and ecosystem services, conserved through effective, integrated and joined up approaches to safeguard biodiversity and ecosystem services including through management of our existing systems of protected areas and

assessment sets out the options for transitional arrangements, if any, to commence the provisions in the Water Act 2003 to bring these abstractors within the licensing regime.

Existing UK Legislation

- 3.9 For some time now we have had in place **existing legislation** designed to bring greater environmental protection. These existing tools are ineffective at achieving the desired standards of protection within the timescales of the WFD while also not fulfilling the requirements for prior authorisation and control of water abstraction.
- 3.10 Conditions placed on abstraction licences allow the regulator to manage water resources to the benefit of abstractors, the environment and society as a whole by building in conditions that reduce the risk of adverse impacts. Where abstractions take place outside of licensing control there are regulatory tools that can be used stop damaging activities and to require remediation. These actions can be achieved through one or more of the following:
- The Environmental Damage (Prevention and Remediation) Regulations 2009 (EDR)
 - The Water Resources Act 1991
 - The Conservation of Habitats and Species Regulations 2010
 - The Wildlife & Countryside Act 1981
 - The Environment Act 1995
- 3.11 These tools are fairly inflexible – they do not allow conditions around when and how water may be taken sustainably and without undue impact, rather they are tools to stop the activity and therefore the damage continuing. They also require that damage has occurred before action can be taken. Abstraction licensing, in contrast, allows prior assessment of the environmental risk of an abstraction and can put in place suitable measures to ensure the abstraction is sustainable.
- 3.12 Increased use of the powers/tools would not resolve the problem and were ruled out at the time of the Water Act 2003: These tools would only be applicable to all unlicensed abstractions in certain circumstances. None of the actions permitted through these powers/tools would address issues of inequity and inconsistency with other abstractors who are already within the licensing regime. They would not enable the regulator to fully, effectively and pro-actively carry out its duty to manage water resources. In addition, none of the actions would meet the requirements of the WFD for a control system including registration and prior authorisation.
- 3.13 Information on relevant actions permitted under each of these powers is provided in **Annex A**.

The Water Framework Directive

- 3.14 The **Water Framework Directive** sets out our environmental obligations regarding the status of our Water Bodies. The licensing regime will be used to meet these statutory obligations but efforts will be undermined without the inclusion of all water abstractors.
- 3.15 The WFD requires Member States to have:

“controls over the abstraction of fresh surface water and groundwater, and impoundment of fresh surface water, including a register or registers of water abstractions and a requirement of prior authorisation for abstraction and impoundment. These controls shall be periodically reviewed and, where necessary, updated. Member States can exempt from these controls, abstractions or impoundments which have no significant impact on water status.”

Government failure to meet this requirement creates a risk of EU infraction. The EU fine related to infraction would likely be large; in a recent case of infringement of environmental impact

the establishment of nature improvement areas.”

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69446/pb13583-biodiversity-strategy-2020-111111.pdf

assessment laws by the Republic of Ireland, the EU issued a lump sum fine of €1.8 million and a daily penalty of over €19,000 for each day after the Court ruling until the infringement ends¹⁵. This ruling took into account the ability of the country to pay; fines for the UK would likely be far higher than this.

Market Failures in water abstraction

- 3.16 There is a clear economic rationale behind bringing exempt abstractors under licence control.
- 3.17 Water is a **quasi-public good**; a “common pool resource”. Where it rains, flows and dissipates is without regard to any geographic boundary: water is to a great extent non-excludable and is difficult to assign property rights to.
- 3.18 As a common pool resource, a finite amount of water is shared over a variety of users and geographic areas. Without the assignment of property rights to all users of the good, individuals may not take into account the effects on the rest of the pool of their own abstraction activities or on the environment. This leads to issues surrounding over-abstraction, such as reduced volumes available to other, licensed abstractors and how best to allocate the long-term stock availability of water for future generations. This overuse can put serious environmental pressure on water bodies and on the ecosystems dependent upon them.
- 3.19 Furthermore the assignment of abstraction rights to the entire pool also helps to internalise the **negative externalities** imposed on the environment that are associated with over-abstraction.¹⁶ We do not expect these to be significant, but where we observe areas under considerable environmental strain we would anticipate the benefit associated with tackling the externalities to increase over time as the pressures from climate change and a growing population also begin to increase.
- 3.20 There could be a further market failure with regard to **asymmetric information** whereby exempt abstractors have more information about the nature of their abstraction activities than the regulator. This would further undermine the abstraction rights offered by the pool and may impose additional cost on current licensed abstractors.
- 3.21 Extending the licensing regime to incorporate all abstraction activities is seen as a necessary step to tackling these market failures.

¹⁵ Source: http://europa.eu/rapid/press-release_IP-12-657_en.htm?locale=en

¹⁶ A negative externality is an unintended cost imposed on a third party from an exchange it is not involved in.

4 Options Appraisal

4.1 This section sets out the options under appraisal and also the methodology used to assess them. We have considered three core options relative to the counterfactual for New Authorisations:

Option 0: **Business as Usual:** the counterfactual, where we do not bring exempt abstractors into licensing but rely on existing regulations surrounding environmental protection to meet our statutory requirements on water bodies.

Option 1: Commence the new licensing requirement for currently exempt abstractors **without the inclusion of transitional arrangements.**

Option 2: Commence the new licensing requirement for currently exempt abstractors with the **inclusion of transitional arrangements** for pre-existing abstractions.
(This is our preferred option)

Option 3: Commence the new licensing requirement for currently exempt abstractors with the inclusion of transitional arrangements as in option 2, yet use these transitional arrangements to also award **compensation for changes to future planned rises in abstraction.**
(This is the policy option consulted on in 2009)

4.2 We have focused on a set of light-touch options in our core analysis. This is because the environmental protection threshold (i.e. curtailing abstractions at risk of causing serious environmental damage) is anticipated to only apply in extreme instances. We anticipate that most exempt abstractors will receive licences through a 'light touch' review requiring minimal scrutiny that limits the burden on both exempt abstractors and the regulator. The options are set out in more detail below, with further information on assumptions and methodology set out in **Section 5.**

Option 0: Business as Usual

4.3 This is the counterfactual that the other three options will be compared to. It contains a number of existing policies that are designed to tackle harmful abstractions in accordance with the Water Act 2003. As such we choose to also detail the costs that exempt abstractors will necessarily have to incur towards stopping harmful abstractions at risk of serious damage to the environment.

4.4 Under this option any detrimental impact on water resources and the environment will be dealt with an imbalance of cost and responsibility towards licensed abstractors. Yet there would still be costs on exempt activities since their abstractions are still subject to enforcement where such activity is changing the environment as set out in section 3.10. The impact of the action is constrained by incomplete information on exempt abstractors and the associated uncertainty around the time taken to identify, locate and then implement regulations.

4.5 To reflect this, these actions are assumed to operate at a slower pace than under licensing – taking approximately an additional ten years to fully capture the effect of exempt abstractors causing serious damage to the environment. This is dealt with in the appraisal by assuming that all impacts surrounding changes to economic output are incurred from appraisal year 10. This means existing environmental legislation will eventually have the impact of New Authorisations but after a ten year delay where exempt abstractions will continue to harm the environment.

Option 1: No Transitional Arrangements

4.6 Under this option the policy will commence immediately at the start of the appraisal period. Without transitional arrangements all licence exempt abstractions would become unlawful and would have to cease once the provisions are commenced unless, that is, a licence was granted. This would create significant regulatory uncertainty and potentially create costly disruptions to

businesses where licence decisions could not be made in the time available. Furthermore, businesses may not have the time to comply with abstraction licence restrictions.

- 4.7 This option would help Government meet its EU statutory obligations on prior authorisation and control of abstractions, as well as help treat exempt abstractions on an equal footing with those already licensed. Not allowing time for exempt abstractors to transition into the regime may be burdensome to exempt abstractors and the regulator.

Option 2: Two Year Transitional Arrangement

- 4.8 This is the Government's preferred option whereby we commence the new licensing requirement after a two-year transitional period. It would help to meet our EU obligations for prior authorisation and control of abstractions; it would also help to treat previously exempt abstractions on an equal footing with those already licensed and also to tackle the market failures outlined in the previous section.
- 4.9 The Water Act 2003 gave the Secretary of State and Welsh Ministers powers to make regulations that provide transitional arrangements for those abstracting lawfully prior to removal of their exemption. This Option proposes transitional arrangements that give a two year application period for new authorisations to make an application and for the regulator to process. It would allow abstraction to continue until decisions were made on the licence application.
- 4.10 This option also allows provision of compensation payments by the regulator if current levels of abstractions were curtailed (where compensation is collected from other abstractors through the regulators abstraction charges) although this would not be applicable in the case where curtailment occurred for reasons of serious environmental damage). Yet following the 2009 consultation we have proposed an approach that will only curtail or restrict abstractions by inclusion of the Hands-off-Flow constraint or those that are causing serious damage to the environment. As such we expect minimum compensation liability to arise that might place financial burden upon those already under licensing control.
- 4.11 This option would provide compliance with licensing arrangements; it would give recognition to the lawful status of existing abstraction, treating them equitably with those already subject to licence control.

Option 3: Compensation for planned abstractions

- 4.12 This option is very similar to Option 2 in that it provides transitional arrangements for historic abstractions. However it additionally also includes an allowance for compensation claims from exempt abstractors who have plans to abstract more water in the future, allowing either for the conversation of plans to carry out irrespective of the New Authorisations, or allowing claims for compensation for the loss caused by interruption or non-conversation of these plans. Compensation claims would need to be made within ten years.
- 4.13 The option is considered to be unduly favourable to currently exempt abstractors and would be likely to allocate future, scarce resources disproportionately towards them, since those already subject to the licensing regime do not have an expectation or right to future water. This is exacerbated through increasing pressures from climate change that would put those brought into this system under these arrangements in a more favourable position. Under this option compensation claims are likely to be significant: the Environment Agency not only has to consider environmental damage but also to consider other abstractors' rights to water.
- 4.14 This option in effect reserves the right to claim compensation for the withdrawal of access to future water. We have not quantified this impact fully. At the aggregate level compensation is a transfer payment, from the regulator towards current licence exempt abstractors, but may well have distortionary effect. On a granular level, the 'Agent Based Model' (as we shall see) provides

some indication of the amounts of compensation involved. We do report the estimates but they come with caveats.

Analytical Methodology

4.15 Here we describe the methodology used to analyse the options.

4.16 Our approach is to combine two pieces of analysis we commissioned to support the evidence base for this IA: The first was produced jointly by HR Wallingford and Vivid economics that helped scope out new evidence on licence-exempt abstractors where none existed previously; the second was produced by Risk Solutions using a sophisticated Agent Based Model (ABM) of water abstraction and investor behaviour, which in turn draws upon the scoping evidence study produced by HR Wallingford/ Vivid Economics.¹⁷

4.17 The majority of the evidence gathered feeds into a top-down assessment of all the currently exempt licensed abstractors. Where possible we have complemented this analysis, particularly for sectors where the scale of impact is relatively large, by drawing on evidence from the ABM.

Sourcing the Evidence

4.18 We commissioned an evidence study design to scope out and understand the impact of implementing New Authorisations on affected sectors in England and Wales. This was necessary to perform as existing evidence in the area was highly limited. The study was commissioned and published by DEFRA and produced with the help of consultants HR Wallingford and Vivid Economics.

4.19 The evidence report helped to scope out:

- The total number of exempt abstractors for each activity;
- The scale of their current abstraction activities and associated costs and benefits;
- Likelihood of abstractors receiving curtailments or restrictions placed on their licence;
- What impact both curtailing abstraction volumes and imposing Hands-off-Flow licence restrictions (if applicable) will have on each activity;

4.20 All of this was done through the collation of disparate sources of existing data and by gathering new information through interviewing a representation of the exempt abstractors.¹⁸ For instance the interviews provided evidence on the likely mitigating options exempt abstractors may choose to take. An analysis was performed on the gathered economic and environmental costs by data interpretation and through use of expert judgement.

4.21 The information from the first phase was used to establish a baseline of existing water abstraction volumes for the various exempt sectors. Both of the following analytical methodologies apply this evidence to assess the impact of New Authorisations on specific sectors.

¹⁷ "The Impact of New Authorisations on water abstractions", published by Defra 2013 in conjunction with HR Wallingford and Vivid Economics. This was a project designed to gain understanding of the commercial risks to abstractors as well as the broader cost and benefit impacts of New Authorisations.

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18618>

¹⁸ Interviews were carried out to gather information on how the exempt sectors were using their exempt abstractors. The interviewees were asked for data on volumes of water abstracted and the value of this abstracted water to their activities. Not all were able to provide the information. As such the information in the top-down assessment is based on the available existing data and supplemented by the information gathered in interview.

Top-Down Assessment

4.22 This part of our analysis encompasses most of the sectors that fall under New Authorisations. It builds upon a methodology used by HR Wallingford and Vivid Economics to assess the impact of the policy. The analysis is constructed as follows:

- Identifying mitigation options for maintaining output levels together with their associated costs;
- Developing a top-down model for an assessment of the impact restricting/refusing future licences. These impact both the choice of mitigation option and each activity's licence compliance cost.

4.23 In this phase of the assessment, our four options were considered against three separate licence scenarios. Only one is chosen for our core option analysis for consistency with the bottom-up modelling approach (to be discussed).¹⁹

4.24 In the licensing scenarios a cautious view was taken over the level of what constitutes 'serious damage' to the environment. In itself, curtailing abstractions that cause serious damage will not be enough to meet all of our 2015 Water Framework Directive (WFD) targets on Water Body status. The licence scenarios under consideration range from setting environmental criteria designed to prevent abstractions causing serious damage to environmental criteria that go further by meeting our WFD objectives. More explicitly, the three licensing scenarios considered are:

- i) *Scenario A* is a very extreme scenario under which **all** licence applications would be refused if the activity contributes to a Water Body not meeting any of its WFD objectives (beyond serious damage), or where catchments are over-abstracted or over-licensed. This would also include licence refusal for all seriously damaging abstractions, and Hands-off-Flow restrictions where applicable.
- ii) *Scenario B* covers a situation where **some** (roughly a half) of licence applications would be refused if the activity contributed towards a Water Body not meeting any of its WFD status objectives (beyond serious damage), or where catchments are over-abstracted or over-licensed. This would also include licence refusal for all seriously damaging abstractions, and Hands-off-Flow restrictions where applicable.
- iii) *Scenario C* covers the least severe licensing restrictions and only looks at licence refusal for all seriously damaging abstractions, and Hands-off-Flow restrictions where applicable. This is light-touch in the context of bringing water body status towards the standard set out in the WFD. *This is our preferred approach and is adopted in all of the core option analysis.*

4.25 More background for the top-down assessment is in **Annex C**.

4.26 The evidence report that underpins our top down assessment gives us our estimates on the numbers of abstraction activities that are potentially at risk of causing serious damage to the environment and what the impact of a Hands-off-Flow restriction on licences might be. All of these figures are central to our analysis.

The Agent Based Model

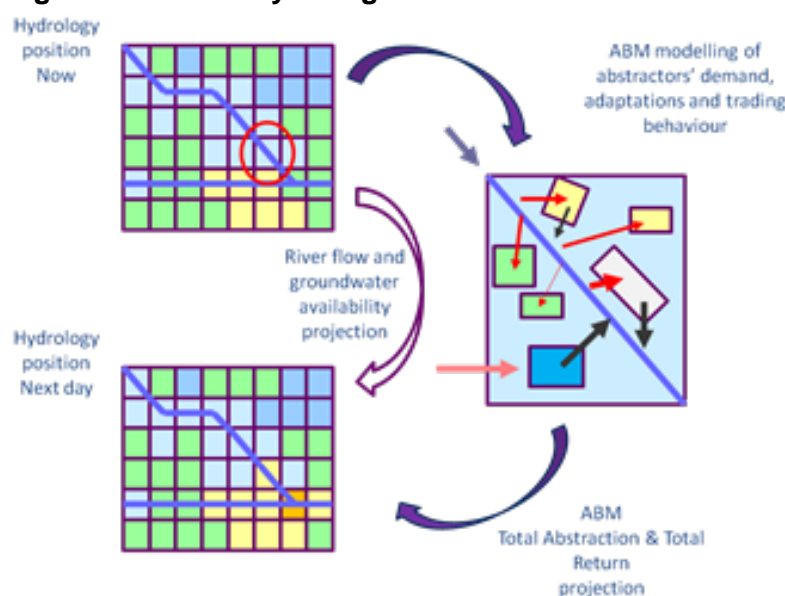
4.27 The top-down assessment gives us an indication of the impact on production and changes to abstraction volumes for an individual activity in isolation of other abstractors. While highly transparent, its simplistic approach misses some of the dynamic interaction effects on the

¹⁹ We do however consider a second licence scenario in the sensitivity analysis in **Section 6**. The third and final licence scenario is considered too extreme in context of the Government's decision to take a light-touch approach – this scenario would be to refuse licences to any activity that is unsustainable, considerably beyond our aim to curtail at 'Serious damage'.

decision making process (such as seasonal rainfall patterns, the impact of one abstractor's water flows on another, etc.) and instead uses expert judgements to suggest what the optimal choices individual abstractors will take. Usually these are judgements made for the average abstractor.

- 4.28 We have drawn on a model to assess in greater depth the interactions between abstractors and water availability; it offers more precision in our estimates but also in the choices that exempt abstractors make in the face of New Authorisations. The model used is the Agent Based Model (or the 'ABM').
- 4.29 The ABM underpins all of the analysis in Defra's Abstraction Reform Impact Assessment and has been adapted by the contractors (Risk Solutions) for use in this assessment. The estimates from the ABM will take precedent in our core analysis where the exempt sector has been adequately modelled.
- 4.30 *Figure 4.1* shows a representation of the interaction between the hydrological position and abstractor behaviour within a particular catchment. It shows how the behavioural model estimates demand for both Public Water Supply and non-Public Water Supply requirements. The model then determines their collective behaviour by taking into account the information received from the hydrological position and then determines both abstraction requirements and the levels of return flows that are fed back to calculate the next day's hydrological position.

Figure 4.1: Linkage between the hydrological model and abstractor behaviour model



- 4.31 Not all of the currently exempt sectors can be modelled using the ABM: The model does not incorporate ports, exempt geographical areas or the Royal Parks. In addition there is only the one canal in all the case study catchments for which the model has been based upon and similarly there are some Ministry of Defence agents abstracting water but this is concentrated to one case study catchment. Finally, while Internal Drainage Boards are modelled in the ABM catchments where relevant, the detail does not exist for providing any economic impact. The proportion of exempt abstractors in terms of their overall water use that are not covered by the ABM is considered to be relatively small.
- 4.32 Nonetheless, while no more or less important, the exempt abstraction activities that we are able to model through the ABM are those most likely to face relatively significant impacts (as indicated in the top down assessment). These are trickle irrigators and the quarries & mining sector. Also we will be able to determine the benefits to existing licensed abstractors.
- 4.33 The ABM can also model the Hands-off-Flow restrictions in a more sophisticated manner than under our top-down approach. We are able to set directly to what level the flow of water must

drop below (defined over percentage points of a statistical distribution) before abstractors have to cease their activities within a localised area. As such we can perform sensitivity analysis on the HoF for sectors modelled in the ABM. Our top-down approach instead generalises the impact of the HoF and is difficult to test adjusting the HoF threshold without constructing further fresh evidence.

4.34 More background on the Agent Based Model is in **Annex B** and is also described in detail in a separate report designed to support the final Impact Assessment on Water Licence Abstraction Reform.²⁰ There is also a short technical report produced by consultants Risk Solutions on the analysis that feeds into this Impact Assessment.²¹

Figure 4.2: Choice of analytical approach for each sector

Exempt Sector	Choice of Analytical Approach
Trickle Irrigation Farms	The ABM
Quarries and Mines	The ABM and Top-Down Assessment
Managed Wetland Systems	Top-Down Assessment
Navigation and Ports	Top-Down Assessment
Internal Drainage Boards	Top-Down Assessment
Royal Parks	Top-Down Assessment
Ministry of Defence	Top-Down Assessment
Exempt Geographical Areas	Top-Down Assessment
Existing Licence Holders	The ABM

How do we assess the options?

4.35 The high level methodology used in this appraisal is summarised here:

- We first developed new evidence on licence exempt abstractors where none existed previously. This critical evidence helped to formulate the base line through scoping the total numbers of exempt abstractors, the scale of their operations, the likelihood and implications of bringing them into the licensing regime and also what strategies they are likely to adopt upon policy commencement.
- To ensure that we fully incorporate the new evidence base, we use two robust, complementary analytical approaches to assess the impact of the options;
- For the majority of exempt sectors we take a *top-down* approach that builds on this evidence. The approach is to set out what proportion of currently exempt abstractors will feel impact (if any at all): this is either through licence curtailment, or restrictions on water use placed on licences. We identify what strategy is optimal for each affected activity to pursue and calculate the cost associated with this.
- We take an alternative, *bottom-up* approach for some exempt abstractors. This entails the sophisticated Agent Based Model that integrates dynamical investment behaviour and hydrological flows of water throughout catchments. This approach acts to both strengthen and complement the top-down analysis where it can be applied. For example, some of the input data and assumptions for this bottom-up analysis have been based on the outputs of the top-down assessment;
- We assume that in the base line (Option 0) existing policies eventually force environmental action with regard to harmful water abstraction at year ten of the appraisal. As such,

²⁰ The Impact of Water Abstraction Reform: A report for Defra, the Environment Agency, the Welsh Government and Natural Resources Wales, April 2014, Issue 2

²¹ <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=19207#Description>

licence exempt sectors would face cost-benefit impacts similar to Option 1-3, where the predominant driver in differences between the cost estimates of each option will be the point at which environmental action is taken. We mostly bring forward the point at which costs (and benefits) of tackling harmful exempt abstractions are incurred – and assume that the cost of tackling harmful exempt abstractions in the base line is equivalent to the costs these exempt abstractors would face when receiving New Authorisations, except that here they will not incur costs directly associated with licensing. For this we choose to clearly set out the approach for each sector alongside the impacts for the base line (Option 0) against which Options 1-3 are then assessed.

- We assess each of the core Options 1-3 within a range of high and low estimates of the cost of financing optimal mitigation strategies pursued by licence exempt sectors. This is because our evidence typically provides us with central estimates that are appropriate for the average abstraction activity; flexing inputs within a range helps us to account for any uncertainty in cost assumptions and also variation in the average size of abstraction operations. This approach is distinct from the sensitivity analysis which considers alternative scenarios that are different to the core options 1-3 to test the potential range of cost-benefit impacts;
- The sensitivity analysis (covered in **Section 6**) considers changes to the options to make them more or less 'light-touch'. It explores: changing the length of the transitional period; the level to which we curtail abstractions for serious damage; and testing the impact of reducing the strength of the Hands-off-Flow condition. In total the sensitivity analysis provides a further 15 impact scenarios.

4.36 We also develop a base line that assumes existing policies will eventually force environmental action with regard to harmful water abstraction. This is to reflect that a lot of the costs incurred by current licence exempt abstractors will happen at some point in time (assumed to be ten years). The predominant driver in the differences in cost estimates between options is due to differences in when environmental action is taken – we are mostly delaying the point at which costs of tackling harmful exempt abstractions are incurred. As such we provide detail for analysis the sectors in the base line and note that the approach is replicated across all options.

4.37 The cost and benefit categories under consideration are outlined in the table below:

Figure 4.3: Cost and Benefit categories

Impact	Description
Compliance & Administration	Costs to currently licence exempt abstractors from having to apply for and comply with the licensing system.
Economic Output	Changes to output that arise from one or a combination of a) having to invest in technology to mitigate against the impact of reductions in allowed abstraction volumes b) reductions in profits directly as a consequence of reduction in allowed water abstraction volume c) having to switch to a new activity, location or perhaps close operations.
Levelling the playing field	This is an extension to the economic output but relates to existing licence holders. Improvements to the availability and level of water flows may help existing licence holders to expand their output.
Environmental Benefits	The associated environmental (natural capital) benefit from improving flows in water bodies.

Compliance and Administration costs

4.38 All exempt abstractors will face the cost of complying with the abstraction licensing regime as they are brought into it. These are split into those occurring as a one-off, those occurring annually and those expected to recur every 12 years at the point of licence renewal (or 3 times over our 25 year appraisal period).

4.39 The range of impacts was set out in the 2009 consultation Impact Assessment, which in turn was updated from the 2003 assessment around the commencement of the Water Act. The impacts are based on data collection and local knowledge.²² The various cost categories have remained the same but the estimates have been revised for this analysis. These categories are:

One-off costs:

- Advertising (costs to the EA and to place in a local newspaper/online);
- Providing an environmental report;
- Seeking professional advice;

Annual costs:

- Annual licence charge (applicable to only full licences only);
- Record keeping, reporting and making payments;

Every 12 years:

- Metering/measurement of required water volumes;
- Time spent gathering data and completing the licence application
- The application fee.

4.40 It is not necessarily the case that all costs will apply and those which do are likely to vary for each individual abstractor. As such we have identified a range of cost estimates and also a likelihood of the coverage of the costs to generate an 'expected' unit cost for each of these charges. It is also assumed that, with the exception of two categories ('professional advice' and 'abstraction charges'), the average unit cost for each of these categories will be identical for all abstractors; any variation in sector compliance cost is driven by the number of abstractions needing licences in each sector.

4.41 We use these average figures and their associated ranges to calculate the NPV impact of licence compliance for each sector. In all of our assessment none of these costs are expected to be sufficiently large on their own to influence the behaviour of currently exempt abstractors. So for those activities (most of them) which do not face licence restrictions or curtailment to their abstraction volumes, we do not expect any adjustment to their behaviour when facing the cost of licensing and compliance alone.

4.42 In our option analysis we assume that all of the one-off costs occur once the transitional period is over. In practice, if there is a transitional period, it may be the case that some of these one-off costs occur throughout the transition; our assumption on the timing of these costs may be to underestimate the overall NPV impact of licensing and compliance cost.

4.43 An overview of the compliance and administration costs is in **Annex D**.

²² See Sections 3 and 4 of the 2009 consultation impact assessment for more detail.

Assumptions

4.44 Some of the key assumptions that feature in each of the options are discussed in the table below:

Input	Description	Modelling Assumption
Transitional Arrangements	This refers to the process to bring exempt abstractors into the licensing regime. It includes both the period of time allocated to allow currently exempt abstractors to apply for a licence and also time for the regulator to make a decision on whether to award a licence.	Application and Determination period modelled as one. All impacts are incurred at end of transition period. Abstractors to carry on activities as normal throughout the transition. Various lengths of time considered
Compensation	Compensation could be payable unless the licence is revoked due to association with an activity causing serious environmental damage. As such, we would expect only minimal compensation claims.	Under Option 3 we look at the cost of compensating for loss of future planned abstractions over a ten year period.
Hands-off-Flow	Regulatory control applied to licences that require holders to stop abstracting when the flow of surface water in a river drops below a particular depth. Occurs from licence commencement.	Treated differently depending upon analytical approach. For the top-down studies have taken fresh evidence to determine likely impact; for Agent Based Modelling Approach we have been able to impose a HoF restriction to a Q-level of 70% ²³
Licence Costs	New Authorisations face fees associated with licensing. These are a mixture of: fixed charges towards regulator costs; an annual charge for the management of abstraction and the cost of compensating abstractions associated with revocation of licences (EIUC charge). Around 80% of New Authorisations will be transfer licences.	All New Authorisations would incur these costs. The New Authorisations receiving transfer licences will not pay an annual or EIUC charge.
Curtailment	Abstractors at risk of causing serious damage to the environment may face curtailment to their activities. In the extreme a licence may be refused outright. Occurs at the licence determination stage.	A conservative view of what constitutes serious damage (based on the definition consulted on in 2011) underpins the evidence assessment that feeds into the analysis. Impact assumed to take place at the end of the Transitional Period. In our top-down approach we only consider outright refusal of licences.
Mitigation	Currently exempt abstractors consider measures intended to mitigate any impact of New Authorisations.	In the top-down approach we consider the [combination of] mitigation options that were deemed most suitable or cost-effective when scoping out the evidence. In the Agent Based Modelling we let the choice of mitigation to emerge dynamically.
Licence Review Period	New Authorisations are time limited for a period of around twelve years.	We do not model explicitly in the top-down approach, but this is accounted for in the Agent Based Modelling.
Compliance	Separate to administration cost and refers to the direct costs faced by currently exempt abstractors in complying with licence arrangements	All New Authorisations incur these costs.

²³ For a HoF condition of Q(x): x refers to level of river flow that is exceeded for x% of the year - the HOF restriction will kick in when the flow drops below this level. We chose a level of Q70 for our Agent Based Modelling as this was felt best to mimic the impact of the HOF on trickle irrigators in the evidence report suggested by HR Wallingford.

4.45 Common to all of our options is the decision making process each modelled abstractor is assumed to take:

- Prior to commencement abstractors can carry on extracting unrestricted and unlicensed volumes.
- This unrestricted use will continue until the end of the transitional period. Abstractors will react to any license restrictions immediately after this period. This modelling simplification keeps the analysis tractable and, although abstractors may receive licences with restrictions at various points during the transitional period, this is impossible to predict in advance and has a negligible impact on the cost-benefit profile.
- Throughout the transitional period an abstractor assesses strategically how they might respond to possible curtailments or restrictions to their abstraction when licensing commences; they will have a reasonable expectation of the likely scale of restrictions given their knowledge of their own abstraction/activity.²⁴ The abstractor will consider:
 - i) Administration and compliance costs associated with licensing. This will be incurred by all abstractors;
 - ii) An assessment of the impact of having their activities curtailed where they are at risk of causing serious damage to the environment. This is an impact that would occur at the point of receiving a licence. In the extreme curtailment may lead to outright refusal of an abstraction licence;
 - iii) An assessment of the impact that Hands-off-Flow restrictions on licences might have on their future activity. This is an impact that may have an effect throughout owning a licence and is based on water availability within a catchment.
- In most instances a likely response will be to carry on as normal but incur cost of complying with the licensing regime. Yet for some where the restrictions at the point of licensing or due to the Hands-off-Flow condition on the licence are strong, the abstractor may choose one or a combination of the following:
 - i) Invest in technology to mitigate against the impact of reductions in allowed abstraction volumes;
 - ii) Accept a reduction in abstraction volume and face a reduction in profits/ output volume of the end product;
 - iii) Switch to an alternative activity or location;
 - iv) In the extreme the abstractor may decline the offer of a licence and prefer to close down its activity.
 - v) Improve efficiency of production²⁵

4.46 Each of the decisions an abstractor will choose to take will depend on the activity associated with it. The most cost-effective choice(s) for each abstractor are taken from the scoping analysis done by HR Wallingford/ Vivid Economics.²⁶ In our base line assessment we consider each of the impacted sectors in turn and have summarised at the beginning of each section the types of decision abstractors in the sector will make.

²⁴ In practice abstractors will use part of the transition arrangement period to gather information to submit to the regulator. They are likely to have a reasonably accurate expectation of the restrictions they may face. Only when the regulator has assessed the application will the abstractor know precisely what implications, if any, they might face.

²⁵ This is not a direct response to restrictions on water use but is the results of an up-front capital investment that leads to greater efficiency in water use. For example, a trickle irrigation farm might choose to invest in rainwater harvesting which requires a sizeable upfront cost but in turn leads to a lower marginal cost of water use.

The scope for improvements in productive efficiency – the ability to carry out existing tasks with fewer inputs – was examined in our Evidence Study produced by HR Wallingford. For all of our sectors under considering none the scope for improvements in productive efficiency is considered minimal as mismanagement of water directly leads to greater operating costs in all sectors. See HR Wallingford (2013), page 68.

²⁶ These were in turn based on interviews with current licence exempt sectors, expert judgement and economic theory.

4.47 Our choice of appraisal period is **25 years**. This is in consideration that many significant impacts typically materialise over this time frame using our modelling approach. For example, the decision making to invest in assets such as reservoirs are based on a 20 year lifetime, while the licence review period takes place approximately every 12 years. It is also a more suitable period on which to test climate change impacts in the ABM.

5 Options Assessment

- 5.1 This section shows our assessment of the options. It begins with an assessment of the baseline Option 0, taking each impacted sector in turn, and then looks at the aggregate impacts of the remaining Options.
- 5.2 At a high-level we expect the main driver in the variation in net impacts between Options to be the compliance and administration costs faced by currently licence-exempt abstractors and the point at which licensing commences – the way we calculate the impacts in the base line and across our three Options is the same, but the point in time at which the cost-benefit impacts kick in will differ between them.

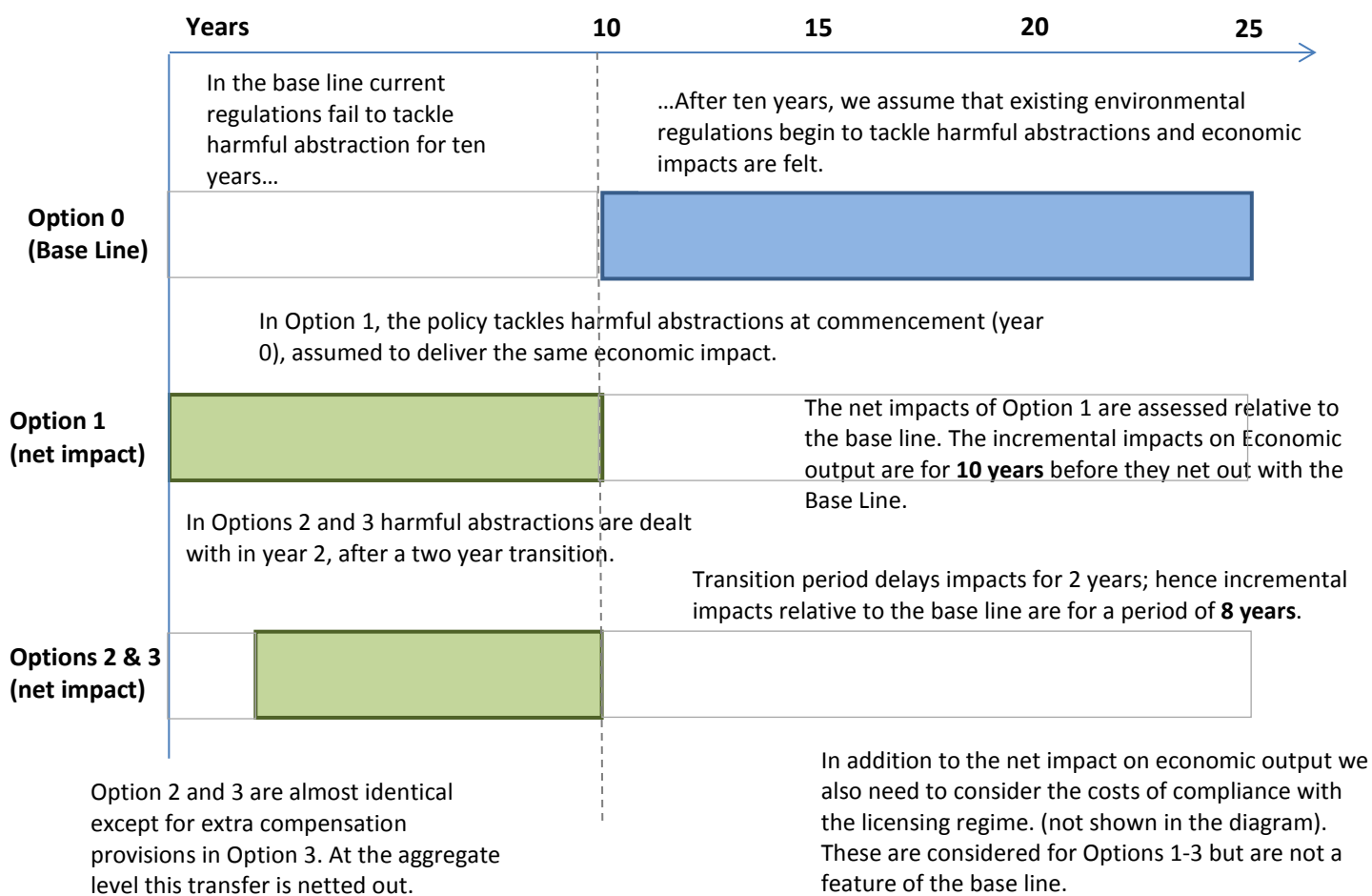
Figure 5.1: Timing of impacts for Options 1-3 and the Base Line

Option	Period in which impacts occur (over 25 year appraisal period)	Key Assumption	Compliance and Administration Costs?
Option 0 - The Base Line	Ten years of no impacts followed by 15 years of impact on economic output and improved flow benefits	Existing environmental regulations begin to tackle harmful abstractions from appraisal year ten. This is assessed in the same way we assess the impacts of other Options.	None
Option 1 - No Transition	Assessment is relative to the base line. Incremental impacts are for a ten year period which incur from appraisal year 1 to year 10 inclusive.	From appraisal year ten, the incremental impacts on economic output are the same as those in the base line and begin to net out.	Yes – starting from the beginning of the appraisal (year 0)
Option 2 - Two Year Transition	Assessment is relative to the base line. Incremental impacts are for an 8 year period and are incurred from appraisal year 3 to year 10 inclusive.	From appraisal year ten the incremental impacts on economic output are the same as those in the base line and begin to net out.	Yes – starting from appraisal year 2
Option 3 - Two Year Transition and compensation for changes to planned abstraction	As Option 2	From appraisal year ten the incremental impacts on economic output are the same as those in the base line and begin to net out.	Yes – starting from appraisal year 2

- 5.3 The approach set out in the table above gives a high-level representation of when impacts are incurred in each affected sector.²⁷ This high-level representation is also explained in *figure 5.2*:

²⁷ Regarding sectors analysed by the ABM: the incremental impacts of new authorisations evolve over time in ways that are dependent on the socio-economic, investor and hydrological conditions at the time the policy is commenced. As these vary year by year, the incremental impacts when comparing an Option 1-3 will not exactly net out with the base line from year ten. Similarly for quarries the length of the transitional period and the commencement date of the policy plays a role in determining the scale and persistence of the impact, to the extent that they do not net out precisely with the base line from appraisal year ten

Figure 5.2: Illustrative timing of impacts for Options 1-3 and the Base Line



Option 0: Base Line Assessment

- 5.4 Here we draw information from the Defra evidence report produced by HR Wallingford and Vivid Economics to provide an overview of exempts sectors as well as the an analysis of the base line which policy options 1-3 are assessed against.
- 5.5 In the base line it is anticipated that existing policies designed to prevent harmful abstractions will eventually have their intended effect.²⁸ We are assuming that after the ten years the impact will be the same as that of implementing New Authorisations, except for the cost of compliance with the licensing regime.
- 5.6 In the base line we are implicitly assuming the regulator will use the existing powers to help meet our statutory environmental objectives. In doing this we have not provided any cost estimates for the regulator’s action to enact this environmental enhancement, which are likely to be small. It should be noted that an assumption that existing policies designed to prevent harmful abstractions to water bodies will be fully effective by year ten of our appraisal period is a simplification aimed at achieving a coherent methodological structure for the analysis and reflects the state of evidence available.²⁹

²⁸ These existing policies are covered in Section 3

²⁹ This was an expert judgement based on discussions between Defra and the Environment Agency. In practice, existing policies might gradually begin to take force and begin tackling harmful abstractions earlier (or indeed later) than ten years into the appraisal period: the profile of restrictions may be more gradual and not clustered around year 10. It has not been possible to predict the profile of any gradual effects, nor

5.7 From the table in *Figure 5.3* below we consider the following nine licence exempt abstraction activities:

- i) Quarries and Mining
- ii) Trickle Irrigation Farming
- iii) Ports
- iv) Navigation
- v) The Royal Parks
- vi) Managed wetland systems
- vii) Internal Drainage Boards
- viii) Ministry of Defence
- ix) Exempt Geographical Areas

5.8 In the assessment we will see that there are no quantified impacts for sectors vi) to ix) and as such will be considered together. We also look at the impact on existing licence holders and any further non-monetised impacts that have not been covered in the sector analysis.

Figure 5.3: Expected Numbers of Exempt Abstractions by activity.

Sector	Number of Abstractions Exempt from Licensing
Quarries and Mining	1557
Trickle Irrigation Farms	990
Ports	400
Navigation (Canals)	116
The Royal Parks	9
Managed wetland systems	1500
Internal Drainage Boards	218
Ministry of Defence	54
Exempt Geographical Areas	140

Source: HR Wallingford/ Vivid Economics (2013)

have we been able to identify whether the time profile itself has a material impact on the overall costs and benefits in the base line. Hence we have taken a pragmatic and proportional approach for these reasons.

Quarries and Mining

- 5.9 There are around 1557 quarries and mines in England and Wales that are currently exempt from abstraction licensing. The economic importance of these sites is sizeable with an approximate turnover of £2.9bn³⁰. Yet only a very small proportion of abstractions for dewatering used in quarrying and mining – around **0.4%** - are estimated to cause serious damage to the environment.
- 5.10 We have taken a top-down approach to assess the impact of New Authorisations on quarries and mines. The ABM was also used to inform the analysis for this sector - the results have helped to support the view that quarries and mines would prefer to close their operations early when facing a restriction to their abstraction activity (dewatering).
- 5.11 Abstractions by quarries and mines are for the purposes of dewatering – the process of removing groundwater, which is necessary for their activities. There are no Hands-off-Flow restrictions for dewatering licences.
- 5.12 Mitigation measures to maintain output are likely to be implemented by operators when facing curtailment or restriction of their current levels of water abstraction. The range of plausible mitigation options identified were:
- i) *Prevention* measures to avoid the need for drawing water from below the water table (the act of drawdown);
 - ii) *Control* measures to restrict the depth, extent or duration of the need to drawdown;
 - iii) *Compensation* measures to ameliorate the impacts of drawdown, such as return water to the aquifer.
- 5.13 All of these measures are characterised by high associated costs.³¹ Interviews carried out for the evidence study suggested that a quarry or mining site was **very unlikely to remain commercially viable if it must undertake high cost mitigation strategies**; sites facing curtailment are assumed to therefore find closing down the site (and opening another site) preferable over mitigation strategies. Use of the ABM, as we will see, supports the decision that the optimal choice for quarries is to close down in light of curtailment due to serious damage.
- 5.14 This is plausible as mitigation options may only be feasible for quarries that have considerably longer operating lives than average; however, as existing regulations designed to prevent harmful abstractions have been in force since 2003, it would be expected that any site opened since this date (and thus having a relatively long operating life) will have been chosen commercially to avoid risk of harm to Water Bodies. We would expect the very few quarries/mines causing serious damage to be old and relatively inefficient.
- 5.15 Our options assessment thus looks at the impact of bringing forward the expected closure date of a quarry or mine. We present the impacts of a quarry or mine deciding to close down in light of restrictions to dewatering on lost output/revenue. The approach we have taken is as follows:
- i) First, we take the assumption that quarries and mines are equally likely to be at any point in their life horizon, such that on average a quarry's or mine's remaining life is half of its typical life.
 - ii) At the point exempt abstractions are ended quarries/mines decide to stop any resource extraction that involves dewatering. Some of the extraction can be done without dewatering so that each site will not necessarily close immediately but will continue to

³⁰ Aggregate Minerals Survey 2009; UK Minerals Yearbook 2011. Turnover figures relate to relevant subdivision: 'quarrying of stone, sand and clay'.

³¹ HR Wallingford Report (2013)

exhaust all resources above the water table before closing. An assumption over how much resource above or below the water table is needed.

- iii) We assume that quarries/mines deplete the resource available to them at a fixed rate over time and expect to a set target return each year given by the hurdle rate. Throughout the lifetime of the site, the operator's return will be used in part to finance the next site; this notional amount is accrued evenly over the site's lifetime.
- iv) We then look at the cost of the next available site that will be opened and calculate what the required annuity value will be over the remainder of its life, assuming dewatering is still exempt from licensing. This factors that some of the cost will have been recovered as in expectation the site will be half way through its lifetime at the start of the appraisal period.
- v) Then the same exercise is repeated but this time we look at the annuity value of having to pay for the next available site over a shorter time frame- that of the remaining life assuming the operator will discontinue with extraction that makes use of dewatering.
- vi) These values are annuitised over the 25 year appraisal period. This difference in annuity value reflects the cost of lost production to a quarry/mine.

5.16 In doing this we have made the following assumptions on the following figures, drawing on figures provided jointly by HR Wallingford and Vivid Economics for the *average* quarry or mine:

- The hurdle rate required is **7%** (pre-tax, real).
We apply a sensitivity test for alternative rates at 6% and at 9%. This is to reflect any potential uncertainty around our central estimate due to our small sample of operators and possible variation to an individual operator's financing costs
- Only a proportion of each site requires dewatering for mineral extraction to take place. Any resource to be extracted that is above the water table will not be impacted by restrictions on dewatering. It is assumed that **50%** of the remaining resource is above the water table based on interview evidence that suggested this proportion of resource extraction is currently dependent upon dewatering.
We also examine what if 25% of the remaining resource is above the water table to capture any potential uncertainty in our central estimate, given that it is based on a small sample of operators.
- The economic life of a quarry or mine is around **40 years**.³² For the purposes of this analysis it is thus assumed that the average quarry has been in operation for 20 years (it is at its mid-point) expected remaining lifetime for our average quarry or mine will be 20 years. If a quarry choses to stop its dewatering activities it will close earlier than anticipated but not right away – it will continue to extract resources above the water table at the same rate. For instance, at 50% of resource above the water table our average quarry could continue for another 10 years. For the base line the quarry will continue to finance the next site as normal for ten years and then, from the point environmental action kicks in, it will only have five (ten x 50%) further years of its life remaining whereby it is restricted to extracting resources without dewatering – the quarry is assumed the spread the remaining financing cost over this period.
- The overall resource available to be extracted in each quarry or mine is around **20million tonnes**³³ (so on average we would expect about 10million tonnes to remain). The rate which resource is extracted is around **500,000 tonnes per year**³⁴.

³² HR Wallingford (2013)

³³ HR Wallingford (2013)

³⁴ HR Wallingford (2013)

- The cost of replacing production capacity/ moving to a new site is around **£35million**³⁵. For simplicity and in the absence of further evidence, we also are implicitly assuming that abstractors are evenly distributed across groundwater sites 'at risk of serious damage' and that any Hands-off-Level restriction will have little-to-no effect on operations; it is expected that quarries or mines are able to use relatively low cost methods to mitigate for the effects of temporary water restrictions. There is a mark-up of 2% on the cost of the next quarry.³⁶

To further test uncertainties associated with the cost of replacing production capacity/ moving to a new site which could vary within a range of 30% higher or lower, we have applied sensitivity testing within this range of 30% more or less than the central average value. The mark-up is tested also at 0% and 4% for the low and high ranges respectively.

5.17 These estimates are for an *average* quarry/mine. Clearly there will be some variation around this for an individual quarry or mine. As such we have looked at high and low estimates based on plausible combinations of the assumptions listed above. These scenarios layer a number of benign or more strict assumptions (relative to the average) to give a cautious, but extreme range of the costs around the average. We do not have the evidence to suggest how likely these scenarios are and will welcome views in the consultation on how better to approximate these costs.

- i) **Central costs:** all of our central assumptions listed above;
- ii) **Low cost:** as central estimate yet with a lower hurdle rate of 6%, and a replacement cost figure 30% lower than the central figure (to capture unknown variation around the average and uncertainty in our assumptions). There is no mark-up on financing the next quarry;
- iii) **High cost:** as central estimate yet with a higher hurdle rate of 9%, none of the remaining resource is above the water table (i.e. site has to close immediately) and a replacement cost figure 30% higher than the central figure. There is a mark-up of 4% on financing the next quarry.

5.18 In calculating the final NPV figures further assumptions have been made: that quarries in the baseline plan and are not compromised. To assume otherwise will increase the baseline costs and lower our NPV impact on quarries. The mark up on cost on paying for the next available quarry is 5%.

5.19 Addressing abstractions causing serious damage in the mining and quarrying sector may yield sizeable benefit, not limited to those just from abstraction.

³⁵ HR Wallingford (2013)

³⁶ It is assumed that the expected market value of the natural resource is captured in these financing assumptions (notably the hurdle rate) of the quarry, and each operator finances the next site over the life-time of the current site. In addition, evidence from HR Wallingford suggests there are a significant number of potential sites for a quarry operator to move to indicating that supply is relatively elastic. Together this suggests there is low opportunity cost of not-extracting the full potential resource from a site; the imposition of water restrictions to a quarry raises the marginal cost of resource extraction, such that it becomes more cost effective to move to an alternative site with little disruption in output – we do assume the operator pays a mark-up on the next available quarry, yet the value paid captures the anticipated return over the total cost of the site. What is lost is the anticipated return over the forgone resource. Crucially the remaining resource from the original site is still available and can be extracted at a future time should it become profitable to do so.

The ABM on Quarries

The Agent Based Model can and was able to examine the impact of New Authorisations on Quarries.

There are few modelled quarries within the ABM. In this small sample, one quarry was chosen with advice from the Environment Agency to possibly be causing serious damage to the environment. Due to the few numbers of modelled abstractors in this sector the proportion receiving licence curtailment due to serious damage would be vastly overstated.

Upon examination there was no discernable impact on quarries and mines (asides from the one we selected to be at risk of serious damage) but also on surrounding abstractors in the catchment. It was felt there may have been some localised benefits but the model works on a 1km grid square which cannot detect effects at a finer resolution than this.

As such there was no impact on aggregate production: while the ABM can model Hands-off-*Flow* restrictions it is unable to model Hands-off-*Level* restrictions (that might have been applicable to groundwater abstractions) and also our licensed quarries do not see further curtailments at the licence review period (twelve years into licensing) as their activities are entirely non-consumptive.

Nonetheless the **ABM is able to confirm findings that ending licence exemptions for dewatering abstractions leads to the early closure of the site.** It was also recommended not to use the figures for lost production.

More information on modelling quarries can be found in Risk Solutions' report supporting this Impact Assessment.

- 5.20 The table below shows the impact of preventing harmful abstractions relating to the Quarries and Mining sector in the base line. The quantified cost reflects that quarries will choose to close when faced with curtailments to their output that is causing serious damage to the environment.
- 5.21 There are likely to be sizeable environmental benefits (not quantified) from curtailing abstractions here: it is estimated that this sector contributes to 40% of groundwater bodies at risk of failing to meet the objectives of the Water Framework Directive. In addition, curtailments are likely to lead to the relocation to sites in low-risk areas, and perhaps with the take up of more efficient technology.

Impact of preventing harmful abstractions relating to Quarries and Mining in the Base Line (met by existing policies) NPV £million		
<i>Low</i>	<i>Central</i>	<i>High</i>
-24.41	-37.61	-91.95

B. Trickle Irrigation Farming

- 5.22 For this sector we used the ABM to determine impact of both licence curtailment and Hands-off-Flow restriction for trickle irrigation farms. The underlying data in the model is built on a database of an actual representation of farms in the sector.
- 5.23 Around **5%** of trickle irrigation farms are anticipated to be refused an abstraction licence on the grounds of causing serious environmental damage. The model is calibrated such that a random sample of 5% of trickle irrigation farms will not be granted a licence at the transition. To help quantify the costs in the base line we take the approach that, ten years into the appraisal, the

impact on the trickle irrigation sector will be equivalent to that of awarding New Authorisations licences to meet our desired environmental standards, but after a ten year transitional period.

5.24 For these currently exempt abstractors, profits from the production of their crops or other produce after the licence transition date can be affected by:

- A refusal to award a licence due to the risk of causing serious environment damage to the Water Body;
- A Hands-off-Flow restriction on the licence such that access to water is limited at times of low flows;
- Due to the time-limited nature of new licences, at the future review stage licences can be taken back (curtailed) if future changes to water usage patterns begin to breach environmental standards.

5.25 We anticipate that trickle irrigators can adapt to a fall in profit due to a reduced access to water. Should mitigation be profitable trickle irrigation farms may, in light of receiving New Authorisations, choose to:

- i) Make use of the public water supply network instead of drawing on water abstraction;
- ii) Engage in licence trading (for example, to buy licences from other abstractors to allow for more reliable access to water);
- iii) Simply reduce, or in the extreme, halt their trickle irrigated production.
- iv) Switch to a crop that uses less water should they have suitable land;
- v) Invest in either *reservoir storage* or *rain water harvesting*.

5.26 Trickle irrigation can be used for both horticulture and for agriculture. The agriculture farms are assumed to have no pre-existing water storage facilities available to them. As such, any reservoirs that get built are in direct response to a lack of water. Yet for horticulture, the abstractors are expected to have some pre-existing rainwater storage facilities already in place, which is deemed to be standard practice in the industry.³⁷

5.27 The ABM is an aggregation of four ‘catchment’ models. We have taken a straight average of the results in these four modelled catchments for our central results. Yet to construct the High and Low estimates we have looked at the catchments with the smallest and largest impact relative to the average to suggest a suitable range in the variation about the average - around 30% higher and lower.

5.28 The table below shows the impact of preventing harmful abstractions relating to the trickle irrigation farm sector in the base line. Through estimating the combined impact of tackling harmful abstraction by either curtailing output at the point of commencement or placing restrictions on abstraction use (equivalent to receiving a HoF condition on an abstraction licence), we see that the impacts in the base line are substantial at a cost of around £52 million over the 25 years.

Impact of preventing harmful abstractions relating to Trickle Irrigation Farming in the Base Line (met by existing policies) NPV £million		
<i>Low</i>	<i>Central</i>	<i>High</i>
-37.8	-54.1	-70.3

C. Navigation (Canals)

5.29 There are around 400 abstractions made by Canals currently exempt from licensing. Navigable canals are artificial constructions that connect to natural waterways and improve the efficiency of passenger and freight transport. An estimated 300 abstractions are made by the Canal and River

³⁷ Research from discussion with the industry by Risk Solutions when calibrating their model

Trust (CRT) for navigation in England and Wales, whom are responsible for around 75% of the canal network (this number has been appropriately scaled to give the overall figure).

- 5.30 It is estimated that around 30 of these CRT abstractions (**10%**) would lead to a HoF restriction on licences³⁸. Three abstractions are considered to pose risk of serious damage to water bodies – these were determined by the Environment Agency: two of these are in Wales (on the Monmouthshire and Brecon Canal), and a third in England. Overall we anticipate that 10% of the 400 will face restrictions on their use and **1%** will be refused a licence on the grounds of risk of causing serious environmental damage.
- 5.31 We have been able to compile a high-level assessment for this sector and, while we have scoped out the possible mitigation options available to canals, we have only been advised on a single feasible cost of mitigation figure by HR Wallingford/ Vivid Economics.
- 5.32 Canals facing either HoF restrictions or curtailments are assumed to use a combination of low-cost mitigation methods. These include: system optimisation; the development of new surface water sources, and; back pumping. Only once these are explored will the canal operator respond by investing in higher cost options such as developing new groundwater sources or extending reservoirs where it is viable to do so.
- 5.33 Typically canals are expected to prioritise service levels and will attempt to maintain the integrity of the network (if they can) prior to restricting usage. With these service obligations in mind, it has been assumed that canal operators will invest to manage the risk of temporary HoF restrictions in the same way as they would licence curtailment: through a combination of mitigation options, using the lower costs option more extensively than higher cost options.
- 5.34 The approach to assessing canals is as follows:
- We assume that all canal operators take to the same combination of low cost mitigation methods. These include the development of new surface water sources and back pumping. It is estimated that the average mitigation cost per MI of Water per year is around £263.³⁹ *This is an average figure based on judgement over the appropriate choice of mitigation measures. To reflect the underlying uncertainty, the estimate is flexed by 30% for the high and low.*
 - The average combined impact of HoF restrictions and licence curtailment will lead to a loss in abstraction activity of around 9,800 MI per year for the sector as a whole (compared to around 455,000 MI abstracted in total per year). *Again this assumption is flexed by 30% for the high and low ranges.*
 - Canal operators have a duty to maintain their water levels and as such are required to mitigate all losses in abstraction volumes. Thus the total upfront central estimate of the capital cost needed to maintain water levels is around £2.6 million pounds (i.e. yearly loss in abstraction volume multiplied by yearly mitigation cost of water loss or 9,800MI x £263/MI). An assumed hurdle rate 6% and a payback period of 25 years are used to calculate the central estimate of the annualised cost of mitigation.⁴⁰ *The hurdle rate is flexed by +/- 2% for the high and low ranges.*
 - On top of the capital costs to mitigation there are additional, operating costs. They are estimated to be around £38 per MI of water pumped. Combining both the annualised capital costs and the operating cost gives a yearly cost of mitigation around **£574,000 per year**.

³⁸ HR Wallingford (2013)

³⁹ HR Wallingford (2013). Derived from data provided by the Canal and River Trust (CRT) Figure in 2013 prices consistent with source but scaled in final calculations for this Impact Assessment.

⁴⁰ This is based on cost of capital estimates provided by the Canal and River Trust.

5.35 The table below shows the impact of preventing harmful abstractions relating to the Navigation sector in the base line. The assessment by the regulator that around 10% of abstractions harm the environment and would lead to some environmental enforcement action (equivalent to a HoF restriction on a licence). In addition, an estimated 1% will face curtailment due to serious damage. The combined impact of restrictions and serious damage curtailment are quantified below.

5.36 There are also likely to be great environment benefits from curtailing harmful abstractions and introducing restrictions on water use here.

Impact of preventing harmful abstractions relating to canals in the base line (met by existing policies) NPV £million		
<i>Low</i>	<i>Central</i>	<i>High</i>
-2.8	-4.79	-7.28

D. Ports

5.37 In the Base Line we are assuming that existing measures will eventually have the same impact as implementing New Authorisations. The key difference is in the timing of the impact. For the Base Line assessment on Ports we examine the impacts on economic output through licensing and assume this will have the same effect as existing policies.

5.38 There are an estimated 116 ports in England and Wales that are currently exempt from licensing. The majority of these ports are or can be maintained by saline water and will not receive any Hands-off-Flow restriction or curtailment. This is because most ports and harbours are also covered by a proposed exemption for abstractions from saline waters.

5.39 An estimated 24 of the 116 ports and harbours in England and Wales instead require the use of abstracted fresh-water to replenish depleting water in their enclosed docks. It also is not anticipated that these fresh-water abstractions will be refused licences. It is anticipated that these ports will also be covered by the proposed saline water exemptions. There was also little evidence to suggest that fresh-water abstraction use by Port authorities is causing environmental deterioration. As such no ports are expected to face licence refusal but freshwater ports are assumed to face issue with a HoF restriction that is assumed to prevent 1.5% of freshwater abstractions.

5.40 A licence refusal would necessitate ports to purchase an ‘impounding pump’ (used to import saline water into the port to maintain water level) should the port not have one in place already. However a Hands-off-Flow restriction, one that leads to a temporary reduction in output, would be unlikely to result in operators investing in impounding pumps. Only under substantial, permanent restrictions might a port operator find this mitigating investment commercially viable.

5.41 From the evidence available to us, we would expect the operator to respond to the Hands-off-Flow restriction by a combination of temporarily reducing the level of water in docks, or through restricting the size of ships that could dock (this is assuming the port does not already have an impounding pump installed). Even an assumed revenue loss of 15% due to Hands-off-Flow restrictions in our high case scenario, this loss would not be sufficient for an operator to prefer investment in an impounding pump.

5.42 In our analysis we assume that 8 of a total of 24 will stand to lose revenue due to the HoF restrictions. The remaining 16 ports own impounding pumps already⁴¹. Some of the assumptions in our approach are as follows:

⁴¹ HR Wallingford (2013)

- We examine the cost of installing an impounding pump and also the impact of reductions in revenue associated with the Hands-off-Flow restriction.
- An impounding pump is assumed to cost the operator around £15m and will have a central expected lifetime of 25 years. The hurdle rate associated with the pump is 10%. The yearly maintenance costs are 10% of the initial value of the asset and the operating cost is estimated to be £200k/year. *The cost estimates are estimated within a range of 10% above and below for our high and low estimates. The lifetime of the pump is 25 years in all scenarios. Hurdle rate is tested +/- 3%.*
- Our data for ports has come from the Association of British Ports, which owns around 25% of all Ports. As such the figures are scaled up by a factor of four – with the remaining exempt licences all covered by Harbours. Only ports that make use of freshwater abstractions and without impounding pumps are affected by HoF restrictions. There are an estimated 8 freshwater ports without impounding pumps.
- We calculate the average revenue per port. From this we assume that for the 8 ports without freshwater pumps that they will be unable to abstract for 1.5% of the time.

5.43 The table below shows the impact of preventing harmful abstractions relating to the Port in the base line. The freshwater abstractions made by ports are no anticipated to be causing environmental problems but a small proportion of ports may face small reductions in revenue as the environmental enforcement (equivalent to imposing a HoF condition on a licence) will prevent ports from abstracting water for around 1.5% of the year.

Impact of preventing harmful abstractions relating to ports in the Base Line (met by existing policies) NPV £million		
<i>Low</i>	<i>Central</i>	<i>High</i>
-0.15	-0.34	-0.57

E. The Royal Parks

5.44 The Royal Parks manage nine parks located within Greater London consisting of around 5,000 acres of historic parkland. During the 2009 consultation it was indicated that the largest abstraction volumes take place during dry summers when other water sources, such as lakes, become unavailable. An estimated 63 abstractions take place (although this number highly contingent on weather patterns).

5.45 None of these abstractions are likely to be curtailed as there is no current identified risk of serious damage to the environment. Yet there are likely to be Hands-off-Flow licence restrictions placed on abstractions during period of drought where the Parks will be unable to irrigate. Mitigation measures (such as rainwater harvesting) might reduce any impact of a potential constraint but it was not clear whether Royal Parks would choose to invest in these.

5.46 In the base line we assume that existing regulations *will* eventually impact on the Royal Parks' ability to abstract during drought in the central scenario. We do not have evidence on the frequency of drought and how it might impact on operations.

5.47 Nonetheless to capture the effect of Hands-off-Flow restrictions on revenue we have assumed a modest reduction in yearly annual income in the central scenario of 1%.⁴² The low scenario assumes a 0% and the high scenario 2%. In addition, the cost estimates have been flexed within a range of 30% above and below the central figure. Our central figure is based on the average of

⁴² This figure was proposed by engineering consultants HR Wallingford and Vivid Economics in their research into Royal Parks.

the last three reported years of data available in annual accounts. The average total income for the Royal Parks over the three financial years from 2010 to 2013 was **£20.8million**.

5.48 The reduction is assumed to carry throughout every year of licensing. This may misrepresent the true impact as they will be concentrated in years of particularly dry summer weather.

5.49 The table below shows the impact of preventing harmful abstractions relating to the Royal Parks in the base line. The main impact of environmental protection in the base line will be for abstraction to be curtailed during particularly dry periods which may have a modest knock on effect in the Park's income.

Impact of preventing harmful abstractions relating to Royal Parks in the Base Line (met by existing policies) NPV £million		
<i>Low</i>	<i>Central</i>	<i>High</i>
0.0	-1.7	-4.4

F. Further Exempt Sectors

5.50 There are remaining sectors/ activities currently exempt from licensing that we have yet to consider. We have not quantified all the impacts on these exempt activities:

- i) Managed wetland systems;
- ii) Internal Drainage Boards
- iii) Ministry of Defence;
- iv) Exempt Geographical Areas

5.51 Our research into these areas indicates there is no or a very small current risk of serious environmental water issues associated with each activity. As such, somewhat trivially in the options analysis there is expected to be no impact either due to curtailment associated with serious damage or due to the imposition of a Hands-off-Flow condition placed on the licence. Nonetheless, there will be administration and licensing costs for each of these sectors to bear in the options analysis.

5.52 Managed wetland systems: There are approximately 190 water meadows and up to 4,000 wet grassland systems within England and Wales. Of these it is estimated that **1,500** activities (entirely located in England) may need water control in order to function.

5.53 The evidence research assumes that no water meadow are in breach of serious damage to the environment and all will entirely avoid curtailment or the need for HoF conditions to be incorporated in their licence. There are no discernable impacts on business activity or environmental stewardship schemes.

5.54 Internal Drainage Boards: The Land Drainage sector covers the Internal Drainage Boards (IDBs) within England and Wales, covering 123 in total. The Environment Agency estimate that around 218 abstraction made by IDBs are under exempt status. These are typically located in areas with special drainage requirements, such as floodplains of rivers or broad open areas. IDBs indirectly support farming.

5.55 It was felt that a very small proportion of land drainage abstractions (if any) may be curtailed or restricted on the grounds of serious environmental damage. A significant amount of scoping and uncertainty exists in the quantification of these impacts on a potential small number of abstractors: IDBs typically raise income from levies on farmers, other occupiers and Local Authorities - our research base from the evidence study was unable to reliably estimate this indirect impact on income. We have not attempted to expand upon this as we feel it would command a disproportionate amount of effort to the overall analysis.

- 5.56 Nonetheless impacts of any potential curtailment have been identified but we have not been able to take any further steps towards quantification. We feel the impacts would be limited to IDBs with extensive agriculture: the crop production of farms could be impacted as water is being abstracted on their behalf. Reductions in water use would perhaps be manageable as the IDB will take an active role in moving water to where it is most needed.
- 5.57 For this consultation Impact Assessment we will assume there are no impacts of curtailment or licence restriction.
- 5.58 Ministry of Defence: it is estimated the Ministry of Defence (MoD) occupies around 1% of UK land areas. This estate provides accommodation and training for employees, the armed services, civil servants and industry partners all to help enable military operations. It abstracts water for a number of uses, particularly for domestic use (88% of water use) such as drinking water for housing and barracks, but also for operational purposes (remaining 12% of water use) such as vehicle washing, cleaning and fire-fighting.
- 5.59 Most of water is supplied from Water Companies but, for around 30% of supply, some water is abstracted where there is no mains supply available. Much of the information on abstraction activities, costs and volumes are not publically available. However, through interview, it was determined that potential reductions in water use could affect the ability to deliver their services which could impact on whether the MoD was able to support its personnel in domestic military duty.
- 5.60 Based on the evidence available we do not expect that abstractions will be curtailed or restricted due to risk of serious environmental Damage since most of The MoD's abstractions support drinking water and sanitation – such high priority usage would be factored into licence decisions by the Environment Agency.
- 5.61 Exempt Geographical Areas: there are estimated to be around 140 geographical areas in England and Wales that are exempt from licence control. Abstractions activities in these areas are expected to be small and as such individual abstractions are unlikely to have an environmental impact.
- 5.62 Abstractions are very unlikely to be curtailed although it is recognised that abstractions in these areas may in combination impact the environment. It is not possible to assess these impacts without knowing the precise locations, associated activities and volumes abstracted. We therefore are unable to comment and determine the benefits to the environment, though are likely to be localised to specific sites.

G. Impact on Existing Licence Holders

- 5.63 Here we use the ABM to quantify some of the direct benefit to abstractors that are already within the licensing system – those that are considered to be *levelling the playing field* in allowing more efficient use of water amongst all abstractors. This is only a partial analysis as it mainly encapsulates **benefits to the agricultural sector only**.
- 5.64 The HOF restrictions and licence curtailments imposed on those entering the licensing system will make more water available in the catchment to the benefit of the existing licensed abstractors, particularly at low flows.
- 5.65 In the baseline restrictions will have impact from year ten of the appraisal due to our assumption on the effect of existing policies. The benefits come about either through a) an increase in market liquidity allows existing licence holders to participate in more beneficial trades, and b) more water is available in the catchment which pushes out the production constraint and allows farms to increase their output.

- 5.66 Our High and Low estimates for existing licence holders are based on the variation in the national level results from looking at the ABM's constituent catchment models. This is the same approach as adopted for the ABM results for trickle irrigation farms.
- 5.67 The table below shows the impact of preventing harmful abstractions relating to the existing licence holders in the base line. There are clear economic benefits to existing licensed abstractors due to improvements in access to, and reliability of water flows from curtailing harmful abstractions.
- 5.68 The benefits are likely to be higher than quantified here: we have only managed to calculate the benefit of ceasing harmful abstractions from trickle irrigators on the rest of the agriculture and horticulture sector. Including all New Authorisations and including a complete set of all abstractors would likely increase the overall benefit.

Impact of preventing harmful abstractions relating to Existing Licence Holders in the Base Line (met by existing policies) NPV £million		
<i>Low</i>	Central	<i>High</i>
9.0	12.9	16.8

Base Line Summary

- 5.69 *Figure 5.4* shows the aggregate impact of tackling harmful abstractions under the base line. It is a summary of the above sector analysis.

Figure 5.4: Summary of impacts in the Base Line (NPV £m 2014)

Sector	Low	Central	High
Quarries and Mining	-24.4	-37.6	-91.9
Trickle Irrigation Farming	-37.8	-54.1	-70.3
Navigation	-2.3	-4.8	-7.3
Ports	-0.2	-0.3	-0.6
Royal Parks	0	-1.7	-4.4
Managed Wetland Systems	0	0	0
Internal Drainage Boards	0	0	0
Ministry of Defence	0	0	0
Exempt Geographical Areas	0	0	0
Existing Licence Holders	9.0	12.9	16.8
Total	-56.2	-85.6	-157.7

Options 1-3: Overview

5.70 Here we set out the aggregate impacts of Options 1-3 *relative to the Base Line (Option 0)* as covered above. The methodology for calculating the costs for each of these sectors is the same as for the Base Line; yet the key driver of difference in the results will be that they fall earlier in the appraisal period as we choose to take environmental protection earlier.⁴³ In addition, they will also include licence compliance and administration costs as environmental protection will be achieved through licensing.

Option 1: No Transition

5.71 Without Transitional Arrangements, abstractions would become unlawful and have to cease once provisions are commenced, unless and until a licence were granted.

5.72 The key driver of the difference in these costs relative to the base line is that New Authorisations under Option 1 deliver immediate reductions (at the point of commencement) in abstractions causing serious damage.⁴⁴ The costs incurred in either having to maintain or reduce output are felt throughout the entire 25 year appraisal period – by contrast with the base line where the impacts are felt after ten years.

5.73 Immediate commencement may limit the time available to abstractors to respond by implementing mitigation measures. However this is unlikely to have notable bearing on costs for the following reasons:

- Exempt abstractors have been aware of potential commencement of licensing provisions since the Water Act 2003. In addition, curtailments and restrictions are also possible under the base line environmental protection regulations. Given the size of the main sectors affected it is highly likely these risks are already reflected in business planning. Evidence from sector interviews⁴⁵ support this;
- The mitigation options identified in the evidence report used in assessment are considered to be the most plausible in terms of their cost effectiveness and time-intensity.

5.74 The above factors taken in combination may imply that most exempt abstractors are positioned to rapidly implement mitigation measures.

5.75 The table in *figure 5.5* shows the range of impacts incremental to the base line for implementing option 1. Figures are NPV £m.

⁴³ Paragraphs 5.2 and 5.3 earlier in this section outline the difference in the timing of New Authorisations amongst the options considered.

⁴⁴ Exempt abstractors would be curtailed or restricted as soon as being brought into the regime.

⁴⁵ These were carried out by HR Wallingford and Vivid Economics.

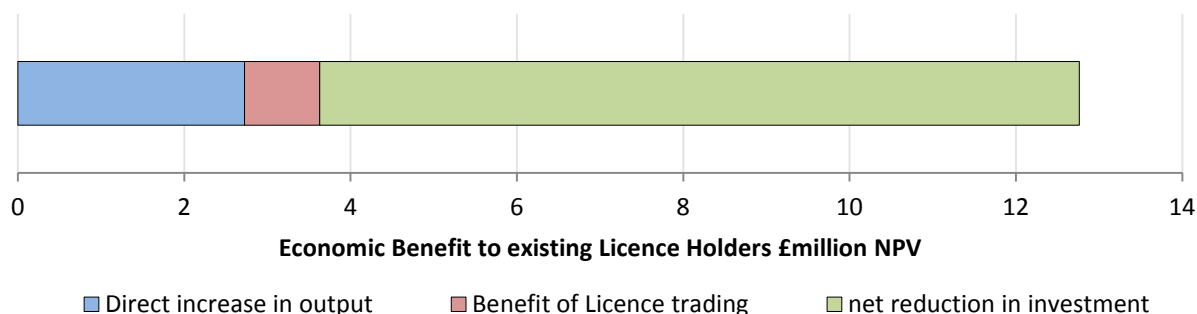
Figure 5.5: Summary of Option 1 net impacts (NPV £m 2014)

Sector	Impact	Low	Central	High
Quarries and Mining	Economic Output	-22.98	-32.35	-79.53
	Administration & Compliance	-4.00	-7.41	-32.49
	<i>total</i>	-26.98	-39.76	-112.02
Trickle Irrigation Farming	Economic Output	-50.91	-72.73	-94.55
	Administration & Compliance	-3.45	-5.54	-27.89
	<i>total</i>	-54.36	-78.27	-122.45
Navigation	Economic Output	-2.88	-4.88	-7.41
	Administration & Compliance	-1.03	-1.90	-8.35
	<i>total</i>	-3.90	-6.78	-15.76
Ports	Economic Output	-0.47	-1.05	-1.73
	Administration & Compliance	-0.30	-0.55	-2.42
	<i>total</i>	-0.77	-1.60	-4.15
Royal Parks	Economic Output	0.00	-1.74	-4.52
	Administration & Compliance	-0.03	-0.05	-0.25
	<i>total</i>	-0.03	-1.79	-4.77
Managed Wetland Systems	Administration & Compliance	-5.23	-8.39	-42.26
Internal Drainage Boards	Administration & Compliance	-0.56	-1.04	-4.55
Ministry of Defence	Administration & Compliance	-0.19	-0.30	-1.52
Exempt Geographical Areas	Administration & Compliance	-0.49	-0.78	-3.94
Existing Licence Holders	Economic Output	8.77	12.52	16.28
<i>Net Impact on Economic Output</i>		-68.5	-100.2	-171.5
<i>Total Impact from compliance and administration</i>		-15.3	-26.0	-123.7
Total		-83.7	-126.2	-295.2

5.76 Under our central analysis the net impact of Option 1 will be an NPV cost of around **£126.2 million**. Of this just over £100 million is due to net costs on abstractors having to either maintain their abstraction volumes due to business need or facing reductions in output. The remaining £26 million reflects the cost of having to comply with the licensing system. Quarries and Mining, and Trickle Irrigation Farms are the largest impacted sectors, taking up respectively around 29% and 56% of the cost to all new authorisations.

5.77 However it is worth noting that licensing is a more efficient mechanism for the prevention of serious environmental damage and will deliver environmental benefits at a faster pace relative to the base line. As well as environmental benefits there will be more benefits to other existing licensed abstractors in terms of 'levelling the playing field' on top of those we've been able to quantify here. The ABM analysis gives indication of the types of benefit to existing licence holders.

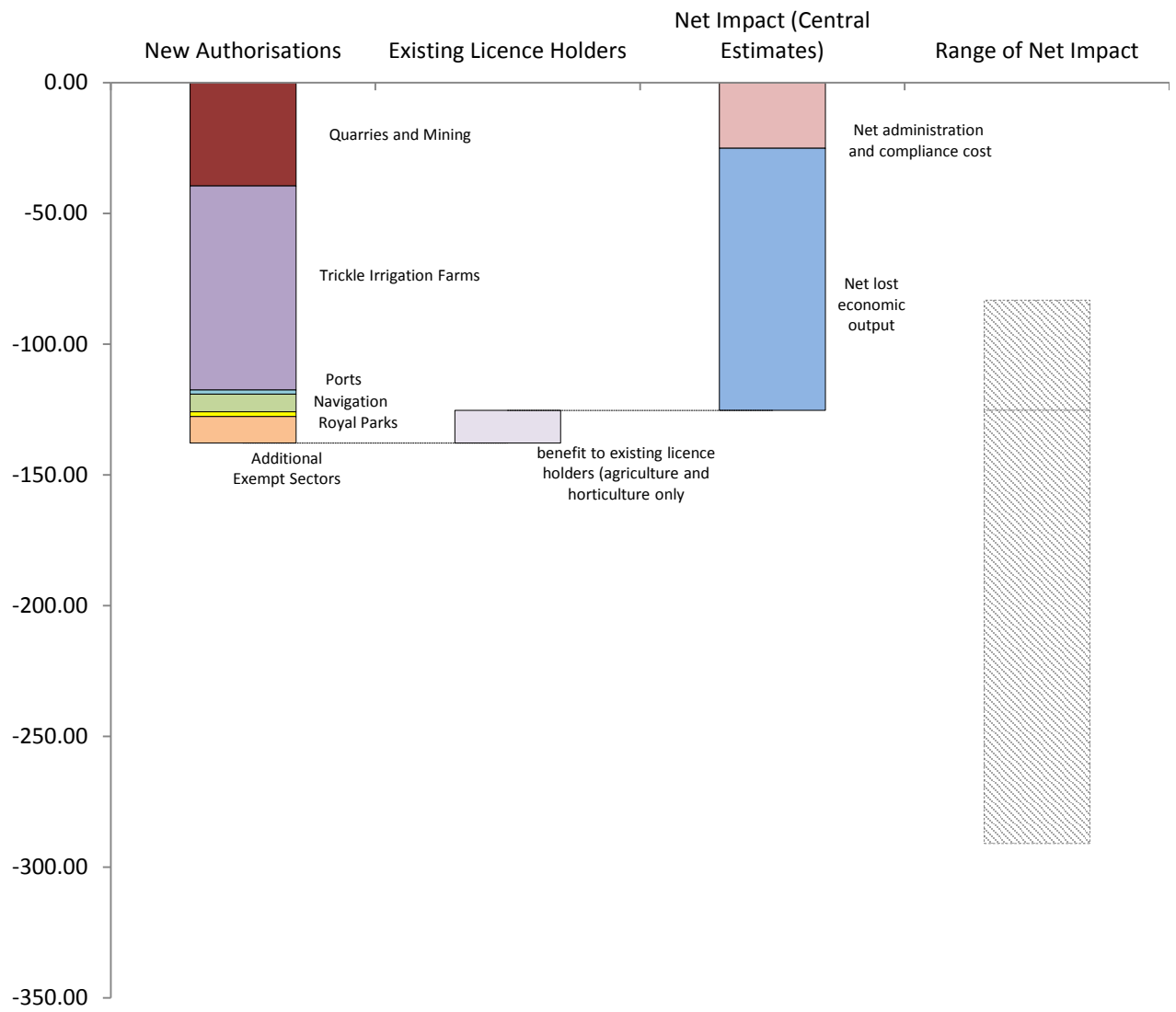
Figure 5.6: The breakdown of benefits to existing agriculture water abstractors. Option 1 relative to the Baseline



5.78 *Figure 5.6* above indicates the breakdown of the type of economic benefit to existing agriculture abstractors under Option 1. We tend to see a net increase in the production values of existing abstractors (for instance, the blue bar) primarily due to there being an increase in the availability and reliability of water. We also tend to observe that there are always benefits to trading for existing abstractions as they are able to make revenue from selling licences to the previously exempt abstractors. On average we see that existing licensed abstractors invest less although it is not clear why this is the case – in some of the ABM's underlying catchment models, we observe investment to both increase or decrease (not shown here) and it is likely that lumpiness in small adjustment to the timing of investments in the model are driving the difference in the investment patterns.

5.79 Finally, the chart in *figure 5.7* below provides a breakdown of the impact associated with Option 1. On the left shows the impact of New Authorisations on each licence exempt sector where we observe that the policy particularly impacts the Quarries & Mining, and Trickle Irrigation sectors. Moving to the right, we see separately some of the quantified benefit to existing licence holders (within agriculture and horticulture only). This reduces the net effect of New Authorisations as seen in the third bar from the left which highlights the split between the impact on economic output and the impact through complying with the licensing regime. Finally, on the right of the chart the grey bar gives an indication of the range of overall net costs when we change the assumptions around costs and financing.

Figure 5.7: Breakdown of the impacts in Option 1 (relative to the base line)



Option 2: Two Year Transitional Period

5.80 This option allows for a two year transitional period whereby licence exempt abstractors can continue their activities as usual until licensing is enforced. This will delay the benefits from preventing serious environmental damage but also delays the point at which exempt abstractors are impacted from New Authorisations.

Figure 5.8: Summary of Option 2 net Impacts (NPV £m 2014)

Sector	Impact	Low	Central	High
Quarries and Mining	Economic Output	-18.49	-26.26	-64.09
	Administration & Compliance	-3.43	-6.41	-26.74
	<i>total</i>	-21.92	-32.67	-90.83
Trickle Irrigation Farming	Economic Output	-41.21	-58.87	-76.53
	Administration & Compliance	-2.92	-4.81	-22.57
	<i>total</i>	-44.13	-63.68	-99.10
Navigation	Economic Output	-2.22	-3.76	-5.72
	Administration & Compliance	-0.88	-1.65	-6.87
	<i>total</i>	-3.10	-5.41	-12.59
Ports	Economic Output	-0.36	-0.81	-1.34
	Administration & Compliance	-0.26	-0.48	-1.99
	<i>total</i>	-0.62	-1.29	-3.33
Royal Parks	Economic Output	0.00	-1.34	-3.49
	Administration & Compliance	-0.03	-0.04	-0.21
	<i>total</i>	-0.03	-1.38	-3.69
Managed Wetland Systems	Administration & Compliance	-4.42	-7.29	-34.19
Internal Drainage Boards	Administration & Compliance	-0.48	-0.90	-3.74
Ministry of Defence	Administration & Compliance	-0.16	-0.26	-1.23
Exempt Geographical Areas	Administration & Compliance	-0.41	-0.68	-3.19
Existing Licence Holders	Economic Output	11.97	17.10	22.23
<i>Total Impact on Economic Output</i>		-50.3	-74.0	-129.0
<i>Total Impact from compliance and administration</i>		-13.0	-22.5	-100.7
Total		-63.3	-96.5	-229.7

5.81 Under our central analysis the net incremental impact of Option 2 will be an NPV cost of around **£96.5 million**. Of this just around £74 million is due to net costs on abstractors having to either maintain their output or facing reductions in output. The remainder reflects the cost of having to comply with the licensing system.⁴⁶ The net impacts here are lower than those under Option 1 as the policy is launched after a two year delay. Similarly as under Option 1, Quarries & Mining and Trickle Irrigation farms are the two sectors that make the majority of the overall impact, contributing around 29% and 56% of the net cost to new authorisations.

5.82 From the table in *figure 5.8* we observe that here the central net benefit to existing license holders is higher here under Option 2 than under Option 1. We might anticipate the benefits to be lower under Option 2 as the main driver of differences between the two options is to delay the commencement date of new authorisations by two years, which of course acts to delay the costs and benefits associated with the policy. The reason why we instead observe greater benefit under Option 2 is for the reasons described in 5.78 whereby small changes in the timing of investment in the ABM can lead to big changes in behaviour. The differences are slight, but had more resource been available to us we might have observed a smoothing out of this lumpy investment behaviour when repeating the runs over several socio-economic and climate-change scenarios.

⁴⁶ The transitional period may also be expected to deliver benefit we have not been able to quantify. This is from allowing the regulator sufficient time to determine applications.

- 5.83 Licensing will deliver greater environmental and economic benefit compared to the base line but this will be delivered later than compared with Option 1 and as such would deliver these potential benefits at a later date.
- 5.84 This Option also allows for compensation to be paid to new authorisations unless their abstraction has been curtailed due to risk of serious damage to the environment. As the regulator will take a light-touch approach towards the assessment of awarding new authorisations, it will not refuse an abstraction licence or place a licence restriction where there is no evidence of current, or risk of future serious environmental damage. As such we do not expect any compensation payments under this option.

Option 3: Compensation for planned abstractions

- 5.85 This option is similar to Option 2 in that it allows for transitional arrangements of two years. The key difference is that it also allows for provision of compensation claims for the loss of planned abstractions over a ten year period where the abstractor had made provisions to substantially *increase* abstraction volumes in the future.
- 5.86 While this option makes allowance of compensation payments for planned future abstractions, complete evidence required to calculate the size of these payments is not available. An indication of the potential scale of such payments for the agricultural sector is estimated at around **£1.91m NPV** (central value). Our evidence base only allows for a reliable estimate for this sector since it is the Agent Based Model that provides these estimates of compensation costs and the current scope of the ABM only outputs such figures for the agricultural sector; the aggregate figure reflecting compensation costs for all sectors is likely to be higher. At an aggregate level we can treat these as transfer payments from the regulator to the exempt abstractors.⁴⁷ The changes in economic output are therefore assumed identical to Option 2.
- 5.87 The ABM is able to inform the size of compensation to existing licence holders within agriculture and horticulture through replicating the mechanism of the regulator's Environmental Improvement Unit Charging (EIUC) scheme, which also applies to these measures.⁴⁸ In the ABM, there is a modelled regulator who grants new licence applications to abstractors. Where an abstractor wishes to increase its production (and hence its water use) it can apply to the regulator for its additional licence volume needs. If the application is not granted because the catchment does not have spare water, the abstractor could instead seek to buy a licence from another abstractor where the maximum price it would be willing to pay would be the value of the additional production it hoped to achieve. In contrast, a licence exempt abstractor would be able to increase its abstraction without having to apply through the regulator or trading. As such, the additional costs borne by the trickle irrigators in Option 2 are a good proxy for the compensation costs for the future plans that would be payable under Option 3.
- 5.88 Looking at the ABM's sub-catchment models (which normally aggregate to give the aggregate results) we see that national level compensation ranges from zero in the Stour catchment to £2.75m NPV from examination of the Cam and Ely Ouse for the trickle irrigation sector as a whole. The central value averaged over the catchments is £1.91m NPV. This is the best available figure we have for these compensation costs and they are included under Option 3.⁴⁹

⁴⁷ This was the approach suggested by HR Wallingford.

⁴⁸ See Section 1.17 and 1.18 for details of the EIUC.

⁴⁹ Compensation claims must be made within a ten year period from the point the regulator provides a decision on a licence application. In this assessment we assume the NPV compensation costs regarding this foregone output are spread evenly throughout the ten year claim window from the end of the transitional arrangement period.

Figure 5.9: Summary of Option 3 net Impacts (NPV £m 2014)

Sector	Impact	Low	Central	High
Quarries and Mining	Economic Output	-18.49	-26.26	-64.09
	Administration & Compliance	-3.43	-6.41	-26.74
	<i>total</i>	-21.92	-32.67	-90.83
Trickle Irrigation Farming	Economic Output	-41.21	-58.87	-76.53
	Administration & Compliance	-2.92	-4.81	-22.57
	<i>total</i>	-44.13	-63.68	-99.10
Navigation	Economic Output	-2.22	-3.76	-5.72
	Administration & Compliance	-0.88	-1.65	-6.87
	<i>total</i>	-3.10	-5.41	-12.59
Ports	Economic Output	-0.36	-0.81	-1.34
	Administration & Compliance	-0.26	-0.48	-1.99
	<i>total</i>	-0.62	-1.29	-3.33
Royal Parks	Economic Output	0.00	-1.34	-3.49
	Administration & Compliance	-0.03	-0.04	-0.21
	<i>total</i>	-0.03	-1.38	-3.69
Managed Wetland Systems	Administration & Compliance	-4.42	-7.29	-34.19
Internal Drainage Boards	Administration & Compliance	-0.48	-0.90	-3.74
Ministry of Defence	Administration & Compliance	-0.16	-0.26	-1.23
Exempt Geographical Areas	Administration & Compliance	-0.41	-0.68	-3.19
Existing Licence Holders	Economic Output	11.97	17.10	22.23
<i>Total Impact on Economic Output</i>		-50.3	-74.0	-129.0
<i>Total Impact from compliance and administration</i>		-13.0	-22.5	-100.7
Total		-63.3	-96.5	-229.7

5.89 The quantified costs are the same as for Option 2. Similarly the identified benefits from licensing will also be identical with Option 2, yet in allowing compensation provisions for planned abstractions this will give generous protection to those abstractions that plan to abstract at the expense of abstractors who are already licensed. Compensation would be payable from the EIUC charge to the detriment of existing licence holders who themselves have no right to the future availability of water. We would also expect the regulator would need to make significant compensation payments and/or curtail current or future applications for abstraction licences under this option.

Non-Monetised Impacts

5.90 Despite both drawing upon the Agent Based Model of water abstraction and our Top-Down assessment there are further impacts that are not amenable to monetisation due to gaps in the evidence base. They are discussed qualitatively here.

5.91 Environmental and Natural Capital Benefits: part of the rationale for New Authorisations is to help meet objectives on water body environmental status. There will be benefit to curtailing abstractions at risk of causing serious damage to the environment and the stock of natural capital, and also benefit from putting restrictions on water usage (through Hands-off-Flow conditions) that prevent environmental damage taking place at times of water scarcity. While we decide only to curtail harmful abstractions that are seriously damaging the environment, the

benefit is unlikely to be trivial. For instance it has been estimated that the benefit from improving our water body ecological status from 'Bad' status to 'Moderate' status is around £51m⁵⁰ – although in the context of water use restrictions under either existing regulations or through licensing, the determinations here will be driven mainly by *habitats at risk* which do not necessarily correspond with the *ecological status* of water bodies; in some cases, the improvement could be from 'Bad' to 'Moderate', or instead from 'Moderate' to 'Good', while there is every possibility that in some cases there might be no overall improvement. As such this specific metric may under or overstate the likely benefits here.

- 5.92 Although we might particularly anticipate environmental and natural capital benefits for the quarries and mining sector, as evidence suggests that addressing abstractions causing serious damage in these sectors may yield sizeable environmental benefit.⁵¹ The associated negative externalities here are high: this sector has been identified as potentially contributing to 40% of groundwater bodies at risk or deemed failing under Water Framework Directive objectives.
- 5.93 It is difficult to monetise the environmental benefits here: the specific location of abstractions causing serious damage are challenging to assess given marked variation in WTP estimates at a regional level and our access only to national level data, and; in addition, there is a limitation to site specific abstraction data necessary to assess the scale of damage and improvement in environmental flows or ecological status - For instance, in the mining and quarries sector the associated abstraction activity concerns groundwater that in turn has very complex interactions with surface flow levels. Any estimates of environmental benefit will need to link to specific water bodies on a case-by-case basis and further evidence is needed to make this robust.
- 5.94 Levelling the playing field: Over abstraction of water can reduce the availability of water for existing licence holders. The incentives faced by licence exempt abstractors are different to those of their licensed counterparts: the social cost of their actions diverges from their private cost.
- 5.95 Unlicensed abstractions that deplete water flows over a sustained period are deteriorating the water availability in water bodies. Gradually the licensing system would reflect this with stronger abstraction restrictions imposed on abstractors in the licensing system but, relative to unlicensed abstractors, those that are licensed will incur higher associated costs. Bringing abstractions into licensing control will correct for this tragedy of the commons.
- 5.96 We have attempted a partial analysis of the benefit associated here for existing licence holders associated with Agricultural activities. We anticipate there to be a more efficient allocation of water amongst abstractors once all activities are brought within licence control.
- 5.97 Benefits of the transition: The Transitional Arrangements are designed to let exempt abstractors gather information, assess strategically their response to New Authorisations and to carry out any necessary investments; a longer transition would be associated with a more efficient outcome.
- 5.98 We have not been able to model, either with the ABM or through the top-down assessment, any benefit to abstractors of knowing in advance when restrictions will happen. In the ABM the differences in the results between the different transition periods will therefore come *mostly* from delaying the impacts in time, although there are two caveats to this:
- i) Modelled abstractors will observe more years of emerging climate with a longer transition period, so they can compare their production growth plans against the availability of water over a longer period (reservoir investment decisions for example are based over several years), and;
 - ii) The optimum adaptation strategy can change depending on when the restrictions bite due to the modelling circumstances in that particular year.

⁵⁰ Capita Symonds & Tamar Consulting, EA WTP Benefits Report (2007). Figure inflated to 2014 prices.

⁵¹ HR Wallingford (2013)

5.99 In practice we might expect abstractors to be able to plan for and mitigate against the impacts of potential water restrictions. The other benefit of a longer transition is the delay to cost impacts on the affected sectors which have been captured in the analysis.

Limitations

5.100 The bulk of our analysis is based on two robust pieces of evidence. However some limitations in the approach do remain. While sensitivity testing and scenario analysis has been designed to capture much of the uncertainty involved in the analysis, there are steps to ensure the analysis can be further strengthened in future through increased use of the ABM:

- Future developments to the ABM will provide us a more enriched understanding of the environmental benefits from New Authorisations in terms of the changes to water flow availability and its impact on existing licenced abstractors.
- We might benefit from extending the database of licence exempt abstractors in the ABM. Since we commissioned analytical work with the ABM there have been developments to the coverage of the model which mean the evidence will soon be based on a geographically larger sample of the country once the Trent and Derwent catchments have been included in the model. In addition, the impact on navigation (canals) will be better understood after this future update.
- There are possible steps to improve the way the abstractor decision making process feeds into the model. Risk Solutions are also in the process of identifying improvements to the ABM to enable the modelled abstractors to have warning of when restrictions to water abstraction are imminent.
- Finally, it has only been feasible for us to carry out our modelling on one underlying climate change scenario and one underlying socio-economic scenario. Adding more combinations of climate and socio-economic scenarios will only strengthen the robustness of the results.

6 Sensitivity Analysis

6.1 Here we look at changes to options 1-3 through testing each of the following aspects of our policy design in turn:

- i) Adjusting the length of transitional arrangement;
- ii) Adjusting the level at which curtailment due to serious damage is set;
- iii) Adjusting the threshold the Hands-off-Flow restrictions are set against.

6.2 In order to ensure a proportionate approach which maximises our resources, these sensitivities have been tested on only one of the four representative catchments in the ABM: the Cam and Ely Ouse. This catchment was selected out of the four since it is the most representative due to being water stressed and also has a high number of agricultural abstractors (whom are most likely to be sensitive to changes in water availability).

i) Transitional Arrangement Sensitivity

6.3 The set-up of this sensitivity is similar to Option 2 in our core analysis. However we instead look at the impact of a seven year transitional arrangement (rather than two years under Option 2). We were able to test this sensitivity across all of the currently exempt sectors scheduled for New Authorisations.

Figure 6.1: Impact of a seven year transitional period compared to Options 1-3 (Impacts NPV £m 2014)

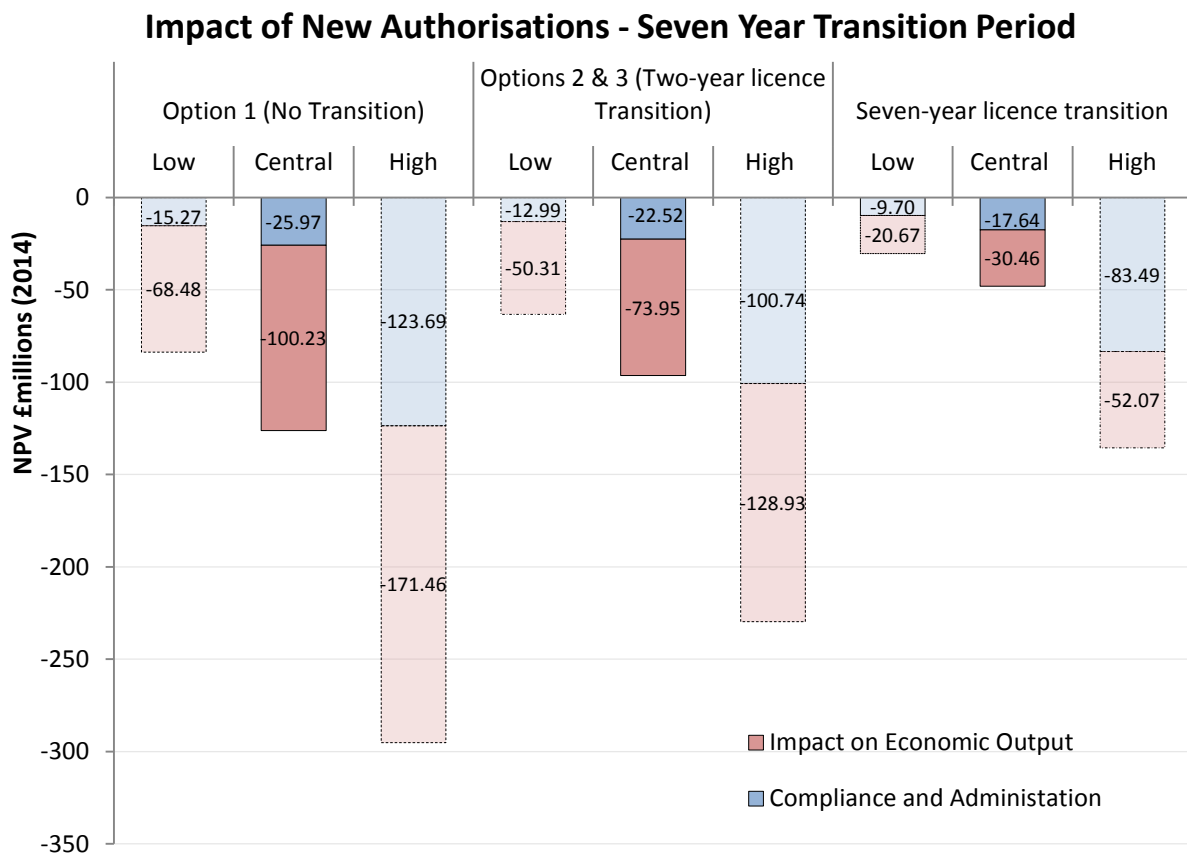


Figure 6.2: Comparison of Impacts between seven year transitional arrangement sensitivity, Option 1 and Option 2 (compared to the base line)

All NPV Figures are relative to the Base Line

Aggregate Central NPV figures	Option 1 (No Transitional Arrangements)	Option 2 (Two Year Transitional Arrangement)	Seven Year Transitional Arrangement
Lost Economic Output	-100.23	-73.95	-30.46
Compliance and Administration	-25.97	-22.52	-17.64
Total	-126.20	-96.47	-48.09

Aggregate Low NPV figures	Option 1 (No Transitional Arrangements)	Option 2 (Two Year Transitional Arrangement)	Seven Year Transitional Arrangement
Lost Economic Output	-68.48	-50.31	-20.67
Compliance and Administration	-15.27	-12.99	-9.70
Total	-83.75	-63.30	-30.36

Aggregate High NPV figures	Option 1 (No Transitional Arrangements)	Option 2 (Two Year Transitional Arrangement)	Seven Year Transitional Arrangement
Lost Economic Output	-171.46	-128.93	-52.07
Compliance and Administration	-123.69	-100.74	-83.49
Total	-295.15	-229.67	-135.56

- 6.4 We see from *figure 6.2* that there is a net loss of around **£48.1m NPV** relative to the baseline in the central scenario. £17.6m NPV will be on the associated administration and compliance costs of the policy, with the remaining £30.5m due to lost economic output. These impacts are lower than that of our core options mostly because we are substantially delaying the stream of impacts into the future.
- 6.5 The reductions to the compliance and administrations costs in the seven year transition compared to the core options are in part due to the delays in the stream of payments over the 25 year appraisal period. Yet as a component of the administration cost will only occur every twelve years in line with licence renewal, the seven year transition sensitivity will only incorporate one round of licence renewal cost within the 25 year appraisal period. This also helps to explain the difference in cost.
- 6.6 There may be additional impact here that has not been captured quantitatively:
- We have made no assumptions on how the transitional arrangement could influence the administration and compliance costs. The administrative burden of having to comply could well be lower as abstraction make more efficient use of their time to gather information and expend resources, although this is not likely to have material impact on the cost profile;
 - There may be further benefit of the Transitional Period to take more efficient strategic decisions towards investing in any necessary changes to operations.

- A seven year transitional period however suggests there are lower benefits to the environment and from the regulation of water flows at times of scarcity for existing abstractors due to the delay in policy implementation.

ii) Serious Damage Sensitivity

6.7 This sensitivity explores changes to the level at which we set serious damage. This also acts as a test to the maximum potential scale of costs given the underlying uncertainties related to exempt abstractors and their associated abstraction locations which may be causing serious damage. We choose to set the level to which we curtail for risk of serious damage to the environment at a stricter level, one that is comparable to “Licensing Scenario B” described under the Top-Down methodology in Section 4.

6.8 The adjustments to the core runs to create these sensitivities are tabled in *figure 6.3*.

Figure 6.3: Adjustments to core runs for Serious Damage Sensitivity

Sector	Adjustment to Core Analysis
Quarries and Mining	Numbers curtailed due to Serious damage double from 0.4% to 0.8%
Trickle Irrigation Farming	ABM adjusted so that 15% of trickle irrigation abstractions are refused a licence.
Ports	No Adjustment
Navigation	Numbers curtailed due to Serious damage to rise from 3 to 6
Royal Parks	No adjustment
Existing Licence Holders	No adjustment per se. Change in modelled in ABM from changes to assumptions on trickle irrigators
Remaining Exempt Abstractors	-

6.9 The impact of curtailing licences to a more strict level of environmental criteria is severe. We can see this by comparing the figures from the core runs in grey on the left hand side in *figure 6.4* with those of the higher serious damage on the right hand side (in green)

Figure 6.4: Comparison of impacts between our central view of serious damage and a more strict view of serious damage across both Option 1 and Option 2 (compared to the baseline)

All NPV Figures are relative to the Base Line

Aggregate Central NPV figures	Option 1 (Central view of serious damage)	Option 2 (Central view of serious damage)	Option 1 (More Strict view of serious damage)	Option 2 (More Strict view of serious damage)
Lost Economic Output	-100.23	-73.95	-142.42	-124.84
Compliance and Administration	-25.97	-22.52	-25.97	-22.52
Total	-126.20	-96.47	-168.39	-147.36

	Option 1 (Central view of serious damage)	Option 2 (Central view of serious damage)	Option 1 (More strict view of serious damage)	Option 2 (More strict view of serious damage)
Aggregate Low NPV figures				
Lost Economic Output	-68.48	-50.31	-98.35	-86.05
Compliance and Administration	-15.27	-12.99	-15.27	-12.99
Total	-83.75	-63.30	-113.62	-99.04

	Option 1 (Central view of Serious damage)	Option 2 (Central view of Serious damage)	Option 1 (More strict view of Serious damage)	Option 2 (More strict view of Serious damage)
Aggregate High NPV figures				
Lost Economic Output	-171.46	-128.93	-263.79	-225.05
Compliance and Administration	-123.69	-100.74	-123.69	-100.74
Total	-295.15	-229.67	-387.48	-325.79

6.10 The impacts are substantially higher and are largely as a direct consequence of imposing higher curtailments on the two key sectors of trickle irrigation farms and quarries & mining.

iii) Hands-off-Flow (HoF) Sensitivity

Here we look at the impact of imposing a less restrictive Hands-off-Flow criterion on New Authorisations. A Q70 HoF condition was used to in our options analysis to create an upper limit of abstractor costs. However, it should be noted that this assumption takes a stringent view on the scope of restrictions that may be implemented. It makes the assumption that the new licence applications have no pre-existing rights, so at low-flow levels the water is protected. As this is a stringent view a Q95 HoF condition was also tested here in the sensitivity analysis, which is a more plausible outcome across the range of exempt abstractors.

6.11 Again this mostly looks at those exempt abstractors within the ABM framework. Our top-down analysis has not lent itself to much detailed examination of the HoF here.

Figure 6.5: Adjustments to core runs for the Hands-off-Flow sensitivity

Sector	Adjustment to Core Analysis
Quarries and Mining	No Change
Trickle Irrigation Farming	ABM adjusted so that New Authorisations receive a Q95 HoF condition on their licence (less restrictive than in core option analysis)
Ports	Time spent losing revenue reduced by 1/3
Navigation	No Change
Royal Parks	No Change
Existing Licence Holders	Use of the ABM where New Authorisations receive a Q95 HoF condition on their licence
Remaining Exempt Abstractors	-

6.12 In our core options analysis we assumed that trickle irrigators would receive a Hands-off-Flow restriction set to Q70. In this sensitivity analysis we instead explore the impact of imposing a less stringent Hands-off-Flow restriction set to Q95.

6.13 There were three further activities dealt with in our top-down analysis that saw impact of HoF restrictions. Only one of these – Ports – we have adjusted here the impact that the HoF will have on abstractions activities. This is a small change whereby freshwater ports without impounding

pumps stand to only face a loss in revenue for 0.5% of the time, where previously in our core options we assumed this was 1.5%.

- 6.14 The other two sectors are Navigation and Royal Parks. For Navigation we did not analyse a different impact of the HoF restriction as it is difficult to decompose what the impact both the HoF and serious damage are having on the mitigation costs (or evidence study lent to a single combined unit cost of mitigation here). For Royal Parks we chose not to change the core assumption of the HoF as a drought would be considered to have the same impact.

Figure 6.6 Comparison of Impacts between an assumed HoF condition in our central runs of Q70 and a less strict HoF of Q95 across both Option 1 and Option 2 (compared to the base line)

All NPV Figures are relative to the Base Line

Aggregate Central NPV figures	Option 1 (Q70 HoF)	Option 2 (Q70 HoF)	Option 1 (Q95 HoF)	Option 2 (Q95 HoF)
Lost Economic Output	-100.23	-73.95	-104.76	-83.93
Compliance and Administration	-25.97	-22.52	-25.97	-22.52
Total	-126.20	-96.47	-130.73	-106.45

Aggregate Low NPV figures	Option 1 (Q70 HoF)	Option 2 (Q70 HoF)	Option 1 (Q95 HoF)	Option 2 (Q95 HoF)
Lost Economic Output	-68.48	-50.31	-71.83	-57.44
Compliance and Administration	-15.27	-12.99	-15.27	-12.99
Total	-83.75	-63.30	-87.09	-70.43

Aggregate High NPV figures	Option 1 (Q70 HoF)	Option 2 (Q70 HoF)	Option 1 (Q95 HoF)	Option 2 (Q95 HoF)
Lost Economic Output	-171.46	-128.93	-177.11	-141.73
Compliance and Administration	-123.69	-100.74	-123.69	-100.74
Total	-295.15	-229.67	-300.80	-242.47

- 6.15 The tables indicate perversely that a less stringent HoF condition is leading to larger negative reduction in NPV figures. For instance, under the core Option 1 with a Q70 HoF we see there is a net loss of around £100 million in economic output (central case); whereas by comparison with a Q95 HoF leads to a greater reduction in NPV of £105 million.

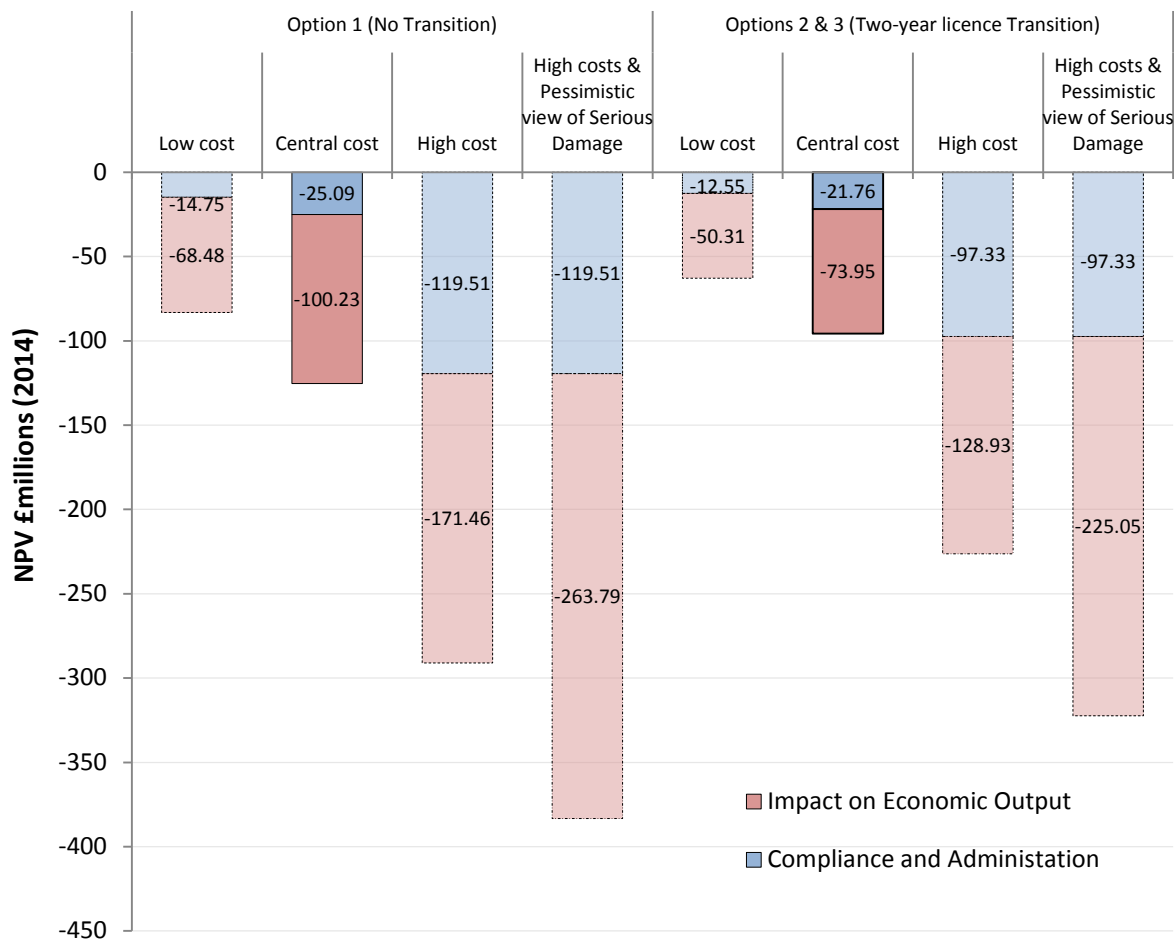
- 6.16 This observation is driven purely by the results in the ABM. A reduction in the stringency of the HoF does lead to a positive benefit to trickle irrigators – that is to say, by reducing the threshold the water level needs to drop below before restrictions on water use are imposed, trickle irrigators are able to maintain their activities for a longer period of time. Yet we might feel the difference observed is perhaps relatively small given such a stark jump in the level at which the HoF is applied. This may be because there is little need for trickle irrigation abstractors in the ABM to abstract when the river flows are between Q70 and Q95 (i.e. they would not be making much use of their access to water when the flow is below Q70 anyway). On net, the benefit to existing licence holders is also reduced to the extent it more than offsets the reduction in impact to trickle irrigators.

7 Conclusion

7.1 The overall costs of Options 1-3 relative to the Base Line are illustrated in *figure 7.1*.

7.2 The costs of Option 1 are the greatest mostly due to the immediate commencement date of environmental protection and the subsequent impact on business. Whereas for Options 2 and 3, the transitional arrangements allow for two years of avoided costs to business, but do nonetheless deliver both environmental benefits (from curtailing and restricting harmful abstractions) and economic benefits.

Figure 7.1: Summary of net impacts of New Authorisations for Options 1-3



8 One-In, Two-Out

8.1 This policy is out of scope.

8.2 Amongst the objectives of this work is the requirement to comply with the European Union Water Framework Directive. The regulator will impose cost on abstractors new to the system to meet their administration costs of the scheme, as is done under the arrangements for existing licensed abstractors.

8.3 There are other potential costs of the policy that abstractors will face. If they are currently causing serious damage to the environment, or are likely to do so in future, they will have their access to water constrained or refused, and is in keeping with the arrangements for licensed abstractors. Licensing itself is a requirement to meet the prior authorisation measure under the Water Framework Directive.

8.4 We are not Gold Plating:

- We are implementing beyond the deadline for the measure to be in place (which was December 2012);
- The licensing system is considered the least-cost and most efficient way to help meet the Water Framework Directive with regarding to water abstraction. This was set out in the Cave review of competition and innovation in the water markets⁵², and is also set out in the Abstraction Reform consultation Impact Assessment.
- We will direct that the level at which the regulator refuses to issue licences is at 'serious damage'. In context the scale spans several statuses; we are required to have all our water bodies at 'Good' Status by 2015. Only targeting abstractions that are causing serious damage is seen as a cautious but necessary initial step to achieving this goal. In addition, abstractors considered to be of low environmental impact will continue to remain exempt as per the Water Act 2003.
- The licences will be issued based on historic rates of abstraction to ensure currently exempt abstractors are given their fair allocation.
- The scheme will also grant a transitional period that allows currently exempt abstractors sufficient time to submit their licence application. During this application and determination period, applicants will be able to continue abstracting water. Once brought into the licensing regime, all abstractors will be treated on the same-level playing field.
- We are providing additional further licence exemptions in accordance with Better Regulation principles.

Option	Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as...
	Costs	Benefits	Net		
Option 1	6.2	0.6	-5.6	No	N/A
Option 2	5.1	0.8	-4.3	No	N/A
Option 3	5.1	0.8	-4.3	No	N/A

⁵² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69462/cave-review-final-report.pdf

Annex A: Profile of Currently Exempt Abstractors

1. Here we set out both the hydrological and environmental characteristics for each of the groups currently exempt from licensed abstraction. The following groups are currently exempt:
 - i) Quarries and Mining
 - ii) Trickle Irrigation
 - iii) Managed Wetland Systems
 - iv) Navigation and Ports
 - v) Land Drainage
 - vi) The Crown Estate
 - vii) Exempt Geographical Areas.
2. In setting out hydrological and environmental characteristics for each group, it is worth considering the some of the differences in characteristics of abstraction source type: surface-water and ground-water.⁵³
3. Surface-water is that consisted in rivers, lakes or wetlands. It is to a large extent renewable, mostly by the rainfall from the clouds, but also with waste-water resulting from the consumption of water by individuals and industry. Ground-water is water held underground in the soil or in pores and crevices in rock. By contrast ground-water holds more characteristics of being a non-renewable resource: while its stock is replenished the rate of renewal is considerable low.
4. Surface-water is considerably easier to obtain than ground-water but is in general of a lower quality. The quality problem is exacerbated by pollution from agricultural, urban and industrial waste. The supply of surface water is highly uncertain and may drop below subsistence levels during periods of drought.
5. All of these characteristics affect the decisions exempt abstractors take and the source of abstraction will have differing degrees of environmental and hydrological impact for each sector. Much of the information here has been sourced from an evidence project commissioned by Defra and produced by consultants HR Wallingford.⁵⁴

Quarries and Mining

6. The abstraction activities of Quarries and Mines relate to the process of dewatering – the process of removing water from a resource. It is necessary to remove water because hard rock quarries must be worked dry to allow stone to be cut. Sand and Gravel quarries are usually worked dry also; in this context dewatering acts to reduce operating costs as more of the extracted resource can be recovered if the material is worked dry. However these soft compounds can be worked wet if necessary; some are worked wet out of choice where dewatering is impractical or costly.
7. Dewatering applies to the access (or ingress) of ground-water, either locally or from a neighbouring watercourse, or from rainfall collected in quarries and mines.
8. Abstractions for the purpose of dewatering are anticipated to lower the stock of ground-water in the local vicinity; the abstracted water is typically discharged to surface-water systems. Subsequently these activities are unusually deemed to be non-consumptive, i.e. the abstracted water is discharged back to the water environment, usually to the most convenient watercourse. There is some consumptiveness in that a small amount may be lost to evaporation.

⁵³ See J. Dalhuisen (1999) for a more complete discussion on the characteristics of water.

⁵⁴ <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18618>

9. Both surface-water and ground-water can be affected by this drawdown of water. It has the potential to influence water resources, surface water features and a number of environmental designations.⁵⁵
10. Dewatering can affect water resources and subsequently its quality through working below the water table as well as the silting of watercourses from discharges. Where fragile ecosystems are concerned (e.g. wetlands), even small scale dewatering operations may have an impact.⁵⁶
11. Finally, dewatering tends to run counter-seasonal to water shortages. For instance, in winter months or at times of high rainfall, it is common to observe higher dewatering volumes as both rainfall and groundwater volumes are higher. This seasonal pattern is site-specific and depends on factors such as geology, local climate and weather.

Trickle Irrigation

12. Trickle irrigation is where water falls by drop from a pipe near to the roots of plants. It is used mainly for horticulture (i.e. the cultivation of fruit and vegetables), particularly in glasshouse production, and in some cases for pot plants by farms for arable crops. The greatest proportion of water use is in the cultivation of soft fruits; water management here has a direct and sensitive impact on the quality of a high value product.
13. Constant abstractions can place pressure on the environment in water stressed locations. The timing and volume of water abstracted for trickle irrigation tends to be driven by the seasons – it is linked to specific crop growing seasons as well as local weather conditions.
14. Unsustainable abstractions from agriculture can affect groundwater as well as surface water flows. This can be to prolong or worsen low flows that in turn may affect the ecological status of water bodies and have impact on licensed abstractors. Irrigation from groundwater pumping may reduce the flows from springs and impact on overall water levels. This can have a detrimental impact on groundwater fed wetlands in regions such as East Anglia.
15. For the agriculture and horticulture sector as a whole, where trickle irrigation is licensed but become constrained, a small reduction in water would lead to a large loss in crop value. A number of mitigation options may be available to the farm businesses (each with an associated cost). These mitigation options are highlighted in the report and in **Annex B**.

Managed Wetland Systems

16. Managed wetland systems are areas of land either periodically inundated with water or areas over which water flows; these flows help to insulate from front and act to deposit of nutrients and silt which encourage grass growth.
17. The management of water flows to managed wetland systems for growing grass was historically a widespread agricultural practice but has declined due to changes in practice. Managed wetland systems are now recognised as an important habitat with high levels of biodiversity. Grants exist for managing wetland systems under the Environmental Stewardship, Countryside Stewardship and Welsh Stewardship schemes. The removal of exemption from licensing will mean farmers must seek a licence for the abstraction of from a river to a managed wetland system.
18. The abstraction from a donor river for feeding a managed wetland system may result in depleted reaches and associated environmental impacts on the donor river. The managed wetland

⁵⁵ Smith, R.J., Johnson, K., and Stewart, R. (2009) The relationship between aggregate extraction, the hydrology of the surrounding landscape and Sites of Special Scientific Interest in England. Unpublished Report to Natural England for the Department of the Environment, Food and Rural Affairs. The Centre for Construction Innovation Northwest, University of Salford, Manchester

⁵⁶ Wheeler, B.D, Gowing, D.J.G, Shaw, S.C., Mountford, I.O. and Money, I.P. (2004) Ecohydrological Guidelines for Lowland Plant Communities (eds.) Brooks, A.W., José, P.V. and Whiteman, M.I. Environment Agency (Anglian Region), Peterborough.

systems provide many services to ecosystems with regard to valuable habitat, water quality and value of natural landscape. There is considered to be a minimal loss of water resource.

Navigation and Ports

19. Ports, harbours and navigable canals are artificial constructions that connect to natural waterways, typically to improve the efficiency of passenger and freight transport. The water levels in impounding docks and canals have to be maintained for the assets to operate effectively; a consistent supply of water is required to maintain water levels. In most cases water is supplied from surface water, although is sometimes drawn from groundwater abstraction or water impounded in reservoirs as typically occurs in the case of canals.
20. In some cases the relevant authority may have an operating agreement for individual abstraction with the environmental regulator. This is an agreement to reduce water abstraction when the river flow is low. Canals may need greater amounts of water to maintain levels during dry years when evaporation increases. Water levels are typically only topped up during the summer boating season. The canal network requires water abstractions in order to maintain function. Under the circumstance than an abstraction licence were not granted then a combination of mitigation needed would be needed (such as the repair of leakages on the network).
21. Harbours and Ports will be covered by a proposed exemption for saline abstractions below fixed tidal limits (i.e. that abstractions from saline waters will be exempt). There is no evidence that the freshwater abstraction used by port authorities is causing environmental problems. The risk of licence refusal is considered to be very low and is assumed in our analysis that no operators are refused a licence. It is expected that under hands-off-flow conditions, ports and harbours can respond to the reduction in freshwater abstraction by substituting for saline abstractions where economically viable. More extreme measures would be to impose temporary or permanent restrictions on ship size using impounded docks, or even the suspension/ cessation of dock services.

Land Drainage

22. Here we refer to the Internal Drainage Boards (IDBs) of England and Wales. An IDB is a local public authority that manages water levels and are located in areas with special drainage requirements either within the floodplains or in broad open areas (e.g, the fenlands). They are typically concentrated mainly in Cambridgeshire, Kent, Lincolnshire, Norfolk, Nottinghamshire, Somerset and Yorkshire. IDB's typically abstract from both groundwater and surface water, and redistribute to drainage channels. This for example includes activities such as wet fencing and warping.
23. Each IDB has a Biodiversity Action Plan and holds a duty to further the conservation and enhancement of all designated environmental sites within their districts.
24. While of low-risk, any curtailment of abstractions for land drainage may affect third parties that are dependent on this activity. For instance, in IDBs with extensive agriculture, farms would be affected as water is currently being abstracted on their behalf. Large reductions in volumes abstracted would mostly impact on crop production (both quality and type of crop). Farmers could lose out financially.

The Crown Estate

25. The current exemptions for the Crown Estate extend to land owned by the Ministry of Defence (MoD) and the Royal Parks.
26. The MoD abstracts water, generally in areas where there is no mains supply, for a number of uses that include drinking water for housing and barracks accommodation (domestic demand, making up 88% of water use), and for operational water (12%), e.g. for vehicle washing, cleaning and water for emergency fire-fighting supplies. The majority of these abstractions come from

groundwater sources, with minimal abstractions from surface water. A number of abstractions are located in or adjacent to sensitive aquatic habitats with no readily available alternative water source. Licensing may have economic impacts for specific sites but is unlikely to result in large scale disruption of operations. Since the MoD abstractions support drinking water and sanitation uses, this high priority water use would be taken into account in licensing decisions and hence is felt likely that a small number of licences (if any) would be refused.

27. The Royal Parks manages nine parks located in the London area, consisting of 5,000 acres of historic parkland. The largest volumes of water are abstracted during dry summers when other water sources, such as lakes, become unavailable. The Royal Parks is actively looking to increase sustainable development in the management of the parks and monitors their water usage. Our analysis assumes that under licensing, environmental regulators may issue hands off flow conditions. If there is the risk of serious environmental damage the Parks to be unable to irrigate during dry periods. There are likely to be mitigation measures (such as rainwater harvesting) that reduce any impacts of this constraint.

Exempt geographical areas

28. Exempt areas are those geographical areas where a general exemption has been given from the need for abstractions to be licensed. Abstractions in exempt areas are expected to be small and therefore individual abstractions are unlikely to have an environmental impact, although it is recognised that a number of these activities in the exempt areas may have a cumulative impact on the environment. Therefore, it is assumed for our analysis that all of these abstractors would be granted licences, although hands off flow conditions could be implemented if there is a risk of serious damage. It is not anticipated that there will be any impacts on business activity as a result of licensing.

Annex B: Agent Based Modelling

1. This annex gives further detail on the bottom-up model of abstraction behaviour used in our analysis. The model used is referred to as the 'Agent Based Model' (hereafter ABM) and where possible it is our preferred approach to assessment the full range of impacts.
2. The modelling here was developed by consultants Risk Solutions in support of the consultation stage Impact Assessment on the reform of the Abstraction Licensing system. The full detail of the ABM model specification is covered in a supporting report to published alongside final Abstraction Reform Impact Assessment.⁵⁷ Nonetheless we recapture some of the high-level information here and set-out the few adjustments to the model done for this analysis.
3. The ABM is the integration of two interacting models: a hydrological model of river catchment areas combined with an 'agent based' behavioural model of water abstraction. Together they help to explore the effects of different policies concerning water abstraction and allow for the comparison of economic costs and benefits, and the environmental performance of each option.

Why adopt this approach?

4. Modelling Abstraction behaviour is inherently complex and the level of benefits will be critically dependent on local characteristics of each of the catchments such as hydrology (which determines who *can* trade with whom) and also the characteristics of abstractors (which determines who *will* trade with whom).
5. The determination of the level of benefit must take account of complex interactions and feedbacks between the hydrology, weather, the licensing regime and abstractor behaviour. Abstractors also range significantly in their type: whether from water companies with substantial water management capacity and subject to economic regulation; to large industry needing very reliable water; to small farmers irrigating potatoes when the weather is dry.
6. Traditional "top down" economic modelling (e.g. at regional or national scale) struggles to deliver meaningful conclusions in these situations because it is difficult to represent these complex interactions. Nonetheless we have used a "top down" model as part of our wider analysis to complement and provide some degree of comparison with the "bottom up" catchment model - the ABM. Furthermore it has not been possible to model of the exempt sectors under consideration in the ABM for this consultation stage IA. The top down modelling approach we use instead for these sectors is detailed in **Annex C**
7. The catchment-based models rely on insights from behavioural economics. The literature on this branch of economics was summarised in a paper by Defra⁵⁸ in July 2013 that looked at how key theories and empirical studies could be applied to policy. The conclusion was that there is a role for behavioural economics both in 'fine tuning' existing policies and in thinking about how best to design new policies.
8. 'Agent-Based Modelling' has emerged as a key methodology for developing understanding of the interactions between people and their environment in situations such as these. Drawing on techniques from social sciences (in particular behavioural economics) and ecology, agent-based modelling allows the investigation of several key issues including: the effects of policy on decision-making, inertia, the impact of heterogeneity for example of agents, and feedbacks between agents such as learning, imitation and communication; and feedbacks between environmental change and agent actions. Further, agent-based modelling is a bottom-up

⁵⁷<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18182#RelatedDocuments>

⁵⁸https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223835/pb13986-behavioural-economics-defra.pdf

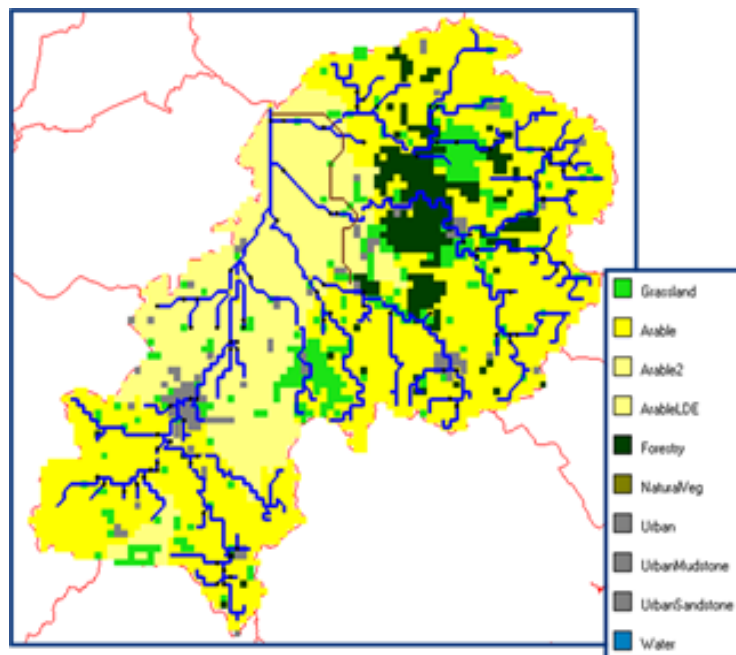
approach that allows more specific local arrangements, rules and complexities to be incorporated (such as local hydrology, real licence conditions and production process specific requirements).

9. As such the ABM is at the focus of our analysis where its use is applicable.

How it works

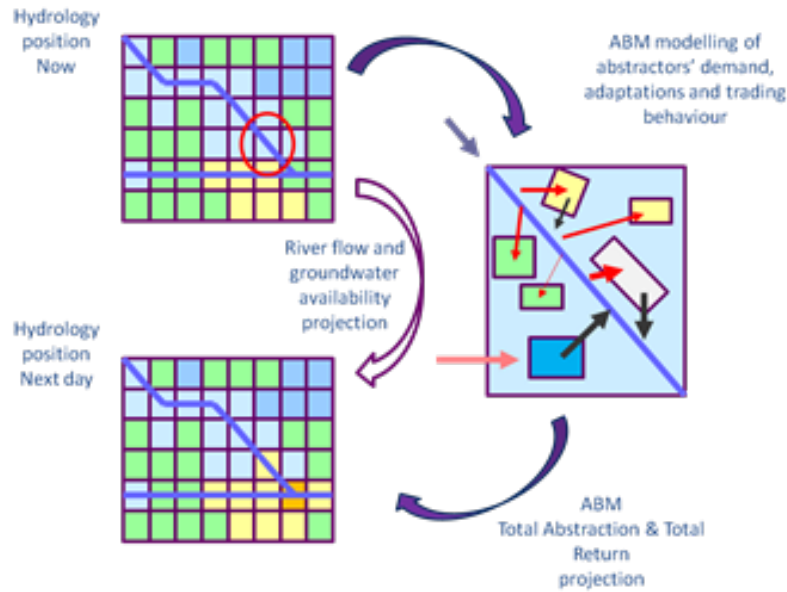
10. The ABM is the integration of two processes: a hydrological model of river catchment areas, and; an agent based behavioural model of water abstraction. In turn each is modelled separately on four case study catchments. The final results are aggregated from these four separate catchment models to produce the overall figures. The case study catchments are:
 - The Cam and Ely Ouse;
 - The Hampshire Avon;
 - The Stour, and;
 - The Usk
11. For each of these modelled catchments, the overall costs and benefits of each scenario or 'policy option' are calculated in one-day time steps over a 25 year period. These are consistent with the available data on climate change and socioeconomic scenarios.

Figure B.1: Snapshot of the Cam and Ely Ouse hydrological catchment



12. Information is passed from the hydrological model to the abstraction behavioural model. *Figure B.2* below shows this interaction between the hydrological model and the abstractor behaviour model.
13. More specifically, for each case study catchment the hydrological model calculates the river flow and ground water for a point in time for each 1km² cell. The behavioural model estimates the demand for both Public Water Supply and non-Public Water Supply requirements. It then determines their collective behaviour by taking into account the information received from the hydrological model. It determines the abstraction and levels of return flows, and passes this information back to the hydrological model. This is then used to calculate the hydrological position for the next day.

Figure B.2: Linkage between the hydrological model and abstractor behaviour model



14. In addition to the day-to-day operational decision making (for example, whether to irrigate crops or from which source to abstract water to serve customers on the public water supply) the model also determines an abstractor's longer-term decision making. This may include, for example, a decision to stop producing a particular product or to invest in water infrastructure such as reservoir storage. At each step the model establishes the costs to abstractors associated with water abstraction and also their investment decisions. This feedback is illustrated in *figure B.2* above.
15. Finally, in order to provide figures on costs and benefits at the National level, we apply a scaling factor to each of the ABM's four sub-catchment models. The options are each separately analysed on the four catchment models and, assuming that each of these catchments is representative of the country as a whole and that the most appropriate parameter to use when scaling is the total water abstracted, then the scaling is done using the following formula:

$$C_{NA} = C_{CA} \times \frac{W_{NA}}{W_{CA}}$$

Where:

C_{NA} = Costs at the National Level of Agriculture;

C_{CA} = Costs at Catchment level for Agriculture;

W_{NA} = Total water abstracted at National level by Agriculture;

W_{CA} = Total water abstracted at Catchment level by Agriculture;

16. The separate catchment analysis shows that scaling up the results from the four underlying catchment models gives four different National cost estimates. For this analysis we have discarded the modelled catchment of the Usk; this is because the results are not considered to be nationally 'representative' as the Agriculture and Horticulture sectors are a small proportion of total water demand. As we have no real basis to decide which of the other three modelled catchments are most representative of the national average, we have used a straight average of the 'Stour', 'Hampshire Avon' and 'Cam and Ely Ouse' model catchment results.

Modelling Exempt Abstractors

17. Not all of the abstractors in scope of New Authorisations can be modelled within the ABM: in the version of the model used for this assessment there was only one modelled canal and Ministry of Defence abstractor, and no inclusion of ports, exempt geographical areas, the Royals Parks or managed wetland systems; Internal Drainage Boards are modelled where relevant but are not set up such that their economic impacts can be measured.
18. Yet significantly the behaviours of Agricultural & Horticultural trickle irrigation and quarry dewatering can be modelled in detail using the ABM. As identified in our top-down assessment, these activities are where the policy impacts are likely to be most significant, particularly in terms of scale and economic impact.
19. To adapt the ABM to incorporate Trickle Irrigation farms some assumptions were taken from the Defra evidence report (that used in the Top-Down assessment). These were:
 - That 2% of the area used for cultivating potatoes and field vegetables uses trickle irrigation;
 - All greenhouses make use of trickle irrigation systems;
 - 46% of other horticultural area makes use of trickle irrigation.
20. The ABM contains a list of *licensed* agricultural and horticultural abstractors, yet it is not known precisely the distribution of unlicensed trickle irrigators across the nations' farms. The assumption was made that the areas listed above are distributed amongst the existing irrigating abstractors in the catchment; these are listed in the accompanying report to this consultation Impact Assessment.
21. Similar assumptions were made in the ABM regarding environmental damage to those in our Top-Down assessment:
 - Five per cent of trickle irrigators are refused a licence on the grounds of causing serious environmental Damage'. In the model a random sample of 5% of modelled trickle irrigation abstractors are not granted a licence upon implementation of the policy (i.e. the start of the transition).
As a sensitivity, the percentage refused a licence was increased to 15% in line with the Scenario analysis in the Defra Evidence report (Scenario B).
 - In the ABM none of the modelled quarries are likely to be refused a dewatering licence in reality. For modelling purposes one quarry was selected with consultation with the Environment Agency and it was assumed this quarry would be prevented from operating after the transition date on the grounds of risk of serious damage. The purpose of this restriction was to see whether the halting of dewatering and licensed abstraction activities at the point of implementation resulted in economic benefits to other abstractors.
 - No other previously exempt abstractors were refused a licence on the grounds of causing serious damage.
 - All previously exempt abstractors taking water from surface water sources have a new Q70 HOF condition applied.
22. Further discussion on the adaption of the ABM for this work is included in Risk Solutions' technical report published alongside this Impact Assessment.⁵⁹

⁵⁹ <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=19207#Description>

Further Assumptions and Simplifications

23. The ABM was designed to model the impact of the future reform of the abstraction licensing system. In the consultation stage Impact Assessment for this work a number of climate-change and socio-economic scenarios were tested. However there was only scope to consider one scenario combination for this analysis and, as such, all of our analysis with the ABM for New Authorisations includes a single climate-change scenario and a single socio-economic scenario. These are climate change Scenario C and the 'Sustainable Behaviour' socio-economic scenario in the language of the Abstraction Reform consultation Impact Assessment.⁶⁰
24. These were chosen because they generally produced results that were close to the midpoint of the range of results from all the scenarios explored in ongoing model analysis that has been carried out in support of the Abstraction Reform Impact Assessment. However, it should be noted that the sustainable behaviour socio-economic scenario is considered a 'low' growth scenario. As such there is a limited price incentive for the representative abstractor to grow.
25. It is recommended that a wider range of scenarios be considered for the final Impact Assessment on New Authorisations.
26. More general simplifications and assumptions used in the ABM are covered in Annex D of the Abstraction Reform consultation stage Impact Assessment.

Simulating the real-life decision making process

27. In the ABM, non-Public Water Sector abstractors are not represented at purely profit maximisers in the same way as they might in a traditional economic model. Modelled abstractors do not take decisions (such as determining their output level) in order to generate the maximum theoretically feasible level of profit. Although they do take expected profit into account in their decisions, many act in a variety of 'sub-optimal' ways identified in the behavioural economics literature and through consultation. For instance:
 - Modelled Abstractors use rules of thumb to specify the range of production levels and the investment options that they will consider;
 - They exhibit delays in their decision making when compared to the optimum timing of decisions. For example, in the timing of investment decisions;
 - Some modelled abstractors imitate their peers rather than calculating their own optimum strategies;
 - Satisficing behaviour is reflected in the behaviour of some modelled abstractors. This means they may target a level of satisfactory profits rather than maximum profits;
 - An abstractor's decision making may change depending on their recent experiences.
28. By simulating the simultaneous operations and interactions of multiple agents with the different policy options, the ABM is able to model complex systems behaviours that may emerge when many individual elements of a system interact together following relatively simple rules. This emergent system behaviour may lead to unanticipated impacts, both good and bad.

Quality Assurance/ Peer Review

29. The ABM has been peer reviewed by leading technical experts in modelling, economics, hydro-geology and water policy. This has been to provide quality assurance of the methodology and also to establish priority areas for model development. The experts were:

⁶⁰ More detail can be found in the Abstraction Reform consultation Impact Assessment.

- Professor Jon Stern (City University), specialising in policy decision making and economics;
- Rob Soley (AMEX) specialist in hydrological modelling;
- Dr Kieran Conlan (Cascade Consulting) specialising in water management;
- Professor Scott Moss (Scott Moss Associates) specialist in agent-based modelling;
- Robin Smale (Vivid Economics) specialist in Economics.

30. More details on the gathering of evidence and quality assurance of the ABM are included in Annex A of the consultation Impact Assessment on Water Abstraction Reform.

Annex C: Top-Down Assessment

1. The majority of our evidence is founded on a Defra research study into the scale and impact of New Authorisations; if not drawn upon directly in the analysis in the Impact Assessment, some of the study's findings will have underpinned input assumptions in the Agent Based Model.
2. This study was published by DEFRA in 2013 and was the result of work commissioned by consultants HR Wallingford and Vivid Economics.⁶¹ The findings of the study then feed into our top-down analytical assessment. In particular estimates on the numbers of licences to be refused due to risk of serious damage, and what impact (qualitative or quantitative) will a Hands-off-Flow restriction have are used in our core assessment.
3. This work was commissioned to help contribute towards an evidence base where little-to-no information on exempt licence activities had existed previously. It has made possible the top-down analytical work to be completed.

⁶¹ <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18618>

Annex D: Compliance and Administration Costs

1. Note these costs are not NPV figures and are in 2008/09 prices as they originate from the original 2009 consultation on secondary legislation. They have been represented as 2014 prices in our final analysis. Orange estimates indicate uses of updated figures that have been revised down to 2008/09 prices.

<i>Transfer Licence</i>	2008/09 Prices	Cost			Coverage			Expected Cost		
		Best	Low	High	Best	Low	High	Best	Low	High
<i>Cost Category</i>	<i>Frequency</i>	<i>Cost Best</i>	<i>Cost Low</i>	<i>Cost High</i>	<i>Coverage Best</i>	<i>Coverage Low</i>	<i>Coverage High</i>	<i>Expected Best</i>	<i>Expected Low</i>	<i>Expected High</i>
Metering/measurement	12 years	400	0	5000	50%	50%	50%	200	0	2500
time gathering data	12 years	182	91	910	100%	100%	100%	182	91	910
application fee	12 years	118	118	1309	100%	100%	100%	118	118	1309
advertising (newspaper)	One-off	350	300	400	5%	5%	5%	18	15	20
Advertising (admin)	One-off	87	87	87	5%	5%	5%	4	4	4
environment report	One-off	5000	5000	5000	20%	0%	100%	1000	0	5000
professional advice	One-off	1500	1500	1500	20%	0%	100%	300	0	1500
Annual charge	Annual	0	0	0	100%	100%	100%	0	0	0
Record keeping, etc..	Annual	102	102	102	100%	100%	100%	102	102	102

<i>Full Licence</i>	2008/09 Prices	Cost			Coverage			Expected Cost		
		Best	Low	High	Best	Low	High	Best	Low	High
<i>Cost Category</i>	<i>Frequency</i>	<i>Cost Best</i>	<i>Cost Low</i>	<i>Cost High</i>	<i>Coverage Best</i>	<i>Coverage Low</i>	<i>Coverage High</i>	<i>Expected Best</i>	<i>Expected Low</i>	<i>Expected High</i>
Metering/measurement	12 years	400	400	5000	50%	50%	100%	200	200	5000
time gathering data	12 years	182	91	910	100%	100%	100%	182	91	910
application fee	12 years	118	118	1309	100%	100%	100%	118	118	1309
advertising (newspaper)	One-off	350	300	400	5%	5%	5%	18	15	20
Advertising (admin)	One-off	87	87	87	5%	5%	5%	4	4	4
environment report	One-off	5000	0	5000	20%	0%	100%	1000	0	5000
professional advice	One-off	2000	2000	2000	20%	0%	100%	400	0	2000
Annual charge	Annual	36	22	36	100%	100%	100%	36	22	36
Record keeping, etc..	Annual	102	102	102	100%	100%	100%	102	102	102

Annex E: England and Wales Impact Disaggregation

1. Below is a breakdown of the net impact to England and to Wales for the base line (Option 0) and for Options 1-3.

Option	Nation	Low	Central	High
Base Line (Option 0)	England	-53.2	-80.9	-146.7
	Wales	-3.0	-4.7	-11.0
	<i>Total (E&W)</i>	<i>-56.2</i>	<i>-85.6</i>	<i>-157.7</i>
Option 1: No Transitional Arrangements	England	-79.6	-119.8	-277.1
	Wales	-4.2	-6.4	-18.1
	<i>Total (E&W)</i>	<i>-83.7</i>	<i>-126.2</i>	<i>-295.2</i>
Option 2: Two-Year Transitional Arrangement	England	-60.2	-91.6	-215.5
	Wales	-3.1	-4.9	-14.1
	<i>Total (E&W)</i>	<i>-63.3</i>	<i>-96.5</i>	<i>-229.7</i>
Option 3: Two-Year Transitional Arrangement	England	-60.2	-91.6	-215.5
	Wales	-3.1	-4.9	-14.1
	<i>Total (E&W)</i>	<i>-63.3</i>	<i>-96.5</i>	<i>-229.7</i>

2. We have arrived at these figures by apportioning the total England & Wales impact between the two constituent nations. In most instances we have apportioned the impact using the population shares of each country. Where more information has been available to us from the HR Wallingford/ Vivid Economics Evidence Study, we have made use of this in splitting out the combined England & Wales impact. The methodology for splitting out the impact is covered in the table below:

	Impact on Economic Output	Impact of Compliance and Administration
Quarries and Mining	Apportioned using shares of the number of Abstractions in England and Wales. From the HR Wallingford/ Vivid Economics Evidence Study, 171 of 1557 quarry and mining abstractions across England & Wales are located in Wales	Same as for Impact on Economic Output: apportioned using shares of number of Abstractions between the two countries
Trickle Irrigation Farming	Apportioned using shares of the number of abstractions in England and Wales. From the HR Wallingford/ Vivid Economics Evidence Study, 16 of the 990 abstractions are assumed to be taking place in Wales.	Same as for Impact on Economic Output: apportioned using shares of number of Abstractions between the two countries
Ports	Only freshwater ports without impounding pumps have their economic output impacted. According to the HR Wallingford/ Vivid Economics Evidence Study there are eight such ports across England & Wales, four of which are in Wales. $4/8 = 50\%$ of total England & Wales figure apportioned to Wales.	Apportioned using the population shares of England and Wales. Wales' population represents around 5.4% of the total England and Wales population according to most recent available ONS data (June 2014).
Navigation	Apportioned using the population shares of England and Wales	Apportioned using the population shares of England and Wales.
Royal Parks	There are no Royal Parks in Wales	There are no Royal Parks in Wales
Managed Wetland Systems, Internal Drainage Boards, Ministry of Defence and Exempt Geographical Areas	The Impact on Economic Output is not considered for these remaining sectors	Apportioned using the population shares of England and Wales
Existing Licence Holders	Apportioned using the population shares of England and Wales	Apportioned using the population shares of England and Wales.

3. Compensation payments under Option 3 are also apportioned using population shares.