LONDON ASHFORD AIRPORT, LYDD (LAA)

NITROGEN DEPOSITION (RUNWAY) REPORT

August 2008

Prepared by
Parsons Brinckerhoff Ltd
Amber Court
William Armstrong Drive
Newcastle upon Tyne
NE4 7YQ

Prepared for
London Ashford (Lydd) Airport
Lydd
Romney Marsh
Kent
TN29 9QL

Report Title	**:**	**Nitrogen Deposition (Runway) Report**
Report Status	**:**	**Final**
Job No	**:**	**HAG91877A/3.1**
Date	**:**	**August 2008**
Prepared by	**:**	**..** **Pp Bethan Tuckett-Jones**
Checked by	**:**	**................................** **Mark McLellan**
Approved by	**:**	**................................** **Mark Mclellan**

THE IMPACTS OF NITROGEN DEPOSITION ON DESIGNATED SITES

1.1 In December 2006, London Ashford Airport (Lydd) ("LAA") submitted a planning application for a runway extension (reference Y06/1648/SH) and a planning application for a new terminal building (reference Y06/1647/SH) supported by an Environmental Statement. Following consultation that took place at the beginning of 2007, LAA submitted in October 2007 Supplementary Information to further support the two planning applications.

1.2 The Supplementary Information was consulted upon during Autumn/Winter 2007, with Shepway District Council ("SDC") requesting additional information in March 2008. The points in relation to nitrogen deposition on the designated sites is replicated below as follows:-

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and 'perennial vegetation of stony banks'	SAC, SSSI	i. Following consultation with Natural England, provide a clear and concise definition of 'perennial vegetation of stony banks', including clarification of whether this includes unvegetated shingle and which NVC communities comprise this feature within the SAC. ii. Clarify what background total N deposition figure has been used from the APIS website in the N deposition modelling and assess the likely accuracy of this estimate based upon a review of relevant local information. iii. Clarify what increase in N deposition would likely have a significant adverse effect on 'perennial vegetation of stony banks'. iv. Clarify what future trend in background N deposition has been used in the N deposition modelling and assess the likely accuracy of this estimate based upon a review of relevant local information. v. Clarify what area of 'perennial vegetation of stony banks' within the SAC would be significantly adversely affected under four scenarios: (i) an increase to 500,000 ppa and no change in the current background N deposition rate; (ii) an increase to 300,000 ppa and no change in the current background N deposition rate; (iii) an increase to 500,000 ppa and the most likely trend in background N deposition; and (iv) an increase to 300,000 ppa and the most likely trend in background N deposition. These estimates should be accompanied by maps to show the affected areas of 'perennial vegetation of stony banks' and the boundary of the SAC and SSSI. NB: the distribution of 'vegetated shingle' shown in the N deposition mapping that has been submitted appears to be substantially inaccurate and any future calculations and maps should be based upon correct distribution data on this designated feature, for example utilising Natural England NVC data. vi. Clarify what area of 'perennial vegetation of stony banks' occurs within the entire SAC. vii. Clarify what mitigation or compensation is proposed for

ISSUE	Designated site (plus potential and intended)	Request/clarification
		any significant negative effects on ‘perennial vegetation of stony banks’, to the degree that there is no reasonable scientific doubt that the measures are adequate, feasible and deliverable. In addition, assess whether any such measures are ‘compensation’ or ‘mitigation’ in the context of the Habitats Directive.
3. Ozone and ‘perennial vegetation of stony banks’	SAC, SSSI	i. Provide an assessment of the effects of the proposed developments on ‘perennial vegetation of stony banks’ via any changes in ozone levels caused by the proposed developments.
7. Plant-insect interactions	SSSI, SAC	i. In consultation with Kent Wildlife Trust, clarify the need, or otherwise, to consider for the purposes of the EIA Regs possible changes to plant-insect interactions as a result of continued/increased nitrogen deposition and consequent possible effects upon endemic species or subspecies. If this proves to be reasonably necessary, undertake an assessment and submit the results.

2 NITROGEN DEPOSITION

2.1 Response to Comment 2(i)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and ‘perennial vegetation of stony banks’	SAC, SSSI	i. Following consultation with Natural England, provide a clear and concise definition of ‘perennial vegetation of stony banks’, including clarification of whether this includes unvegetated shingle and which NVC communities comprise this feature within the SAC.

2.1.1 Parsons Brinckerhoff ("PB") wrote to Natural England seeking clarification on the definition of ‘perennial vegetation of stoney banks’. Natural England responded with the comments below:

“*The title perennial vegetation of stony banks is taken from the Annex I of the Habitats Directive. This title encompasses what is more commonly known as vegetated shingle. This habitat is characterized by zonations of vegetated and bare shingle, it is important to note that the vegetation can include apparently unvegetated areas of shingle which have important lichen flora. Vegetated shingle (in common with many other coastal communities) does not fit precisely into the National Vegetation Classification. The supporting information for the 2006 SSSI re-notification states* “The shingle communities at Dungeness are not always covered by the NVC and have been subject to a separate classification.

Given the difficulty of applying the NVC to vegetated shingle in general and to Dungeness in particular, Natural England recommends that you use the *vegetated shingle maps from the SSSI notification*. *In addition you should be aware that impacts on apparently unvegetated shingle should be taken into account, due to the potential for vegetation communities to develop and also the presence of lichen communities within this apparently unvegetated shingle*."

2.1.2 This suggests that 'perennial vegetation of stony banks' should include both vegetated and unvegetated shingle.

2.2 Response to Comment 2(ii)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and 'perennial vegetation of stony banks'	SAC, SSSI	ii. Clarify what background total N deposition figure has been used from the APIS website in the N deposition modelling and assess the likely accuracy of this estimate based upon a review of relevant local information.

2.2.1 In the 2006 Environmental Statement (Table 15.8 of Chapter 15) for the runway extension planning application (reference Y06/1648/SH), the estimates of background nitrogen deposition shown in Table 1.2.1 below were used. Deposition for the year 2000 was taken from the APIS website (www.apis.ac.uk), extracted from the 5km x 5km square between OS grid references 605000, 120000 to 610000, 125000, for the 'shingle, rocks and cliffs' habitat.

Table 1.2.1 Nitrogen deposition used in the 2006 Environmental Statement

Year	Nitrogen deposition kgN/ha/yr
2000[1]	15.3
2005	13.8
2009	12.8

2.2.2 At the time of writing the 2006 Environmental Statements, the data provided on the APIS website were relevant to the years 1999 to 2001, and were taken to be representative of conditions in the year 2000. Deposition for years following 2000 was calculated on the basis of an estimated 2%, non-cumulative, decrease per annum. This was based on the results of the transboundary deposition modelling for 1997 to 2010 undertaken by the National Expert Group on Transboundary Air Pollution (NEGTAP), which estimated that across the UK, deposition was expected to decrease by 1.5% to 2.6% per annum due to increasingly stringent emission limits.

2.2.3 In October 2007, APIS was updated to allow searching for critical loads and pollutant deposition on a site-specific basis for the UK Natura 2000 network, which includes the Dungeness SAC. Furthermore, in March 2008, the APIS nitrogen deposition data were updated to a 3 year average for 2003 to 2005, plus a projection for 2010. For the Dungeness SAC in the vicinity of LAA, the updated APIS nitrogen deposition values are shown in Table 1.2.2.

[1] Table 15.8 of Chapter 15 in the 2006 Environmental Statement for the runway extension planning application (reference Y06/1648/SH) referred to the year 2001 which is a typographical error as can be noted by paragraph 15.4.9 of Chapter 15 referring to the year 2000.

Table 1.2.2 Updated nitrogen deposition available from the APIS website (July 2008)

Year	Nitrogen deposition kgN/ha/yr
2003-2005	11.5
2010	9.8

2.2.4 The updated APIS data are lower than the values used in the 2006 Environmental Statement. These revised data have been used in the estimation of impacts provided in Section 1.5 below.

2.2.5 The accuracy of the APIS data and the likely temporal trends are discussed in Section 1.4.

2.3 Response to Comment 2(iii)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and 'perennial vegetation of stony banks'	SAC, SSSI	iii. Clarify what increase in N deposition would likely have a significant adverse effect on 'perennial vegetation of stony banks'.

2.3.1 Pollutant deposition is assessed against a critical load, which is defined as: 'a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge'.

2.3.2 A site specific range for the critical load for 'perennial vegetation of stony banks' in the Dungeness SAC is specified on the APIS website to be 10-20 kgN/ha/yr. This is consistent with the critical load of 10-15 kgN/ha/yr used in the 2006 Environmental Statements (paragraph 15.4.8 of Chapter 15 of the runway extension 2006 Environmental Statement).

2.3.3 In the absence of detailed site and/or species specific information, which would allow a reduction in the uncertainty range for the critical load, a conservative approach to the assessment of nitrogen deposition is to use the lower limit of the critical load range i.e. 10 kgN/ha/yr.

2.3.4 By this measure, and taking into account modelling and monitoring uncertainty, background nitrogen deposition over the designated sites in the vicinity of LAA currently exceeds the critical load. It should be noted, however, that there is no indication that this is definitely the case. Based on the best available information, background nitrogen deposition is anticipated to decrease to below the critical load in the years after 2010. (This is discussed in more detail below).

2.3.5 There are no universally accepted criteria for the assessment of the significance of effects of changes in exposure to air pollution and expert judgement must be used. Therefore, any assessment of significance will, ultimately, be qualitative.

2.3.6 For the 2006 Environmental Statements, the criteria shown in Table 1.3.1 below were used for assessing the significance of impacts (Table 15.6 in the 2006 Environmental

Statement). These criteria are relevant to the assessment of impacts on human health and take into consideration the following:

- o the total deposition over the site (PEC), and
- o the magnitude of the change in pollutant deposition (PC)

Table 1.3.1 Significance criteria for air quality impacts used in Environmental Statements. PEC = total predicted environmental concentration, PC = process contribution i.e. PEC = PC + Background contribution.

Factor	Significance			
	Major	**Moderate**	**Minor**	**Negligible**
Local air quality	PEC > 70% of limit value and PC > 10% Or PC > 50%	PEC ≤ 70% of limit and PC ≤ 50% of limit value Or PEC > 70% and PC ≤ 10%	PEC ≤ 70% of limit and PC ≤ 10%	PC ≤ 1% of limit value

2.3.7 It is widely accepted that any changes less than 1% of the relevant standard for that air pollution measure may be classed as being insignificant. This should not, however, be interpreted as ‘any changes greater than 1% will be significant’, since there will be a range of impacts from negligible through to the major as the magnitude of the change increases above 1%.

2.3.8 The assessment of impacts on a sensitive habitat should also take into account the following:

- o the area of the sensitive habitat impacted by the change in deposition

2.3.9 It is our opinion that any increase in pollutant deposition which affects an area of the sensitive habitat which is less than 1% of the total area of that habitat within the designated site is also insignificant since it will have no measurable effect on the integrity of the feature.

2.3.10 The table below represents a formal quantification of the expert judgement used in the 2006 Environmental Statements and the 2007 Supplementary Information to assess the significance of changes in an air quality metric on the integrity of a habitats site.

Table 1.3.2 Significance criteria for air quality effects on the integrity of sensitive habitats The significance of the change in deposition is assessed using the criteria in Table 1.3.1.

Area Affected (as % of sensitive habitat)	Significance of Change in Nitrogen Deposition			
	Major	**Moderate**	**Minor**	**Negligible**
<1%	Negligible	Negligible	Negligible	Negligible
≥1% and <5%	Minor	Negligible	Negligible	Negligible
≥5% and <10%	Moderate	Minor	Negligible	Negligible
≥10%	Major	Moderate	Minor	Negligible

2.3.11 In essence, it is assumed that the significance of effects increases as both the magnitude of the change and the magnitude of the area affected increase.

2.4 Response to Comment 2(iv)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and 'perennial vegetation of stony banks'	SAC, SSSI	iv. Clarify what future trend in background N deposition has been used in the N deposition modelling and assess the likely accuracy of this estimate based upon a review of relevant local information.

2.4.1 As explained in paragraph 2.2.2 above, for the 2006 Environmental Statement, a 2% decrease per annum was assumed.

2.4.2 The updated deposition presented on the APIS website indicates that, on the basis of the best available data, background nitrogen deposition was over-estimated in the 2006 Environmental Statement in both the baseline year (2005) and the future year (2009 and 2010). Furthermore, the updated modelling estimates that between 2003-2005 and 2010, deposition over Dungeness will decrease by approximately 2.5% per annum. Therefore, for the nitrogen deposition impacts discussed in Section 1.5 below, the updated APIS data have been used, with a linear decrease assumed between the APIS provided data 2004 and 2010 (Table 1.4.1).

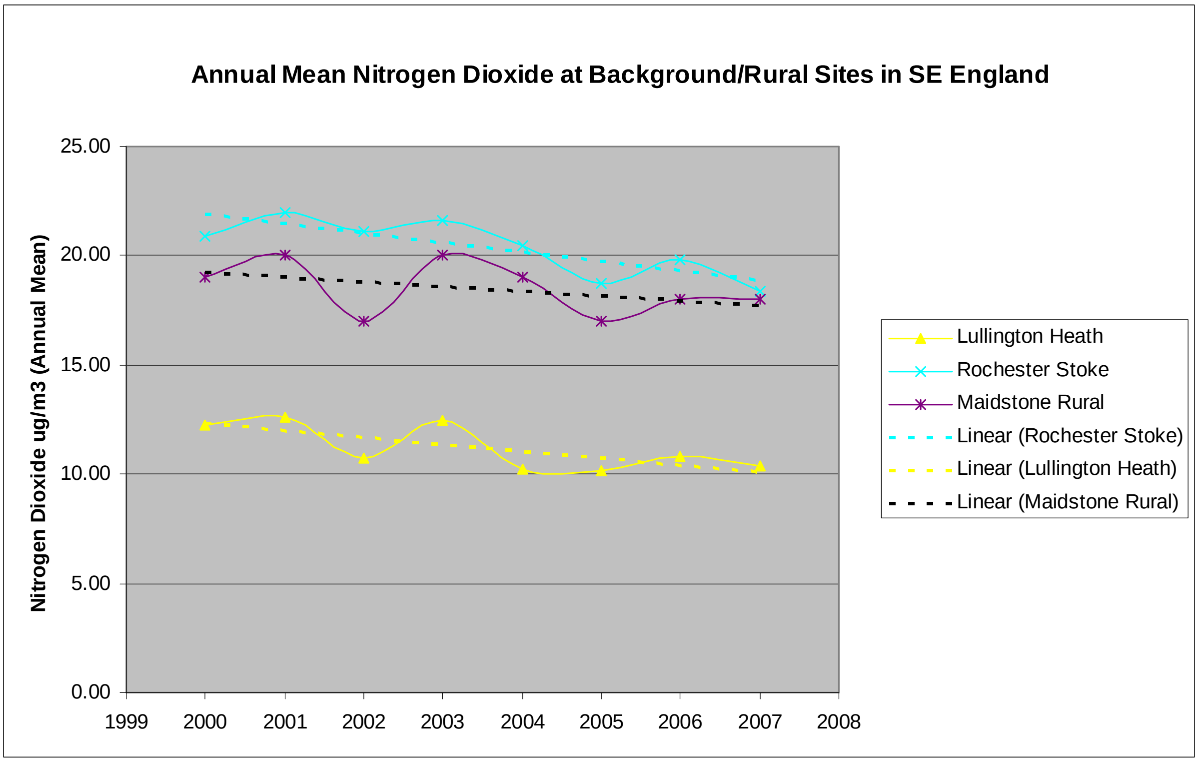
Table 1.4.1 Nitrogen deposition, interpolated in time, used in the assessment of nitrogen deposition presented in this report.

Year	Nitrogen deposition kgN/ha/yr
2004	11.5
2005	11.2
2009	10.1

2.4.3 Nitrogen deposition is not monitored in the immediate vicinity of LAA, nor are nitrogen oxides or reduced nitrogen (the primary sources of nitrogen deposition). Therefore, the accuracy of the estimate of the temporal trend in nitrogen deposition can only be assessed by examining the trends in relevant pollutant concentrations at rural or background monitoring sites in the South-East of England. Nitrogen deposition includes contributions from both oxidised nitrogen (around 55% of the total) and reduced nitrogen (around 45%). The former is related to concentrations of oxides of nitrogen in air e.g. NO, NO2 etc, whereas the latter is related to ammonia and related compounds.

2.4.4 The closest continuous monitoring stations, at rural or background sites, in the UK's national air quality monitoring network are at Lullington Heath (55km west-south-west of the site) and Rochester Stoke (60km north-west). In addition, a rural site near Maidstone (46km north-west) is part of the Kent Air Quality Monitoring Network. The diagram below shows the trend in nitrogen dioxide concentration at these sites between 2000 and 2007. There is a mean 2% per annum decrease across all sites. This is consistent with the anticipated decrease in nitrogen deposition.

Diagram 1.4.1. Monitored nitrogen dioxide concentrations at background/rural sites



2.4.5 Ammonia concentrations are also measured at Lullington Heath. However, given the resolution of the available data, it is not possible to ascertain whether there is a significant temporal trend in this data.

2.4.6 The UK Air Quality Strategy indicates that at background sites and in cattle dominated areas, there appears to be a slight increase in ammonia concentrations, even though emissions are not estimated to have increased. In contrast, in sheep, and in pig and poultry dominated areas, there is a slight (non-significant) reduction in NH3 concentrations. This suggests that the decrease in total nitrogen deposition with time may, potentially, be slightly overestimated in the APIS data and in the nitrogen deposition assessment below. This possibility is considered further in the model results described in Section 5.

2.4.7 Finally, the deposition data provided by APIS for specific sites are based on the output of the long-range dispersion model FRAME. The model undergoes a calibration procedure which compensates for the difference between modelled deposition data and maps of deposition generated from measurements. Monitoring data for Lullington Heath and Barcombe Mills (63km west-south-west) will have been incorporated into the model output. In the absence of major sources of air pollution in the vicinity of these sites and LAA, the estimated nitrogen deposition from the APIS web site is considered to be robust.

2.5 Response to Comment 2(v)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition	SAC, SSSI	v. Clarify what area of 'perennial vegetation of stony banks' within the SAC would be

ISSUE	Designated site (plus potential and intended)	Request/clarification
and 'perennial vegetation of stony banks'		significantly adversely affected under four scenarios: (i) an increase to 500,000 ppa and no change in the current background N deposition rate; (ii) an increase to 300,000 ppa and no change in the current background N deposition rate; (iii) an increase to 500,000 ppa and the most likely trend in background N deposition; and (iv) an increase to 300,000 ppa and the most likely trend in background N deposition. These estimates should be accompanied by maps to show the affected areas of 'perennial vegetation of stony banks' and the boundary of the SAC and SSSI. NB: the distribution of 'vegetated shingle' shown in the N deposition mapping that has been submitted appears to be substantially inaccurate and any future calculations and maps should be based upon correct distribution data on this designated feature, for example utilising Natural England NVC data.

2.5.1 The assessment of whether areas of 'perennial vegetation of stony banks' and unvegetated shingle within the SAC, SSSI and LAA boundary would be significantly adversely affected under the four scenarios listed above has been based on the modelled local contribution to nitrogen deposition described in Appendix 4.1 (for the runway extension) of Volume 3A to the Supplementary Information dated October 2007.

2.5.2 These model runs have, however, been updated to reflect the receipt of new traffic data in April 2007, and also take into account the potential deterioration of aircraft engines with time. This latter effect has been modelled using the same approach as that used in the assessment of Heathrow, with an approximate 8% increase in emissions of NOx from all aeroplanes in relation to the ICAO emissions for new engines under test conditions.

2.5.3 The October 2007 model inputs are the same as the model inputs used in the 2006 Environmental Statements, with the exception that emissions from gate activities are significantly reduced. This reduction was based on a number of surveys of activity levels at a regional airport of a similar size to LAA i.e. Cardiff-Wales Airport. Gate activities in the 2006 Environmental Statements were based on data from large international hub airports and overestimate the level of activity required at a small, regional airport.

2.5.4 This report presents the results of the assessment for the proposed runway extension (300,000ppa) under two scenarios; with constant background nitrogen deposition and under the 'most likely' scenario.

2.5.5 For the scenarios in which background nitrogen deposition decreases at its 'most likely' rate, background nitrogen deposition is taken from the data provided in Table 1.4.1, with the runway (300,000ppa) assumed to open in 2009. In the scenarios with constant background nitrogen deposition rate, background nitrogen deposition is assumed constant at its 2005 baseline level. Figures 1.5.1 to 1.5.5 show the total deposition in the vicinity of LAA for the baseline and the four future year scenarios as requested in Comment 2(v).

2.5.6 The change in nitrogen deposition is provided as the change with respect to the 2005 baseline conditions.

The area affected is calculated as the area of each habitat area which experiences a change in deposition greater than the specified level. This takes into account the potential colonisation of the shingle and the potential presence of lichens on shingle considered to be unvegetated.

Area of affected SAC within the Dungeness designated site as a function of the change in nitrogen deposition

2.5.7 In the absence of explicit boundaries for specific vegetation a highly conservative approach is to assume the whole area of the SAC (24.5km^2 excluding water bodies) is made up of 'perennial vegetation of stony banks'. Further details of this assumption are provided in Section 2.1.

2.5.8 Table 1.5.1, shows the area of 'perennial vegetation of stony banks' in the Dungeness SAC which is affected by the expansion of the airport as a function of the total area of 'perennial vegetation of stony banks' within the SAC. Due to the lack of explicit boundaries of the vegetation, water body areas are included in the affected areas of the expansion. This will over estimate the percentage of impact on the SAC, this is a conservative approach. The changes in pollutant concentrations in the four scenarios are shown as contour plots in Figures 1.5.1 to 1.5.5.

Table 1.5.1 Area of affected SAC within the designated site as a function of the change in nitrogen deposition.

Change in deposition		Change with most likely trend in background nitrogen deposition		Change with constant background nitrogen deposition	
Absolute change (kgN/ha/yr)	Change as % of critical load	Expansion to 300Kppa		Expansion to 300Kppa	
		m^2	% of SAC	m^2	% of SAC
>0.1	1%	2731	0.01%	1365248	5.57%
>0.2	2%	2250	0.01%	602702	2.46%
>0.3	3%	0	0.00%	331686	1.35%
>0.5	5%	0	0.00%	118677	0.48%
>1.0	10%	0	0.00%	4733	0.02%
>1.5	15%	0	0.00%	265	0.00%
>2.0	20%	0	0.00%	0	0.00%

2.5.9 The data presented in Table 1.5.1 show that, if background nitrogen deposition decreases with time following the 'most likely' trend, then the effects of the expansion of LAA to 300,000ppa are negligible with respect to current conditions on site.

2.5.10 Referring back to the effects significance criteria in Table 1.3.2, the area of 'perennial vegetation of stony banks' experiencing a change in deposition of more than 1% of the critical load is less than 0.05% of the total area of shingle within the SAC. This implies that the overall effects on the integrity of the site will be negligible. The increase in local emissions from the airport sources is largely offset by the anticipated decrease in background emissions.

2.5.11 If the background nitrogen deposition is constant in time, then the area affected by the expansion of the airport is correspondingly larger. In this case, the increase in local emissions is not offset by the decreasing background concentrations. Figures 1.5.8 and 1.5.9 show the extent of the affected area.

2.5.12 Referring again to the significance criteria of Table 1.3.2, the effects of the expansion of the airport to 300,000ppa are assessed to be minor adverse i.e. the area experiencing a moderate increase in deposition just above 5% of the total area of 'perennial vegetation of stony banks'. However, the area experiencing a >10% change in deposition is less than 0.1% of the total area of shingle and is negligible.

2.5.13 It must be stressed that, with background nitrogen oxides concentrations decreasing with time and ammonia concentrations showing no significant trend, the scenario of a constant background deposition rate is an unrealistic worst case. Included in these worse case scenarios is the over estimation of the affected areas, due to inclusion of the water bodies. The increase in deposition with respect to the baseline will, in reality, be lower that in the scenarios presented in Figures 1.5.8 and 1.5.9.

2.5.14 Overall, therefore, taking into consideration the likely uncertainty in the change in background deposition with time, the magnitude of the airport contribution to nitrogen deposition, the existing exceedence of the critical load for Dungeness SAC and the inclusion of water body areas, it is concluded that the impact of the expansion of LAA to 300,000ppa on the integrity of the 'perennial vegetation on stony banks' habitat will at worse case negligible.

<u>Area of affected SSSI within the Dungeness, Romney Marsh and Rye Bay designated site as a function of the change in nitrogen deposition</u>

2.5.15 In the absence of explicit boundaries for specific vegetation a conservative approach is to assume the whole area of the SSSI (90.9km^2 excluding water bodies) is made up of 'perennial vegetation of stony banks'.

2.5.16 Table 1.5.2, shows the area of 'perennial vegetation of stony banks' in the Dungeness, Romney Marsh and Rye Bay SSSI which is affected by the expansion of the airport as a function of the total area of 'perennial vegetation of stony banks' within the SSSI. Due to the lack of explicit boundaries of the vegetation, water body areas are included in the affected areas of the expansion. This will over estimate the percentage of impact on the SSSI, this is a conservative approach. The changes in pollutant concentrations in the four scenarios are shown as contour plots in Figures 1.5.6 to 1.5.9.

Table 1. 5.2 Area of affected SSSI within the designated site as a function of the change in nitrogen deposition.

Change in deposition		Change with most likely trend in background nitrogen deposition		Change with constant background nitrogen deposition	
Absolute change (kgN/ha/yr)	Change as % of critical load	Expansion to 300Kppa		Expansion to 300Kppa	
		m^2	% of SSSI	m^2	% of SSSI
>0.1	1%	96180	0.11%	3519373	3.87%
>0.2	2%	61913	0.07%	1812113	1.99%
>0.3	3%	43363	0.05%	1132109	1.25%
>0.5	5%	20851	0.02%	481349	0.53%

>1.0	10%	5250	0.01%	89555	0.10%
>1.5	15%	2070	0.00%	27416	0.03%
>2.0	20%	37	0.00%	6928	0.01%

2.5.17 The data presented in Table 1.5.2 and in Figures 1.5.2 and 1.5.4 show that, if background nitrogen deposition decreases with time following the 'most likely' trend, then the effects of the expansion of LAA to 300,000ppa are negligible with respect to current conditions on site.

2.5.18 Referring back to the effects significance criteria in Table 1.3.2, the area of 'perennial vegetation of stony banks' experiencing a change in deposition of more than 1% of the critical load is less than 0.2% of the total area of shingle within the SSSI. This implies that the overall effects on the integrity of the site will be negligible. The increase in local emissions from the airport sources is largely offset by the anticipated decrease in background emissions.

2.5.19 If the background nitrogen deposition is constant in time, then the area affected by the expansion of the airport is correspondingly larger. In this case, the increase in local emissions is not offset by the decreasing background concentrations. Figures 1.5.3 and 1.5.5 show the extent of the affected area.

2.5.20 Referring again to the significance criteria of Table 1.3.2, the effects of the expansion of the airport to 300,000ppa are assessed to be negligible i.e. the area experiencing a moderate increase in deposition below 5% of the total area of 'perennial vegetation of stony banks'.

2.5.21 It must be stressed that, with background nitrogen oxides concentrations decreasing with time and ammonia concentrations showing no significant trend, the scenario of a constant background deposition rate is an unrealistic worst case. Included in these worse case scenarios is the over estimation of the affected areas, due to inclusion of the water bodies. The increase in deposition with respect to the baseline will, in reality, be lower that in the scenarios presented in Figures 1.5.4 and 1.5.5.

2.5.22 Overall, therefore, taking into consideration the likely uncertainty in the change in background deposition with time, the magnitude of the airport contribution to nitrogen deposition and the inclusion of water body areas, it is concluded that the impact of the expansion of LAA to either 300.000ppa on the integrity of the 'perennial vegetation on stony banks' habitat will be negligible.

Area of unvegetated shingle potentially affected by a potential change in nitrogen deposition

2.5.23 In accordance with Natural England's recommendations detailed in Section 2.1 unvegetated shingle has been considered as part of the nitrogen deposition impact assessment above.

2.5.24 However, unvegetated shingle; with the potential to support rare lichen species is also present within the airport boundary and outside of the SAC. For this reason the potential impacts of nitrogen deposition on unvegetated shingle has also been considered separately. The results of this assessment are provided below.

2.5.25 The table below, Table 1.5.3, shows the area of shingle within the Dungeness SAC and LAA boundary which is affected by the expansion of LAA as a function of the total area of shingle present. The total area of shingle; established using aerial mapping, is 15.5km^2. The changes in pollutant concentrations in the four scenarios are shown as contour plots in Figures 1.5.1 to 1.5.5.

Table 1.5.3 Area of affected shingle within designated sites as a function of the change in nitrogen deposition.

Change in deposition	Change with	Change with constant

		most likely trend in background nitrogen deposition		background nitrogen deposition	
Absolute change (kgN/ha/yr)	Change as % of critical load	Expansion to 300Kppa		Expansion to 300Kppa	
		m^2	% of shingle	m^2	% of shingle
>0.1	1%	1646	0.01%	396395	2.56%
>0.2	2%	426	0.00%	131591	0.85%
>0.3	3%	9	0.00%	66720	0.43%
>0.5	5%	0	0.00%	20498	0.13%
>1.0	10%	0	0.00%	1914	0.01%
>1.5	15%	0	0.00%	0	0.00%
>2.0	20%	0	0.00%	0	0.00%

2.5.26 The data presented in Table 1.5.1 and in Figures 1.5.2 and 1.5.4 show that, if background nitrogen deposition decreases with time following the 'most likely' trend, then the effects of the expansion of LAA to 300,000ppa are negligible with respect to current conditions on site.

2.5.27 Referring back to the effects significance criteria in Table 1.3.2 above, the area of shingle experiencing a change in deposition of more than 1% of the critical load is less than 0.05% of the total area of shingle. This implies that the overall effects on the habitat will be negligible. The increase in local emissions from LAA sources is largely offset by the anticipated decrease in background emissions.

2.5.28 If the background nitrogen deposition is constant in time, then the area affected by the expansion of LAA is correspondingly larger. In this case, the increase in local emissions is not offset by the decreasing background concentrations. Figures 1.5.3 and 1.5.5 show the extent of the affected area.

2.5.29 Referring again to the significance criteria of Table 1.3.2, the effects of the expansion of LAA to 300,000ppa are assessed to be negligible i.e. the area experiencing a moderate increase in deposition (>1% and <10% of the critical load) is less than 5% of the total area of shingle.

2.5.30 It must be stressed that, with background nitrogen oxides concentrations decreasing with time and ammonia concentrations showing no significant trend, the scenario of a constant background deposition rate is an unrealistic worst case scenario. The increase in deposition with respect to the baseline will, in reality, be lower than that in the scenarios presented in Figures 1.5.3 and 1.5.5.

2.5.31 Overall, therefore, taking into consideration the likely uncertainty in the change in background deposition with time, the magnitude of LAA's contribution to nitrogen deposition and the existing exceedence of the critical load, it is concluded that the impact of the expansion of LAA to either 300,000ppa on the shingle habitat will be negligible and that accordingly the integrity of the SAC will not be adversely affected.

2.5.32 This conclusion is consistent with the conclusion presented in the 2006 Environmental Statements and the 2007 Supplementary Information.

2.6 Response to Comment 2(vi)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and 'perennial vegetation of stony banks'	SAC, SSSI	vi. Clarify what area of 'perennial vegetation of stony banks' occurs within the entire SAC.

2.6.1 As detailed in section 1.1 above, the information provided by Natural England suggests that 'perennial vegetation of stony banks' should include both vegetated and unvegetated shingle. In addition it is recommended that the vegetation maps for the SSSI are used to determine the subsequent area of the habitat.

2.6.2 Review of the SSSI mapping data and further consultation with Natural England revealed that all areas shown to be vegetated are in fact assumed to be vegetated shingle. Unvegetated shingle is assumed by Natural England to comprise all unmapped areas. Comparing the SSSI data to aerial photography of the site and using PB's knowledge of the current habitat distribution, it is apparent that the SSSI data does not accurately reflect the habitat which is present. For this reason the mapping data provided has not been utilised to calculate the area of perennial vegetation of stony banks within the SAC. This area has been calculated based on the general site character details provided on the Joint Nature Conservation Committee website:

Habitat Type	Coverage of SAC (%)
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	20%
Salt marshes. Salt pastures. Salt steppes	1%
Coastal sand dunes. Sand beaches. Machair	2%
Shingle. Sea cliffs. Islets	64%
Inland water bodies (standing water, running water)	2%
Bogs. Marshes. Water fringed vegetation. Fens	10%
Coniferous woodland	1%

2.6.3 In accordance with the recommendations made by Natural England all vegetation coverage within the SAC (excluding Inland water bodies, tidal rivers, estuaries, mud flats, sand flats and lagoons) is assumed to represent 'perennial vegetation of stony banks'. This is equal to 76% of the SAC.

2.6.4 76% of the total area of the SAC is 24.5km^2. Therefore, the area of 'perennial vegetation of stony banks' within the SAC is 24.5km^2.

2.7 Response to Comment 2(vii)

ISSUE	Designated site (plus potential and intended)	Request/clarification
2. Nitrogen deposition and 'perennial vegetation of stony banks'	SAC, SSSI	vii. Clarify what mitigation or compensation is proposed for any significant negative effects on 'perennial vegetation of stony banks', to the degree that there is no reasonable scientific doubt that the measures are adequate, feasible and deliverable. In addition, assess whether any such measures are 'compensation' or 'mitigation' in the context of the Habitats Directive.

2.7.1 On the basis of the model results presented in Section 1.5 and the significance criteria outlined in Section 1.3, no significant negative effects on 'perennial vegetation of stony banks' are anticipated and accordingly the integrity of the SAC will not be adversely affected. Therefore, no mitigation or compensation is proposed for this habitat type.

3 OZONE

3.1 Response to Comment 2(i)

ISSUE	Designated site (plus potential and intended)	Request/clarification
3. Ozone and 'perennial vegetation of stony banks'	SAC, SSSI	ii. Provide an assessment of the effects of the proposed developments on 'perennial vegetation of stony banks' via any changes in ozone levels caused by the proposed developments.

Overview of Emissions and Atmospheric Chemistry

3.1.1 Ozone is not emitted in significant quantities by man-made sources.

3.1.2 Combustion processes, including those occurring in aircraft engines, lead to the formation of nitrogen oxides (NO_X). The majority of these are emitted as nitric oxide (NO), which reacts with ozone (O_3) in the atmosphere to form nitrogen dioxide (NO_2).

3.1.3 In the presence of sunlight, NO_X chemistry is further complicated by the photo dissociation of nitrogen dioxide which results in the reformation of nitric oxide and ozone. The equation below illustrates the basic reactions which occur in the vicinity of a source of NO_X.

Equation 1. Simplified representation of NO_X chemistry

$$NO + O_3 \overset{(sunlight)}{\leftrightarrows} NO_2 + O_2$$

3.1.4 If ozone is present in excess of nitric oxide, and has a typical UK background concentration of 30ppb (60µg/m^3) as at LAA, the reaction of nitric oxide and ozone is rapid, taking about 90seconds. Although it should be noted that in 90seconds, a parcel of air can travel close to 300m in a modest 3m/s wind, or 1000m in a 10m/s wind.

3.1.5 If the concentration of nitric oxide is comparable to that of ozone, the formation of nitrogen dioxide can take several minutes. Furthermore, if nitric oxide exceeds ozone, which may be the case in the immediate vicinity of the LAA runway and the main roads approaching the airport, the reaction will be incomplete.

3.1.6 On a regional scale, reactions involving volatile organic compounds ("VOC"), nitrogen oxides and sunlight – known as ozone precursors – generate ozone. These reactions are, however, significantly slower than the reactions involving nitrogen oxides described above. Ambient air monitoring data from stations around Heathrow airport will be used in the following paragraphs to demonstrate that it will be the reaction of nitric oxide with ozone which will be the principal local control on ozone concentrations in the vicinity of LAA.

3.1.7 For road traffic, the proportion of nitrogen oxides directly emitted as nitrogen dioxide (primary nitrogen dioxide) has been increasing with time due to the fitting of particulate matter abatement on diesel engines. However, this is not a significant consideration for aircraft engine emissions.

Trends around other Airports.

3.1.8 Extensive monitoring is undertaken in the vicinity of Heathrow airport. A comprehensive report on the monitoring was presented in Chapter 2 of the Report of the Air Quality Technical Panels, published by the Department for Transport in 2006.

3.1.9 The regional background concentration of nitrogen oxides is of the order of 35 to 40$\mu g/m^3$. This is enhanced by Heathrow airport activities to give a local background concentration of 70 to 80 $\mu g/m^3$, which is further enhanced close to the motorway to 110 to 210 $\mu g/m^3$. At the Heathrow airport perimeter, nitrogen oxides concentrations are 120 to130 $\mu g/m^3$.

3.1.10 Corresponding regional background ozone concentrations are 45 to 50 $\mu g/m^3$. However ozone is depleted to around 30 to 35$\mu g/m^3$ at the Heathrow airport perimeter, and to 20 to 25$\mu g/m^3$ at roadside sites.

3.1.11 The depletion is due to the reaction of nitric oxide with ozone to form nitrogen dioxide. This is consistent with the assertion above that in the vicinity of the airport, the primary effect of airport related emissions will be to deplete ozone levels.

Implications for Ozone Concentrations in the Vicinity of LAA

3.1.12 Increased passenger numbers and aircraft movements at LAA will increase nitrogen oxides concentrations in the immediate vicinity of the airport. This will result in a net depletion of ozone.

3.1.13 Whilst LAA is a source of ozone precursors, notably nitrogen oxides and volatile organic compounds, ozone formation reactions are sufficiently slow that they have no significant direct impact on ozone concentrations in the vicinity of LAA. Furthermore, on the regional scale, LAA represents a negligible source of VOC and NOx.

Implications for Perennial Vegetation of Stony Banks

3.1.14 Ground level ozone is an extremely phyto-toxic pollutant causing serious damage to agricultural productivity, forest health and semi-natural ecosystems. Indeed critical levels for ozone have been designed to protect forests, agricultural crops or semi-natural habitats.

3.1.15 The effects of ozone on the perennial vegetation and other natural ecosystems are less well understood. Nevertheless, it is reasonable to assume that exposure to high levels of ozone will cause a similar range of effects to those that have been observed in other vegetation types, for example visible leaf injury, growth reductions and altered sensitivity to biotic and abiotic stresses.

3.1.16 Depleted ozone concentrations in the vicinity of LAA with the planned expansion are, therefore, considered to have a potentially beneficial impact on the surrounding sensitive habitats. There is, however, no published data to suggest the likely magnitude of this effect.

4 PLANT-INSECT INTERACTIONS

4.1 Response to Comment 2(i)

ISSUE	Designated site (plus potential and intended)	Request/clarification
7. Plant-insect interactions	SSSI, SAC	i. In consultation with Kent Wildlife Trust, clarify the need, or otherwise, to consider for the purposes of the EIA Regs possible changes to plant-insect interactions as a result of continued/increased nitrogen deposition and consequent possible effects upon endemic species or subspecies. If this proves to be reasonably necessary, undertake an assessment and submit the results.

4.1.1 As requested, PB consulted with Kent Wildlife Trust ("KWT") on this issue, stating to KWT that:

"PB is undertaking additional studies on the possible impact of nitrogen deposition on sensitive plant communities, but has no plans at present to extend this study to any further impacts on plant-insect interactions. Our view is that if nitrogen deposition is sufficient to damage plant species and communities, then in turn, plant-insect interactions would also be affected. However, we are very interested to receive the views of Kent Wildlife Trust in this respect, especially which insect species you consider might be affected, and which plant-insect interactions.

4.1.2 The response from KWT is very useful, listing vascular and lower plants that might be affected by nitrogen deposition, and also listing herbivorous insect species which are nationally threatened and have been recorded in Dungeness.

4.1.3 It is important to note, however, that the issue of these insect species declining in the UK is by KWT's admission, complex: *"There may be a number of reasons why these species are not more widespread in the UK".* This is certainly true; habitat loss, climate change and pollution are all known to cause decline in insect and other populations. KWT go on to say that plant hosts in many cases are common, but that their growing conditions, including nutrient stress, may affect their ability to support host insect species. KWT call for further survey work and research, including which plant and insect species occur in areas likely to be affected by increased nitrogen deposition.

4.1.4 PB's considered view, under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, is that there is already sufficient knowledge, from surveys and research carried out in support of planning applications Y06/1647/SH and Y06/1648/SH, to assess the significant environmental impacts.

4.1.5 Our conclusion is that plant communities, and therefore plant-insect interactions, <u>may</u> be affected by nitrogen deposition in a small area of the airfield adjacent to the runway. In the rest of the airfield and the rest of the local area, plant communities, and therefore plant-insect interactions, will be unaffected by nitrogen deposition. Overall, the impact on plant and insect communities will be insignificant.

4.1.6 It is important to note that the areas of shingle currently adjacent to the runway ought for airfield safety management reasons to be semi-improved 'long grass', and PB recommends that, even without the proposed extension proposals, it is not appropriate for LAA to support wildlife habitat and species in this part of the airfield.

4.1.7 However, it is recommended that under a draft airfield Biodiversity Action Plan (BAP), areas of shingle are created away from areas of increased nitrogen deposition on the airfield, which are capable of providing habitat for the plants and insects of the local area. The true bug *Aphrodes duffieldi* is specifically included in the airfield BAP as a specices which LAA will work towards enhancing, and other species of terrestrial invertebrates will also benefit under the Plan.

5 RELATIONSHIP TO THE 2006 ENVIRONMENTAL STATEMENT AND 2007 SUPPLEMENTAL INFORMATION

5.1 This Report should be read in conjunction with:-

- Chapter 15 of the 2006 Environmental Statement for the runway extension; and
- The Statement to Inform on the Predicted Impacts from the Proposed Runway Extension on the SAC in Volume 4 of the 2007 Supplementary Information.

5.2 The conclusions of this report re-affirm the conclusions within the 2006 Environmental Statement and the 2007 Supplementary Information, which assessed the 2006 Environmental Statement and the 2007 Statement to Inform, which assessed the likely impact on the 'perennial vegetation of stony banks' to be negligible and re-affirms the Statement to Inform which concluded that 'perennial vegetation of stony banks' within the SAC will not be adversely affected.

Figure 1.5.1. Baseline (2005) total nitrogen deposition in the vicinity of LAA. The grey shading shows the area of hard standing. The blue line shows the area of shingle, and bold green line shows the boundary of the Dungeness SAC.

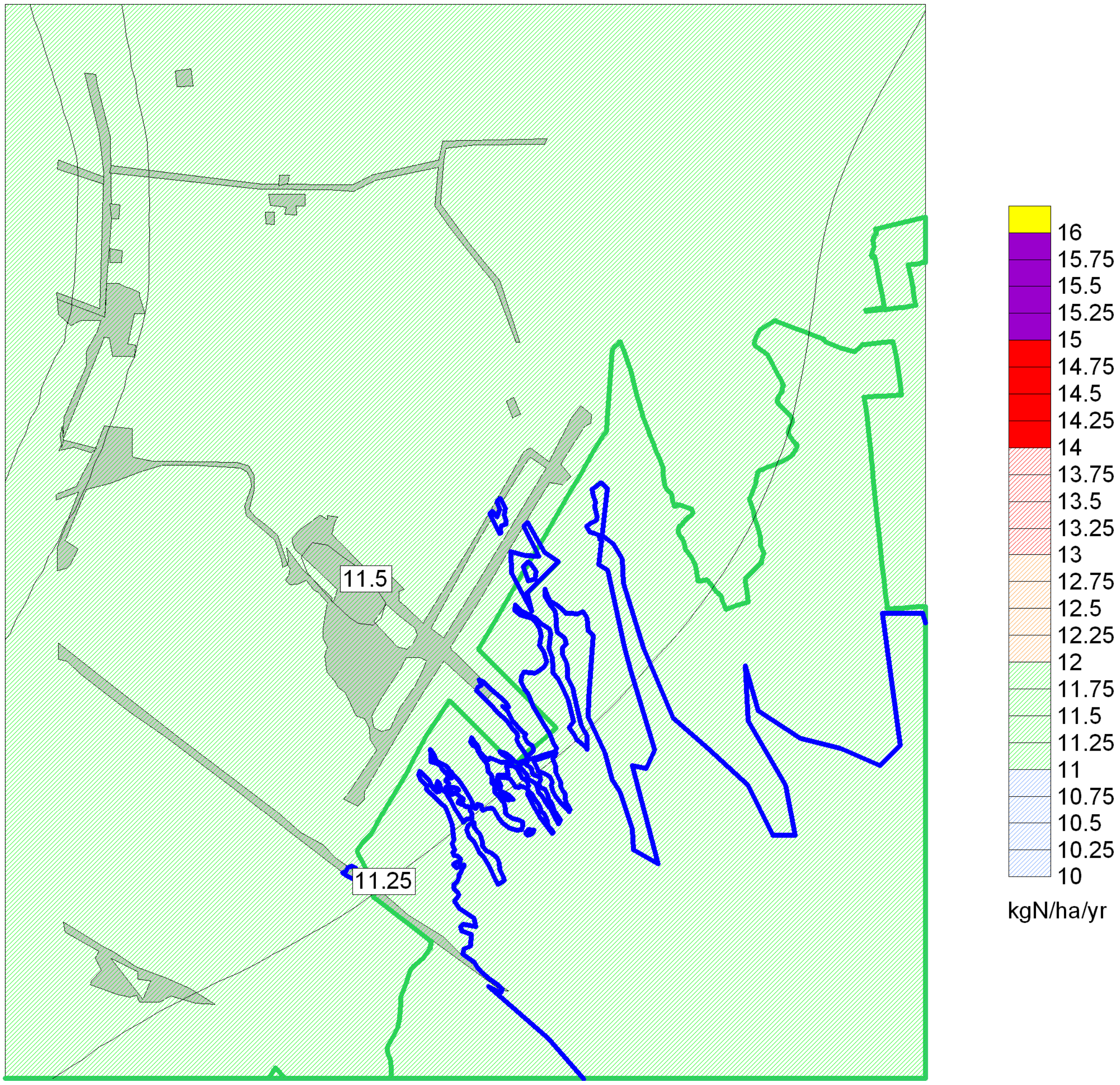


Figure 1.5.2. Total nitrogen deposition in the vicinity of LAA with expansion of the airport to 300,000ppa in 2009. The calculation assumes that background nitrogen deposition changes at its most likely trend. The grey shading shows the area of hard standing. The blue line shows the area of shingle, and bold green line shows the boundary of the Dungeness SAC.

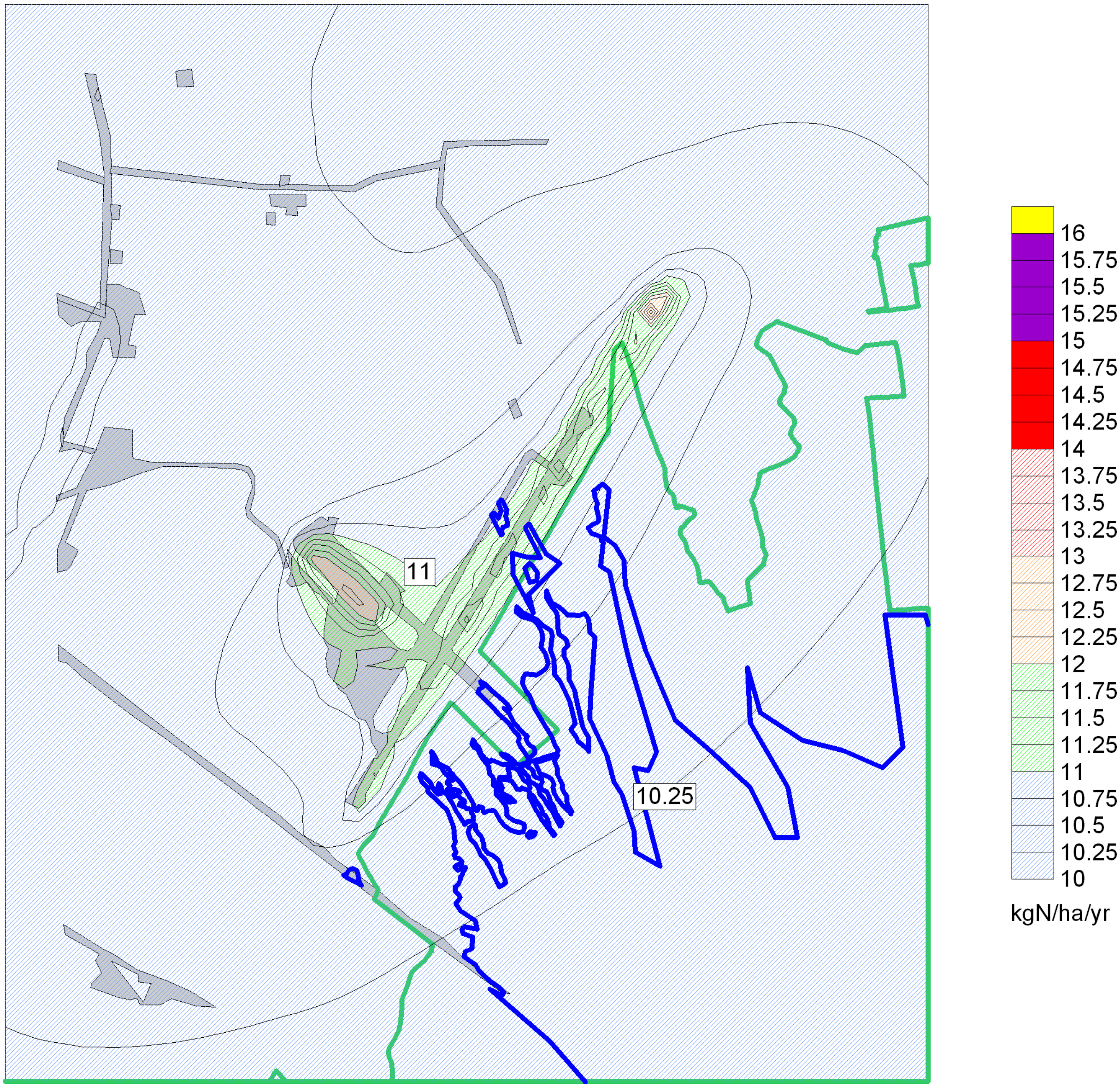


Figure 1.5.3 Total nitrogen deposition in the vicinity of LAA with expansion of the airport to 300,000ppa in 2009. The calculation assumes that background nitrogen deposition changes is constant in time. The grey shading shows the area of hard standing. The blue line shows the area of shingle, and bold green line shows the boundary of the Dungeness SAC.

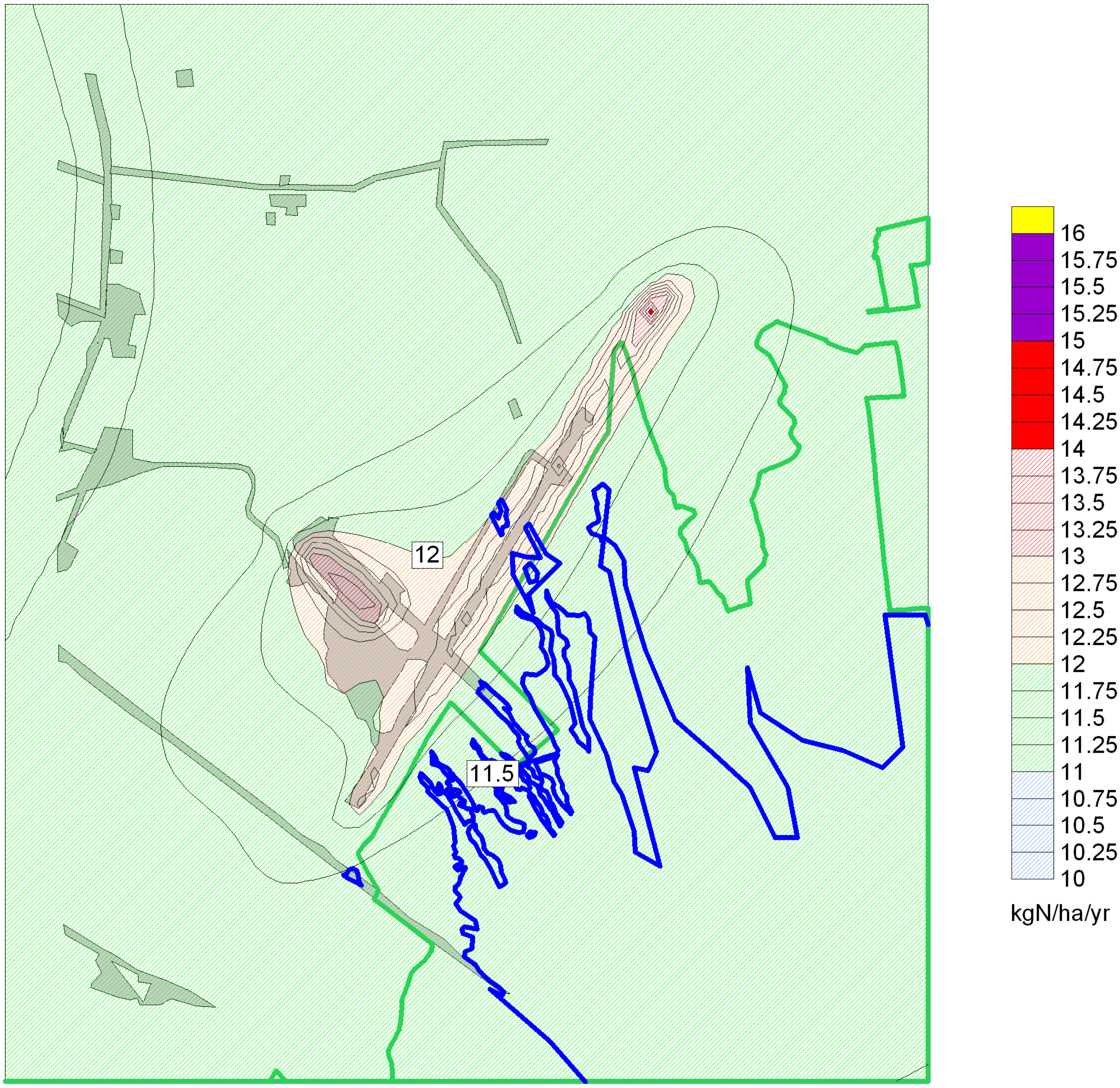


Figure 1.5.4 Change in nitrogen deposition with respect to the baseline in the vicinity of LAA with expansion of the airport to 300,000ppa. The calculation assumes that background nitrogen deposition changes at its most likely trend. The grey shading shows the area of hard standing. The blue line shows the area of shingle, and bold green line shows the boundary of the Dungeness SAC. The purple contour shows the change >1kgN/ha/yr or 10% of the critical load.

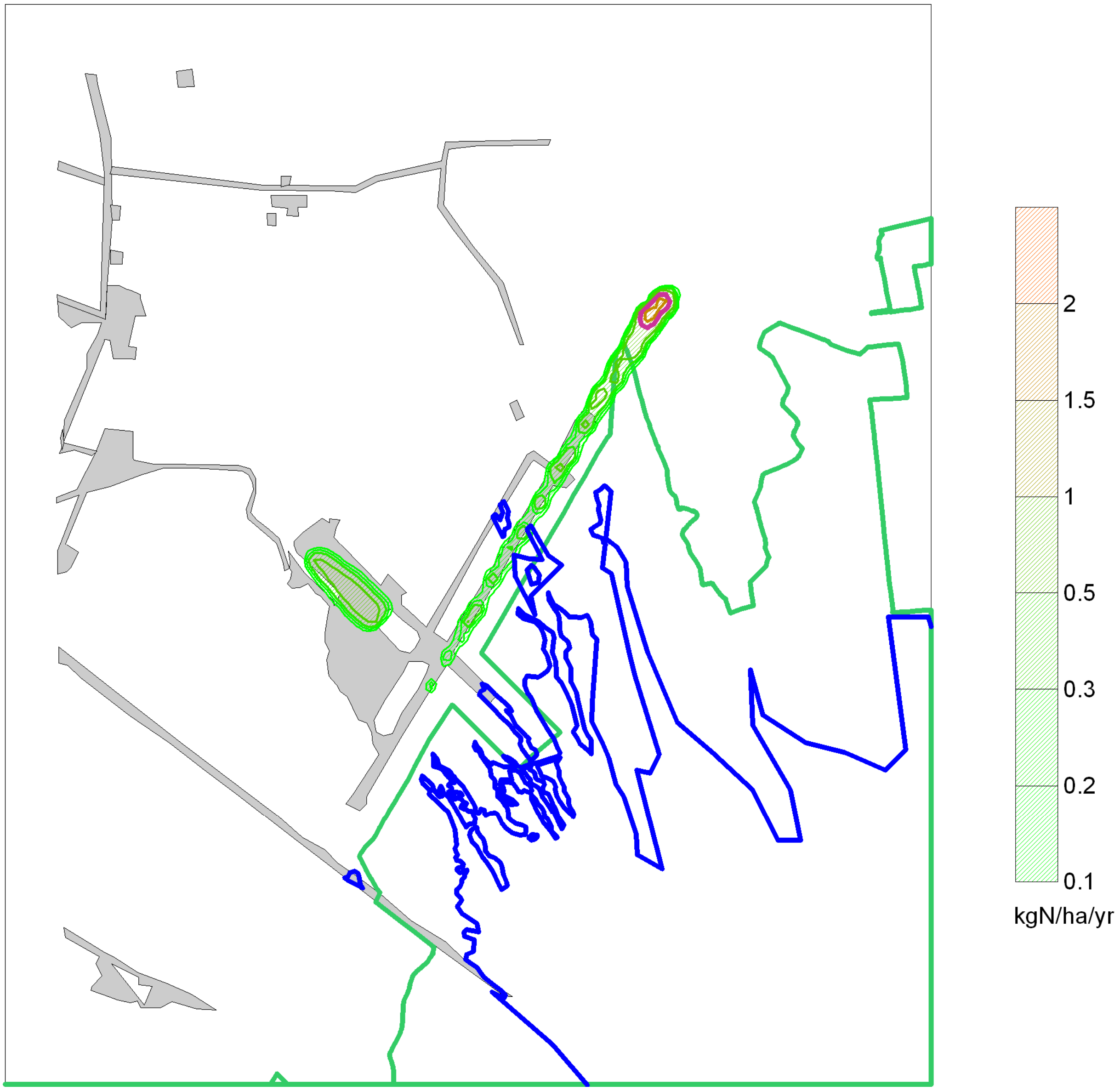


Figure 1.5.5 Change in nitrogen deposition with respect to the baseline in the vicinity of LAA with expansion of the airport to 300,000ppa. The calculation assumes that background nitrogen deposition is constant in time. The grey shading shows the area of hard standing. The blue line shows the area of shingle, and the bold green line shows the boundary of the Dungeness SAC. The purple contour shows the change >1kgN/ha/yr or 10% of the critical load.