

# Optimal Land Use Allocation for the Heathrow Opportunity Area Using Multi-Objective Linear Programming

Melda Salhab<sup>\*1</sup> and Thomas P. Oléron-Evans<sup>†1</sup>

<sup>1</sup> The Bartlett Centre for Advanced Spatial Analysis, University College London

January 31, 2019

**KEYWORDS:** linear programming, land use, optimisation

## Abstract

In 2004, the Greater London Authority (GLA) published the first iteration of *The London Plan*, a “Spatial Development Strategy for Greater London”, with revised and updated versions following at intervals over the following years (GLA, 2004, 2008, 2011, 2016, 2017). In order to address the objective of “[accommodating] London’s growth within its boundaries without encroaching on open spaces” (GLA, 2004, p.6), one key policy presented in the original plan was the designation of an initial twenty-eight “Opportunity Areas” (OAs) across Greater London, where the construction of new homes and creation of jobs could be concentrated. These areas were identified on the basis of their capacity for development, their overlap with existing brownfield sites and their accessibility (or potential accessibility) to public transport (GLA, 2004, pp.39-41).

One of the Opportunity Areas identified in the 2004 plan was “Heathrow/Feltham/Bedfont Lakes”, for which initial targets of 5500 new jobs and 930 new homes were set, to be realised by 2016 (GLA, 2004, p.260). However, while Opportunity Area Planning Frameworks (OAPFs) were produced and adopted for other OAs, by the time of publication of the most recent version of the London Plan (GLA, 2016), no such framework had been adopted for the Heathrow area. The consultation draft of the next edition of the London Plan appears to confirm that planning in the Heathrow OA has been adversely affected by long-running uncertainty over the proposed expansion of Heathrow Airport, stating that “the area’s potential contribution to London’s growth [will be reviewed and clarified] when expansion proposals and their spatial and environmental implications are clearer.” (GLA, 2017, p.51)

The latest employment and housing guidelines for the Heathrow Opportunity Area suggest that it should support 13000 new homes and 11000 new jobs (GLA, 2018, p.26) over a stated area of 700 ha (GLA, 2016, p.361), though the shapefile of the Heathrow OA (GLA Planning, 2018) appears to cover a significantly larger area than this. However, all editions of the London Plan have indicated that development should not intrude upon the Green Belt (see, for example, GLA, 2017, p.62) and the latest shape files of England’s designated Green Belt land (Ministry of Housing, Communities and Local Government, 2018) indicate that a significant proportion of the Heathrow OA is in this category. Moreover, shape files of the remaining brownfield sites in London are also available (London Planning Authorities, 2018) and the amount of such land in the Heathrow OA appears to be very limited.

In this paper, we therefore seek to answer the following questions:

- Are the latest guideline figures for homes and jobs in the Heathrow OA achievable, both in the case where the plans to expand Heathrow Airport go ahead and where they do not?
- How might we specify optimal allocations of land use in the Heathrow OA to either achieve these guideline figures or to maximise home and job creation (in the case where they are not achievable), while also favouring development on brownfield sites, minimising development

---

<sup>\*</sup> melda.salhab.14@alumni.ucl.ac.uk

<sup>†</sup> thomas.evans.11@ucl.ac.uk

on Green Belt land and maximising the gross value added (GVA) of the available land.

To address these questions, we combine the land use categories and employment density statistics from the London Employment Sites Database (CAG Consultants, 2016) with calculations of GVA per workforce job produced by GLA Economics (2015) alongside other data sources. We then apply optimisation techniques based on linear programming to produce a range of 'optimal' land use allocation plans for the Heathrow OA.

Basic linear programs seek to maximise a single objective function, but some authors have devised variants of the technique that can handle multiple objectives (Glover & Martinson, 1987; Makowski et al.; 2000; Aerts et al., 2003). The research questions covered in this paper intrinsically involve multiple objectives, since they seek land use allocation plans that simultaneously excel across a number of different criteria: job and home creation, Green Belt and brownfield development, and GVA. We therefore combine and adapt the methods of the authors cited above to develop a sophisticated new approach to multi-objective land use linear programming, which will allow policymakers to compare the possible 'optimal' land use allocations that arise from differing prioritisations of their objectives.

## References

- Aerts, J.C.J.H., Eisinger, E., Heuvelink, G.B.M. and Stewart, T.J., 2003. Using Linear Integer Programming for Multi-Site Land-Use Allocation. *Geographical Analysis*. 35(2), pp.148-169.
- CAG Consultants, 2016. *London Employment Sites Database: Final Report*. London: CAG Consultants
- GLA Economics, 2015. *GVA per workforce job in London and the UK*. [online] Available through: London Datastore <<https://data.london.gov.uk>> [Accessed 10 Jan 2019].
- GLA Planning, 2018. *London Plan Opportunity Areas*. [online] Available through: London Datastore <<https://data.london.gov.uk>> [Accessed 17 Jul 2018].
- Glover, F. and Martinson, F., 1987. Multiple-use land planning and conflict resolution by multiple objective linear programming. *European Journal of Operational Research*. 28(3), pp.343-350.
- Greater London Authority, 2004. *The London Plan*. London: Greater London Authority
- Greater London Authority, 2008. *The London Plan: Consolidated with Alterations since 2004*. London: Greater London Authority
- Greater London Authority, 2011. *The London Plan*. London: Greater London Authority
- Greater London Authority, 2016. *The London Plan: Consolidated with Alterations since 2011*. London: Greater London Authority
- Greater London Authority, 2017. *The London Plan: Draft for Public Consultation*. London: Greater London Authority
- Greater London Authority, 2018. *Draft New London Plan Showing Minor Suggested Changes*. [online] London: Greater London Authority. Available at: <<https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/download-draft-london-plan-0>> [Accessed 30 Jan 2019]
- London Planning Authorities, 2018. *Brownfield Land Register*. [online] Available through: London Datastore <<https://data.london.gov.uk>> [Accessed 23 Nov 2018].
- Makowski, D., Hendrix, E.M.T., van Ittersum, M.K. and Rossing, W.A.H., 2000. A framework to study nearly optimal solutions of linear programming models developed for agricultural land use exploration. *Ecological Modelling*. 131(1), pp.65-77.
- Ministry of Housing, Communities and Local Government, 2018. *English Local Authority Green belt dataset*. [online] Available through: data.gov.uk <<https://data.gov.uk>> [Accessed 17 Jan 2019].