Note that the pictures are for illustration purpose: the study concern building fires. The building usually hides the actions of the firefighters!

Standard nozzle approach

Perimeter approach

Maximum flow approach

Three different modes of firefighting

Swedish Civil Contingencies Agency

Three different modes of firefighting

Stefan Särdqvist,

PhD, FPE


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Three Different Fire Suppression Approaches Used by Fire and Rescue Services

CrossMark

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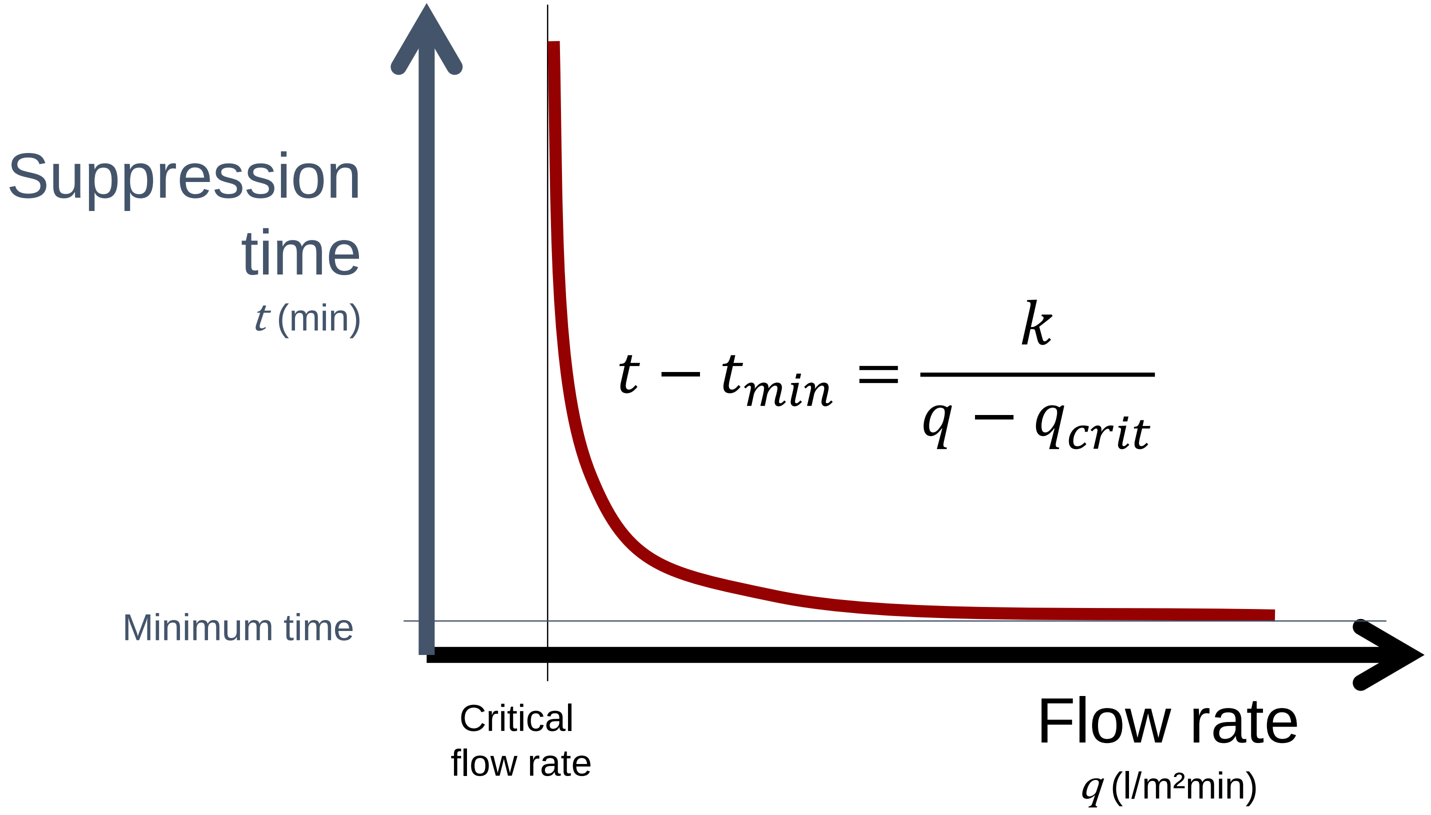
Received: 15 February 2018/**Accepted:** 22 November 2018

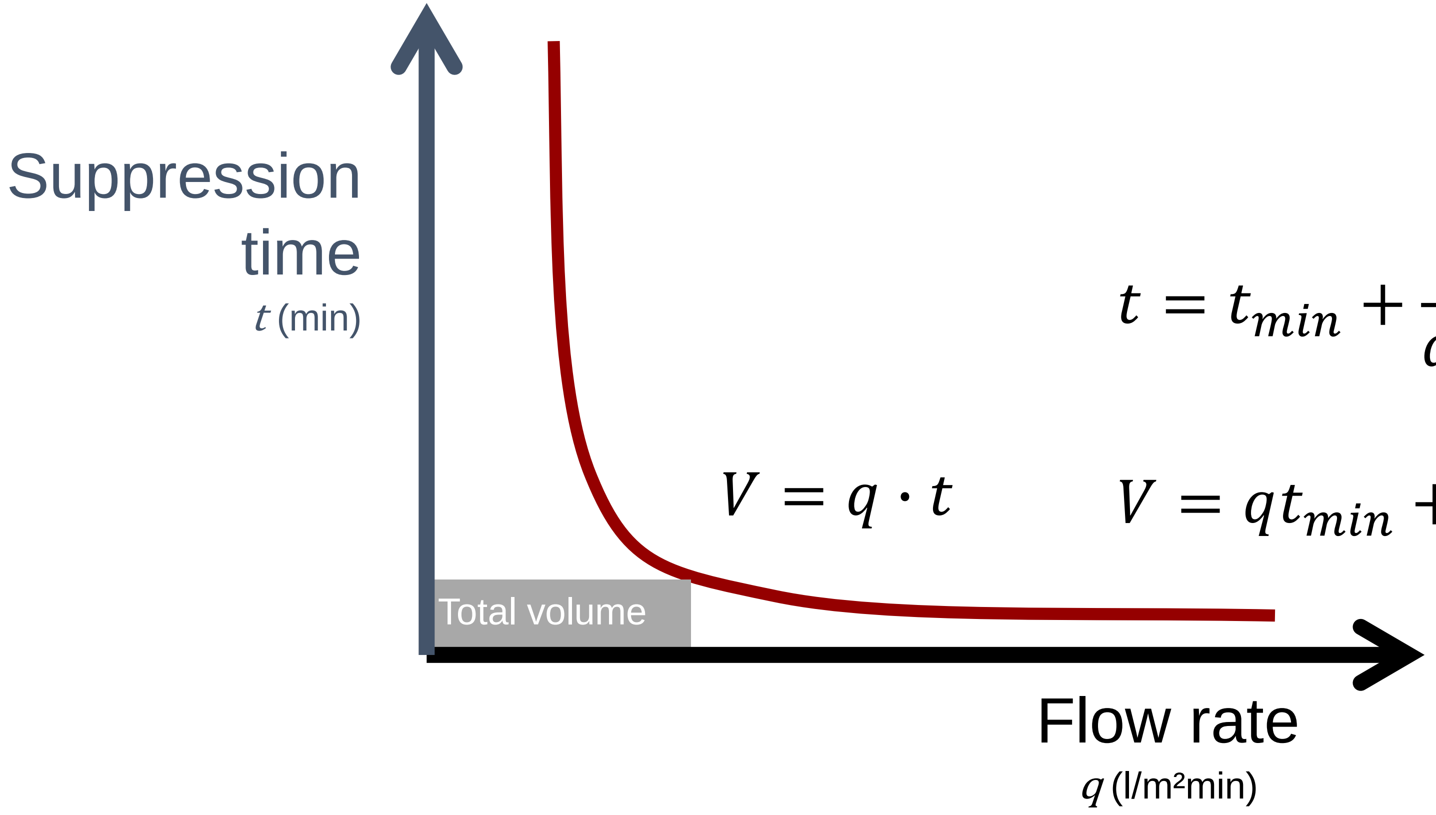
Abstract. This paper describes

Swedish Civil Contingencies Agency

Critical flow rate and optimum flow rate for fire suppression



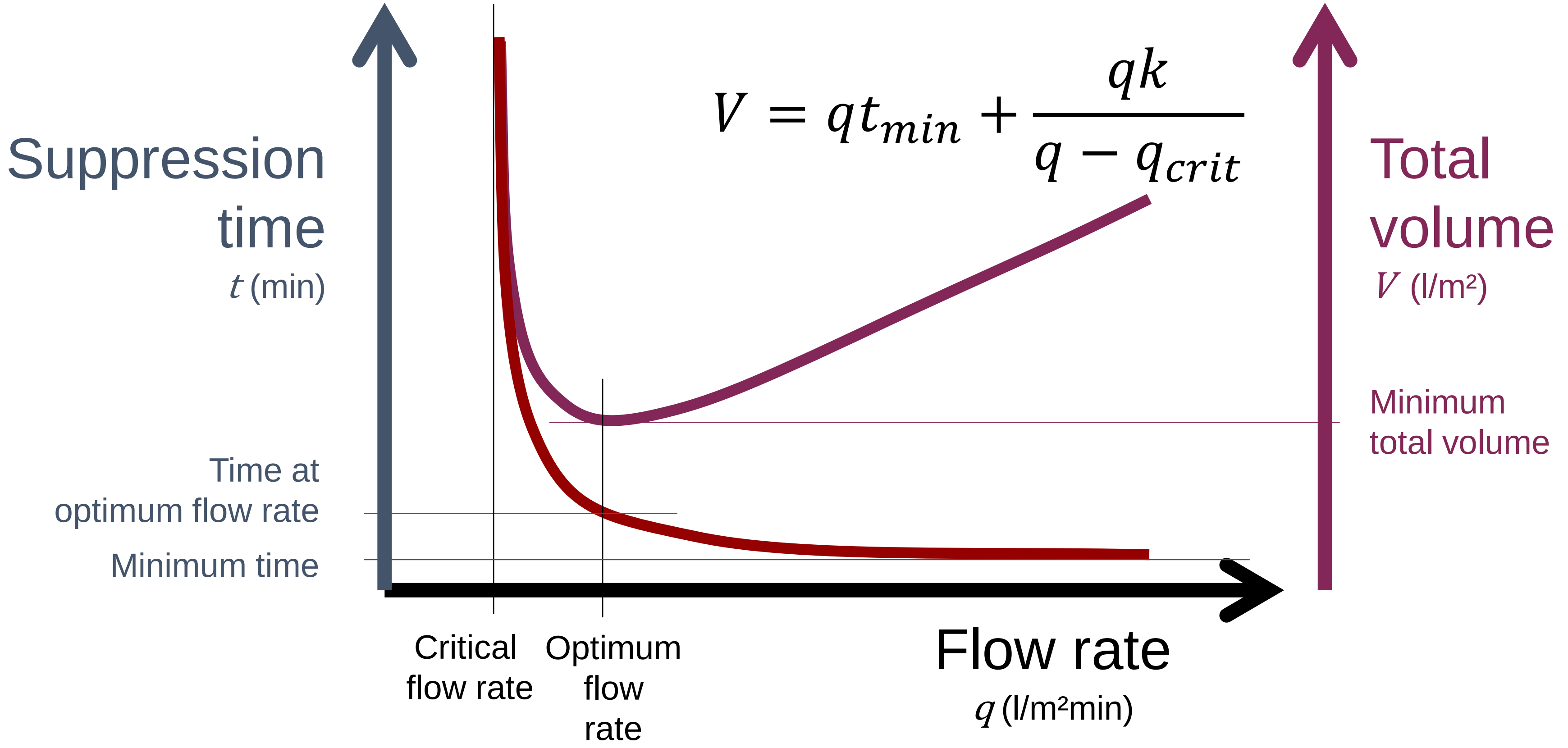
Critical flow rate and optimum flow rate for fire suppression



$$t = t_{min} + \frac{k}{q - q_{crit}}$$

$$V = qt_{min} + \frac{qk}{q - q_{crit}}$$

Critical flow rate and optimum flow rate for fire suppression



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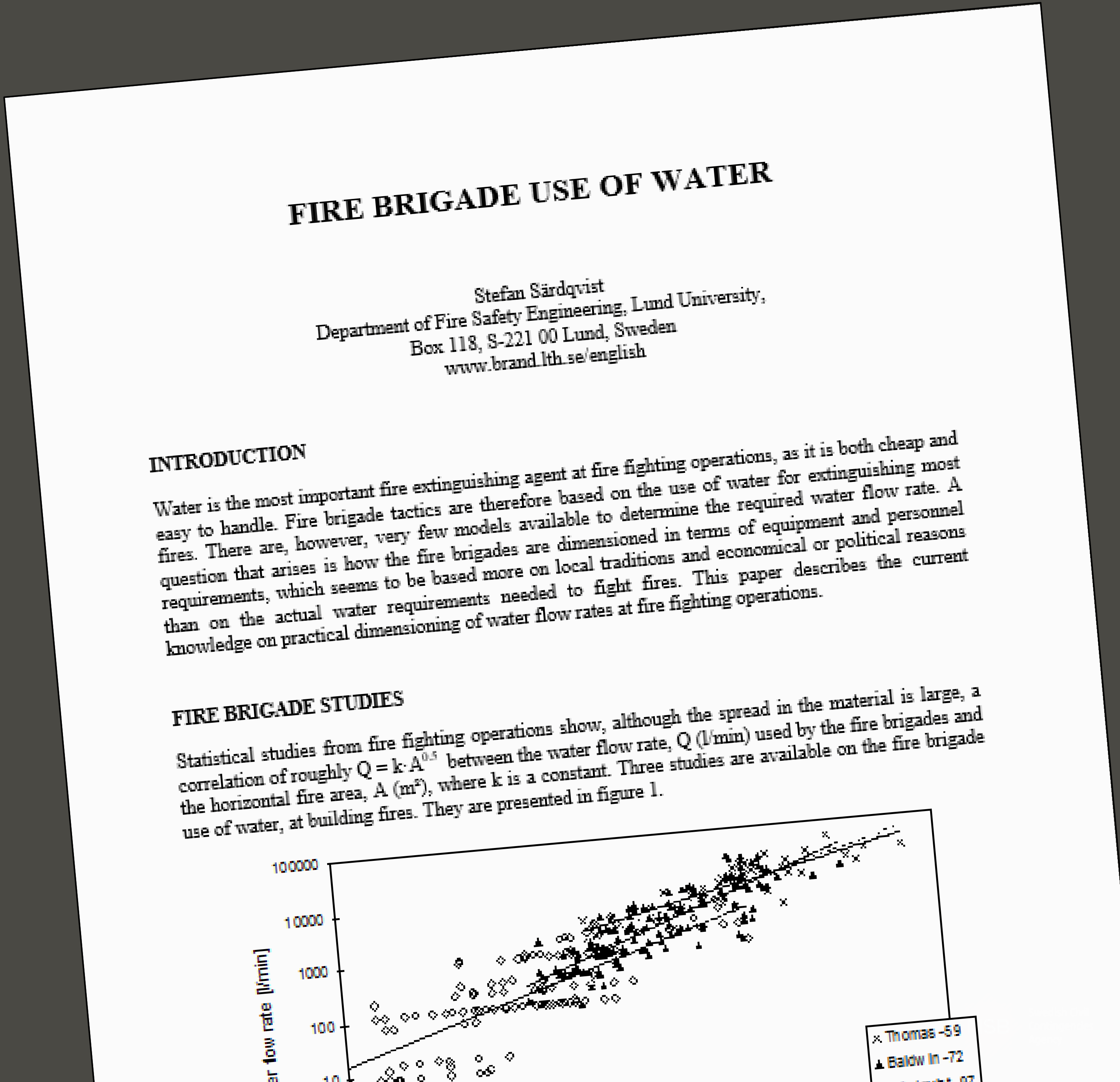

FIRE BRIGADE USE OF WATER

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INTRODUCTION

Water is the most important fire extinguishing agent at fire fighting operations, as it is both cheap and easy to handle. Fire brigade tactics are therefore based on the use of water for extinguishing most fires. There are, however, very few models available to determine the required water flow rate. A question that arises is how the fire brigades are dimensioned in terms of equipment and personnel requirements, which seems to be based more on local traditions and economical or political reasons than on the actual water requirements needed to fight fires. This paper describes the current knowledge on practical dimensioning of water flow rates at fire fighting operations.

FIRE BRIGADE STUDIES

Statistical studies from fire fighting operations show, although the spread in the material is large, a correlation of roughly $Q = k \cdot A^{0.5}$ between the water flow rate, Q (l/min) used by the fire brigades and the horizontal fire area, A (m^2), where k is a constant. Three studies are available on the fire brigade use of water, at building fires. They are presented in figure 1.

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The County/Metro research into fire-fighting suppressive capacity and the impact on building fire damage at > 5000 UK building fires, 2009–2012

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[b] Glasgow Caledonian University, United Kingdom

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ABSTRACT

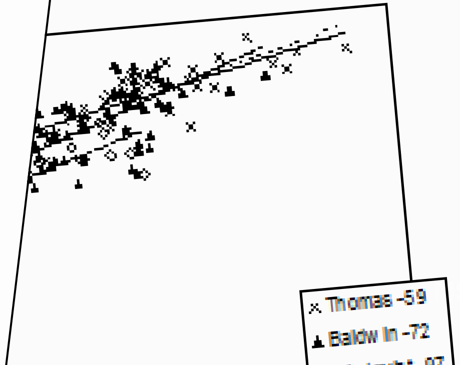
This paper describes research by Glasgow Caledonian University into fire-fighting water flow-rates as actually deployed to control and suppress > 5000 building fires that occurred in two fire authority jurisdictions in the UK between 2009 and 2012. One fire service covered a large county suburban risk area with low to medium populated areas, whilst the other covered a large metropolitan region with heavily populated inner city areas included. Using data from the national IRS fire reporting framework (*UK Fire & Rescue Service National Incident Recording System*), it was demonstrated that the links between the amounts of water used/required for effective fire fighting ... type, the density of the fire load, the estimated ... damage that may ...

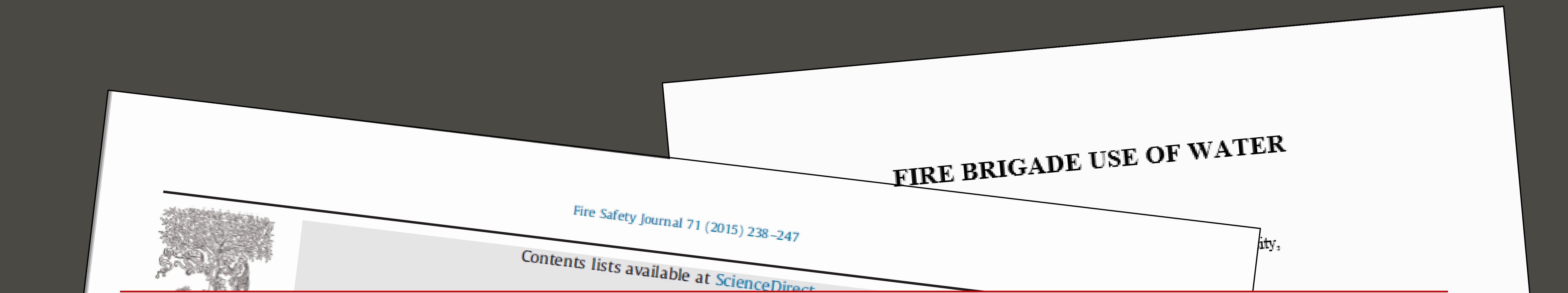
FIRE BRIGADE USE OF WATER

...ity,

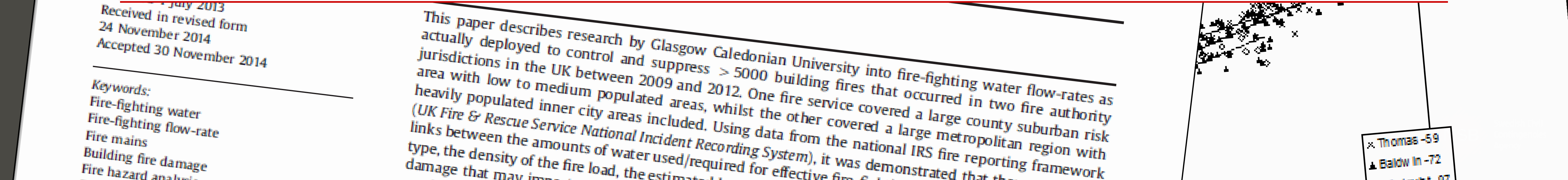
...rations, as it is both cheap and ... water for extinguishing most ... the required water flow rate. A ... of equipment and personnel ... economical or political reasons ... this paper describes the current ... ting operations.

... the spread in the material is large, a ... (l/min) used by the fire brigades and ... udies are available on the fire brigade





Study	Year of publication	Number of fires	Type of fires
Grimwood & Sanderson	2015	4173	UK Metro FRS
Grimwood & Sanderson	2015	1146	UK County FRS
Särdqvist	1998	307	Greater London Non-residential
Baldwin	1972	134	Illinois > 20 m²
Thomas	1959	48	UK, > 5 jets, > 200 m²



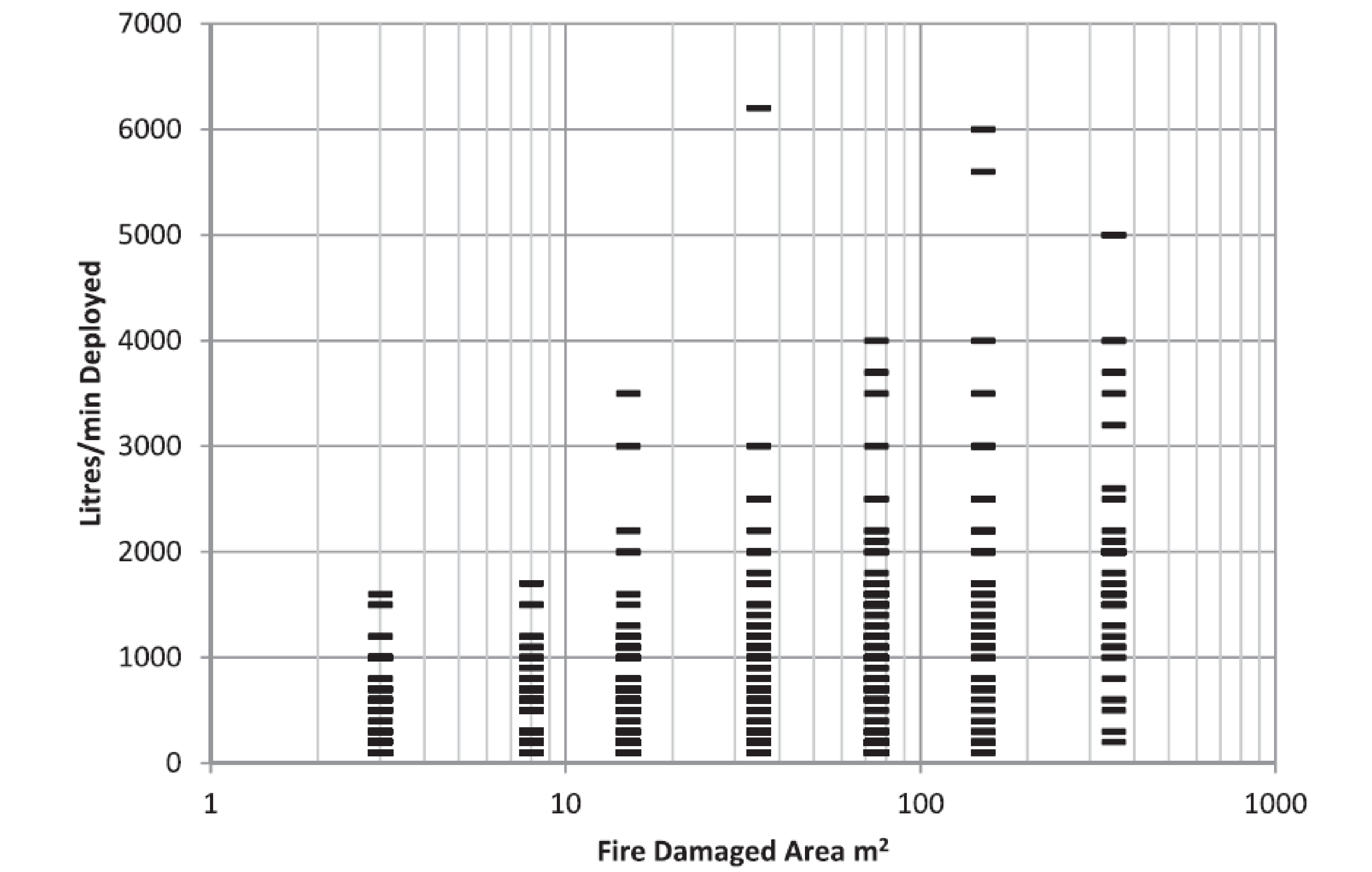


Fig. 3. Metro FRS 4104 building fires 2009–2012: deployed fire-fighting flow-rates in Metro within the targeted zone $< 500\ m^2$ < 6000 LPM where the vast majority of working fires in buildings occurred.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The County/Metro research into fire-fighting suppressive capacity and the impact on building fire damage at > 5000 UK building fires, 2009–2012

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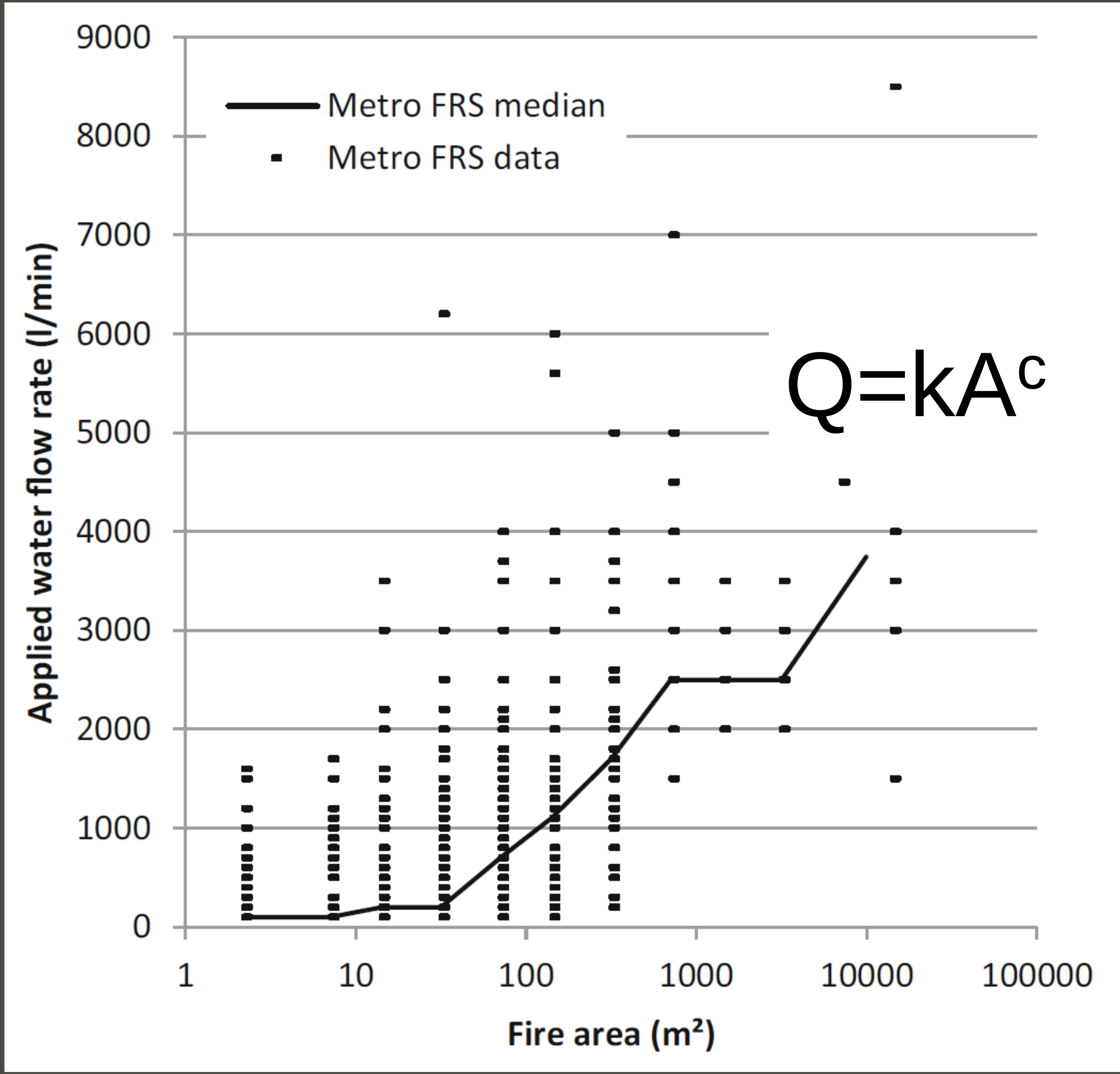

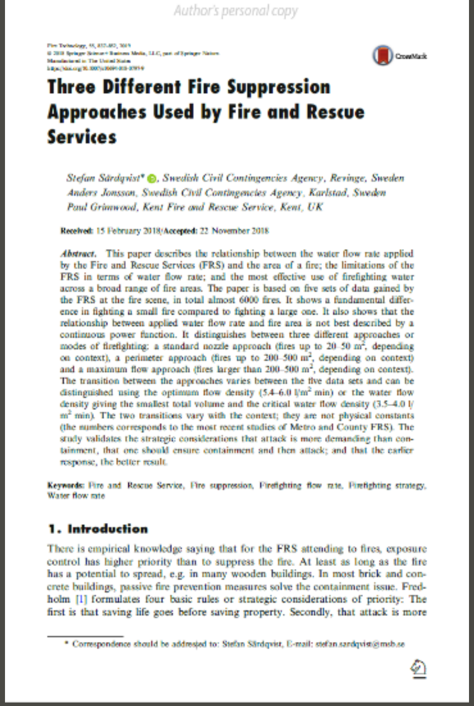

Three Different Fire Suppression Approaches Used by Fire and Rescue Services

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Anders Jonsson, Swedish Civil Contingencies Agency, Karlstad, Sweden
Paul Grimwood, Kent Fire and Rescue Service, Kent, UK

Received: 15 February 2018/**Accepted:** 22 November 2018

Abstract. This paper describes the relationship between the water flow rate applied by the Fire and Rescue Services (FRS) and the area of a fire; the limitations of the FRS in terms of water flow rate; and the most effective use of firefighting water across a broad range of fire areas. The paper is based on five sets of data gained by the FRS at the fire scene, in total almost 6000 fires. It shows a fundamental difference in fighting a small fire compared to fighting a large one. It also shows that the relationship between applied water flow rate and fire area is not best described by a continuous power function. It distinguishes between three different approaches or modes of firefighting: a standard nozzle approach (fires up to 20–50 m^2, depending on context), a perimeter approach (fires up to 200–500 m^2, depending on context) and a maximum flow approach (fires larger than 200–500 m^2, depending on context). The transition between the approaches varies between the five data sets and can be distinguished using the optimum flow density (5.4–6.0 l/m^2 min) or the water flow density giving the smallest total volume and the critical water flow density (3.5–4.0 l/m^2 min). The two transitions vary with the context; they are not physical constants (the numbers corresponds to the most recent studies of Metro and County FRS). The study validates the strategic considerations that attack is more demanding than containment, that one should ensure containment and then attack; and that the earlier response, the better result.

Keywords: Fire and Rescue Service, Fire suppression, Firefighting flow rate, Firefighting strategy, Water flow rate

1. Introduction

There is empirical knowledge saying that for the FRS attending to fires, exposure control has higher priority than to suppress the fire. At least as long as the fire has a potential to spread, e.g. in many wooden buildings. In most brick and concrete buildings, passive fire prevention measures solve the containment issue. Fredholm [1] formulates four basic rules or strategic considerations of priority: The first is that saving life goes before saving property. Secondly, that attack is more

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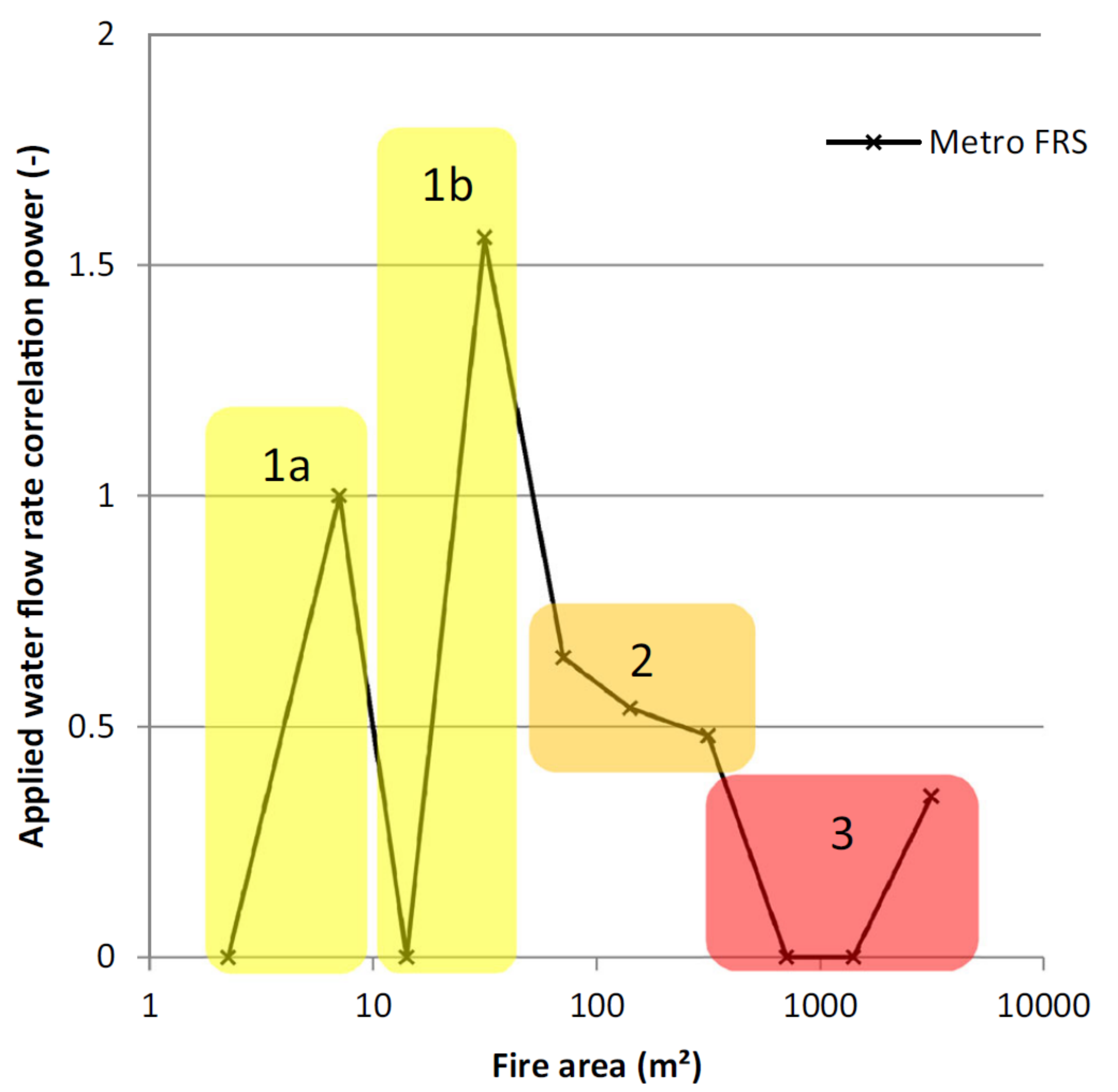

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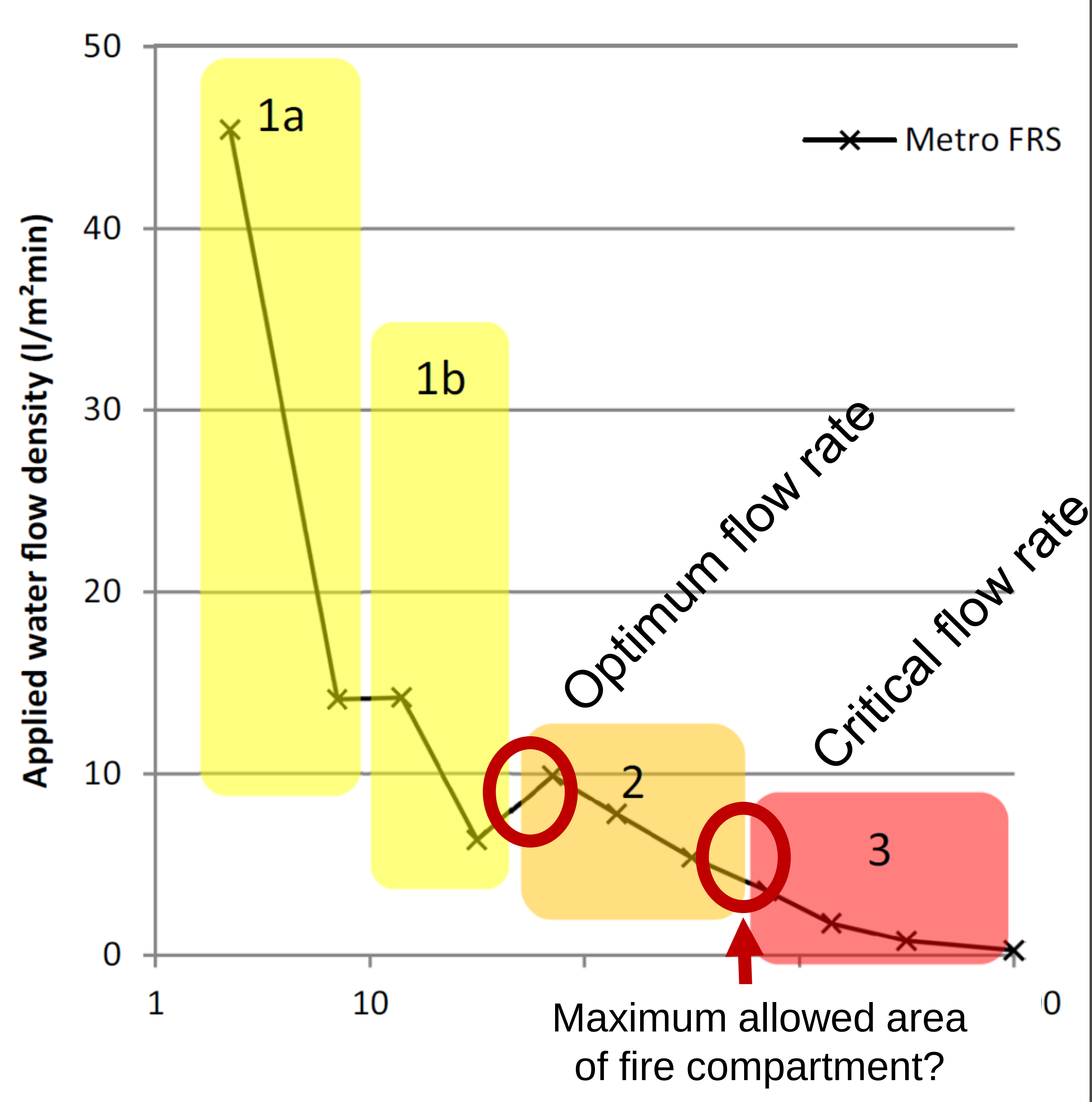
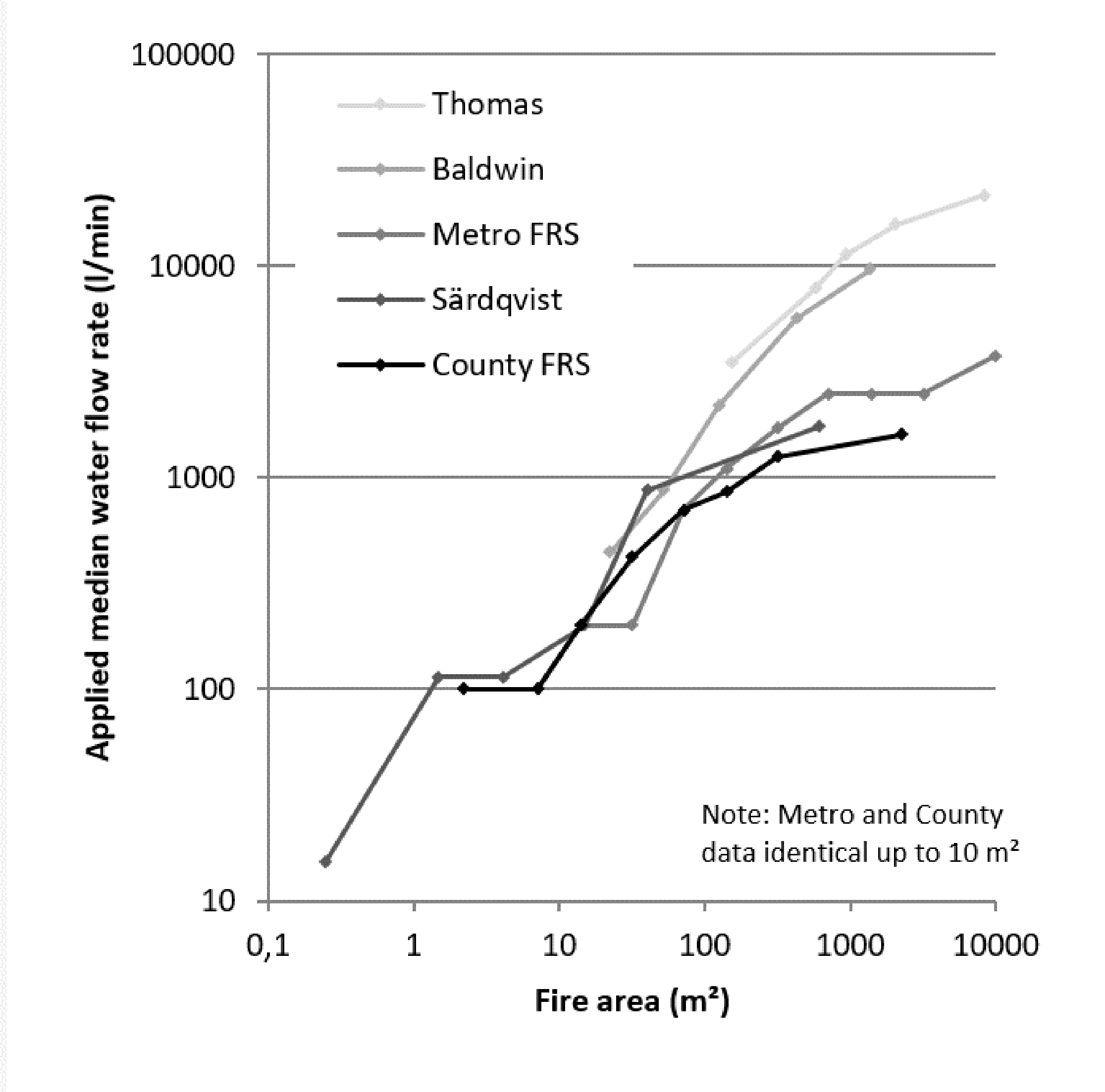
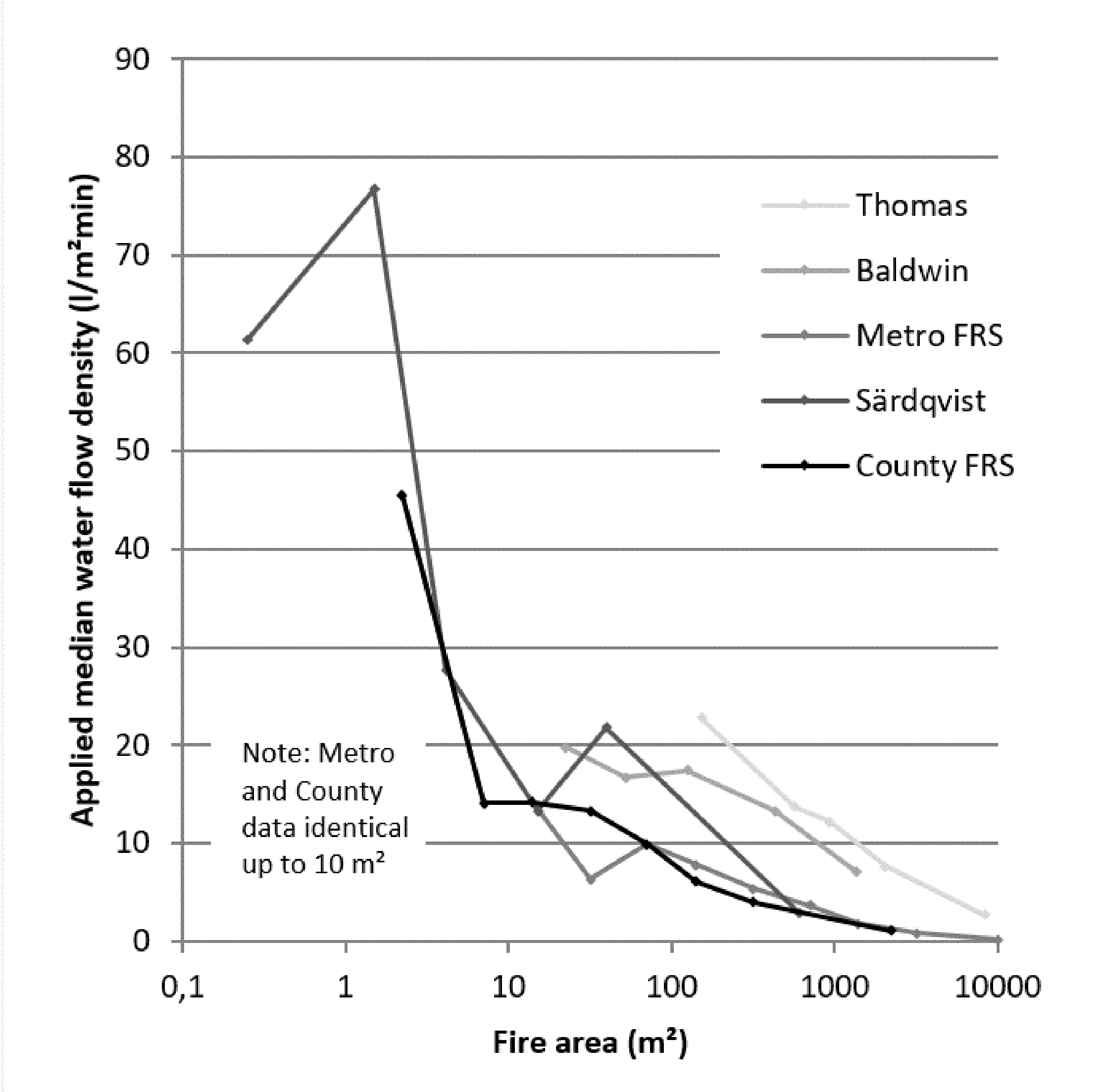


Applied water flow density (l/m²min)
50
40
30
20
10
0
1
10
0
1a
1b
2
3
Metro FRS
Optimum flow rate
Critical flow rate
Maximum allowed area
of fire compartment?


100000
10000
1000
100
10
Thomas
Baldwin
Metro FRS
Särdqvist
County FRS
Applied median water flow rate (l/min)
Note: Metro and County
data identical up to 10 m²
0,1
1
10
100
1000
10000
Fire area (m²)


90
80
70
60
50
40
30
20
10
0
Thomas
Baldwin
Metro FRS
Särdqvist
County FRS
Applied median water flow density (l/m²min)
Note: Metro
and County
data identical
up to 10 m²
0,1
1
10
100
1000
10000
Fire area (m²)

1: Standard nozzle approach

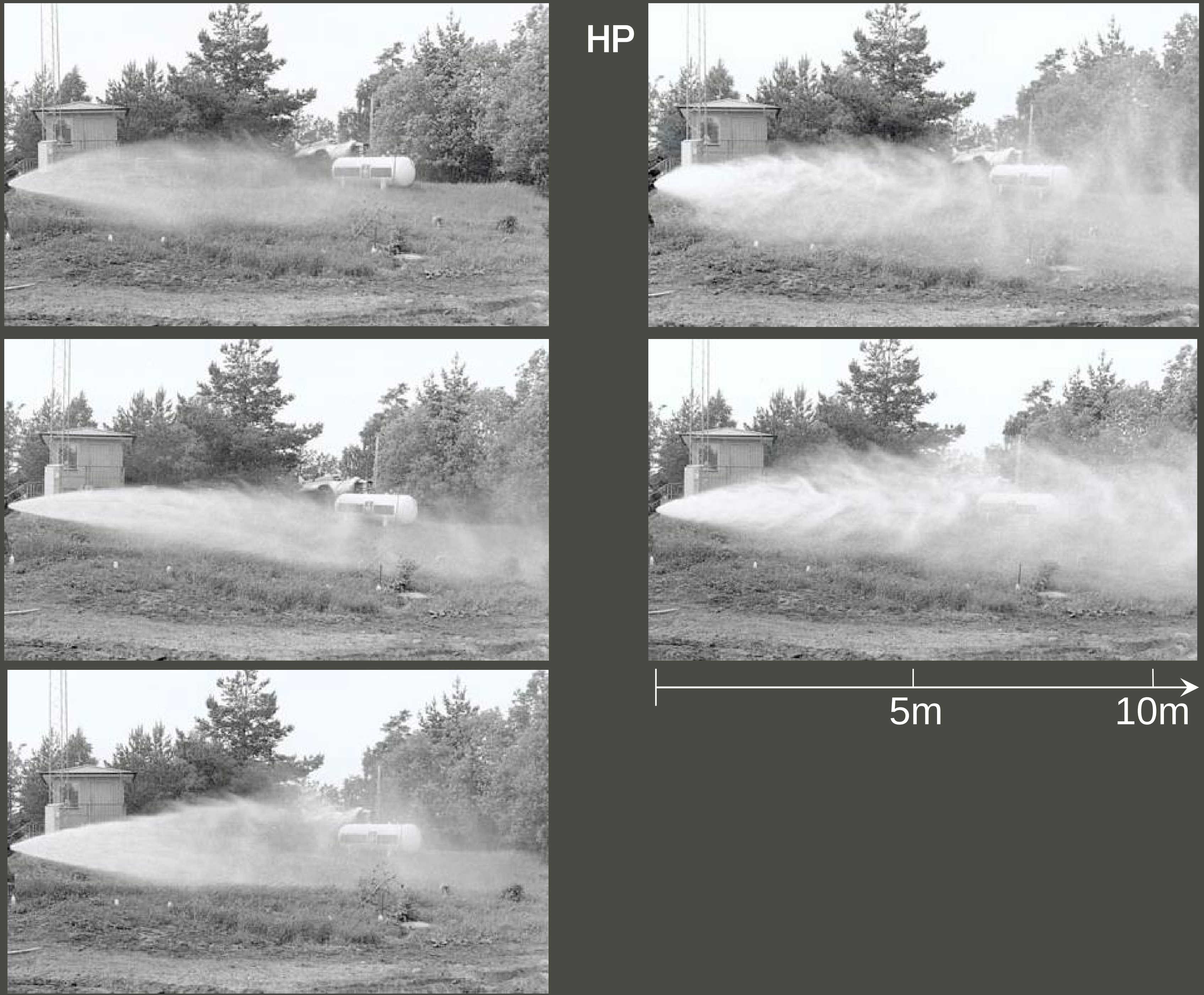
LP

HP

115 l/min

230 l/min

375 l/min



2: Perimeter approach

3: Maximum flow approach

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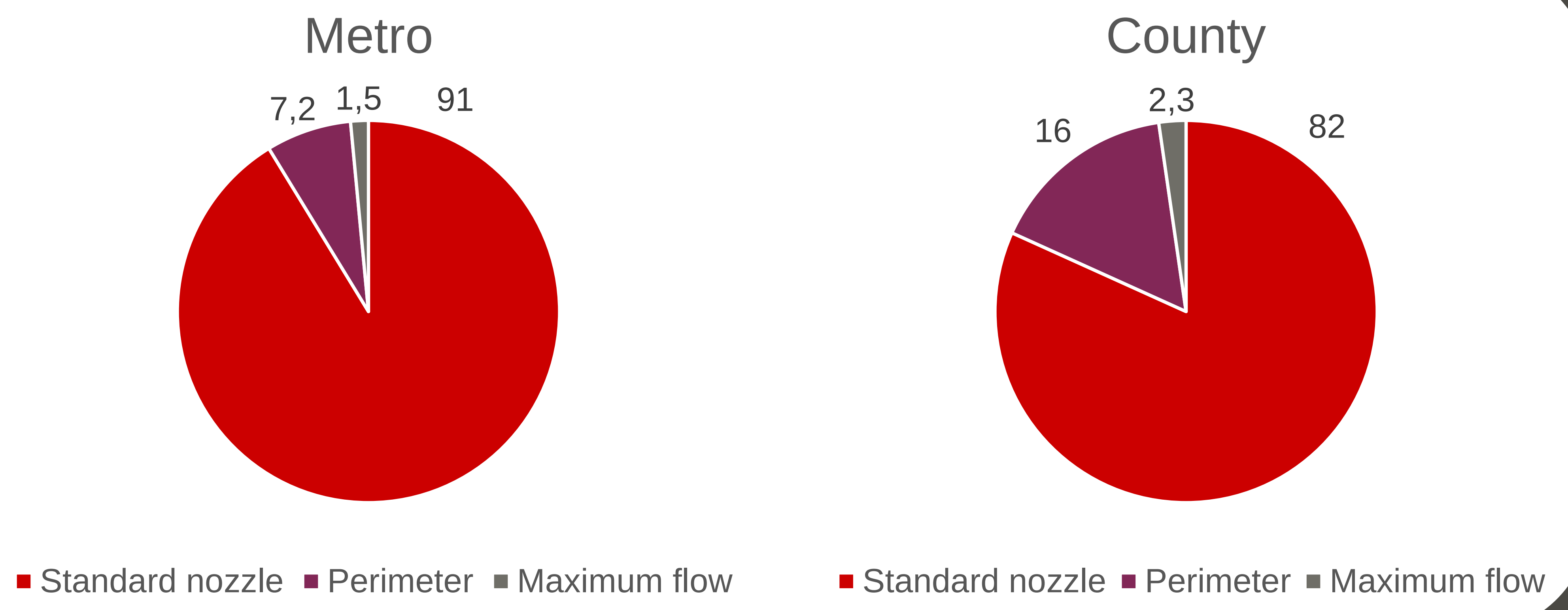
Percentage of fires with different approach



Upper limit for the approach

	Standard nozzle (m²)	Perimeter (m²)
Metro	50	500
County	20	200
Thomas	NA	750
Baldwin	50-100	500
Särdqvist	30	NA

Three different modes of fire fighting:

Standard nozzle approach

Perimeter approach

Maximum flow approach

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