

**Review by Dstl of documents pertaining to the  
Ziegler WaWe 9 water cannon system for SACMILL  
consideration in February 2015**

<redacted>

DSTL/CR86514 2.0  
19 February 2015

**Dstl**  
**Biomedical Sciences**  
Porton Down  
Salisbury  
Wilts  
SP4 0JQ  
© Crown Copyright 2015

## **Release Conditions**

This document has been prepared for MOD and, unless indicated, may be used and circulated in accordance with the conditions of the Order under which it was supplied.

It may not be used or copied for any non-Governmental or commercial purpose without the written agreement of Dstl.

Parts of the document, which are identified, constitute valuable technical information controlled by Dstl or may be commercially sensitive in relation to third parties.

© Crown Copyright 2015

Defence Science and Technology Laboratory UK

Approval for wider use or release must be sought from:

Intellectual Property Department  
Defence Science and Technology Laboratory  
Porton Down, Salisbury, Wiltshire SP4 0JQ

## Executive summary

The Scientific Advisory Committee on the Medical Implications of Less-Lethal Weapons (SACMILL) has been tasked by the Less-Lethal Technologies and Systems Strategic Board to prepare a new statement on the medical implications of the Wasserwerfer 9000 (WaWe9) water cannon system. This medical statement, which will supersede the SACMILL Interim Statement on the system (dated November 2013), will form part of the information used by the Home Secretary to inform the decision on whether to authorise the system for use.

The system comprises three used WaWe9 vehicles imported from Germany in June 2014 and subsequently modified to comply with operational and technical requirements and local regulations along with the underpinning controlling documentation. Some of the vehicle modifications were made in response to recommendations in SACMILL's Interim Statement. Following modification, the vehicles were tested for their functionality by the Home Office Centre for Applied Science and Technology (CAST). The vehicles are owned by the Metropolitan Police Service (MPS).

This briefing document on the WaWe9 water cannon system has been prepared by Dstl at the request of the Chair of SACMILL. In preparing this report, Dstl has reviewed a wide range of documentation, including a technical report emerging from the testing of the vehicles by CAST, the National Police Public Order Training Curriculum Module E4 (prepared by the College of Policing), the MPS Water Cannon Operational Use and Training Standard Operating Procedure, and training, guidance, lesson plans and learning outcomes for the different roles involved in the deployment and use of the WaWe9 water cannon system.

This report is designed to facilitate SACMILL's consideration of the various elements comprising the WaWe9 system and will provide a focus for the committee's further exploration of the medical implications of the system at its meeting on 4<sup>th</sup> February 2015.

Version 2.0 of this report was prepared as a result of discussions held during the SACMILL meeting on 4<sup>th</sup> February 2015 and after further discussions with SACMILL members on 16<sup>th</sup> February 2015. Changes from Version 1.0, other than minor typographical corrections, are indicated by lines in the left-hand margin.

Versions 1.0 and 2.0 restricted distribution of this report to SACMILL. Version 2.1 now removes that restriction.

## Table of contents

<b>Executive summary</b>	<b>i</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Conflicting interests</b>	<b>2</b>
<b>3 Background to the WaWe9 System</b>	<b>3</b>
<b>4 Documents included in this review</b>	<b>4</b>
<b>5 SACMILL Interim Statement (dated 18<sup>th</sup> November 2013)</b>	<b>5</b>
<b>6 Vehicle aspects</b>	<b>6</b>
6.1 Equipment/capability .....	6
6.2 Water Jets.....	7
6.3 Water quality .....	8
<b>7 Training</b>	<b>9</b>
7.1 Command structure.....	9
7.2 Unplanned (spontaneous) circumstances .....	9
7.3 Cannoneer responsibilities .....	9
7.4 Crew and support responsibilities.....	10
7.5 Training scenarios.....	11
7.6 Driver training.....	11
<b>8 Information on injuries/injury mechanisms</b>	<b>12</b>
<b>9 Standard Operating Procedures</b>	<b>13</b>
<b>10 Use by other police services</b>	<b>15</b>
<b>11 Validity of existing medical statements</b>	<b>16</b>
<b>12 Recommendations</b>	<b>17</b>
<b>13 References</b>	<b>20</b>
<b>List of abbreviations</b>	<b>21</b>
<b>APPENDIX A Summary of progress against SACMILL recommendations</b>	<b>22</b>
<b>Initial distribution</b>	<b>28</b>
<b>Report documentation page v4.0</b>	<b>29</b>

## 1 Introduction

This document has been written to provide the Scientific Advisory Committee on the Medical Implications of Less Lethal Weapons (SACMILL) with the opinion of the Defence Scientific and Technology Laboratory (Dstl) on the status of documentation pertaining to the training of personnel, the performance and operation of the WaWe9 vehicles and the policy and guidance for deployment and use of the WaWe9 water cannon system as a policing option in serious public disorder or where there is a threat from such disorder. This document, which has been prepared at the request of the Chair of SACMILL, is designed purely to facilitate the independent medical committee's review of the system.

Version 1.0 of this report was provided to SACMILL members prior to a SACMILL meeting held on 4<sup>th</sup> February 2015 in MOD Main Building, London, and two subsequent meetings, held separately on 16<sup>th</sup> February 2015, with three SACMILL members who were unable to attend the 4<sup>th</sup> February meeting. Version 2.0 of this report was written following these meetings. Amendments between Version 1.0 of this report and Version 2.0, other than minor typographical corrections, are annotated with vertical lines in the margin.

Versions 1.0 and 2.0 restricted distribution of this report to SACMILL. Version 2.1 now removes that restriction.

## 2 Conflicting interests

The authors are permanent Civil Servants who have provided advice to SACMILL throughout the process. They have also provided advice to the Home Office Centre for Applied Science and Technology (CAST) in the formulation of their technical tests. SACMILL is aware of Dstl's role in this latter respect. The authors have no vested interest in the outcome of the SACMILL review.

The authors attended the SACMILL Technical Committee Meeting on 4<sup>th</sup> February 2015 and a further meeting on 16<sup>th</sup> February 2015<sup>1</sup> to discuss the contents of this report and invite challenge on the views provided.

---

<sup>1</sup> This subsequent meeting was held in MOD Main Building with SACMILL Technical Committee members who were unable to attend the 4<sup>th</sup> February meeting. Two SACMILL members, one of whom had attended the meeting on 4<sup>th</sup> February, held a separate meeting on 16<sup>th</sup> February to allow a briefing of the member who could not attend the meeting earlier in the month.

### **3 Background to the WaWe9 System**

The Metropolitan Police Service (MPS) has purchased three used Ziegler WaWe9 water cannon vehicles from the German police authorities as a capability for use in England and Wales [1], [2]. These vehicles, which are more than 20-years-old, were shipped to the UK in June 2014 where they underwent a series of modifications driven by the MPS technical requirements, the need for the vehicles to comply with UK exhaust emission regulations and other modifications [3]. Some of these other modifications arose directly from recommendations made by SACMILL in their interim medical statement [4] on the WaWe9 system, which was based on the system at a very early stage of the procurement cycle (see Section 5). In parallel with the vehicle modifications, the College of Policing (CoP) and the MPS have developed training and guidance documentation for the WaWe9 system [5]-[10]. The documentation reviewed by SACMILL for their interim statement was also at a low level of maturity [11], and this lack of maturity was reflected in the committee's original recommendations [4]. Since this initial work, testing has been undertaken on a variety of features of the water cannon. The outcome of this testing was reported by CAST earlier this month [12].

## 4 Documents included in this review

For this note, a variety of documents have been reviewed. A full list is provided in Section 13 of this document. As the project has progressed, many of these documents have been revised, some more than once and many just prior to this review. However, the present review has been written with reference (in the authors' understanding) to the latest versions of these documents, even where these are still marked as "draft".

Despite obvious attempts by CoP and MPS to co-ordinate the paperwork there are still inconsistencies, particularly in the terminology of some of the roles (for example, the Cannoneer [8] is also referred to as the Water Cannon Operator, and the role and responsibilities of the Loggist are not defined in the Standard Operating Procedure [6]). This is not thought to be a major issue, but should be addressed at the first opportunity to enhance coherency and avoid ambiguity. It is recommended that the urgency in writing these documents is noted by SACMILL and that complete copies of final documentation are requested for review by SACMILL to ensure no changes have been made that would affect the applicability of any ensuing (final) medical statement. [Recommendation 1]



## 5 SACMILL Interim Statement (dated 18<sup>th</sup> November 2013)

The SACMILL Interim Statement on the WaWe9 system [4] was drafted in 2013 in response to a tasking from the Less-Lethal Technologies and Systems Strategic Board. This interim statement was designed to inform the procurement of the German vehicles and was based upon SACMILL's understanding of the system at an early stage: the WaWe9 vehicles were still in Germany and, although a formal requirement had been drawn up, the vehicles had been only cursorily assessed by CAST. The interim statement was therefore written based upon advice from Dstl [11], the experience of DOMILL<sup>2</sup> (SACMILL's predecessor), including review of their medical statement on the Police Service of Northern Ireland (PSNI) Somati Water Cannon [13] and reviews of the available documentation from the National Policing Improvement Agency (now CoP), CAST and the MPS (reported in [11]).

Several recommendations were raised in the SACMILL Interim Medical Statement. These are reproduced in Appendix A<sup>3</sup> to this document along with a response revealing actions that have been undertaken to address these recommendations and an assessment by Dstl to indicate whether, in our opinion, further work is required.

---

<sup>2</sup> Defence Scientific Advisory Council Sub-Committee on the Medical Implications of Less Lethal Weapons.

<sup>3</sup> This Appendix also identifies some of the final recommendations for this report.

## 6 Vehicle aspects

### 6.1 Equipment/capability

Following SACMILL's Interim Statement [4] and an initial assessment by CAST [3], the vehicles were modified in an attempt to render them compliant with various operational requirements [14] (and CAST's interpretation of the recommendations in SACMILL's Interim Statement [3]). Several of these modifications were specifically undertaken in an attempt to make the performance of the MPS Ziegler WaWe9 vehicles match the performance of the Somati Water Cannon currently in use with PSNI. However, it was not possible to modify the German vehicles to meet all aspects of the original Water Cannon Operational Requirement [14]. Specifically:

- The original requirement refers to use of the water cannon in a diffused mode, and this mode is still referenced in the Association of Chief Police Officers/College of Policing document describing the vehicles as a "National Asset" [2]. However, this mode of use is not supported in the recent documentation [12] or in training [8]-[10]. CAST, in their final vehicle assessment [12], recommend giving consideration to introducing this diffuse mode into police tactics. If this tactic is subsequently introduced, then it is recommended that SACMILL assess its suitability. [see Recommendation 6]
- <redacted>
- The original requirement also discussed the use of the water cannon as a limited firefighting capability. This has now been dropped from the requirement of the MPS capability.

The final report on the tests undertaken by CAST [12] notes several modifications undertaken to the vehicles that require further resolution or clarification (these are highlighted in Sections 7.1.1 and 7.1.2 of the CAST report [12]), but specifically:

- Fit the Vehicle 3 pump with a tamper-proof seal to provide assurance that the 16 bar upper limit has not been overridden.
- Remove the additive mixing connecting pipes from Vehicle 1.
- <redacted> That the video cameras on Vehicle 3 should be securely fixed.
- <redacted> Ensure that any remaining German signage is either translated into English or that crew are trained to understand the information these signs convey.
- Add tamper-proof seals to the monitor elevation limits.
- <redacted>.
- Provide improvements to crew environment bump hazards.

The implications of these remaining aspects should be considered by SACMILL, however the authors of the present document believe that these can all be addressed through simple modification or mitigated through training/documentation. SACMILL should seek clarification from the MPS that these aspects have been considered. [see Recommendation 3]

Additionally, CAST were unable to test the vehicles' ability to maintain the water above 4°C. Again, SACMILL should consider the implications of this and determine the need for future testing and any/or mitigation provided by MPS use. [see Recommendation 3]

It was also noted in the CAST report [12] that there were noticeable differences between the vehicles (in terms of feel as well as performance). It is therefore the opinion of the present authors that it is essential that crews are trained on the same vehicles that they will use operationally and that SACMILL should request that the controlling documentation is modified to state this as a requirement for operational use. [Recommendation 8]

The CAST report also highlights multiple points for the MPS to mitigate or note (Reference [12], Section 10); many of these will affect the ability of the water cannon to operate and it is conceivable that many of the issues may only manifest themselves under operational circumstances. The present authors, therefore, recommend that SACMILL request that the Water Cannon Operator (Cannoneer) training syllabus is expanded to include training under conditions where any of the unplanned events noted in the CAST report [12] may occur. [Recommendation 9]

## 6.2 Water Jets

The analysis of the CAST testing of the water jets made the observation that the water jet structure is complex [12]. This was also a finding in the original work on the Somati RCV9000 and this was reported in the DOMILL medical statement on the PSNI vehicles [13]. Issues with jet structure complexity were compounded during this recent series of testing on the WaWe9 by inter-vehicle differences and difficulties in measuring the loads [12] (see later). It is therefore recommended that this complexity is explicitly highlighted in the training, especially for the Cannoneer. In practical terms, the natural tendency of water jets to behave in this complex way means that it is not a simple jet, and pockets of high pressure exist within the water stream. These pockets have the ability to produce pulses of high pressure that may increase the risk of injury to vulnerable parts of the body (such as the eyes) or risk of injury to vulnerable people (for example, those with poor balance).

CAST noted problems with the instrumentation system that they used for measuring the water jet performance [12]. Nevertheless, the review by Dstl of the data reported by CAST still indicates that the tests conducted are useful and that they provide some indication that the water jet outputs of the PSNI Somati RCV9000 vehicles and the MPS Ziegler WaWe9 vehicles are broadly comparable (even taking into account the complexity of the water jet structure). One notable weakness in the present data set is that the comparisons with the Somati water cannon are based on the water output from a single monitor on a single PSNI vehicle. Hence, the reliability of any

comparison with the three WaWe9 vehicles is dependent on an assumption that the output from the single tested PSNI vehicle/monitor was representative (i.e. typical for a Somati RCV9000 water cannon). It is recommended that SACMILL notes that this limited Somati data set introduces some uncertainty into any comparison with the WaWe9.

CAST recommend further tests of the Somati comparator vehicle to verify the stability of the pressure measurement system. This recommendation should be supported by SACMILL and the results of these verification tests reported to SACMILL at the first opportunity. [see Recommendation 2]

### **6.3 Water quality**

It was noted that there were no checks or mitigation for water quality tests (apart from weekly draining of the water pump and tank in the Driver Operator weekly checklist [5]). It is recommended that active checks are undertaken to ensure that poor water quality does not introduce the risk of infection or disease. [Recommendation 17]

## 7 Training

### 7.1 Command structure

The various documents give training, guidance, lesson plans and learning outcomes for the different roles involved in the WaWe9 water cannon system within the MPS. However, there is no explicit requirement for the system-specific knowledge needed by senior officers (Assistant Commissioners) on whose authority the system would be “made available for operational purposes” [6]. There are also some concerns over the wording in the documents relating to the delegation of responsibility of senior Commanders – these are raised later in this document, but it is initially recommended that SACMILL request confirmation that these senior commanders, and the entire command chain, are appropriately trained so that they can make the right operational decisions. [Recommendation 10]

It was reported by the Metropolitan Police during the meeting on 4<sup>th</sup> February 2015 that the Water Cannon Commander is stationed outside the vehicle. This was not clear from the paperwork. This should be clarified. [Recommendation 18]

It was also reported by the Metropolitan Police during the meeting on 4<sup>th</sup> February 2015 that BRONZE Water Cannon can take the role of Water Cannon Commander in the event that the Water Cannon Commander becomes unable to conduct their task. This was not clear in the paperwork. This should be clarified. [Recommendation 18]

### 7.2 Unplanned (spontaneous) circumstances

As noted above, there is no reference in the training literature [5]-[10] to training elements that teach water cannon personnel (Water Cannon Commanders, Drivers, Cannoneers, Support Crew or Public Order Officers) what to do if an unplanned event occurs (<redacted>). It is therefore recommended that SACMILL request the inclusion of a series of learning objectives relating to unplanned events are incorporated as part of the training sessions for water cannon personnel. [see Recommendation 9]

### 7.3 Cannoneer responsibilities

It is stated in the overarching document by Chief Constable Shaw that water cannon will be deployed “in situations of *serious public disorder* where there is the potential for loss of life, serious injury or widespread destruction and where such action is likely to reduce that risk” [2]. This is supported by further statements that the deployment of water cannon must consider the personal actions of officers to be in accordance with the European Convention on Human Rights (ECHR), in the context of its “*manner of use and the training provided to operators*” (see Appendix A, section 3.4 of [2]) and given the reported statements of colleagues in Northern Ireland who “*will state that the availability of water cannon during incidents of disorder in Northern Ireland typically leads to reduced officer injuries. At present there is no data to support this claim however consultation has taken place with PSNI specialist public order trainers who support this claim*” (Appendix A, section 3.5 of [2]). Throughout the documentation there is further reference to compliance with the ECHR and as well as references to Her Majesty’s Inspectorate of Constabulary Principles on the use of

Force, the Police and Criminal Evidence Act 1984, Criminal Law Act 1968, Common Law and Human Rights [6]-[10]. However, these various references may be construed as applying a mixed message to personnel operating the vehicles, especially the Cannoneers. The suitability tests for Public Order Personnel and specific role tests will, it is believed, to some extent mitigate this mixed message, but the present authors believe that further training should be explicitly stated for Cannoneers (who make the decision to aim and fire the water jet) to explore the understanding of “proportionality” and “accountability”. For example, the Cannoneers are explicitly trained on the nature of the injuries (as indeed are all of the crew), but there is no written evidence that Cannoneers are trained on the circumstances where it would be unreasonable for them to fire the water jet.

The authors of the present document accept that the training lessons may go further than is written in the documents themselves (especially referring to Reference [8]), but we believe that explicit statements that “accountability” and “proportionality” for the Cannoneer should specify that the use of the water jet should be justified and that this should take account of the target individual and their actions, in particular:

**[Recommendation 11]**

- Whether the target person was undertaking an act that justified the use of the water jet (ensuring that the targeted individual could be clearly seen (sufficient light to see the individual, sufficient resolution on the screen or clear vision of the person and the application of the jet was not indiscriminate)).
- The water jet was aimed to minimise the risk of injury.
- The individual was not a child or vulnerable adult.
- The use of force was proportionate (i.e. the pressure setting was such that the minimum necessary pressure and most appropriate contact location were used) to provide the required effect.

#### **7.4 Crew and support responsibilities**

Within the documentation, there is reference to a Loggist. The exact role and responsibilities are not defined. If this person has a crucial role in the operation of the vehicle it is recommended that this is included in the controlling documentation. **[see Recommendation 1]**

The PSNI Somati RCV9000 water cannon have a mast mounted camera that, it is understood, is used to provide a view of the area around the vehicle. This provides another method of feedback to the crew and provides additional situational awareness. This may be particularly useful if someone becomes injured. An alternative to provide such feedback may come from shield officers or cordon personnel. It should therefore be considered whether this can be employed during the operation of the Ziegler WaWe9 vehicles. SACMILL should recommend that this is investigated. **[Recommendation 12]**

## 7.5 Training scenarios

The current training syllabus does not explicitly train in poor light conditions (the course timetable currently ends at 16.30 hrs) [8]-[10]. Consideration should therefore be given to including training sessions where water cannon crew (with support staff, shield and cordon officers) operate in low light/night time conditions (this may be part of continuation training but is not specified in the training syllabus). [Recommendation 13]

## 7.6 <redacted> Driver training

During the SACMILL meeting on 4<sup>th</sup> February 2015, the Metropolitan Police Service confirmed that there was no Driver training package for the vehicles. It was therefore recommended by SACMILL that such a package should be developed. [Recommendation 20]

## 8 Information on injuries/injury mechanisms

There is no evidence to suggest that the information provided to system users on the risks and injuries posed by water cannon is incorrect. Furthermore, no injury mechanisms have been identified since the various advisory reports already provided to SACMILL or DOMILL (either leading to the DOMILL statement [13] or the SACMILL Interim Statement [4]). However, different levels of detail are provided in the different training documents. It is therefore suggested that a single, simple summary of the injury mechanisms is provided for reference. This should take account of the original definitions of primary, secondary and tertiary injury in the DOMILL statement [11], with the additional reference to extra care being taken with children and vulnerable adults (alluded to in the Interim Statement [4]), toppling people from structures and causing structural damage with the water jets, etc. [Recommendation 14]



## 9 Standard Operating Procedures

The version of the Standard Operating Procedure for the Water Cannon [6] is a draft document. This document, more than others, provides some inconsistency in defining the roles and responsibilities for the operation of the Water Cannon and does not necessarily reflect the current versions of the National Police Public Order Training [7] or the individual role training [8]-[10]. The authors believe that there is sufficient mitigation in the depth of the training to overcome these issues, but that SACMILL should raise concern and ensure that the Standard Operating Procedure is developed to a state of maturity at which it can be used as a reliable document in the audit trail.

Specifically, the Standard Operating Procedures [6] indicates that:

- The Water Cannon Commander is a different individual to the Crew Commander, but the National Police Public Order Training [7] states that “*the senior crew commander will act as the overall water cannon commander unless an additional officer has been specifically appointed*”. The issues surrounding this should be considered by the police service operating the water cannon, to ensure that the Crew Commander may discharge their duties adequately if given two roles (it is possible that the PSNI vehicles operate with the senior Crew Commander doubling as a Crew Commander and the Water Cannon Commander, but that the MPS would always appoint an additional officer – either way it requires clarification).
- The Standard Operating Procedure does not define the differences between deployment and use. This should be specifically stated in the way MPS intend to operate these vehicles to ensure common terminology.
- The Standard Operating Procedure is inconsistent with National Police Public Order Training [7]. This latter document states that “*Authority level to deploy and make this tactic available for operational purposes; Officer of at least the rank of Assistant Chief Constable/Commander*” and “*Authority levels to use; Once the authority to make water cannon available for operational purposes has been granted, the authority to use the equipment lies with the Silver Commander*”, however, the Standard Operating Procedures states “*the ‘authority to deploy or use’ the Water Cannon as a tactical option lies with the Silver Commander, subject to the express authority of the Gold Commander*”. This inconsistency should be addressed for clarity.
- There is a responsibility on the Assistant Commissioner to monitor and collate any information relating to any incident involving injury directly or indirectly attributable to the deployment or use of the WaWe9 [Paragraph 3.6 Ref [6]]. This responsibility should be extended to informing SACMILL of any such incident. [see Recommendation 7]
- The role terminology is inconsistent with the MPS training documents [8]-[10] (this is also the case with the National Police Public Order Training [7]). For example the Cannoneer is called the Water Cannon Operator and the Loggist is not mentioned.

These are not regarded as items that would prevent the writing of a medical statement, but it is recommended that SACMILL seek confirmation that the above aspects have been addressed before the vehicles enter service. [see Recommendation 1]

## 10 Use by other police services

Throughout the documentation, the WaWe9 water cannon system is described as a “National Asset” [1], [2]. Consideration needs to be given on how this would actually be deployed in areas outside the MPS’s area of jurisdiction, and especially how officers from other police forces, who may be asked to support WaWe9 deployment and use, will be trained. If the decision is made to use MPS Personnel (which may be reasonable) there is a need to ensure that the Command and Control structure understands the issues associated with the use of water cannon and that local (topographical) knowledge is communicated to WaWe9 Commanders so that they can safely operate the vehicles to minimise the risk of injury to targeted persons arising from ignorance of unusual topographic hazards (for example an asymmetrical fall hazard, such as a retaining wall with a greater drop on the side distal to the water cannon). [Recommendation 15]

Discussion with the MPS during the meeting on 4<sup>th</sup> February 2015 revealed that the water cannon will not be regarded as a National Asset, as it is described in the controlling paperwork. It is therefore recommended that any medical statement should reflect this assertion. [Recommendation 21]

## 11 Validity of existing medical statements

In undertaking the present review the authors found no new information that would invalidate the earlier medical statements on water cannon (either the SACMILL Interim Statement that informed the WaWe9 procurement decision or the extant DOMILL statement for the PSNI Somati RCV9000 system). The medical statements on the Somati water cannon in the UK have been in existence for approximately 13 years. It is therefore suggested that, if SACMILL decide to write another statement, this should consolidate some of the earlier information and the Police Service of Northern Ireland should be made aware of, and invited to comment on, any new medical statement during the process of review and finalisation. [Recommendation 16]

## 12 Recommendations

The following recommendations are made as a result of this review:

Recommendation 1: The documentation provided to SACMILL is finalised and the inconsistencies in terminology are removed (see this document for details).

Recommendation 2: CAST have recommended that some verification tests are conducted on the pressure measuring mat. It is recommended that SACMILL endorse this recommendation, but add that it may be advantageous to test more than one PSNI vehicle to increase confidence in the comparison of the PSNI vehicles with the MPS vehicles.

Recommendation 3: SACMILL should seek confirmation from the MPS that the vehicle modifications/improvements recommended by CAST in Reference [12] have been undertaken. Where these have not been undertaken and a suitable mitigation has not been proposed, SACMILL should consider any residual medical implications.

Recommendation 4: SACMILL should seek assurance from the MPS that the vehicle characteristics mentioned in the recommendations contained within the Interim SACMILL statement [Reference [4], paragraph 21] have been considered and that the MPS believe that the vehicles are still safe to operate.

Recommendation 5: <redacted>

Recommendation 6: Any changes to the system (equipment, training, information, etc.) should be reported to SACMILL for consideration of the continued applicability of the medical statement.

Recommendation 7: SACMILL should recommend that the Assistant Commissioner required to monitor and collate information on incidents involving injury should have the additional responsibility to inform SACMILL in a timely manner of such injurious events.

Recommendation 8: Due to the differences between the individual WaWe9 vehicles, SACMILL should suggest that crews of the vehicles should have been trained and deemed competent to operate the specific vehicle in which they will be operationally deployed.

Recommendation 9: SACMILL should request that personnel should be trained in scenarios that provided unplanned but realistic operational circumstance (such as the Cannoneer deeming they cannot operate the water jet because they do not have good visibility; a water cannon failure or what to do in the event someone is injured and requires medical help). This training should not be limited to water cannon crew, but should also include shield, cordon and other public order personnel.

Recommendation 10: SACMILL should seek confirmation that senior Commanders (Gold, Silver and Bronze) are informed and trained on the tactical benefits and limitations of the use of Water Cannon in serious public disorder.

Recommendation 11: SACMILL should consider requesting that water cannon crews and specifically Cannoneers should have a discussion or training module introduced into the syllabus to consider the implications of “proportionality” and “accountability”, (in the context of use of force guidance) when they do not have good visibility from the vehicle.

Recommendation 12: SACMILL should investigate with the MPS whether there are additional methods to provide situational awareness to cannon crews in the absence of a mast mounted camera (such as fitted to the PSNI Somati RCV9000).

Recommendation 13: SACMILL should consider recommending realistic low-light and night-time training for water cannon crews and support staff, so that crews are familiar with operating in such conditions.

Recommendation 14: SACMILL should consider recommending that the nature of injuries caused by vehicle mounted water cannon is briefed out in a consistent manner.

Recommendation 15: The MPS Ziegler WaWe 9 water cannon are described as a “National Asset”, however, it was verbally reported by the MPS at the 4<sup>th</sup> February meeting that this is unlikely to be the case for these vehicles. SACMILL should seek further written confirmation to determine whether this is an asset that will always be deployed by MPS personnel (within or outside the MPS area), whether personnel may be used from another police service (outside the MPS area) but will always be trained in accordance with the MPS training or whether other services will be expected to produce their own training (outside the MPS area). The implications of providing the WaWe9 vehicles to another police service area should be fully considered and, where practical, trained.

Recommendation 16: If SACMILL decide to write a medical statement for the use of the Ziegler WaWe9 water cannon, it is recommended that during the finalisation process the Police Service of Northern Ireland should be asked to comment on such a statement to determine whether they believe the extant statement covering the vehicles they operate is still relevant and whether they can provide additional information to direct the process.

Recommendation 17: The water cannon should be maintained and operated to ensure that the water is always of a quality that does not present a risk of infection or disease.

Recommendation 18: The stationing of the Water Cannon Commander outside the vehicle should be made clear in the paperwork. Also, the possibility that BRONZE Water Cannon can take the role of the Water Cannon Commander (in the event that the latter is incapacitated) should be made clear in the controlling documentation.

Recommendation 19: Training should include scenarios where the crews are disorientated or have degraded performance.

Recommendation 20: A Driver package should be developed and proven before the vehicles are declared operational.

Recommendation 21: If the decision is made to write a medical statement, SACMILL should be cognisant of the declaration by the Metropolitan Police Service that the Water Cannon Capability is not a 'national asset', as originally stated.

## 13 References

- [1] Letter AC Mark ROWLEY QPM to Mr Stephen GREENHALGH, "Water Cannon", Ref ACSCO212/2013, dated 17th September 2013
- [2] Association of Chief Police Officers and College of Policing document written by CC David SHAW, "National Water Cannon Asset", dated 8th January 2014
- [3] CAST Project DISPERSE Team, Project DISPERSE Trial Results for German Water Cannon May 2014 & CAST Response to SACMILL Recommendations, Version 3.0, 6 June 2014
- [4] SACMILL Interim Statement on the Medical Implications of Use of Vehicle-Mounted Water Cannon, with Special Reference to the Ziegler Wasserwerfer 9000, dated 18 November 2013
- [5] Email <redacted> SACMILL response v1.1, dated 12 January 2015 08:56, plus attachments
- [6] SC&O22(2), Water Cannon – Operational Use and Training SOP, Version 7.5, dated 22 April 2014 (Provided as part of Ref [5])
- [7] College of Policing, National Police Public Order Training Curriculum, Module E4 – Water Cannon in Public Order, version 2.2, dated 2 January 2015 (NOTE: this supersedes the version in Ref [5] and the version used in Ref [11])
- [8] SC&O 22 Metropolitan Police Specialist Training Centre, Water Cannon Training Package January 2015-January 2016, Cannoneers (undated)
- [9] SC&O 22 Metropolitan Police Specialist Training Centre, Water Cannon Training Package January 2015-January 2016, Water Cannon Commanders and Crew Commanders (undated)
- [10] Metropolitan Police Specialist Training Centre, Water Cannon Training Package 2015 (undated)
- [11] <redacted>, The medical implications of vehicle-mounted water cannon with special reference to the Ziegler Wasserwerfer 9000 (WaWe 9) system, DSTL/TR74621 Version 1.0, dated 19 July 2013
- [12] CAST Project DISPERSE Team, WaWe9 Trials – Summary Report, Version 1.0, 22 January 2015
- [13] Defence Scientific Advisory Council Sub-Committee on the Medical Implications of Less Lethal Weapons (DOMILL) Statement on the Medical Implications of the use of the Somati RCV9000 Vehicle Mounted Water Cannon, 3rd March 2004
- [14] National Public Order and Public Safety Working Group, Water Cannon – Operational Requirement, Version 2.1, 8th August 2013



## List of abbreviations

CAST	Centre for Applied Science and Technology (part of the Home Office)
CoP	College of Policing
DOMILL	Defence Scientific Advisory Council sub-committee on the Medical Implications of Less Lethal Weapons
Dstl	Defence Science and Technology Laboratory (part of the Ministry of Defence)
MPS	Metropolitan Police Service
PSNI	Police Service of Northern Ireland
SACMILL	Scientific Advisory Committee on the Medical Implications of Less Lethal Weapons
WaWe9	Wasserwerfer 9000 (Water Cannon)

## APPENDIX A Summary of progress against SACMILL recommendations

SACMILL Statement Paragraph Number	Recommendation	Response	Further work required?
18.	<p>The peak forces and pressures developed by the WaWe 9 primary water cannon jets should be measured over a range of target engagement distances and at various pump pressure settings. These should be compared with equivalent measurements made on the in-service Somati RCV 9000 water cannon jets. The force and pressure measurements should be obtained using a range of appropriate force plate sizes. SACMILL has reviewed a draft outline proposal for the force and pressure testing of the WaWe 9 water cannon jets and looks forward to reviewing the final detailed technical plan when this becomes available.</p>	<p>CAST have undertaken a series of tests to quantify the pressures developed by a PSNI Somati RCV9000 and all three MPS Ziegler WaWe9 vehicles. This was not conducted on a series of different plates, but using a single mat with multiple sensing cells so that the force over different areas could be considered. This work confirmed the complexity of the jet structures determined in the original testing of the Somati RCV9000 vehicles conducted in 2003 and 2004. Some concern has been raised over the susceptibility of the force measuring mat so further verification tests are recommended, but these tests do not detract from the findings that the pressures are comparable between the vehicles (following modification of the Ziegler WaWe9's).</p>	<p>Some verification tests for the instrumentation system are required but the results are still relevant. It is also noted that the tests on the Somati RCV9000 vehicle were undertaken on only one vehicle. It is therefore further recommended that, if possible, further vehicles are tested to gain additional confidence in the measurement of the performance of the PSNI vehicles for comparison with the WaWe9's. [Recommendation 2]</p>

SACMILL Statement Paragraph Number	Recommendation	Response	Further work required?
19.	Any substantive differences in performance between the Somati and WaWe 9 water cannon systems should be addressed by a combination of modifications to the WaWe 9 vehicles and implementation of appropriate training, tactics, techniques and procedures.	The WaWe9 vehicles have been modified to reduce the peak pressures to the same as the Somati RCV9000 vehicles and the minimum operational range of the WaWe9s have been extended to match the range of the RCV9000s. Some minor modifications are required to ensure that these modifications are tamper-proof.	Get confirmation from MPS that modifications have been undertaken. [Recommendation 3]
20.	The water jets produced by the WaWe 9 are capable of engaging people at considerably closer distances (and potentially with greater force) than those produced by the Somati RCV 9000. Since close proximity to the jets is likely to increase the risk and severity of injury, it is recommended that the implications of this design difference are thoroughly characterised and understood.	This difference has not been characterised, but the vehicles have been modified instead.	No longer relevant

SACMILL Statement Paragraph Number	Recommendation	Response	Further work required?
21.	Some general characteristics of the WaWe 9 vehicle itself should be established and compared to the Somati model. These include: determining the areas of restricted visibility from the cab, the turning circle, stopping distance of the vehicles in dry and wet conditions, and the effectiveness of any physical countermeasures designed to impede the ability of protesters to climb onto the vehicles.	Some of these aspects have not been measured, however, the crews should be aware of these issues and this should be addressed/mitigated through training. Confirmation should be sought to ensure that the MPS are aware of these concerns and that Drivers believe that they can operate safely within these constraints.	Get confirmation from MPS that these concerns are addressed. [Recommendation 4]
22.	The public address system of the WaWe 9 should be of comparable efficiency to, or better than, that of the Somati RCV 9000. This system is used to warn of the imminent use of water cannon and hence provides an opportunity for people to disperse voluntarily.	<redacted>	Seek clarification that remaining issues over electro-magnetic interference are addressed. [Recommendation 5]
23.	The peak forces and pressures developed by the WaWe 9 rear-mounted water cannon jet should be measured to provide an indication of the effects of this facility (which is absent from the Somati RCV 9000) and its operational role should be clarified.	This monitor has been removed.	No longer relevant.

SACMILL Statement Paragraph Number	Recommendation	Response	Further work required?
24.	A routine maintenance schedule for the WaWe 9 should be designed and implemented and should include both the main vehicle and the water delivery system.	A maintenance schedule has been produced.	No.
25.	A strategy should be developed for the sourcing of spare parts, especially those components whose ageing or failure may have medical implications for the public.	The availability of parts may still be an issue, but the failure of a part is likely to remove a vehicle from service. When parts that are essential to the safe operating of the vehicle or an essential element of the water pressure equipment are replaced, SACMILL should be informed of the changes so that they can consider whether this may affect the applicability of the medical statement.	SACMILL should be advised of any changes to the system that may affect the applicability of the medical statement. [Recommendation 6]
26.	The existing User Guidance is currently specific to the Somati RCV 9000 system. Should a decision be made to acquire the WaWe 9 vehicles, these aspects should be developed to be applicable to both water cannon systems and the final documentation provided to SACMILL for review.	The current guidance and training has been updated. This is now more relevant to the MPS WaWe9 than it was at the time of the interim review. Some inconsistencies in the paper still require resolution.	SACMILL to ask for current inconsistencies within and between documentation to be resolved. [see Recommendation 1]

SACMILL Statement Paragraph Number	Recommendation	Response	Further work required?
27.	The User Training documentation is incomplete in its current form. The training should incorporate more content on injury mechanisms and draw on any lessons learnt in operational use of water cannon in serious disorder in Northern Ireland and elsewhere.	Current documentation is vastly improved. As above, the inconsistencies within the paperwork should be addressed.	SACMILL to ask for current inconsistencies within and between documentation to be resolved. [see Recommendation 1]
28.	Both the User Guidance and User Training documentation, in their final, fully developed form, should be made available to SACMILL for review and endorsement prior to implementation of the WaWe 9 system as a new water cannon capability in the UK. SACMILL believes that it would be inappropriate to introduce the WaWe 9 as a public order capability given the current level of maturity of the documentation controlling the use of water cannon and the training given to users.	This documentation is further improved; however, some inconsistencies still require addressing.	SACMILL to ask for current inconsistencies within and between documentation to be resolved. [see Recommendation 1]
29.	Consideration should be given to the ergonomics of the operating area, the working conditions of the crew and to the risk of injuring police officers standing close to the device when it is operated.	Some consideration is given to the crew ergonomics.	No.

SACMILL Statement Paragraph Number	Recommendation	Response	Further work required?
30.	Any injuries occurring during training that are attributable to the WaWe 9 system should be reported to SACMILL so that the medical advice can be revised if necessary.	It is the responsibility of the Assistant Commissioner to monitor and collate any incident involving injury. This should be further expanded that it is also the Assistant Commissioner's responsibility to report this to SACMILL.	SACMILL to make recommendation that Assistant Commissioner is responsible for informing the committee of any incident resulting in injury. [Recommendation 7]

## Initial distribution

1.	KIS	Dstl	V1.0, V2.0, V2.1	Electronic
2.	SACMILL Chair		V1.0, V2.0	Hard copy
3.	SACMILL Members		V1.0, V2.0	Hard copy
4.	SACMILL Members		V1.0, V2.0	Hard copy
5.	SACMILL Members		V1.0, V2.0	Hard copy
6.	SACMILL Members		V1.0, V2.0	Hard copy
7.	SACMILL Members		V1.0, V2.0	Hard copy
8.	SACMILL Members		V1.0, V2.0	Hard copy
9.	SACMILL Members		V1.0, V2.0	Hard copy
10.	SACMILL Members		V1.0, V2.0	Hard copy
11.	SACMILL Official Member	Dstl	V1.0, V2.0, V2.1	Electronic
12.	SACMILL Secretariat – for file	MOD	V1.0, V2.0, V2.1	Electronic
13.	<redacted>	Dstl	V1.0, V2.0, V2.1	Electronic
14.	<redacted>	Dstl	V1.0, V2.0, V2.1	Electronic
15.	<redacted>	CAST	V2.1	Electronic
16.	<redacted>	CAST	V2.1	Electronic
17.	<redacted>	CAST	V2.1	Electronic
18.	<redacted>	CAST	V2.1	Electronic
19.	RJ Munns	MPS	V2.1	Electronic
20.	K Nutter	MPS	V2.1	Electronic
21.	<redacted>	CoP	V2.1	Electronic
22.	D Shaw	Water Cannon Project Board	V2.1	Electronic
23.	<redacted>	Water Cannon Project Board	V2.1	Electronic
24.	N Basu	Police National Lead LLWs	V2.1	Electronic
25.	S Severn	HO Public Order Unit	V2.1	Electronic
26.	<redacted>	HO Public Order Unit	V2.1	Electronic



## Report documentation page

v4.0

\* Denotes a mandatory field

<b>1a. Report number: *</b>	DSTL/CR86514	<b>1b. Version number:</b>	2.0
<b>2. Date of publication:</b>	19/02/2015	<b>3. Number of pages:</b>	iii + 28
<b>4a. Report UK protective marking: *</b>	UK OFFICIAL—SENSITIVE		
<b>4b. Report national caveats: *</b>	NONE		
<b>4c. Report descriptor: *</b>	NONE		
<b>5a. Title: *</b>	Review by Dstl of documents pertaining to the Ziegler WaWe 9 water cannon system for SACMILL consideration in February 2015		
<b>5b. Title UK protective marking: *</b>	UK OFFICIAL—SENSITIVE		
<b>5c. Title national caveats: *</b>	NONE		
<b>5d. Title descriptor: *</b>	NONE		
<b>6a. Alternative title:</b>			
<b>6b. Alternative title UK protective marking:</b>			
<b>6c. Alternative title national caveats:</b>			
<b>6d. Alternative title descriptor:</b>	NONE		
<b>7. Authors: *</b>	Hepper, A.E.; Sheridan, R.D.		
<b>8. Name and address of publisher: *</b>	<b>9. Name and address of sponsor:</b> Surgeon General MOD Main Building, Horseguards Avenue, Whitehall, London SW1A 2HB		
Dstl Biomedical Sciences Porton Down Salisbury Wilts SP4 0JQ			
<b>10. Sponsor contract:</b>	STECH008		
<b>11. Dstl project number:</b>	705509		
<b>12. Work package</b>	DIS001		
<b>13. Other report numbers:</b>			
<b>14a. Contract start date:</b>	01/04/2014	<b>14b. Contract end date:</b>	31/03/2015
<b>15a. IPR: *</b>	CROWN COPYRIGHT		
<b>15b. Patents:</b>	NO		
<b>15c. Application number:</b>			

Please note: Unclassified, Restricted and Confidential markings can only be used where the report is prepared on behalf of an international defence organisation and the appropriate prefix (e.g. NATO) included in the marking.

## Error! Reference source not found.

\* Denotes a mandatory field

<b>16a.</b>	<b>Abstract: *</b>	
	<p>This report provides a review of the documentation relating to the planned Metropolitan Police Service Water Cannon capability comprising three second-hand German Ziegler WaWe 9 water cannon vehicles. This document has been written for the Scientific Advisory Committee on the Medical Implications of Less Lethal Weapons (SACMILL) to provide advice for their consideration at a meeting on 4th February 2015 to discuss the drafting of a medical statement. This report reviews the trials results from the Home Office Centre for Applied Science and Technology, the Metropolitan Police Service Standard Operating Procedures and Training documentation and the College of Policing Training modules.</p> <p>This document finds that the performance of the WaWe9 water cannon may be regarded as being broadly comparable to the Police Service of Northern Ireland Somati RCV9000 vehicles.</p> <p>Version 1 of this report is dated 30th January 2015. Version 2 updates the report to reflect SACMILL deliberations on 4th and 16th February.</p>	
<b>16b.</b>	<b>Abstract UK protective marking: *</b>	UK OFFICIAL—SENSITIVE
<b>16c.</b>	<b>Abstract national caveats: *</b>	NONE
<b>16d.</b>	<b>Abstract descriptor: *</b>	NONE
<b>17.</b>	<b>Keywords:</b>	
	Water cannon, less lethal weapons, SACMILL, non lethal weapons, injury	
<b>18.</b>	<b>Report announcement and availability *</b>	
	Title and abstract	Full document
<b>18a.</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/> UK MOD has unlimited distribution rights
<b>18b.</b>	<input type="checkbox"/>	<input type="checkbox"/> UK MOD has no rights of distribution
<b>18c.</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Can be distributed to UK MOD and its agencies
<b>18d.</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Can be distributed to all UK government departments
<b>18e.</b>	<input type="checkbox"/>	<input type="checkbox"/> Can be distributed to all UK defence contractors
<b>18f.</b>	<input type="checkbox"/>	<input type="checkbox"/> Can be distributed to all foreign government departments
<b>18g.</b>	<b>Additional announcement:</b>	
<b>18h.</b>	<b>Additional availability:</b>	
<b>18i.</b>	<b>Release authority role: *</b>	Strategy Lead Biophysics

Please note: Unclassified, Restricted and Confidential markings can only be used where the report is prepared on behalf of an international defence organisation and the appropriate prefix (e.g. NATO) included in the marking.

**THIS PAGE INTENTIONALLY LEFT BLANK**

THIS DOCUMENT IS THE PROPERTY OF HER BRITANNIC MAJESTY'S GOVERNMENT, and is issued for the information of such persons only as need to know its contents in the course of their official duties. Any person finding this document should hand it to a British Forces unit or to a police station for safe return to the Chief Security Officer, DEFENCE SCIENCE AND TECHNOLOGY LABORATORY, Porton Down, Wiltshire SP4 0JQ, with particulars of how and where found. THE UNAUTHORISED RETENTION OR DESTRUCTION OF THE DOCUMENT IS AN OFFENCE UNDER THE OFFICIAL SECRETS ACTS OF 1911-1989. (When released to persons outside Government service, this document is issued on a personal basis and the recipient to whom it is entrusted in confidence within the provisions of the Official Secrets Acts 1911-1989, is personally responsible for its safe custody and for seeing that its contents are disclosed only to authorised persons.)



Ministry  
of Defence