



Best Available Technology for Small Arms Ranges

- Reasonable Solutions to Limit Environmental Effects



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Terminology: *BAT* and *BREF*

- BAT "Best Available Technology"
 - Methods of production and treatment that are as efficient and advanced as possible and ***technologically and economically feasible***
 - Methods of design, construction, maintenance and operation to ***prevent or most efficiently reduce*** the harmful environmental impacts caused by activities
- Use of BAT is one of the key legal principles in European environmental regulation
 - Implementation of the IPPC- and IE-Directive
 - Both EU and Finnish environmental regulation are based on a permitting system
 - Use of BAT demanded in permits
- BAT Reference (BREF) - document
 - Guidance document for interpretation of BAT, intended both for actors and permitting authorities
 - Specific for different functions
 - Published on EU or National level
 - Do not exist for most of FDF related installations or operations



Background: Small Arms Ranges in the FDF

- 200 ranges in 49 areas, 13M rounds annually
- Often shared with civilian sport shooters
- Environmental permits demanding, partly inconsistent
 - Use of BAT often required - Nobody knows exactly what it means
 - Challenging schedules for implementation of permit terms
 - Calls for considerable investments

- Need for generally accepted, cost-efficient technical solutions for environmental impact control
- Need for consistency in EP demands by authorities, defining "What is enough?" ?





Project

FDF initiative to produce a national Best Available Technology Reference Document (BREF-Document) for outdoor shooting ranges

”Best Available Technology for Controlling Environmental Impacts of Outdoor Shooting Ranges”

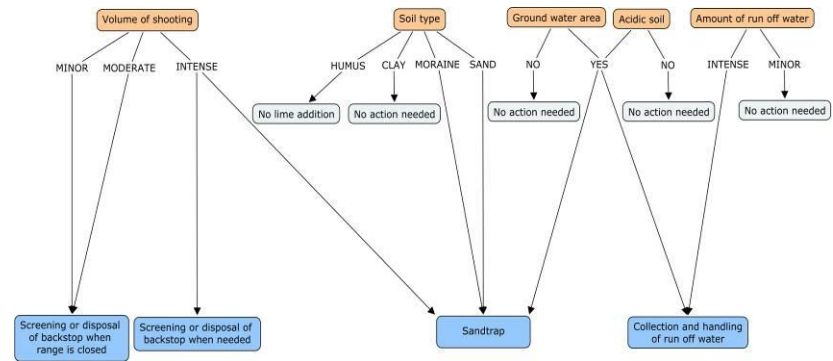


- Covers rifle-, pistol- and shotgun ranges
- Co-operation with environmental authorities and civilian sport shooters
- Timeframe 2010-2013
 - 2nd draft ready 24.5.13
- Will be published as a Finnish Environment Centre guidance document
- Applies nationally to all outdoor small arms ranges



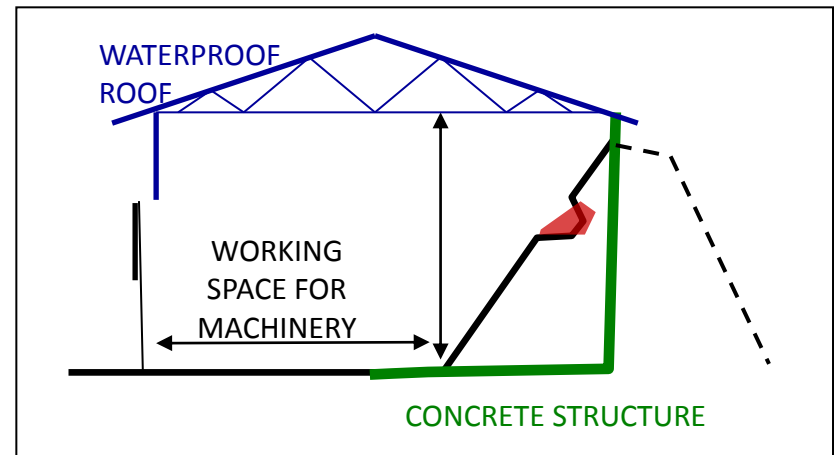
End Products

- National BREF-document for environmental protection of small arms ranges
- Optimal, cost-efficient solutions tailored for different types of ranges
 - Different range types and volumes
 - Settings and sensitivity of environment
- A process for BAT selection
- Model solutions / plans including cost estimates
- Guidance documents (BEP)
 - Baseline survey of small arms range
 - Environmental monitoring of small arms ranges





BAT for Soil and Groundwater Protection





Process

1. Analysis of data from environmental surveys carried out on small arms ranges in Finland
 - 37 surveys
 - Summary of reported environmental impacts (soil, groundwater, surface water, sediment)
2. Identification of existing technical environmental protection techniques on the market, and under development
3. Setting up a frame for environmental protection requirements on small arms ranges → BAT-levels
4. Evaluation of the technical feasibility of the various techniques
 - Evaluation table assessing efficiency and reliability of contaminant management, possibility for recycling bullets, noise impacts, safety risks (ricochets), availability and applicability on different types of ranges
5. Estimating cost for the evaluated techniques
6. Producing a guidance document for a baseline survey
7. Producing technical model plans
8. Identification of further development and discussion needs



Evaluated Technologies and Practices - Rifle and Pistol Ranges

Sand Traps

- Traditional earthen back berm
- With contact water control
 - Impermeable bentonite-, rubber-, asphalt or plastic liner to prevent contaminant migration
 - Water collection and treatment possibility
- Pit and Plate





Steel Bullet Traps

- Deceleration traps
 - Snail Trap
 - Escalator Trap
 - Total Containment Trap
- Steel Box Traps for pistol and .22 cal ranges

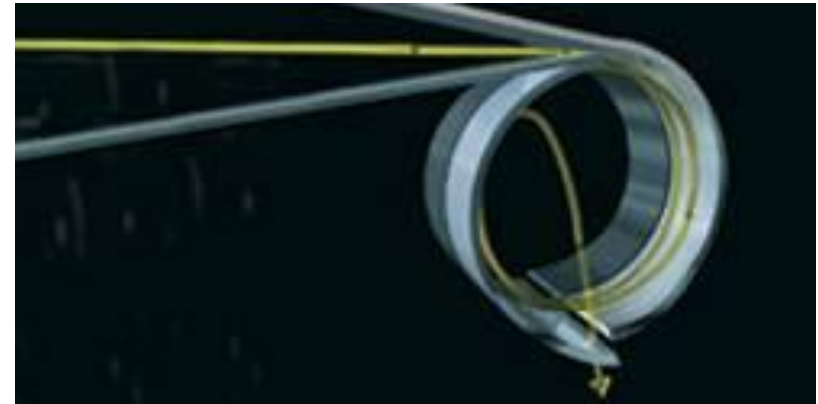


Photo: Manufacturer





Rubber Granulate and Other Bullets Traps

- Rubber Granulate Traps
 - Granulate bed installed on back berm, model "STAPP"
 - Granulate boxes
- Lamella Traps
- Other traps
 - Sand-filled pipe
 - Box trap filled with alternative materials (plastic granulate etc)



Photo: Manufacturer



Other Methods

- Roofing of back berm
- Reducing solubility of contaminants using soil amendments
 - Iron
 - pH control (lime)
 - Other reactive materials
- Shock-Absorbing Concrete and other absorbing walls
- Treatment of runoff- and contact waters
- Alternative bullet materials

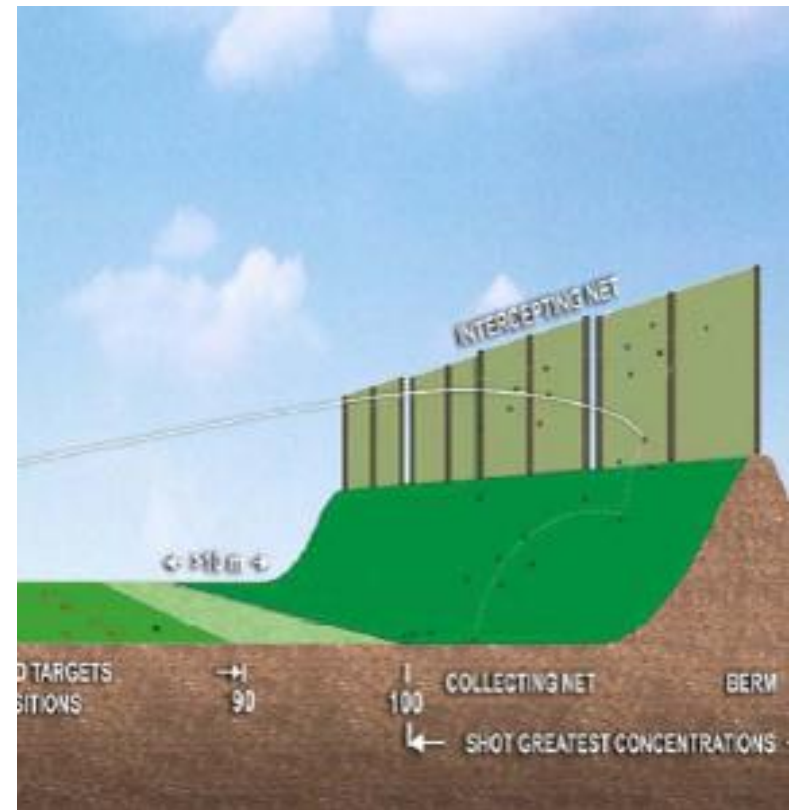




Evaluated Technologies and Practices

Berm ~~Shotguns~~ ~~Barriers~~

- Reducing shot distribution area
 - High earthen berms
 - Walls
 - Lighter curtain solutions
 - Collection of pellets in front of the structure intercepting their flight path





Other Methods

- Water management and treatment if necessary
 - Impermeable liner on most critical shot landing areas
 - Ditches around the range
 - Control and collection of range waters
- Covering the soil
 - Soil contamination prevention
 - Enables shot collection
- Alternative materials
 - Lead-free shots
 - "Green" clay pigeons (no tar coating)





Characteristics Influencing the Environmental Impacts of a Range

- Geological and hydrological settings
 - Soil type: permeability, ability to bind metals, pH...
 - Hydrogeology: type of aquifer, depth to GW , water extraction...
 - Surface waters: amount of surface runoff, runoff directions, sensitivity of receiving waterway...
- Range characteristics
 - Volume of activity
 - Rounds/year
 - Size of contaminated area
 - Age
 - Type of weapon





EP Demands: Chosen Approach

- What is the minimum level of environmental impact control in different conditions?
 - Acceptable risk
- What is the maximum level that can be demanded?
 - Acceptable cost

- ***Risk-based criteria for setting environmental protection demands***
- ***Definition of different levels of environmental impact control***
- ***Technical recommendations for each level***

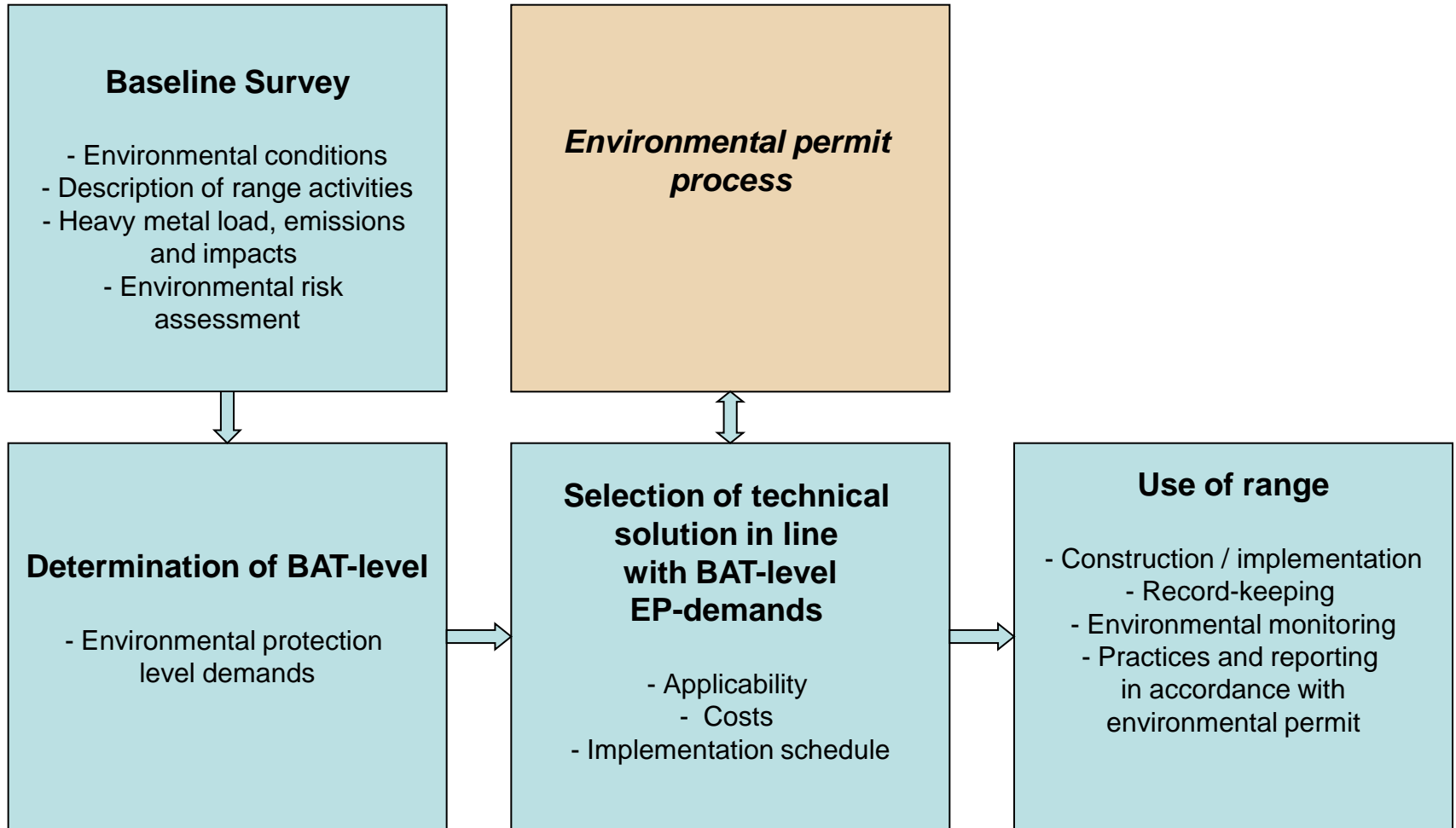


EP Demands for Different Types of Ranges, Principles

- New ranges
 - Choice of location primary risk management measure
 - Contaminant control and monitoring generally demanded
 - Double protective measures on classified groundwater areas
- Existing ranges
 - Baseline survey and risk assessment
 - Measures planned according to risk, 4 levels
 - Several choices of technical structures within the level, cost-efficiency and actor's preferences decide
 - Time-scale of environmental risk should be considered in implementation schedule
 - Monitoring and record-keeping are always part of the management system
 - If baseline survey and risk assessment indicate acute environmental risks
 - Remediation need



BAT-Process for Contaminant Management





Soil and Groundwater Protection of Small Arms Ranges

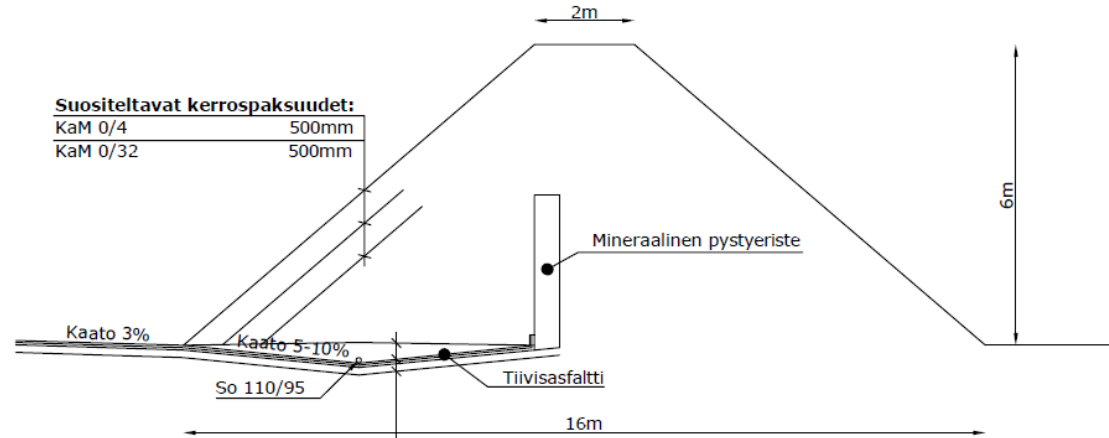
Environmental Protection Demand Levels, "BAT-levels"

	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	No applicable technical solutions available
Description	Basic	Demanding, surface water	Demanding, groundwater	Very demanding	
Estimated risk potential According to baseline survey and risk assessment	Very low risk of pollutant migration Existing ranges only	Long-term risk of pollutant migration to surface waters New range, not on gw-area	Long-term risk of pollutant migration to groundwater on classified groundwater areas or other aquifers used for potable water extraction New range in insensitive gw-environment	Acute or short-term risk of pollutant migration and possibly severe impacts New range in sensitive environment	<i>Shooting on marsh or open water</i>
Environmental protection demands	Record keeping and reporting	Runoff water control and treatment if necessary or bullet containment	Contact water control in back berm and treatment if necessary or bullet containment	Contact- and runoff water control in backstop, firing and range area Bullet containment Double protection for new ranges Remediation if necessary	<i>No BAT solutions exist for meeting minimum EP demands</i>
Technical EP solutions	Generally not demanded	Table X	Table X	Table X	-
Record-keeping (heavy metal load)	Yes	Yes	Yes	Yes	-
Emission monitoring	Generally not demanded	Yes	Yes	Yes	-
Impact monitoring	Not demanded or limited and focused	Surface water monitoring, possible groundwater monitoring 1-3 year interval	Monitoring of groundwater, contact water and possible surface water 1-3 year interval	Monitoring of groundwater, contact water and possible surface water Yearly or more frequently	-
Schedule	-	0-10 years No acute need for measures	0-10 years No acute need for measures	0-5 years Measures to be carried out as soon as possible.	-





Model Plans

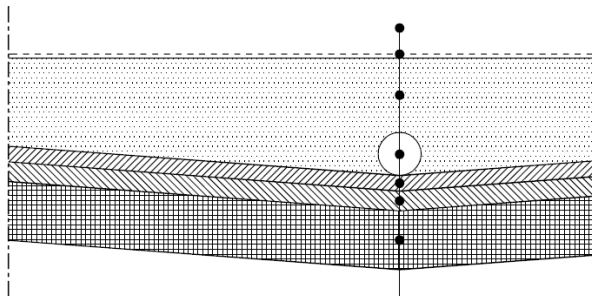


Suosittelavat kerrospaksuudet:

KaM 0/4	500mm
KaM 0/32	500mm

Suosittelavat kerrospaksuudet:

Geotekstiili (esim. N3)	
Kuivatuskerros (esim. murske KaM 16/32)	300mm
Tiivisasfaltti ABT11 (esim. Lemdense 11)	40mm
Asfaltti AB16 tai ABT16 (esim. Lemdense 16)	50mm
Murske, mineraalinen tiivistekerros (esim. Lemground) tai stabiloitu PIMA (esim. Ekostab)	150mm



Vallihiekka tai kiviaines	
Geotekstiili, esim. N3	
Kuivatuskerros, KaM 16/32	300mm
Salaoja, So 110/95	
Tiivisasfaltti ABT11	40mm
Asfaltti AB16 tai ABT16	50mm
Murske	150mm

Annex D Model plans for small arms ranges

- D1 Back berm with bentonite liner
- D2 Back berm with plastic liner
- D3 Back berm with plastic liner
- D4 Bullet trap (boxtrap for .22 cal)
- D5 Roofing of back berm
- D6 Treatment of contaminated water

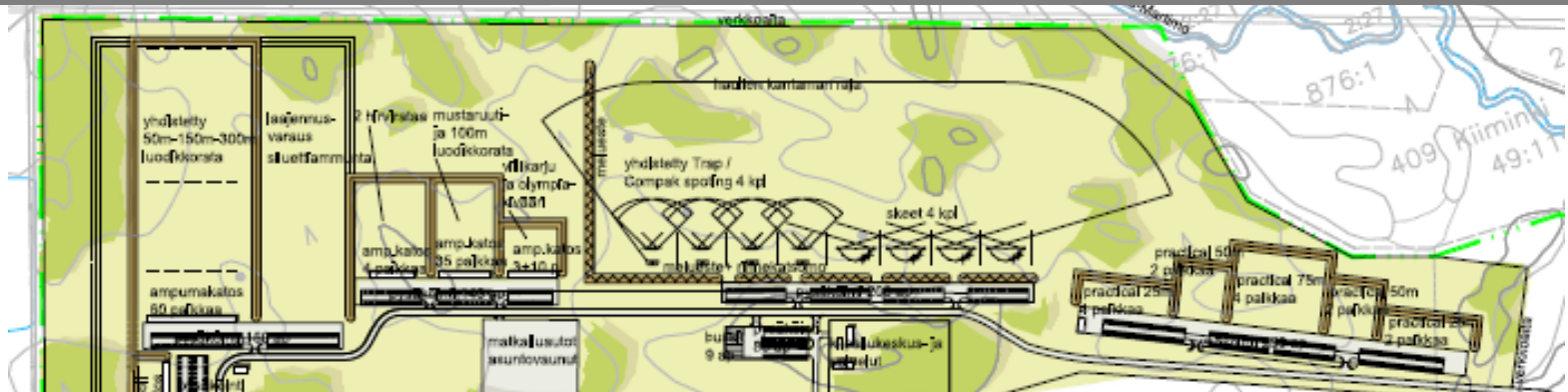
Annex E Model plans for shotgun ranges

- E1 Runoff water control and treatment
- E2 Reduction of shot distribution area
- E3 Covered shot distribution area





BAT for Noise Control





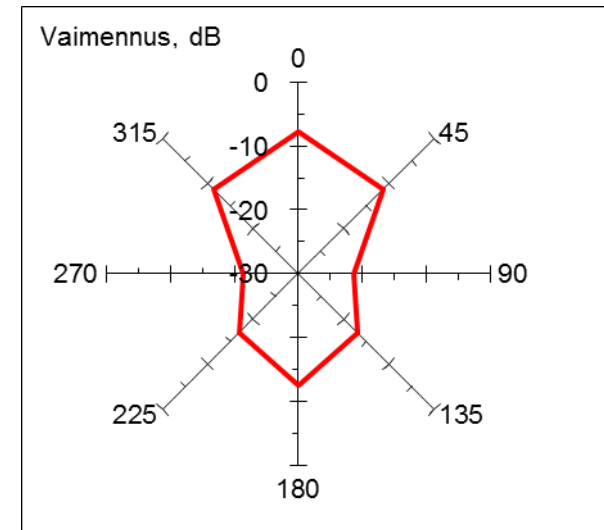
Objectives of the Noise Working Group

- Identification and evaluation of technical noise abatement methods
 - Acoustically absorbing shooting stall
 - Absorbing divides in the stall
 - Noise control berms and walls
 - Effect and limitations of the constructions
- Identification and evaluation of other methods for noise control
 - Weapons and ammunition: Sub-sonar speed bullets, sound suppressors, Reducing caliber
 - Scheduling of activities
 - Re-arrangement of shooting directions
- Model plans including cost calculations
- Evaluation of the cost-efficiency of the various solutions
- Assessment of the possibilities and limitations of abatement noise from small arms ranges
- Identification of further development and discussion needs



Challenges

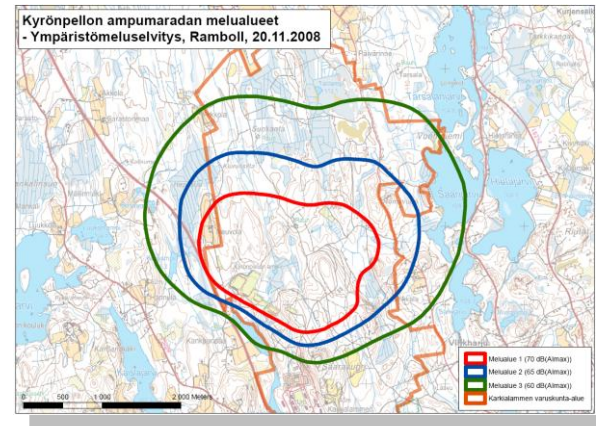
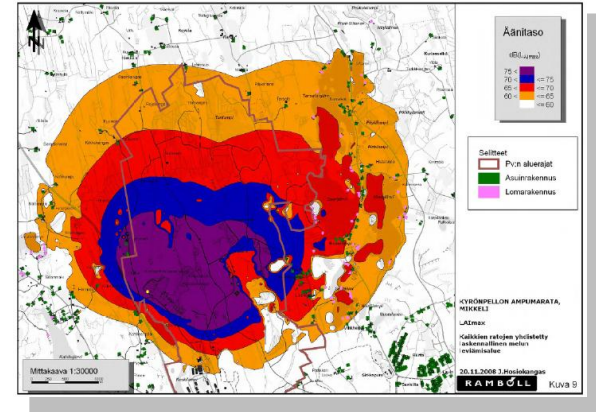
- Limited noise reduction possible with reasonable investments
 - Guidance / limit value levels can not always be obtained with any kind of investments
- Noise can only be reduced in certain directions from the emission source
- Frequency of noise emission is usually not considered when setting demands for noise control
- All surveyed methods can not be used in all functions
 - Competition rules
 - FDF training needs





Suggestions: EP Demand Principles for Small Arms Ranges

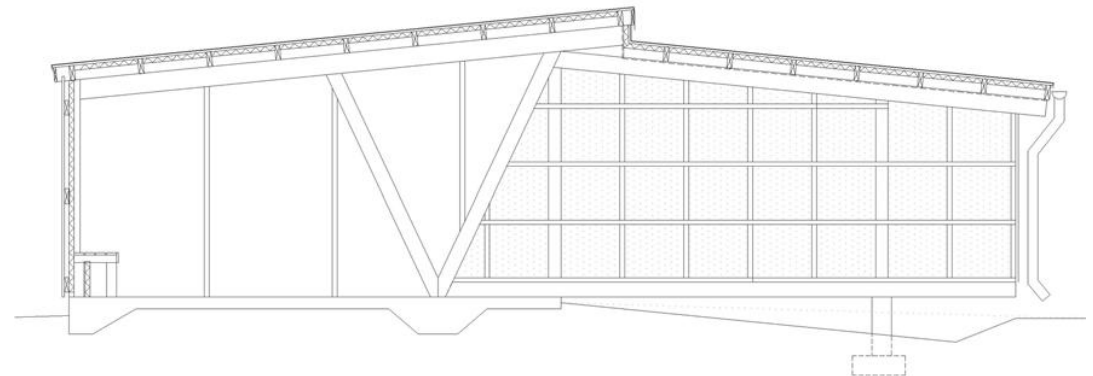
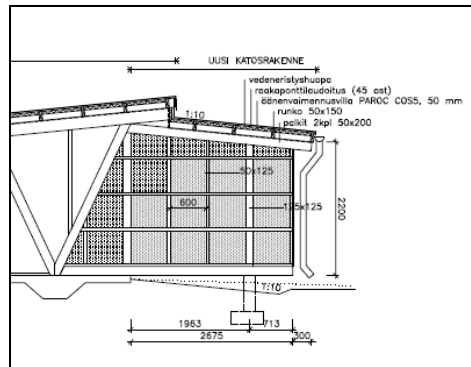
- Noise reduction requirements between 5 and 15 dB considered possible to fulfil
 - Less than 5 dB; effect not possible to prove due to measuring and modelling uncertainty
 - More than 15 dB not economically feasible on outdoor ranges
- No measures necessary on ranges where only .22 caliber weapons are used
- No measures necessary on ranges with less than 2000 rounds/yr
 - Noise emissions considered a temporary nuisance
- Recommendation chart for noise control demands





Model Constructions

- Acoustically lined shooting stall
 - 3 variations
 - Detailed construction plan
 - Cost calculation
 - Noise reduction estimate 1-8 dB, mainly behind the stall
 - Divides reduce noise emissions also on the sides





Experiences of contaminant management structures 2012-2013

EP – For Mission Sustainability

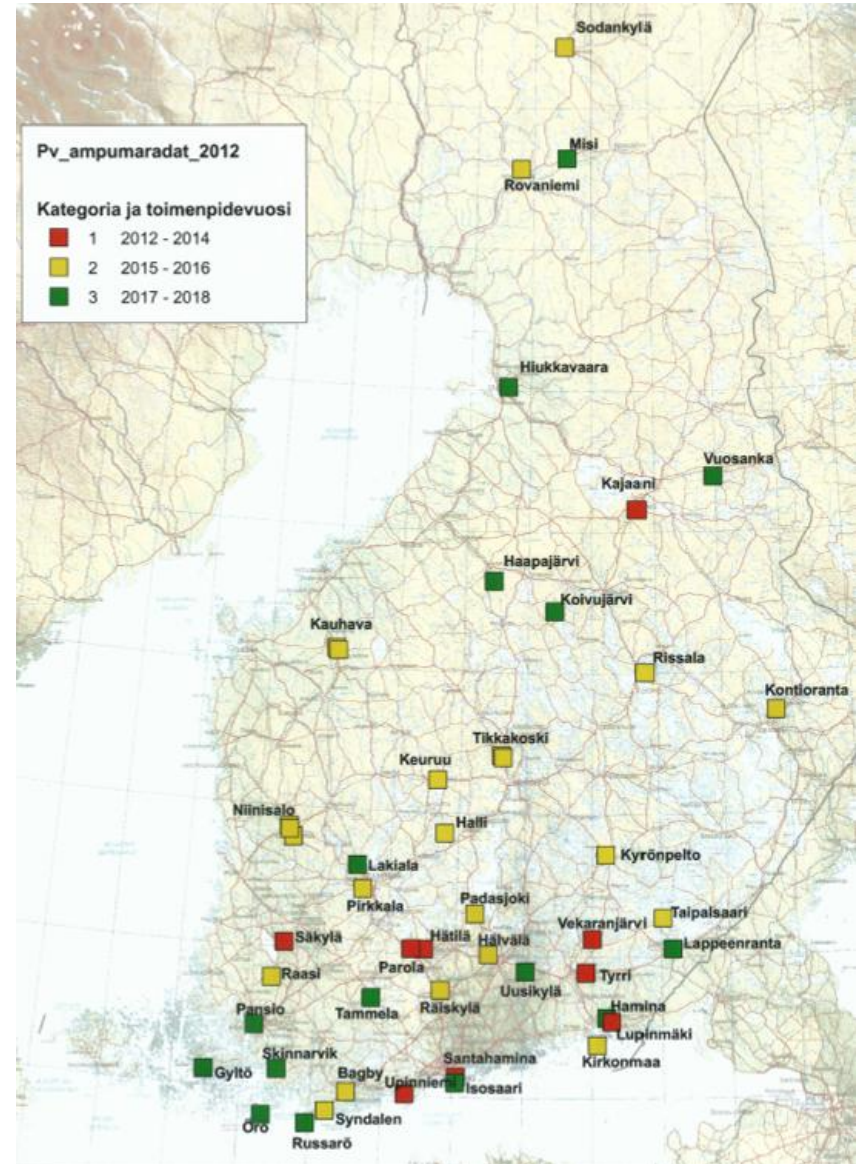


**CONSTRUCTION ESTABLISHMENT OF FINNISH DEFENCE ADMINISTRATION
ENVIRONMENTAL SERVICES
M.Sc. SARA KAJANDER**



Strategic Development Plan for Small Arms Ranges

- Objectives:
 - Sustaining sufficient training range capacity
 - Raising the EP level of small arms ranges
- Timeframe 2012-2018
- Cost estimate 20-25 M€
- Prioritization of sites based on environmental impacts and FDF training needs
 - Three categories





Contaminant management structures

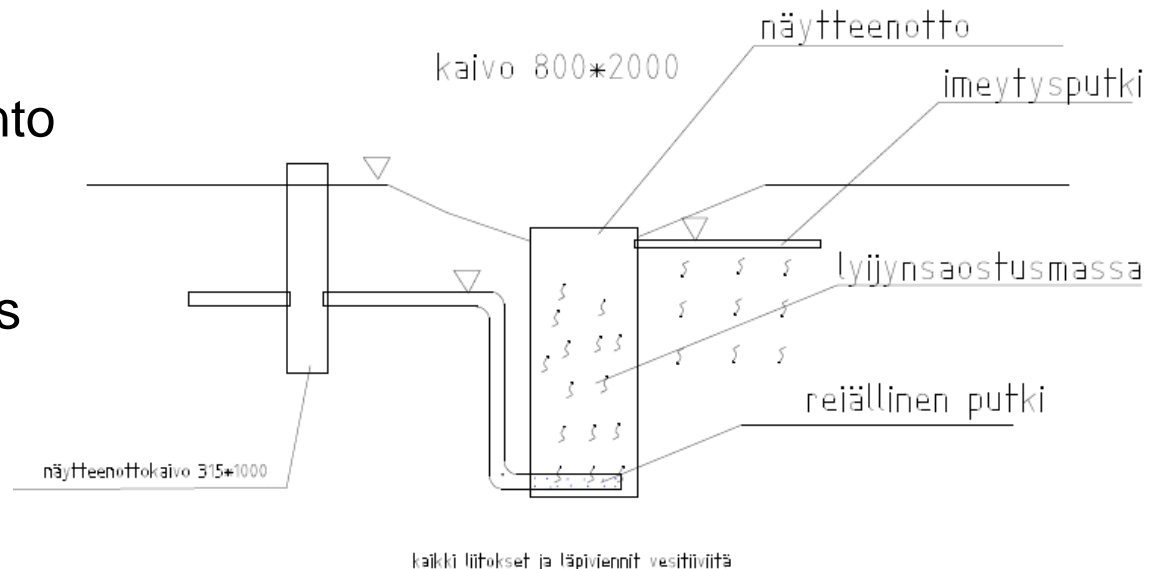
- Required mainly on classified groundwater areas
- Several technical solutions
 - Dense asphalt (Parolannummi)
 - Bentonite (Vekaranjärvi)
 - Plastic liner
 - Concrete





Water treatment

- Water control plans on all small arms ranges (away from backberm)
- Design should allow monitoring of waters
- When necessary, runoff and contact waters are treated before infiltration into terrain
 - Settling ponds
 - Treatment wells (for example with ferrihydroxy-granules)



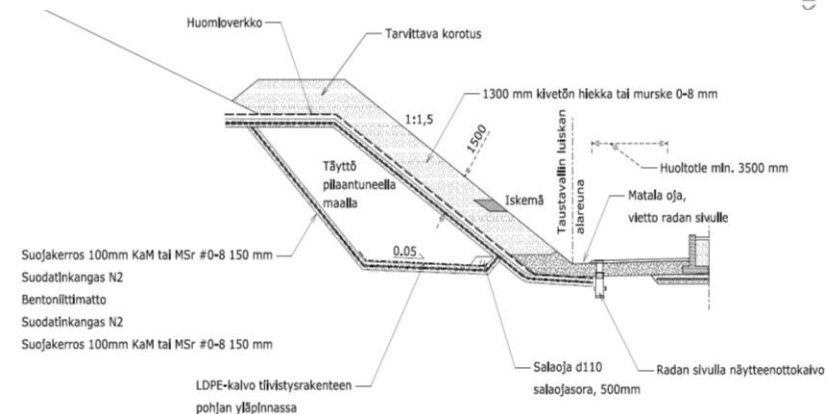
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Contaminated Soil Remediation

- Frequent "unnecessary" remediation demands in environmental permits
 - Remediation in association with technical EP construction work
 - Systematic removal of bullet concentrations
 - Bullet separation
- Aiming for as little remediation as possible, as activity will continue
- Remediation need and level is assessed in the baseline survey
- Possible utilization of contaminated soils in structures



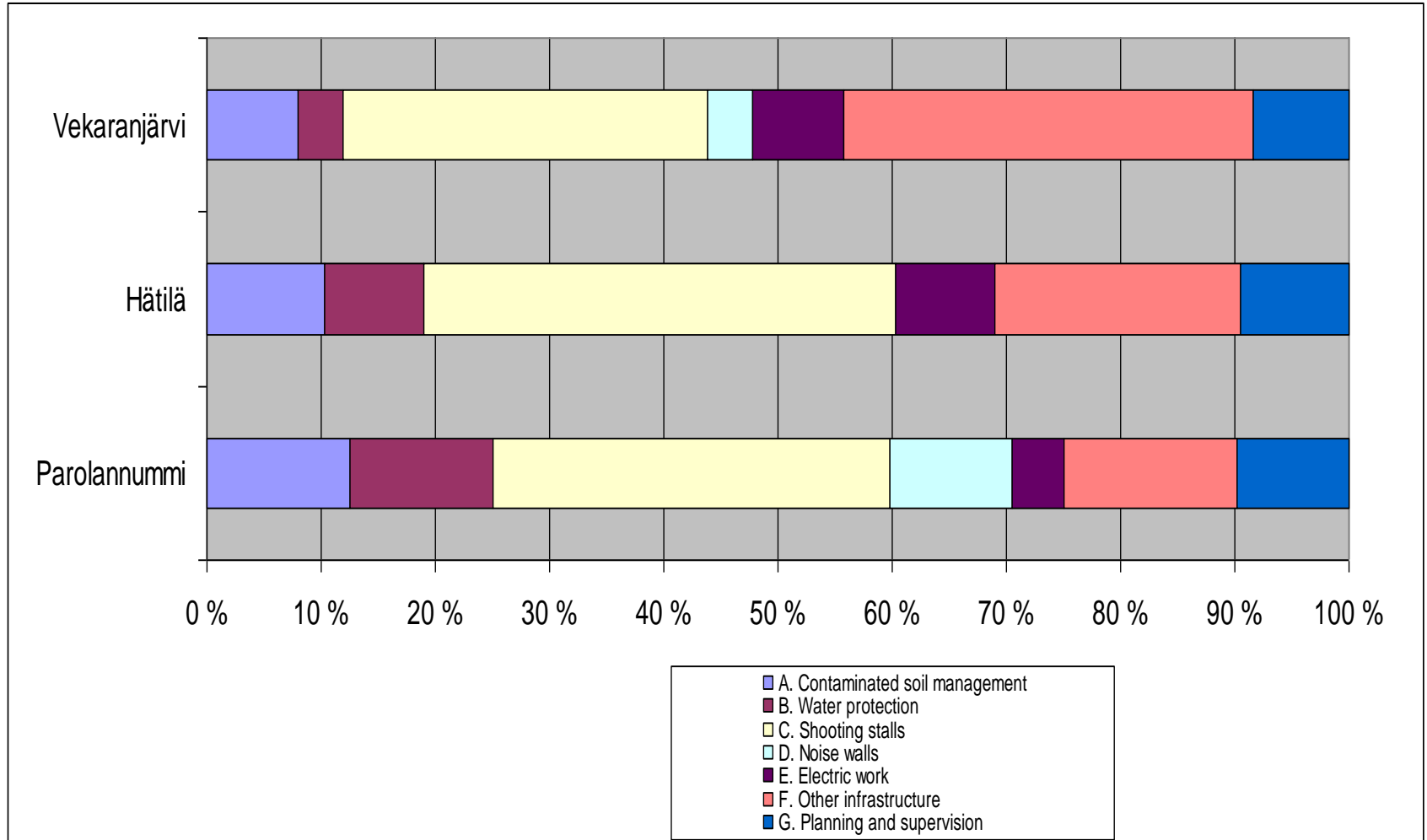


Realized cost (1 000 €)

<i>Range capacity</i>	<u>Parolannummi</u> 3 ranges (94 sp), 2 ranges removed	<u>Hätälä</u> 4 ranges (135 sp)	<u>Vekaranjärvi</u> 5 ranges (230 sp), 1 range removed
<i>Environment</i>	<i>GW-area, housing area</i>		<i>Vacation housing</i>
A. Contaminated soil management	140	120	200
B. Water protection	140	100	100
	Asphalt liner. Water monitoring and infiltration	Ditches, settling ponds	Plastic+bentonite liner, settling ponds
C. Shooting stalls	390	480	800
		2 new stalls, 2 acoustic linings	3 new stalls, 1 lining, 1 expansion
D. Noise walls	120	0	100
E. Electricity	50	100	200
F. Other infra	170	250	900
	Improvement of roads.	Expansion of range	Expansion of range
G. Planning and supervision	110	110	210
			Consultant
ALTOGETHER	1 010	1 050	2 300
		Not yet finished	Not yet finished



Project costs (%)





Thank You for Your Attention!

Questions?