Field study on the construction of a flood-proof riverbank filtration well in India – challenges and opportunities

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- Riverbank filtration (RBF) and effects of floods
- Flood-proof wells in Europe
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Riverbank filtration and effects of floods

Destruction of clogging layer, High pressure gradient, Submerge unsaturated regions

Inundation of well

→ less retention time, remobilisation
→ less removal

→ direct entry of water, damage
→ contamination, inoperativeness
RBF site in Srinagar, Uttarakhand

- Population: 150,000, Altitude: 560 mASL
- Monsoon: Heavy rainfall → annual flood events
Flood events in Srinagar

New wells under construction (2011)

Monsoon flood (2011)

Extreme Flood (2013)

After extreme Flood (2013)
Damage and coliform counts after flood 2013

- RBF well not operational
  - 1-3 m sand deposition, limited site access, damage to equipment
Damage and coliform counts after flood 2013

- RBF well not operational
  - 1-3 m sand deposition, limited site access, damage to equipment

- Contamination of GW well

Need to develop and implement flood-proofing measures
Vulnerable points at common RBF well

- No Sealing of annular space of well bore
- Direct contamination through openings and fissures
Flood-proof wells in Europe

- Sealing of annular space of well bore
- DVGW W122: Well chamber above highest flood level

→ Otherwise watertight structure + buoyancy force compensation

(after Treskatis, 2014)
Flood-proof wells in Europe

- Sealing of annular space of well bore
- DVGW W122: Well chamber above highest flood level
  - Otherwise watertight structure + buoyancy force compensation

- Flood-proof manhole cover would be key element
Watertight well elements in Uttarakhand, India

- Generally no construction of well chamber
  - High requirements for watertight concrete
- Flood-proof manhole covers
  - Not available → Import
  - Maintenance intensive, heavy loads, high temperatures and humidity
- Annular rubber seals
  - Not available → Import
  - Has to be custom-made for Indian standard sizes
  - Watertight Polyurethane foam
- Clay Pellets
  - Not available → bentonite powder
- Strong welding experience of local firms
Conceptual design of flood-proof well

- Horizontal sealing:
  
  **Flood-proof well head** + bitumen sheets + bentonite apron seal

- Allow filtered flood water to enter
  
  → Reduce buoyancy force, water pressure, risk of contamination and post flood cleaning operations
Design for flood-proof well head

- Dimensions: DIN 4926, stainless steel

Press-ring seal brought from Germany
Fabrication and testing of flood-proof well head
Fabrication and testing of flood-proof well head
Fabrication and testing of flood-proof well head

→ Watertight ≥ 0.8 bar
Installation of well head with bitumen sheets
Installation of well head with bitumen sheets
Installation of well head with bitumen sheets
Well chamber under construction
Well chamber under construction
Capital costs for flood-proofing wells

- RBF well Srinagar: Diameter 300 mm, depth 25 m, length of Johnson filter screen 8 m

- Installation and testing of pump and related items, SCADA, electric generator and disinfection equipment: 38%
- Flood-proof well head: 2%
- Well chamber: 5%
- Manhole covers: 2%
- Filter chamber: 1%

- Flood-proofing components 10 % of total costs
Conclusions

- Raise awareness for risks from microbial contamination of wells through information and education campaigns
- Focus on horizontal sealing of the bore hole by flood-proof well head
- Fabrication of prototype flood-proof well head and construction of well chamber at RBF site in Uttarakhand, India
- Filter chamber for allowing flood water to enter well chamber to compensate buoyancy force and water pressure
- Establish order/ market for watertight well elements (sealings) in India

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