

# BED REMEDIATION CASE STUDY: RETROFITTING A FILTER BED

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ESSE CANADA

- Study Background
- Objectives
- Methodology
- Conclusions
- Opportunities



- Failing filter bed system in Cumberland, ON
- Site inspection October 2007 to determine system condition
- Design flow calculated at 1,600 L/day
- Bed installed in clay soil, 6.1m (20ft) laterals at 0.75m (2.5') spacing
- No mantle
- Existing sandy-clay overburden

- Ponding effluent above distribution lines
- Significant biomat clogging
- Overburden acting to prevent adequate aeration
- Lack of mantle also identified as a cause of ponding and failure



Ponding  
effluent  
above  
distribution  
pipes



Biomat in filter media

- Study completed by the ORWC, University of Guelph – Alfred Campus
- Primary objective was to evaluate the effect of retrofitting an existing septic system under conditions of significant bed clogging with a Bionest bioreactor
- Using technology to regain infiltration capacity and eventually extend the bed's lifespan
- Secondary objective was to evaluate total nitrogen reduction with the addition of a Bionest de-oxygenation (De-Ox) unit on the recirculation line of the Bionest treatment chain

- Several other failed onsite wastewater treatment systems were inspected to determine the best candidate for study
- The failed filter media bed in Cumberland, ON was selected due to three factors
  1. complete hydraulic failure of the system was observed with effluent ponding above the distribution pipes
  2. significant biomat development throughout the filter media material
  3. cooperation of the homeowner to conduct the study

- Bionest BN-400 Bioreactor tank was installed after the existing septic tank in November 2007
- Bioreactor rated to treat up to 1,600 L/day
- Purpose of the Bioreactor was to reduce the effluent to tertiary levels (10 mg/L cBOD<sub>5</sub> & 10 mg/L TSS) and to increase oxygen levels prior to discharge into the filter bed



- Bionest BN-400 Bioreactor was an approved ATU under the 2006 OBC Part 8
- Listed in Supplementary Standard SB-5 Approved Sewage Treatment Units
- The Bioreactor is a fixed film suspended media with continuous aeration via a linear air pump and fine bubble diffusers
- Media is a non-toxic, synthetic polymer ribbon providing large surface area for microbial growth, acts as a physical and biological filter

- Effluent was recirculated from the Bioreactor outlet to the septic tank inlet to provide total nitrogen levels through denitrification in the septic tank
- A De-OX unit was also installed to reduce dissolved oxygen levels in the recirculated effluent to enhance denitrification
- Gravity flow was able to be maintained through entire treatment chain



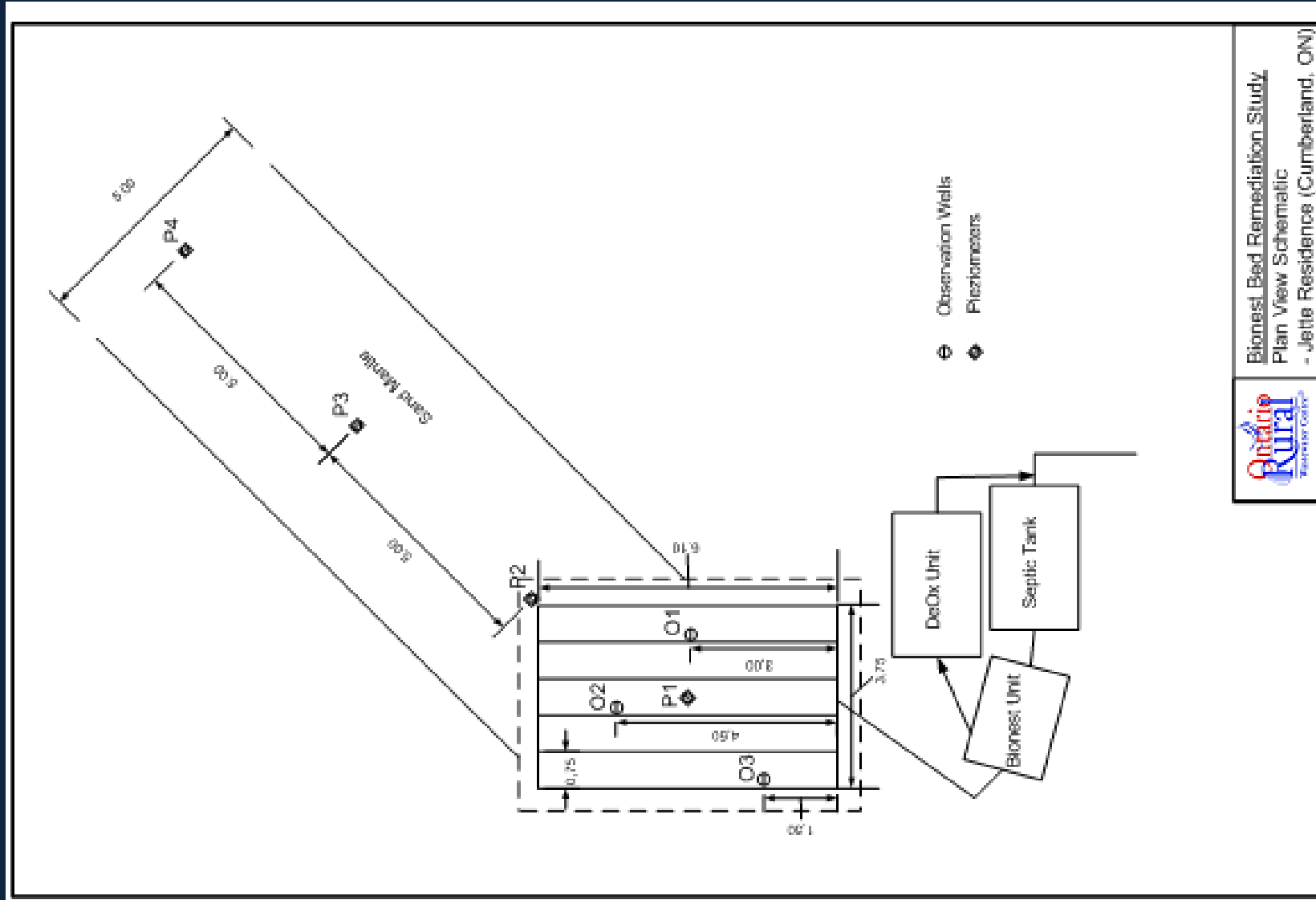
- The sandy-clay overburden was replaced with new sand
- Distribution lines and filter media materials remained undisturbed
- New sand mantle installed at outlet of filter bed
- Lack of mantle created “bathtub” effect in native clay soil
- Significant reason for hydraulic failure of system
- Effluent poured out of bed once clay barrier pierced



Effluent breaking through  
during mantle install



Peizometer installation

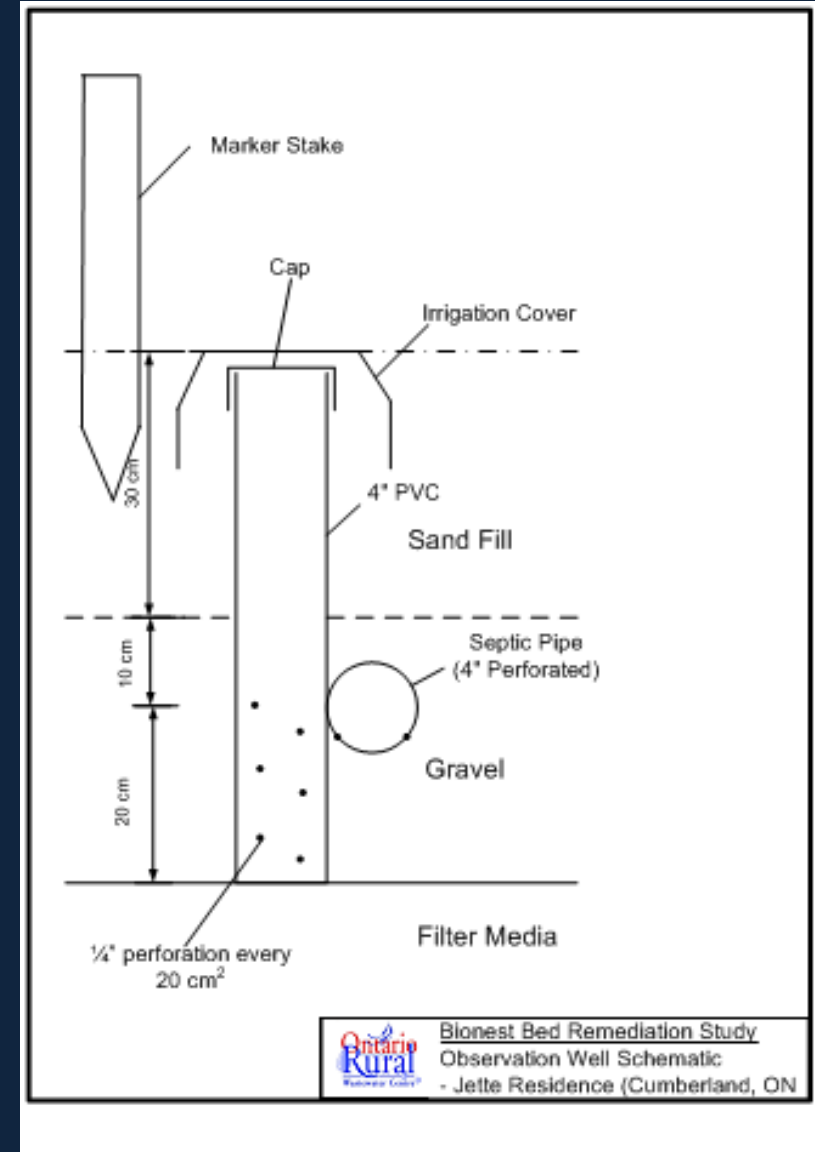




Septic Tank (foreground),  
Bionest (Left) and filter  
bed with observation  
wells and piezometers  
(DeOx Unit not installed in  
this picture)

Three 4" PVC observation wells installed to bottom of gravel layer adjacent to distribution laterals

Bottom 0.2m of the well perforated to allow effluent migration across biomat surface

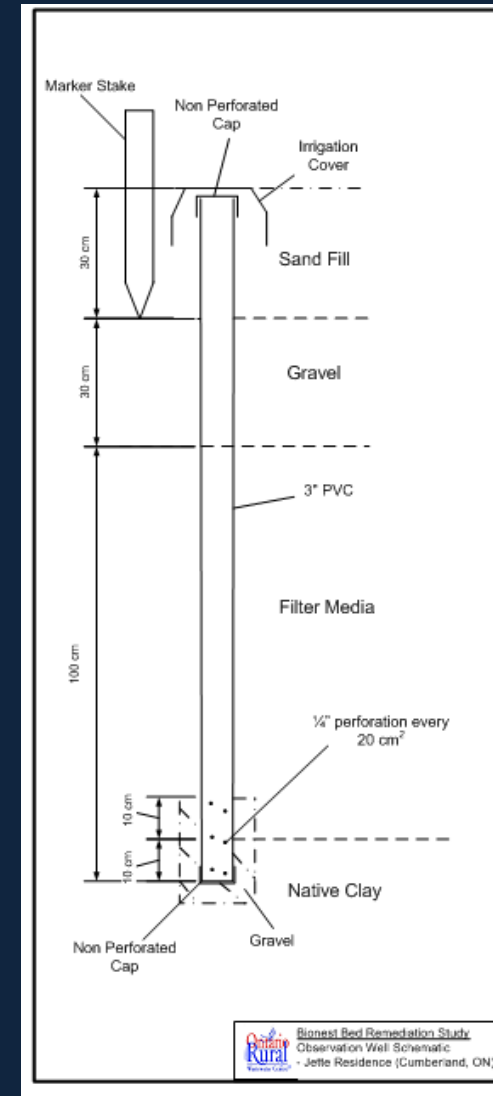




Four 3" PVC piezometers were installed at sand-native clay interface to collect samples of effluent quality mounding above clay layer

Bottom of piezometer perforated with a gravel layer surrounding it

Installed in middle and end of filter bed and along the mantle



- Initial water quality sample collected to determine background conditions prior to Bioreactor use
- Grab samples from the Bioreactor outlet, De-Ox Outlet and piezometers
- Sampled monthly for first 6 months (Nov 2007 to April 2008)
- Then every spring/summer/fall in 2008, 2009 & 2010
- Percolation tests or ponding water level measurements were conducted on each of the sampling days (depending on saturation levels)

- Water quality analysis completed by the ORWC's Environmental Quality Laboratory
- Soil cores collected in triplicate from filter media material at various depths below gravel layer and analyzed for volatile solids at beginning of the study and again at various intervals afterwards
- Grain size distribution determined by sieve analysis of the existing filter media material, the old fill material and the new fill material

Parameter	De-Ox	Bioreactor	Piezometers
cBOD5	X	X	
TSS	X	X	
Nitrogen: TKN, NH3, NO3	X	X	X
TP	X	X	X
<i>E.coli</i>	X	X	X
Insitu: DO, redox, pH, T	X	X	X

Activity	Date
Site Investigation	Oct, 2007
Construction	Nov 2007
Sampling Days (17)	2007 – Dec 2008 – Jan, Feb, Mar, Apr, May, July, Sept, Nov 2009 – Apr, July, Sept, Nov 2010 – May, July, Aug, Oct
De-Ox Removed	June 2010
Final Report	January 2011

- Bioreactor performed very well after start-up even under cold temperature conditions (installed in November)
- Tertiary quality effluent avg 3 mg/L cBOD5; 6 mg/L TSS
- Total nitrogen concentrations upon start up were 38.0 mg/L
- Averaged 13.5 mg/L TN after operation
- Reduced total nitrogen by 65%
- Nitrogen and phosphorus concentrations further reduced at the end of the mantle

- Use technology to make systems last longer
- Avoid need to haul away concrete and aggregates
- Save materials and labour costs to replace systems
- Limit disturbance on properties
- provides more options to installers/designers in addressing complex projects

- Still need careful site evaluation to determine if leaching field can be remediated
- Not in high ground water table
- Horizontal setbacks maintained



- Bionest Zenith series certified at CAN-BNQ with a single compartment trash tank with 1Q size
- Certification provides an easier path for permit application
- Option to utilize existing septic tank on house expansion projects
- May be able to leave leaching field, or expand
  - i.e. QT/200 vs QT/ 300 for absorption trenches

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THANK YOU

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