WONDER MAKERS
ENVIRONMENTAL

BENEFECT REAL-WORLD REMEDIATION STUDY

Conducted by
Wonder Makers Environmental
May-June 2015

Project Number GC15-13183

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1.0 Abstract

Since many water intrusion events in buildings involve water contaminated with pathogens, a representative test was conducted to determine the effectiveness of a botanical degreaser and a botanical cleaner disinfectant when used as part of a standard cleaning process. Benefect Atomic Degreaser and Decon 30 were tested using methods designed to replicate real-world conditions, but with detailed controls that would allow replication.

Wonder Makers Environmental developed the test design and conducted experiments on a contract basis for the manufacturer. Testing involved saturation with raw sewage of a simulated wall cavity constructed of standard lumber and orient strand board (OSB), a simulated concrete floor, and a simulated concrete wall. Benefect Atomic Degreaser was sprayed on the saturated surfaces and allowed to dwell on those surfaces for a short period of time. The surfaces were then wiped with disposable towels. The surfaces were then sprayed with Benefect Decon 30. Two testing methods were utilized to determine the effectiveness of the products: swabs with analysis by a direct-read adenosine triphosphate (ATP) instrument, and environmental sponges, which were sent to a laboratory for culturing of the collected bacteria. The standard sewage screen of *Enterococcus*, total coliform, and *E. coli* bacteria was used for analysis of the environmental sponge samples.

Testing indicated that, when used according to the manufacturer's Decon 30 product label directions, Benefect Atomic Degreaser and Decon 30 were effective in addressing high levels of bacterial contamination. The application and cleaning with these products on standard lumber, OSB, and concrete reduced ATP levels, the universal energy molecule found in all animal, plant, bacteria, yeast, and mold cells, to zero. The levels of *Enterococcus*, total coliform, and *E. coli* bacteria on the surfaces were reduced by 99.99% or more.

2.0 Introduction

This study was undertaken to evaluate the performance of Benefect Atomic Degreaser and Decon 30 during a simulated residential remediation of a black water loss in a basement or on a first floor. The testing was conducted on wall cavities constructed of standard lumber and OSB, and a concrete floor and wall after being contaminated by black water (sewage).

Several common questions raised in the remediation industry when evaluating product usefulness were considered during the design phase of the project, including:

- How do the chemicals perform when cleaning sewage from unfinished wood-framed assemblies?
- How do the chemicals perform when cleaning sewage from concrete surfaces?
- How do the chemicals perform based on the orientation of the surfaces (vertical or horizontal)?

Wonder Makers Environmental, Inc. was contracted by Benefect to provide an independent study that addressed these issues. A protocol was designed and implemented by Wonder Makers Environmental in May and June of 2015 to provide objective data and answers to these questions.

3.0 Test Design

Although extensive testing is conducted on all products that are registered by the U.S. Environmental Protection Agency (EPA) or Health Canada's Therapeutic Products Directorate (TPD) as antimicrobial or disinfectants, those tests are closely controlled laboratory experiments. As such, different results may occur when the products are used in "real-world" settings.

For example, classification as a disinfectant is based on specific tests of the chemical on hard, non-porous surfaces. While this standardizes the comparison of the test data between chemicals, it does not necessarily represent the full range of surfaces on which chemicals such as Benefect Atomic Degreaser and Decon 30 are utilized during a restoration process.

In an effort to provide a test process that more closely represents the typical use of antimicrobial products in a water loss restoration scenario, a test design was proposed that included application of the Benefect products on classic framing members (wooden studs and OSB) in a wall cavity configuration that is typically present after flood cuts (horizontal and vertical framing members). Also included in the water loss restoration scenario were horizontal and vertical concrete surfaces, which are often found in typical basements.

An important difference between testing protocols used for American and Canadian registration and the proposed test design for this study was the use of actual sewage as the contaminant for this study. Registration testing of disinfectants utilizes simulated sewage, a standardized mix of known bacterial types. In contrast, the types and levels of contaminants in sewage from a wastewater treatment plant are constantly changing. A sample of the actual wastewater was submitted for analysis so that a baseline of bacterial contamination could be determined.

All told, a considerable number of steps were incorporated into the test design in an effort to accurately evaluate how Benefect Atomic Degreaser and Decon 30 would perform in real life

restoration scenarios. The test parameters were incorporated to determine how the products would perform under a worst-case scenario (*i.e.*, raw, undiluted sewage as the test agent). The following table summarizes the distinctions between the standard test parameters for chemical registration purposes in the United States and Canada and those utilized for this evaluation of the Benefect products. Additional details regarding the testing process are included in sections 4.0 and 5.0 of this report.

SUMMARY OF TEST PARAMETERS	
EPA Test of Disinfectants	**Industry Representative Test of Atomic Degreaser and Decon 30**
• Standardized, hard, non-porous, inanimate surfaces (smooth)	• Porous, untreated, unsealed wood and concrete (uneven)
• Horizontal surfaces only	• Horizontal & vertical surfaces
• Pre-cleaning required (~95% soil removal)	• Spraying and wiping of contaminated surfaces during remediation process
• Spray application	• Spray foam application
• 10 minutes contact time prior to air dry	• Variable contact time, depending on surface orientation and application method
• Standardized contaminant (simulated sewage)	• Real-world raw sewage from wastewater plant, no standardization (includes particulate)
• Standardized, consistent application of contaminant	• Multiple saturations of real sewage on real wood and concrete, no standardization

4.0 Materials and Equipment

An extensive array of equipment, materials, and supplies were marshaled to support the testing process. The primary items utilized for this project are briefly described here. Additional details regarding the equipment and setup can be gleaned from the photograph log that is included as Appendix 10.1.

4.1 Mock wall and floor sections. A wood frame assembly used to represent a wall cavity was constructed from 2x4 unfinished lumber and ½" unfinished oriented strand board (OSB) sheathing. The assembly was approximately 27" wide by 48" tall. The OSB was secured to one side of the panel, and an OSB "foot" was constructed at the base to provide additional stability to the upright panel. Prior to contaminating the panel it was HEPA-vacuumed to ensure that no residual construction dust was present that could skew the sampling and laboratory analysis.

Two concrete assemblies constructed with frames of 2x4 lumber were also assembled. The 2x4 frames were constructed with 24" x 24" openings. Ready mix concrete was prepared according to the package directions, poured into the forms, and troweled to a semi-smooth finish. After the concrete was set the forms were set on edge and allowed to dry from both sides for several weeks. Wooden supports were attached to one of the frames so that it would remain upright during the testing.

4.2 Sewage (black water), bucket, brush. The local wastewater treatment plant provided raw sewage that was post-screening but pre-treatment, so that biological pathogens would still be present in the liquid. Approximately three gallons of sewage was obtained in a 5-gallon bucket and then brought to the study site. The sewage was stored in a warm location for two weeks to represent a worst case scenario where a time lapse occurs between contamination and remediation, which allows pathogens to proliferate. Using a soft-bristled brush with a long handle, the sewage was mopped onto the assemblies. A liquid sample of the sewage was obtained for lab analysis.

4.3 FOAM-iT pressurized sprayer. The FOAM-iT pressurized sprayer was used to separately apply Benefect Atomic Degreaser and Decon 30 in spray foam form. The two-gallon sprayer was manufactured by Innovative Cleaning Equipment Incorporated.

4.4 ATP luminometer, swabs. A portable meter was used to assess the effectiveness of surface decontamination immediately after cleaning. The field portable direct read device uses special swabs to collect and measure adenosine triphosphate (ATP), the universal energy molecule found in all animal, plant, bacteria, yeast, and mold cells. When ATP is brought into contact with the chemical reagent in the sample collection swab, light is emitted in direct proportion to the amount of ATP present. The system measures the amount of light generated and provides information on the level of contamination after 15 seconds. The higher the reading, the more contamination present.

The ATP luminometer used was manufactured by Hygiena, model "SystemSURE Plus", a portable palm-sized unit. Test swabs used in the study were "UltraSnap", also manufactured by Hygiena. They had an expiration date of April 13, 2016, marked on each unit. Use of the ATP luminometer and swabs followed manufacturer's guidelines.

The size of the area sampled with the ATP luminometer and swabs was 4" x 4" as marked on the wood frame and concrete assemblies with a black permanent

marker prior to the contamination of the panel. Samples were collected both prior to and after cleaning of the sewage-contaminated panels. The sample collected after cleaning was taken from an area similar in material and orientation as was sampled prior to cleaning. Until they were used the swabs were kept refrigerated.

4.5 Sterile SampleRight™ Environmental Sponge collection and transport systems prepared by World Bioproducts and sealed with 10 ml of Letheen Broth in 8 ounce bags. Bacterial samples were collected using the sponges within this collection and transport systems. The lot number on each sample package was LOT SR18-10324 with an expiration date of 03/12/2016. The sponge media and packaging are designed to maintain the viability of the bacterial organisms collected during transport to the laboratory.

5.0 Procedures

A specific series of steps were followed to implement the sampling plan developed as part of the investigative process. The primary stages of the testing process included:

5.1 Following the construction of the simulated wall cavities of standard lumber and OSB and the simulated concrete floor and wall, the surfaces were HEPA-vacuumed and then marked to indicate consistent areas for sampling. Areas were marked and numbered for each sampling method (ATP or sponge) and each orientation (horizontal or vertical) using a permanent marker. 12 ATP sample locations and 12 sponge sample locations were marked (6 pre-clean locations and 6 post-clean areas).

5.2 Initial contamination of the panels occurred out-of-doors in a parking area and involved brushing all exposed surfaces of the simulated wall cavities, concrete floor, and concrete wall with raw sewage, using a soft-bristled brush with a long handle. The surfaces were mopped with raw sewage two times over the course of an hour prior to testing.

5.3 Both ATP and sponge samples were collected from each of the panels prior to cleaning to provide comparative data for post-cleaning samples.

5.3.1 Sponge sampling was conducted in accordance with the manufacturer's instructions. Using sterile gloves, the sponges were removed from the sterile bags. Each sample was collected by gently rubbing the sponge over the surface of a 100 cm^2 area of the selected location as marked on the surfaces with a black marker prior to contamination of the surfaces. Each sponge was then re-inserted into its bag and sealed. Samples were placed

in a cooler containing ice packs for transport to Summit Laboratory for analysis.

Samples were collected both prior to and after cleaning of the sewage-contaminated surfaces. The samples collected after cleaning were taken from areas similar in material and orientation as were sampled prior to cleaning.

For analysis, the levels of total viable coliform, *E. coli*, and *Enterococcus* were determined and reported as colony forming units per milliliter of swab solution (cfu/L). Because of the specifics of the analytical process used for *Enterococcus* bacteria the results from those tests are reported as "most probable number" per milliliter of swab solution (MPN/mL). This result has a close correlation to colony forming units but is stated differently because the analytical technique requires multiple repetitions of the diagnostic process and the selection of the sample result that is most representative of the entire batch. The selection of these analytical parameters to properly represent sewage/black water contamination was based on research done for previous studies related to sewage contamination of contents. These particular bacterial contaminants are used by multiple laboratories, and even government agencies, as surrogates for identifying sewage contamination in water and porous materials.

5.4 Atomic Degreaser was foamed on the contaminated surfaces. The surfaces were then wiped with disposable towels. The cleaned surfaces were then foamed with Decon 30. Samples were collected from the cleaned areas using both sampling methods.

5.4.1 Foam application was selected because it clearly shows where the chemicals have been applied. It is important for the workers who conduct such projects to be able to ensure that they have complete coverage of the impacted surfaces. Using foam for this test process also enabled individuals reviewing the study to view the concentration of product that was applied.

5.4.2 In addition to the foam application increasing the visibility of Decon 30 on surfaces, some industry literature indicates that the foam process itself might improve the effectiveness of an antimicrobial. However, it has been concluded from past studies, namely “Benefect Decon 30 Study, 2013”, that traditional spray application produces equivalent results.

5.5 The ATP sampling data was recorded on a sample collection form.

5.6 The sponge samples were placed into a cooler with a chain of custody form and an ice pack and were then delivered to Summit Laboratory.

5.7 Photos taken during the process were downloaded to the project file.

5.8 All surfaces of the work area and the previously contaminated test surfaces were foamed with Decon 30 and allowed to air dry.

5.9 On June 4 data from the analysis of the bacteria swab samples was received from Summit Laboratory.

6.0 Data Presentation Format

The results of all testing are presented in the appendices. The Summary of Results (Appendix 10.2) includes ATP readings and lab results from samples collected using sponges prior to cleaning and after cleaning with Atomic Degreaser and Decon 30. Therefore, the summary table compares the pre- and post-cleaning results that could be expected if the user follows the manufacturer's instructions.

7.0 Results

A number of clear trends were revealed by a simple review of the test results. Overall, a near total reduction in biological contamination was observed after cleaning with Atomic Degreaser and application of Decon 30. Some specific notable outcomes include:

7.1 Complete reductions in contamination levels as measured with the ATP meter and swabs. ATP levels were reduced to zero on the four wood surfaces and the two concrete surfaces cleaned with Atomic Degreaser and sprayed with Decon 30. These reductions were observed regardless of whether the surface was vertical or horizontal.

7.1.1 ATP readings on the vertical wood stud surface and horizontal wood stud surface were 1,038 and 1,203 RLU, respectively, before cleaning. After cleaning, the ATP readings were zero—a 100% decrease.

7.1.2 ATP readings on the vertical OSB sheathing surface and horizontal wood sill plate surface were 980 and 1,137 RLU, respectively, before cleaning. After cleaning, the ATP readings were zero—a 100% decrease.

7.1.3 ATP readings on the horizontal concrete surface and the vertical concrete surface were 1,309 and 876 RLU, respectively, before cleaning. After cleaning, the ATP readings were zero—a 100% decrease.

7.2 Total coliform levels were reduced by greater than 99.99%—a minimum 4-log reduction of microbial contaminants.

7.3 *E. coli* levels were reduced below the laboratory's ability to measure the bacteria.

7.4 *Enterococcus* levels were reduced below the laboratory's ability to measure the bacteria.

7.5 Laboratory tests confirmed the elimination of specific marker organisms contaminating raw sewage: total coliforms, *E. coli*, and *Enterococcus*. Although the specific marker bacteria were cultured to gauge the cleaning efficiency of Atomic Degreaser and Decon 30, it is critical to keep in mind that raw sewage contains a plethora of microorganisms, including bacterial, viral, and even fungal materials. The ATP test, which is not bacteria specific, verified extensive removal of microorganisms.

7.6 For specific sample information refer to Appendices 10.2 and 10.3, Summary of Laboratory Results and Summit Laboratory Data.

8.0 Conclusions

8.1 The use of Benefect Atomic Degreaser and Decon 30 on a variety of standard building products (including unfinished wood studs, OSB, and concrete) is effective in substantially reducing bacterial contamination as demonstrated by a >99.99% to 100% reduction of sewage indicator microbes on tested surfaces.

8.1.1 These results were achieved with an application of Atomic Degreaser as a spray foam and wiping with disposable towels, followed by an application of Decon 30 as a spray foam without any additional cleaning steps.

8.1.2 Standard cleaning procedures that are often used when dealing with areas of known bacterial contamination (such as vacuuming, drying, agitation with brushes, wiping, etc.) may affect final results or intermediate readings.

8.1.2.1 Generally, it would be expected that any activities that supplement the chemical action of Atomic Degreaser and Decon 30 could improve the already positive results.

8.2 Benefect Atomic Degreaser and Decon 30 were applied as a foam.

8.2.1 None of the individuals involved in the testing noted any adverse reaction to the chemical throughout its use and handling.

8.2.2 VOCs seemed negligible, skin reaction minimal, and leave-behind ghosting or film on treated surfaces were not significant.

8.3 There is a strong correlation between the laboratory results and the ATP sample numbers when the pre-clean and post-clean numbers are compared.

8.4 The study provided solid data to answer the questions that framed the study design.

8.4.1 How do the chemicals perform when cleaning sewage from unfinished wood-framed assemblies?

8.4.1.1 Visual and sample results showed that the product was very effective in eliminating bacterial contamination from wood-framed assemblies.

8.4.1.2 The high level of bacteria reduction with minimal cleaning effort should give restoration contractors confidence that they can deal with black water flooding of wooden sill plates and structural components in an efficient manner.

8.4.2 How do the chemicals perform when cleaning sewage from concrete surfaces?

8.4.2.1 Restoration contractors often consider concrete to be difficult to sanitize after a black water loss because of the texture and porosity of the surface. The combination of the two Benefect products showed that near total elimination of bacteria can be achieved with simple cleaning and disinfecting steps.

8.4.3 How do the chemicals perform based on the orientation of the surfaces (vertical or horizontal)?

8.4.3.1 Test results showed that the effectiveness of the Benefect products was equal, regardless of the orientation of the material being cleaned.

9.0 Recommendations

Although the design of the test of the effectiveness of Benefect Atomic Degreaser and Decon 30 on porous materials that are typically impacted as part of black water losses was detailed and comprehensive, no single testing process can answer all the questions related to a product or

process. However, the results of this test show that a botanical cleaning and sanitizing process can be effective in addressing black water losses.

9.1 The fact that Atomic Degreaser and Decon 30 was shown to be effective in reducing black-water style contamination on porous building materials (oriented both horizontally and vertically) should be shared with the restoration industry.

9.1.1 Even though EPA registration of disinfectants is for hard, non-porous surfaces, many antimicrobial products are applied to porous building materials by restoration professionals as part of the remediation process.

9.1.2 Industry guidance documents, such as the Standard and Reference Guide for Professional Water restoration (IICRC S500), recommend the application of antimicrobials as part of the restoration process for category 2 or category 3 water losses.

9.1.3 This study offers evidence that Atomic Degreaser and Decon 30 can be effective when used as part of a water loss response, even if the material being treated is porous.

9.2 Utilization of field test devices such as ATP meters can be recommended with some reliance for evaluating the effectiveness of Benefect Atomic Degreaser and Decon 30 on water-damaged building materials as long as proper precautions are provided to users.

9.2.1 Individuals choosing to use an ATP meter to help determine the effectiveness of decontamination after water loss should be warned that the results may show an increase in relative light units as the cleaning process is underway due to the release of contaminants from inside the porous structural materials.

9.2.2 Instruction should be provided that pre-cleaning sample results should be compared to post-cleaning conditions for the most accurate understanding of the decontamination process.

9.3 As noted previously, all of the tested materials absorb water when wetted. As such, by definition they are considered to be porous materials. Nevertheless, in the restoration industry dimensional lumber and concrete are often characterized as semi-porous, while OSB is typically treated as porous material. It is important to emphasize that Benefect Atomic Degreaser and Decon 30 performed similarly on OSB as compared to dimensional lumber and concrete. Such positive results mean that some OSB impacted by black water could be saved during remediation.

10.0 Appendices

As discussed above, appendices that supply significantly more detail are included with this report. A photograph log, a summarized table of sample results, and the analytical data from analysis of the bacterial sponges are attached as Appendices 10.1 through 10.3.

11.0 Certifications

Michael Pinto provided oversight and generated the report for this study. Mr. Pinto's post-graduate training is in Public Administration and Environmental Engineering, and, in addition to his scholastic achievements, he holds the titles of Certified Safety Professional and Certified Mold Professional. He is a member of the American Society of Safety Engineers, Restoration Industry Association, American Industrial Hygiene Association, Indoor Air Quality Association, and the Cleaning Industry Research Institute. Mr. Pinto is the author of over 220 published technical articles and has successfully conducted industrial hygiene/indoor air quality investigations since 1988.

Dave Batts assisted with the implementation and documentation of this study. Dave is a certified Mold Remediation Supervisor and also holds other certifications related to indoor air quality investigations and abatement. Dave has been involved in the building construction and inspection industry since 1971.

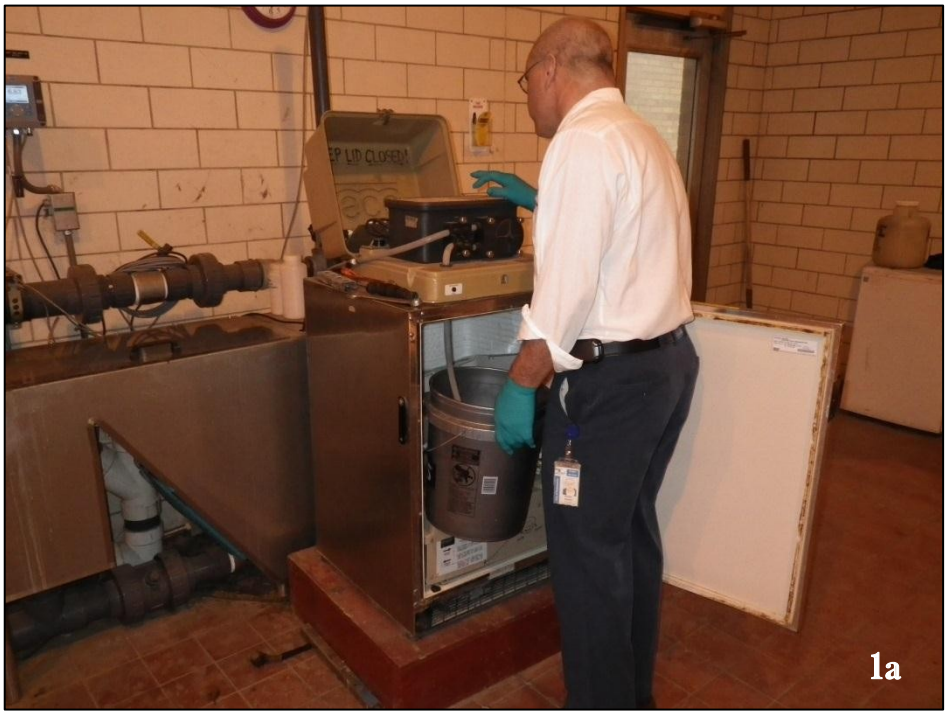
Michael A. Pinto, CSP, CMP
CEO

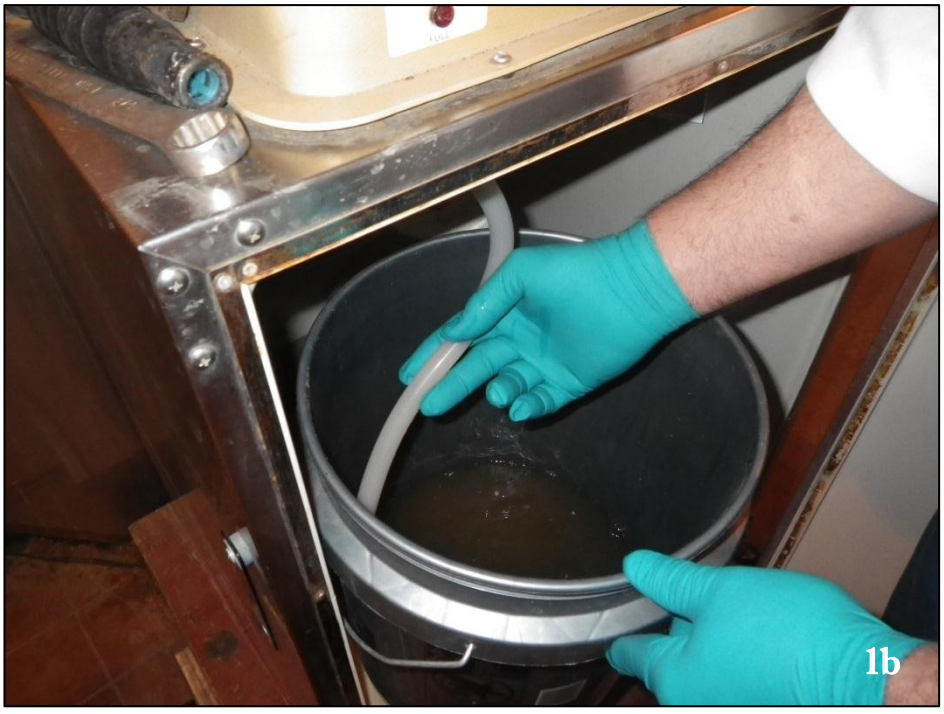
David Batts
Director of Environmental Services

Wonder Makers Environmental

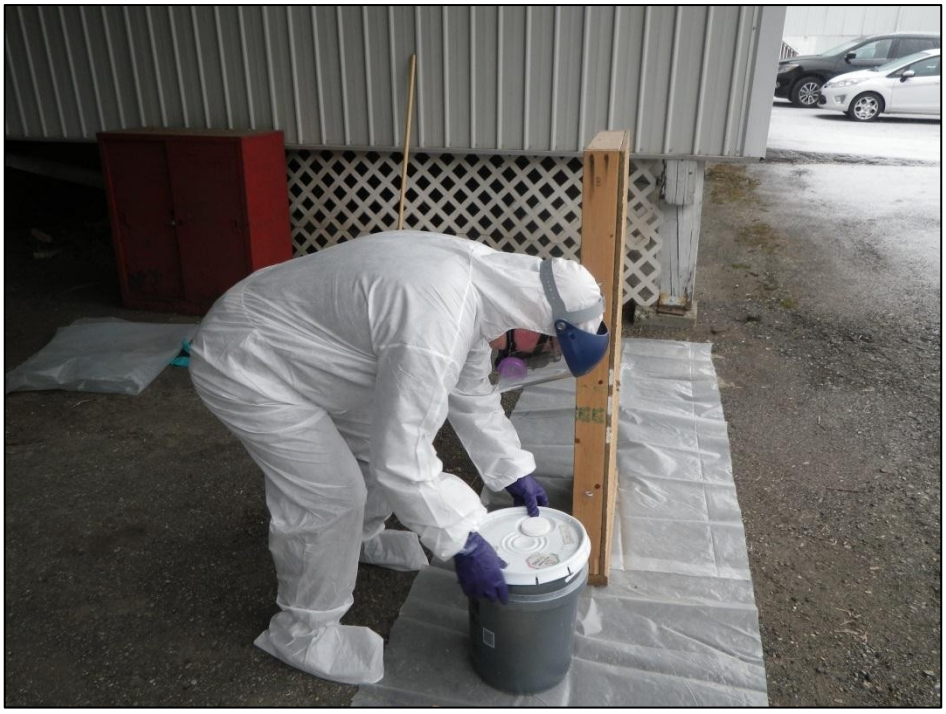
Appendix 10.1 — PHOTOGRAPH LOG

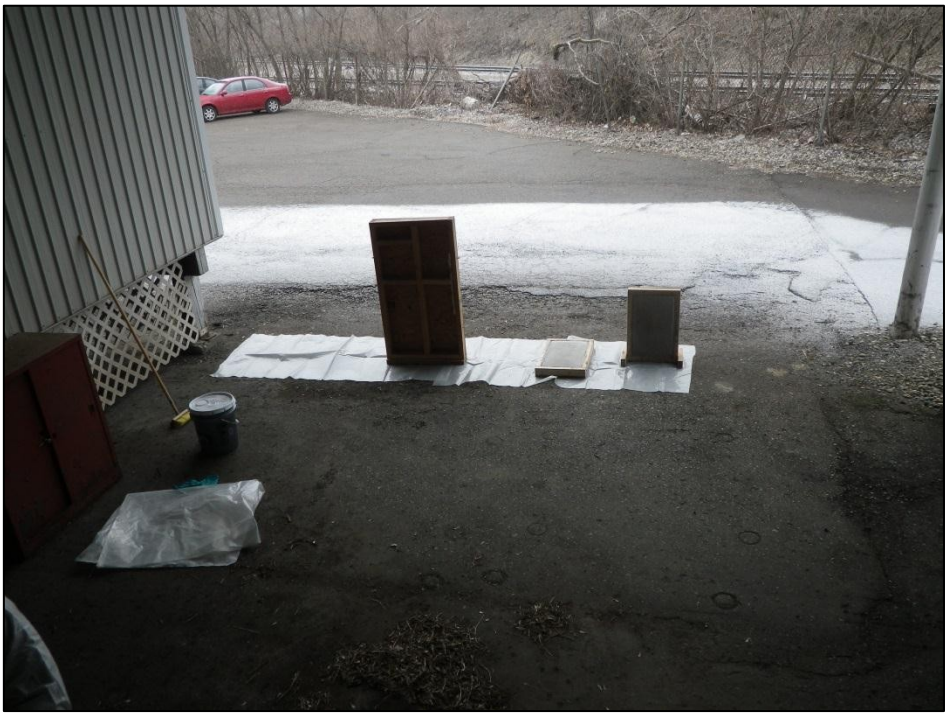
PROJECT:	GC15-13183	**DATE:**	5/28/2015
PROJECT NAME:	Benefect Real-World Remediation Study	**SPECIALIST:**	D. Batts





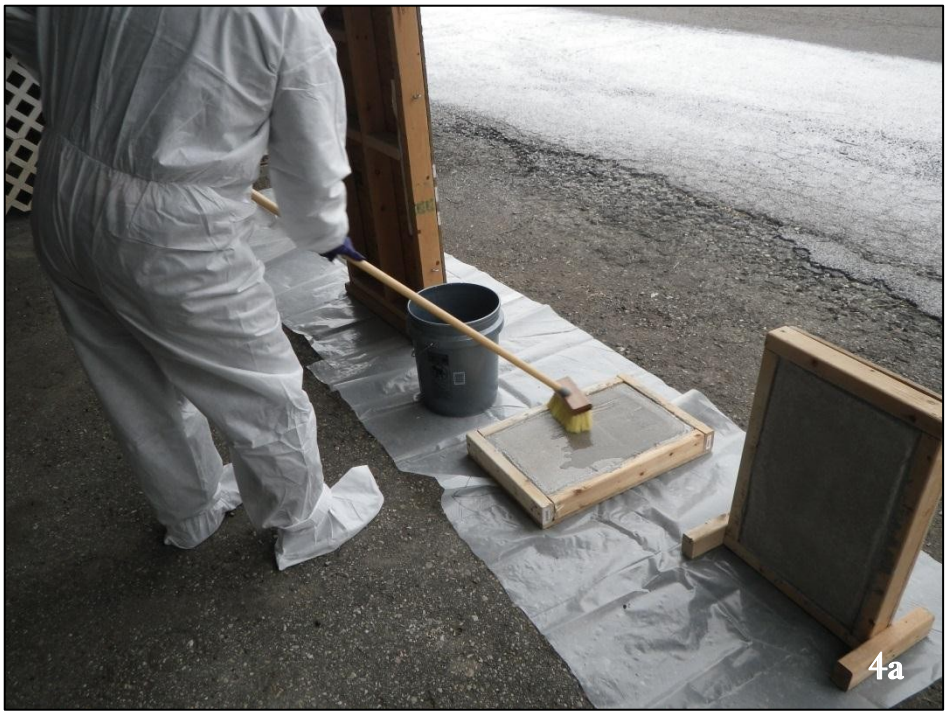
1. Untreated raw sewage in a 5-gallon bucket was retrieved from the Kalamazoo Water Reclamation Plant and used in the evaluation of the effectiveness of Benefect Atomic Degreaser and Decon 30 botanical cleaning and disinfection solutions.

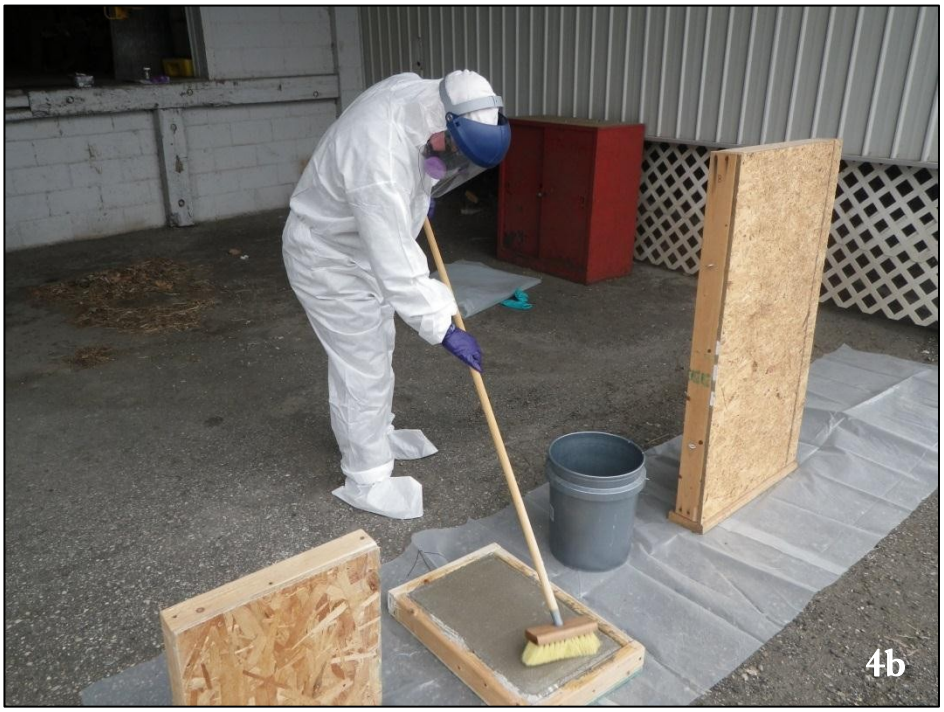




2. The bucket of sewage was transported to the Wonder Makers Environmental facility where it was used to contaminate various simulated building surfaces.

3. A simulated wooden wall assembly, concrete floor, and concrete wall were contaminated with the untreated sewage in an out-of-doors parking area at the Wonder Makers Environmental facility.





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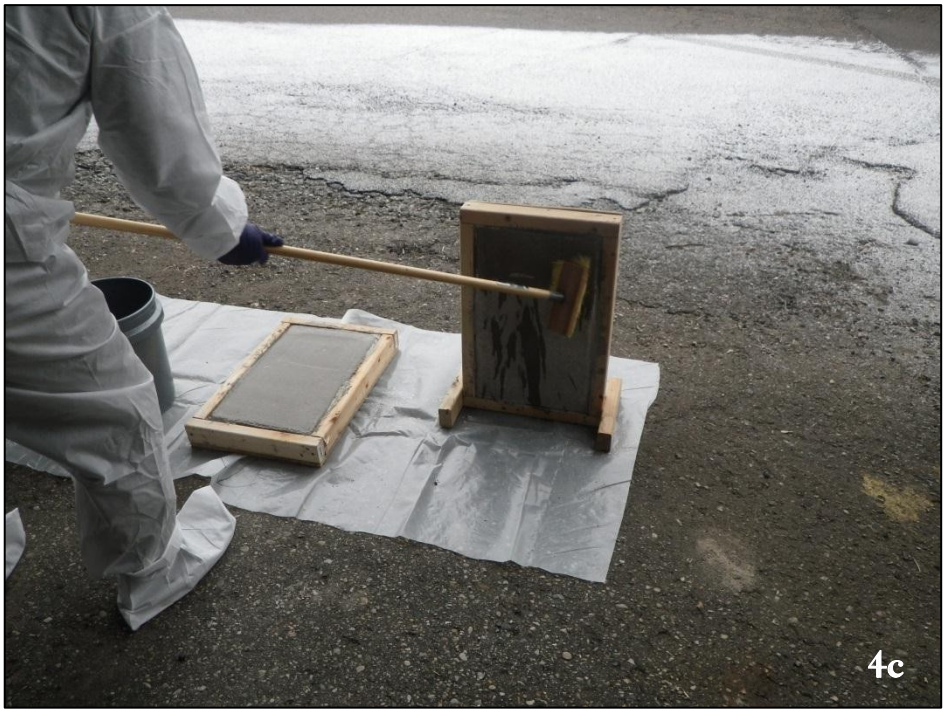
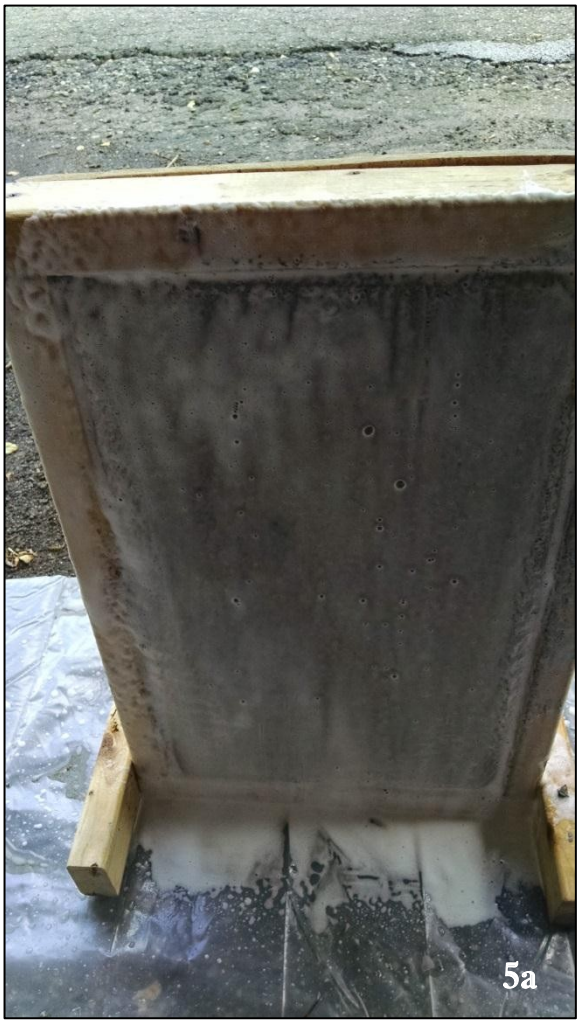
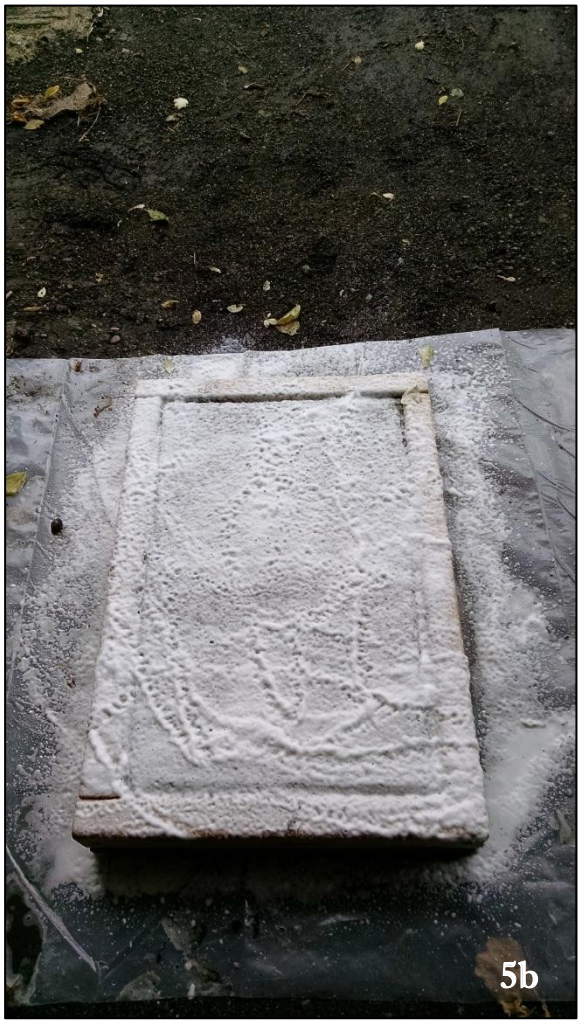


4. Simulated vertical wood stud surfaces, horizontal wood stud surfaces, horizontal wood sill plate surfaces, vertical OSB sheathing surfaces, horizontal concrete surfaces, and vertical concrete surfaces were contaminated with raw sewage. Sponge samples were collected from the contaminated surfaces.





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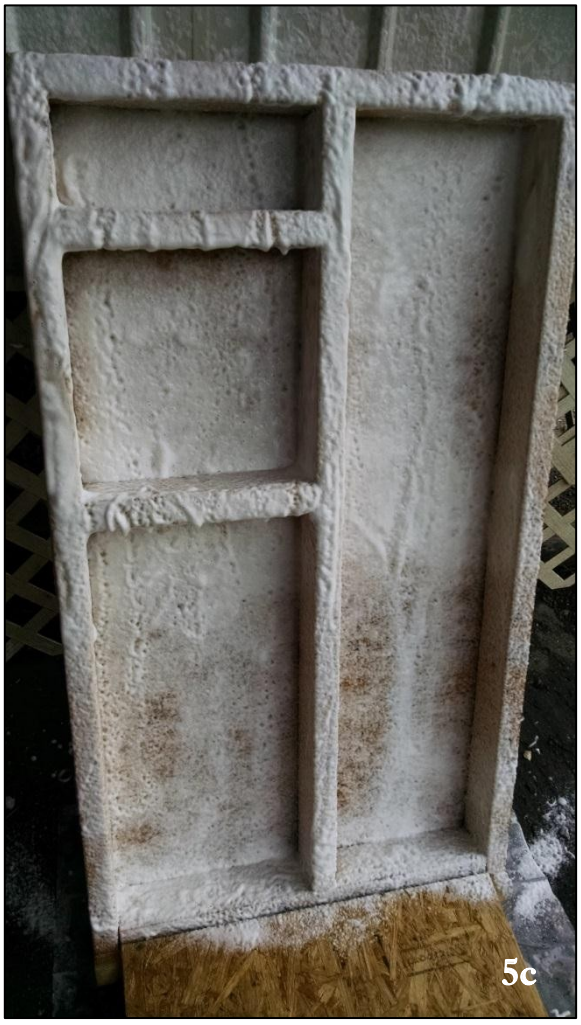
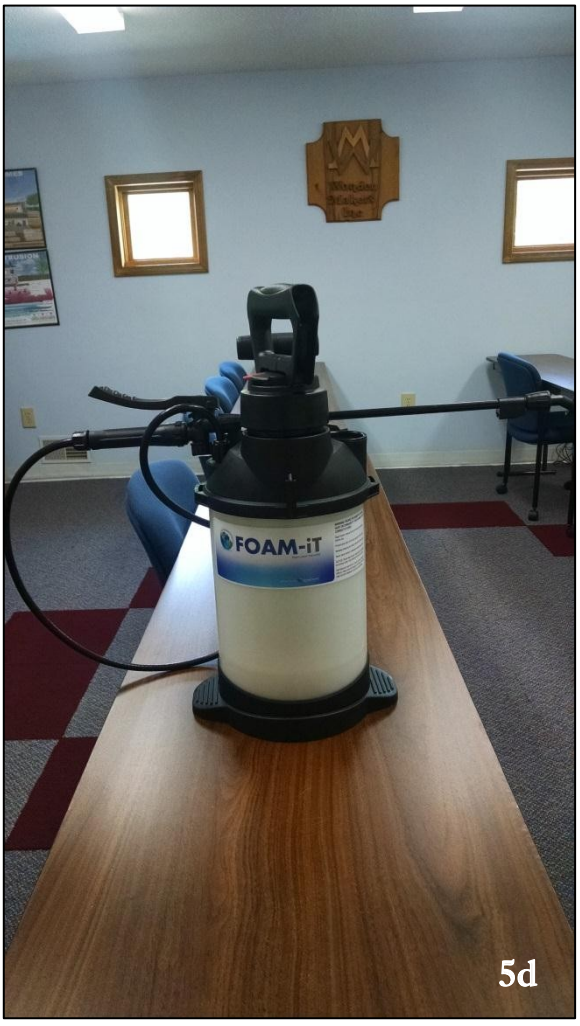
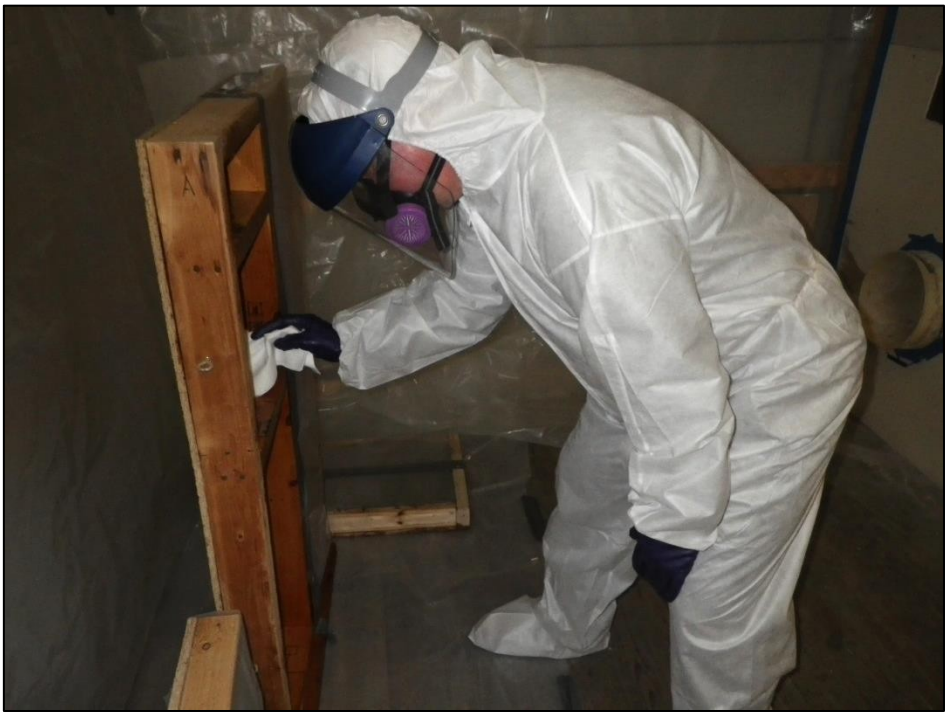




5. Following sponge sampling, the contaminated surfaces were sprayed with a diluted mixture of Atomic Degreaser using a FOAM-iT sprayer.



6. Following application of Atomic Degreaser, the surfaces were cleaned with disposable towels. Then Decon 30 was sprayed on the surfaces using the FOAM-iT sprayer.

Appendix 10.2 — SUMMARY OF SAMPLE RESULTS — Pre- and Post-Cleaning

Benefect Real-World Remediation Study

VERTICAL WOOD STUD SURFACE						
Sampling Scenario	**Adenosine triphosphate (ATP)**		**Bacterial swab samples**			
	Sample #	Reading	Sample #	Total Coliform [1]	*E. coli* [1]	*Enterococcus* [2]
Soiled with raw sewage (pre-cleaning)	14	**1,038**	01	**331,400**	**92,100**	**27,400**
After cleaning with Atomic and Decon 30	20	**0**	08	**<1**	**<1**	**<1**
Percent reduction		**100**		**>99.999**	**>99.999**	**>99.997**

HORIZONTAL WOOD STUD SURFACE						
Sampling Scenario	**Adenosine triphosphate (ATP)**		**Bacterial swab samples**			
	Sample #	Reading	Sample #	Total Coliform [1]	*E. coli* [1]	*Enterococcus* [2]
Soiled with raw sewage (pre-cleaning)	15	**1,203**	02	**647,400**	**242,000**	**98,000**
After cleaning with Atomic and Decon 30	21	**0**	09	**1**	**<1**	**<1**
Percent reduction		**100**		**99.9999**	**>99.999**	**>99.999**

HORIZONTAL WOOD SILL PLATE						
Sampling Scenario	**Adenosine triphosphate (ATP)**		**Bacterial swab samples**			
	Sample #	Reading	Sample #	Total Coliform [1]	*E. coli* [1]	*Enterococcus* [2]
Soiled with raw sewage (pre-cleaning)	16	**980**	03	**316,000**	**141,400**	**13,000**
After cleaning with Atomic and Decon 30	22	**0**	10	**<1**	**<1**	**<1**
Percent reduction		**100**		**>99.999**	**>99.999**	**>99.997**

VERTICAL OSB SHEATHING						
Sampling Scenario	**Adenosine triphosphate (ATP)**		**Bacterial swab samples**			
	Sample #	Reading	Sample #	Total Coliform [1]	*E. coli* [1]	*Enterococcus* [2]
Soiled with raw sewage (pre-cleaning)	17	**1,309**	04	**81,400**	**37,200**	**25,700**
After cleaning with Atomic and Decon 30	23	**0**	11	**<1**	**<1**	**<1**
Percent reduction		**100**		**>99.999**	**>99.998**	**>99.997**

HORIZONTAL CONCRETE SURFACE						
Sampling Scenario	**Adenosine triphosphate (ATP)**		**Bacterial swab samples**			
	Sample #	Reading	Sample #	Total Coliform [1]	*E. coli* [1]	*Enterococcus* [2]
Soiled with raw sewage (pre-cleaning)	18	**876**	05	**133,800**	**43,600**	**33,500**
After cleaning with Atomic and Decon 30	24	**0**	12	**2**	**<1**	**<1**
Percent reduction		**100**		**99.999**	**>99.998**	**>99.997**

VERTICAL CONCRETE SURFACE						
Sampling Scenario	**Adenosine triphosphate (ATP)**		**Bacterial swab samples**			
	Sample #	Reading	Sample #	Total Coliform [1]	*E. coli* [1]	*Enterococcus* [2]
Soiled with raw sewage (pre-cleaning)	19	**783**	06	**64,300**	**20,500**	**24,200**
After cleaning with Atomic and Decon 30	25	**0**	13	**<1**	**<1**	**<1**
Percent reduction		**100**		**>99.998**	**>99.996**	**>99.996**

1. cfu/mL of swab solution 2. MPN/100mL of swab solution

Appendix 10.3 — LABORATORY SAMPLE RESULTS

SUMMIT LABORATORY, LLC

900 Godfrey Avenue SW
Grand Rapids, MI 49503

Ph 616-245-3818
1-800-213-9589
Fax 616-245-3884

Client: Wonder Makers Environmental, Inc.
PO Box 50209
Kalamazoo, MI 49005-0209

Report Date: June 4, 2015

Report Prepared by: Ashley Fortier

Contact: Mr. Dave Batts

Summit Laboratory Job #: 1505443

Samples Collected: 05/27/15 by client
Samples Received: 05/27/15 @ 3:15PM
Analyses Started: 05/27/15 @ 6:00PM
Analyses Completed: 06/02/15

Analysis Requested: Quantification of *Enterococcus* (US EPA Method 1600)
Quantification of *Escherichia coli* and Total Coliform Bacteria (SM9223B)

Following are the analytical results for the "**Environmental Swab**" samples submitted:

Sample ID #		**Total coliform results:** (MPN/mL of swab solution)	***Escherichia coli* results:** (MPN/mL of swab solution)	***Enterococcus* results:** (MPN/mL of swab solution)
		Samples processed at 1:100 dilution		
GC15-13183-01	=	331,400	92,100	27,400
GC15-13183-02	=	647,400	242,000	98,000
GC15-13183-03	=	316,000	141,400	13,000
GC15-13183-04	=	81,400	37,200	25,700
GC15-13183-05	=	133,800	43,600	33,500
GC15-13183-06	=	64,300	20,500	24,200
		Samples processed at 1:1 dilution		
GC15-13183-07	=	<1	<1	<1
GC15-13183-08	=	<1	<1	<1
GC15-13183-09	=	1	<1	<1
GC15-13183-10	=	<1	<1	<1
GC15-13183-11	=	<1	<1	<1
GC15-13183-12	=	2	<1	<1
GC15-13183-13	=	<1	<1	<1

Analyses are in accordance with the Manual of Environmental Microbiology, 2nd Edition, 2002 and/or current AOAC methodologies. Results reported are provided "as is" and relate only to samples tested.

Report approved by:

Joel Steenstra
Laboratory Analyst