WORTHINGTON
BASEMENT HEALTH SYSTEMS
Waterproofing | Air Quality | Structural | Egress

Basement Health 101

A free E-Book to help you better understand how water is affecting your home and your family's health.

www.worthingtonbhs.com

Hello,

My name is Sean Worthington. My family has been waterproofing basements in the Delaware Valley for over 60 years and 3 generations. We have seen many companies, techniques, and fads come and go over the years and we understand how difficult it can be to know what the right answers are. I have put together this e-book as a first step for you to better understand what is happening to your home so that you can make better decisions about how to fix it, and who to choose as a contractor. I firmly believe that an educated customer is our best customer. Please take a few minutes to read through this e-book completely so that you can arm yourself with the knowledge you need to make the best decisions for your family. If you have any questions after reading this book, please contact us to set up an appointment for a free assessment of your basement or crawlspace. We look forward to hearing from you.

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A+ rating

This book is intended for two different audiences. The first group is people who already know they have a water problem because they see water on the basement floor after a rainstorm. The second group is people who don't see water on the floor but are still concerned about the overall health of their home. Both groups should read the entire e-book in order to understand the big picture. You can't understand the entire problem with only half the facts.

We'll start out by talking about water in its vapor form – what we typically call 'moisture'. In order to understand moisture, we need to first understand a principle called the 'Stack Effect'. Anytime a structure is placed into the ground, it naturally creates the 'Stack Effect'. This is not a defect or design flaw – it is just the laws of physics at work. The basic principle is this: Hot air rises. Air in the upper floors is typically hotter than air at the foundation level. The air in the upper floors eventually escapes through the roof. When that happens, it creates a draw through the entire house – including the basement. In fact, **50% of the air you breathe on the first floor came from the basement or crawlspace**. (and all the stuff in the air down there came up as well) As the air from the basement moves up into the house, replacement air must enter the basement – otherwise there would be a vacuum. That air gets pulled through the basement walls and floor. Soil is very porous and contains a surprising amount of air. As the air gets sucked out of the damp soil around your foundation, it picks up moisture and brings it into the house (see the "Where Did My Water Come From" section to understand why the soil around your foundation is always damp). An average sized house brings in **15-20 GALLONS of water vapor** due to the Stack Effect every day! If you have a stone foundation, or a dirt floor crawlspace, then it is likely even more than that! In addition to the water vapor that enters the house through the stack effect, human beings also generate moisture just by living our normal everyday lives inside a home. Cooking, laundry, showering, sweating, and just living add on average another **22 pints of moisture** into the air every day.

So now that we understand where all this moisture in the air is coming from, we have to ask ourselves – 'Why do we care?'.

To answer that question, we turn to 4 authoritative sources:

- **The EPA (Environmental Protection Agency)**
- **The National Institutes of Health**
- **The Centers for Disease Control**
- **The American Lung Association**

You might be thinking 'hold on – these agencies have nothing to do with construction, home building, foundations drainage, or anything even remotely related.' That is true. All of these agencies are focused on protecting the inhabitants inside the home, rather than the home itself. All four agencies recommend maintaining a Relative Humidity (RH) between 30-50% in the home (click on the links above to see their respective statements on moisture in the home). The reason for this is that when the RH gets above 50%, bad things start to happen. Mold can grow, insect activity increases – which also can also increase bacterial and viral traffic, structural members start to rot – in short – nothing good happens when you cross the 50% RH threshold. Sometimes people see the results of this negative activity in their daily lives. Asthma is often triggered by toxins in the basement (**click here** to read an Abstract from the National Institutes of Health stating that 21% of Asthma cases are caused by excess moisture and mold in the home). Excess snoring can be triggered by dust mites, which can thrive when the RH is above 60%. Fevers and low threshold headaches can be triggered by mold, as well as sneezing, coughing, and runny nose. High RH can attract cockroaches and other insects which can spread bacteria around the house and lead to infections. So excess moisture can cause real life problems for you and your family – and without taking active steps to manage the underlying causes, you are at risk of elevated RH.

Did You Know?

Just by our daily activities, we create **22 pints** of additional moisture every day!

Did You Know?

An average sized house brings in **15-20 GALLONS** of water vapor every day due to the stack effect.

So now the natural question is: "What can I do to protect my family from elevated RH?"

There are several layers of protection available to you.

Step one is to 'drain the bowl'. When you get into the 'where did my water come from' section of this e-book, you will learn about how your house sits in a clay bowl that fills with water on a regular basis. That excess water is the starting point of all this moisture. So, until we get as much water out of the bowl as possible, any other steps to mitigate elevated RH will have limited effect. Read below to learn more about how we 'drain the bowl'. For now, just understand that it is the first step in a multi-layered approach to protecting your home.

After we have drained the bowl, there are 3 other layers of protection available.

- **Wall Encapsulation**
- **Dehumidification**
- **Ventilation**

Wall Encapsulation

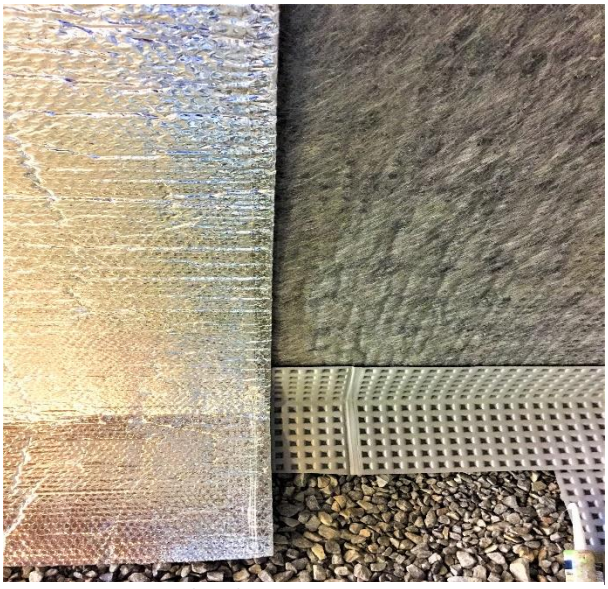
There are several different types of wall encapsulation available – but only one that makes sense.

Chemical Encapsulation is when a contractor seals the inside of the wall with a waterproof paint or sealant of some sort (DryLok is the most commonly known brand). This prevents moisture from passing through to the living space, but it also traps the moisture in the wall which can cause a long-term structural problem. Especially in block foundations – moisture in the wall will eventually deteriorate the wall's components and cause an eventual failure. We do not ever recommend using Chemical Encapsulation.

Chemical Encapsulation (DryLok)

Basic Mechanical Encapsulation is when a contractor will put plastic sheeting or HDPE (High Density Poly Ethylene) directly on the walls. As long as they seal it at the top and terminate it properly, this will also prevent moisture from entering into the living space – BUT it also traps the moisture against the wall. Not only will this cause a long-term structural problem, but it also creates what I call the 'shower curtain effect'. Have you ever noticed your plastic shower curtain fold on itself and stick together when it gets wet? And if you don't unfold it – mold will start to grow in between. Well, the same thing can happen when wet plastic sticks to a wet wall. Many contractors have taken down HDPE sheeting on walls only to discover it covered with mold. We do not ever recommend using Basic Mechanical Encapsulation.

Breathable Wall Encapsulation is when we install a layer of RainScreen (which is a small drainage plane that allows water and moisture to pass through) on the wall first. Then we install specially designed Insulated HDPE sheeting over the drainage plane. We then seal it at the top and lead it into our drain at the bottom. This allows moisture to pass through the wall (allows the wall to breathe), then lets it condensate on the HDPE and run down into our drain so it does not enter the living space. And since we use Insulated HDPE, it also adds an R5 insulation factor to your basement walls which increases the energy efficiency of your home. This is the only type of encapsulation that we recommend.



Insulated HDPE over Rainscreen

Dehumidifiers

Everybody understands the concept of a dehumidifier. But there is a big difference between the type you buy off the shelf at a big box store vs a commercial grade unit like we recommend. The biggest difference is the size and spacing of the coils. Small coils too close together leads to freezing. When the coils freeze, the unit has to go through a defrost cycle before it starts working again. This means no moisture is being removed from the air during that time. Commercial grade units like the ones we offer are larger, have larger coils spaced further apart, and will actually achieve their pint/day rating. We offer AprilAire commercial grade dehumidifiers.

Did You Know?

The air in your home is **5X more polluted** than the air outside.

Ventilation

Ventilation is the layer of protection that is most often overlooked. A good whole home ventilation system, such as an EZ-Breathe System, can help reduce the stack effect by drawing air back down into the basement and pumping it out of the house (like a dryer vent). This causes makeup air to come through windows, doors, and cracks upstairs which brings in OUTDOOR ABOVE GRADE AIR. That is the cleanest and healthiest air available. That is what you want coming into your home. In addition to pumping out the moisture, a ventilation system also pumps out any other airborne pollutants such as pet dander, dust particles, VOC's (volatile organic compounds often found in building materials), and even Radon! So, while we introduce ventilation as a mechanism for reducing RH, we feel the other benefits are just as beneficial.

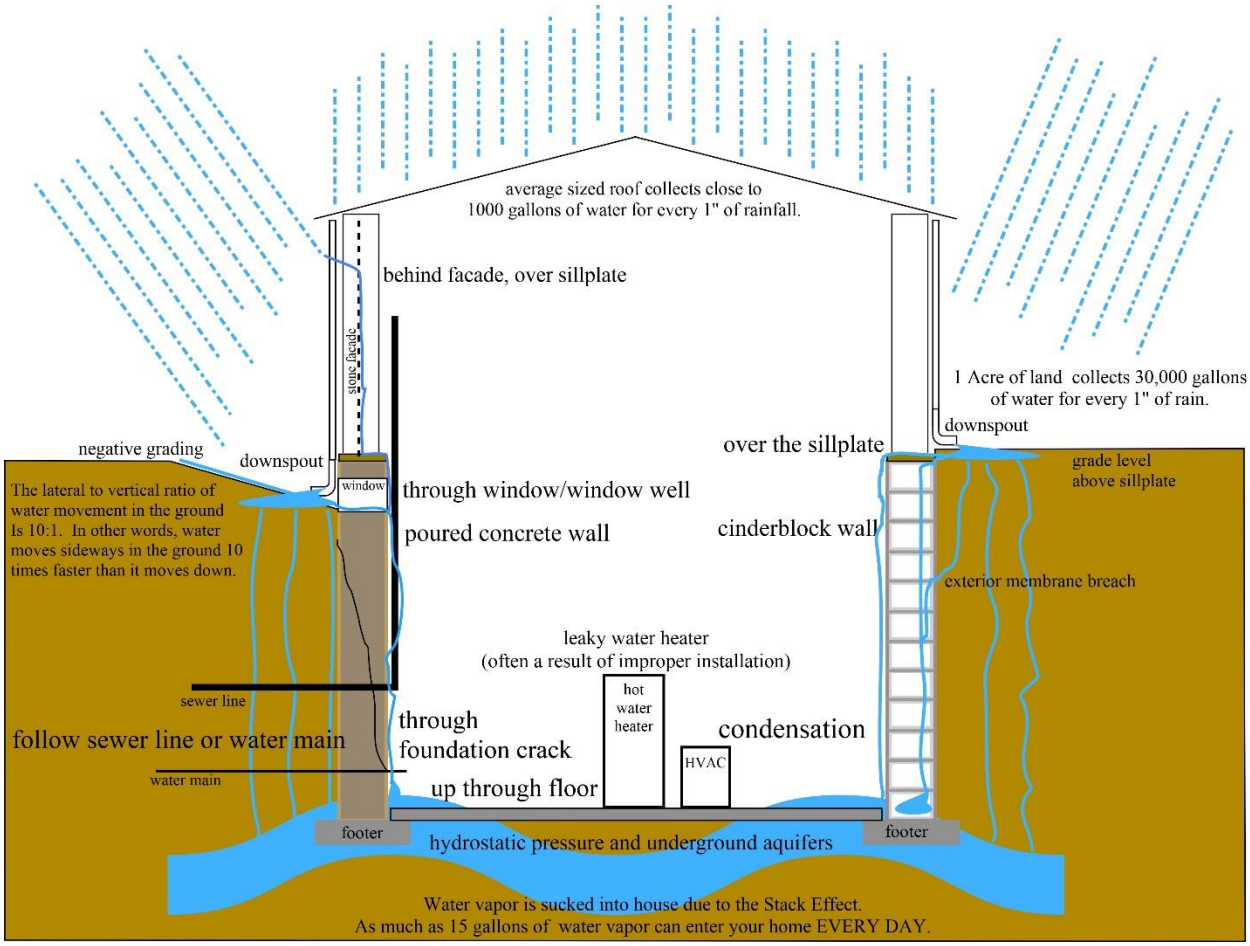
So now that we have introduced you to the various layers of moisture protection, let's jump into the details of how liquid water gets to your foundation and what you can do about it.

Did You Know?

50% of the air you breathe on the first floor came from the basement or crawlspace.

Discovering that you have a water problem in your home can be a very unnerving experience. Some people discover the problem because they notice an odd odor coming from the basement. Other people discover it because they wake up to a foot of water in their basement after a heavy rain. No matter how you discovered the problem, or how severe it is, understanding the basic concepts behind how it all may have started is the first step towards reclaiming your home from the elements. This short document aims to provide some basic education as to the possible sources, causes, and solutions to your water problem. This document will not be able to address every single scenario, and every single problem. To ensure you have your particular issue properly assessed, be sure to call an experienced, reputable, and licensed waterproofing professional to examine your property.

Where did my water come from?



There are many different possible sources that can cause a water or moisture problem in a home. Some of the most common ones are illustrated above.

Begin by looking at some of the most common, and easiest to determine and fix.

Did You Know?

A 2000 square foot house will collect

1250 gallons of water for every 1” of rain!

Non Waterproofing Issues:

Leaky pipes, plumbing issues, and condensation are common sources of water or moisture. These problems are typically not addressed by basement waterproofers. If you are a DIYer, you might be able to find and fix some of these problems yourself. But if not, be sure to call a qualified, professional plumber or HVAC specialist.

Possible DIY Issues:

Poor grading and a lack of downspout extensions are two other common sources that are easy to see, but not always so easy to correct. Grading, in particular, can be a difficult thing to solve on your own, depending on what your property is like. Grading should always be down and away from your house, BUT always be sure to keep grade level BELOW the sillplate. Failure to do this can cause unintended consequences that could

include termites, a rotted sillplate, and structural damage to your home. If you can't easily regrade while being sure to keep grade level below the sillplate, then call in a professional. Downspouts should be extended at least 10' from your foundation, and empty in a location that allows the water to flow away from your house. About $50 worth of PVC from your local hardware store should be sufficient to make that happen, depending on your property. But if your property is such that you don't see an easy and obvious way to accomplish that, then you might need to call in a pro. Burying downspout extensions to the street, feeding them into a storm drain, or emptying them into a drainage pit might be your only options. An experienced waterproofing contractor can help you identify your options.

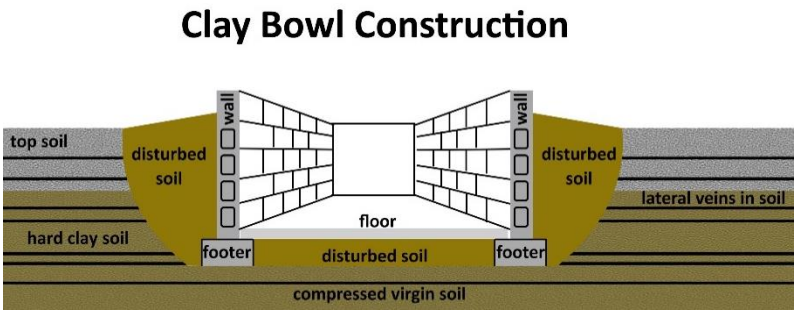
Non DIY Issues:

There are several problems that are definitely NOT good DIY projects. Between the amount of labor required, the product specifications, and the little details that make the difference between being effective and being a complete waste…these issues really require a professional waterproofing contractor.

Once water gets into a basement, once we have ruled out plumbing or HVAC issues as a possible cause, then we classify water into 2 main categories. Ground Water (also known as Hydro-Static Pressure), and Surface water. Each has different behaviors and characteristics and has a completely different set of solutions. So, it is crucial to determine what type of water you have, before applying any solution, because a solution for ground water will do nothing to stop a surface water problem. It is also important to realize that while rare, it is possible that you have both, which requires 2 separate solutions.

Ground Water (aka Hydro-Static Pressure):

When rain hits the ground, it reacts in three ways. Some of it runs along the surface (about 1/3), some of it evaporates (not much evaporation happens while it is still raining), and the rest of it percolates into the ground. As it sinks into the ground it passes through several soil horizons (layers). Horizon A is a relatively loose mix of sand, silt, and clay. There is also grass, dead leaves, rocks, organic material – all the stuff that makes up what you think of as typical 'dirt'. Water can pass through horizon A fairly easily. But the clay and rocks from horizon A eventually migrate downward and form Horizon B. This is a much denser layer and water cannot pass through this horizon as easily. In fact, at Horizon B, water starts to travel sideways 10x's faster than it travels downwards. Add to this the fact that



your foundation is surrounded by backfilled soil, which is much less dense than the soil just 10 feet away that was not disturbed during the construction of your home. Since water always seeks out the path of least resistance, and your basement basically sits in a giant hole in the ground (we call this the 'clay bowl'), water is naturally attracted to it. Remember – for every 1 acre of land over 28,000 gallons of water collects for every 1" of rain. When that water gets into the ground, it's looking for a place to go. If you are reading this, then your basement or crawlspace is likely one of the places the water found.

Surface Water:

Did You Know?

Every acre of land collects over 28,000 gallons of water for every 1" of rain!

Surface water is when the rain falls onto the ground, and instead of getting absorbed deep into the ground, the water runs along the surface (or just slightly below the surface) towards your foundation. An average sized roof will collect close to 1000 gallons of water for every 1" of rain. That water is then concentrated to your downspouts and is typically emptied onto the surface not far from your foundation. Additionally, for every 1" of rain, over 28,000 gallons of water falls on every 1 acre of land. Depending on the grading of the surrounding properties, soil conditions, and saturation levels – a lot of that water could be heading towards your foundation. Eventually surface water either percolates into the ground and becomes ground water, runs off into municipal drains or streams, or ends up in your basement.

Foundation Cracks:

Did You Know?

All soil is a combination of sand, silt, and clay. The proportion of these 3 is what determines what soil type you have.

Cracks in your foundation walls are another way water can enter your basement when the soil is wet. Although any type of foundation can develop a crack, when we talk about it in waterproofing terms, we are generally referring to poured concrete walls. Block walls can develop cracks of many sorts, but these are typically structural concerns, not water concerns. Stone foundations can easily develop cracks or breaches in the mortar, but these are typically handled in a different way than poured concrete walls. Cracks in poured concrete walls fall into one of 4 types. Lateral vs vertical, and full depth vs partial (depth refers to the depth from the inside to the outside of the wall, not depth within the earth). Lateral cracks are generally considered to be structural concerns. They are outside the scope of this ebook. If you see lateral cracks in your basement, it is worth calling an engineer to look at it, just to make sure there is no danger. An engineer typically charges $200-250/hour. For a few hundred dollars you can

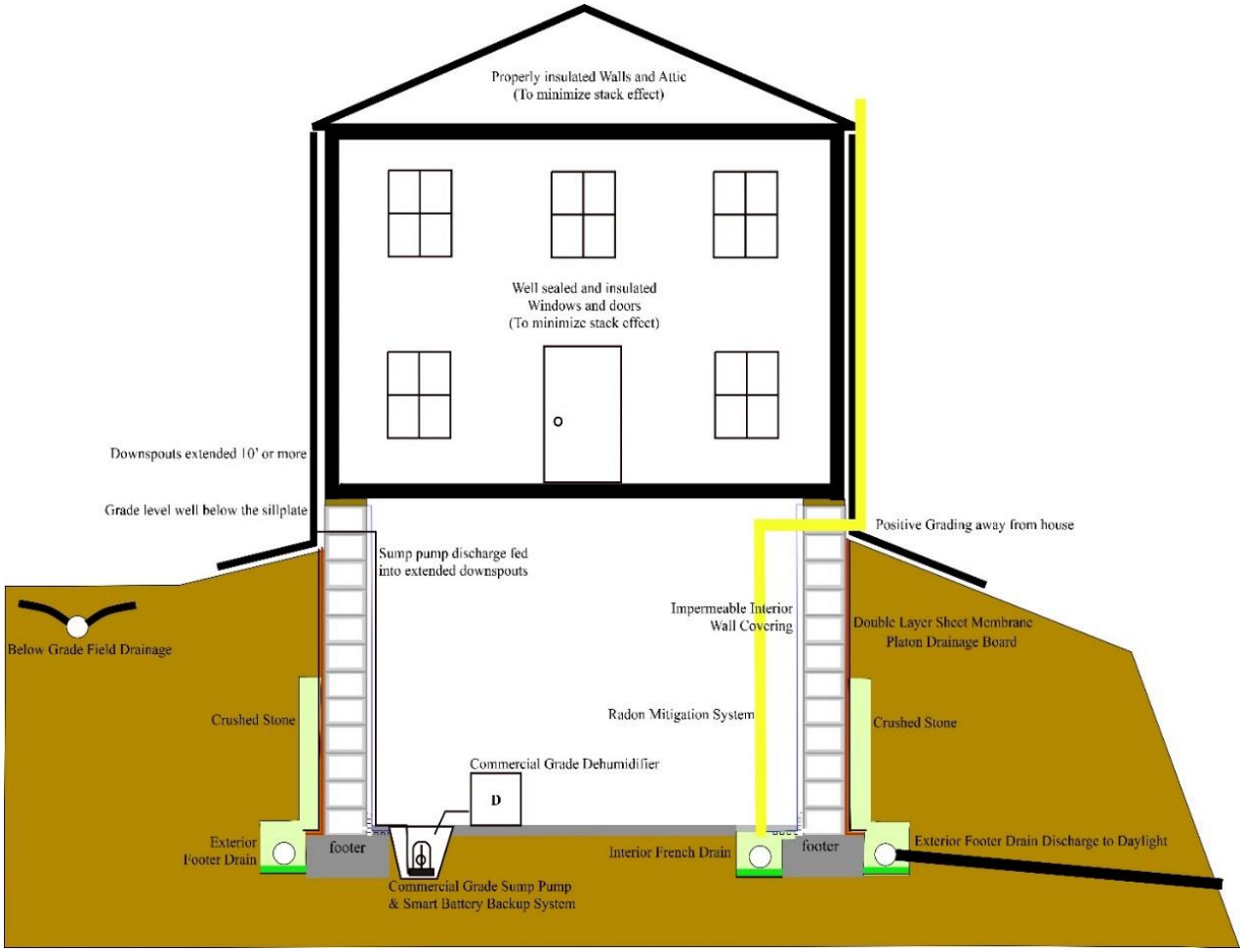
purchase some peace of mind. It is well worth it. Vertical cracks, however, are typically not a structural concern. Vertical cracks that are only partial depth are not water concerns – at least not yet. But vertical cracks that go full depth are in fact water concerns. You can usually tell when a vertical crack is leaking due to the staining from small amounts of mud or rust that follows the water in through the crack. Wet soil pushing against a vertical full depth crack is like pushing a wet sponge against your foundation wall. The pressure from the weight is going to push the water out, and once the water has found an opening, it will come right through. Sometimes water can come through cracks with enough pressure to look like a fountain. Water can also find its way in by following along a sewer line or water main. Although these openings are made on purpose, we treat them the same as a crack repair, and therefore classify them under the same category.

Over the Sillplate:

Improper grading and poor drainage can allow water to enter a basement by running over the sillplate and running down the basement walls. This can happen if the property was poorly planned to begin with, or if landscapers constantly put new mulch down every season so that it builds up over time. Either way, this can be a serious problem that can cause even more problems than just water on the floor. Termites, insects, and even structural damage can occur if left untreated for too long. Another common way for water to get over the sillplate is when it gets behind stucco or stone façade's higher up in the structure. It could come in through cracks, windows, doorways, or even from the roofline. In cases like this, there are often multiple problems that need to be addressed by multiple contractors. An experienced eye should be able to point this out as a possibility when the threat exists.

So now that you know how water and moisture are getting to the foundation and getting into your basement or crawlspace, let's take a look at some of the various techniques and tools available to you for solving these problems.

Possible Solutions:



The diagram above illustrates an ideal combination of waterproofing measures. Most houses fall short of this standard. Some because physics don't allow for it, others because the builders or homeowners weren't willing to make the necessary investment in their home's health. Compare this diagram to your own house. How many components are missing?

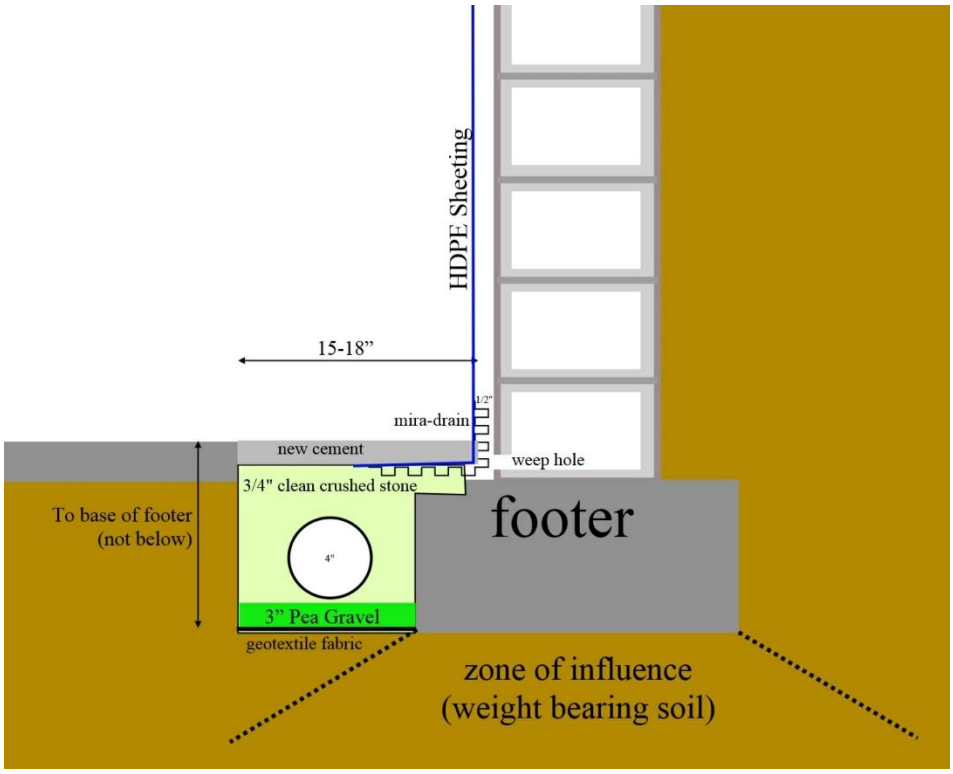
Outlined below are some of the possible solutions for some of the most common water sources. This is by no means an exhaustive and comprehensive list, but it does cover the most common fixes.

French Drains:

(I will spend a fair amount of time on this topic, since 75% of the time a professional waterproofer is called in, this is the first step that is required.)

Most often, the first step in protecting your home from water and moisture is to 'drain the bowl'. The method for this to install what is called a French Drain. The name comes from its inventor, Henry French, a New England lawyer in the 1800's who utilized ancient farm drainage techniques inside his basement in an attempt to improve the air quality in his house by removing the moisture in the

basement. For a thorough history of the development of the French Drain, read the book ***French Drain For Health*** by Stephen Andras (available on Amazon). A french drain is basically a trench dug underneath the basement floor, filled with perforated pipe and gravel that feeds either to a gravity drain, or a pit in which a sump pump is installed to pump the water out of the basement. While its basic concept is pretty simple and straight forward, the devil truly is in the details. That is why this is definitely NOT a DIY project. Some contractors will use the term 'outside French drain' to refer to yard drainage. This is technically not correct. Henry French's innovation is specifically putting a drain inside of a basement. Exterior Drainage Systems had existed for centuries before Henry French. Some important factors in an effective French drain include:



Width: 15-18". A narrow trench barely has any room for a pipe, let alone any gravel. The gravel is there to act as a filter to prevent clogging and is the primary conduit through which water travels to the pump. Crushed stone is 40% open space, which means the more stone you have, the more space for water to pass through. This is a key factor in the longevity of your system. Many waterproofing companies have trenches somewhere between 8-12" wide. Ours are typically between 15-18" wide. Digging a trench as deep and wide as ours typically means removing between 20-30,000 pounds of cement and dirt.

Depth: A French drain must NEVER go lower than the bottom of the footer, or the basement wall (in the case of stone foundations without a footer). Underneath the footer, or wall, is an area called the 'zone of influence'. This is the soil that bears all of the weight of the wall. The zone of influence is an area that spreads out at a 60-degree angle from the corner of the footer or wall. If your trench pushes into this area, you are

Did You Know?

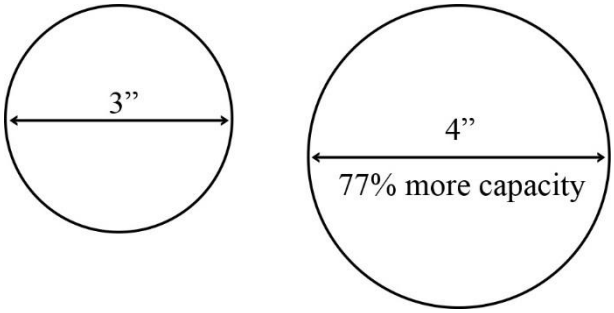
Henry French researched and developed the first French Drain in New England in the 1800's after his wife died from 'consumption', which Henry believed was due to excess moisture in their basement.

compromising the strength of the soil that is holding up the house! (If your waterproofing contractor doesn't mention this to you, then there is a good chance they are not very experienced, not educated on the topic, and certainly are not certified by the Basement Health Association.)

Filter: A good French drain system has multiple layers of filter. On the bottom might be a layer of geotextile fabric, although in highly sandy or silty soils, we will sometimes exclude that to prevent buildup and a dam effect. A combination of pea gravel and ¾" clean/modified crushed stone is the main filter system for an effective French drain. As long as the trench is deep and wide enough to allow for plenty of gravel, then your French drain should run clog free for the lifetime of the structure!! One thing that you do NOT want to use as a filter, is a perforated pvc pipe with a mesh 'sock' around it. Although this may seem like a good idea at first, the sock has such a fine screen that it captures even very small particles, which leads to a buildup, and ultimate dam effect. Allowing small amounts of sand/silt/soil to flow through the system is better than creating this situation. Any decent sump pump can pass solid material through it up to a ½" wide. So, pumping out a little bit of sand or silt is no problem.

Weep Holes: If your French drain is being installed in a cinderblock foundation, then you want to make sure to drill weepholes. Weepholes are drilled into every hollow chamber along the bottom course of blocks to allow any water built up in the wall to drain out into the trench. Since quite often the weepholes are drill fairly close to floor level, Mira-drain is a plastic waffle-board material used to keep the weepholes open, and to make sure water coming out of them funnels down into the drain and doesn't bubble up over onto the floor.

Pipe Size: Pipe size is a more important consideration than you might think initially. Most people would think that the difference between a 3" and a 4" pipe is only 1", or 25%. But the capacity of a pipe is equal to the square of its radius. The area of a 3" pipe is 22.18. The area of a 4" pipe is 39.44. That is a 77% increase!! That may not matter much during 'regular' rain, but when we get torrential 'storm of the century' type rain, which seems to happen more and more often, then pipe size could mean the difference between a dry basement, and a foot of water in your basement



Closing the system: For many years, standard operating procedure in the waterproofing industry was to leave a 'safety slot' when re-cementing over the trench. This slot allowed for any water traveling down the wall to get into the drain, rather than onto the floor. From a water standpoint, that makes perfect sense. But recent research along with the cooperation between the waterproofing and indoor air-quality industries has taught us

Click Here to see a short video of a French Drain Installation, or visit our website at www.worthingtonbhs.com

that leaving an open slot may allow water in, but is also allows water vapor, and worse – RADON to flow up from the slot and into the home. Some waterproofing companies have responded to that by installing only closed systems. That is, they won't drill weepholes, and they re-cement all the way up to the wall. That might help with radon, but it still leaves you with a less effective water solution. To account for that, and not sacrifice any protection against water, we have come up with our unique closed system approach. We drill weepholes (in block foundations), and we still leave a safety slot held open by mira-drain. But then we install thick HDPE sheeting from the sillplate (top of the basement wall), all the way down the wall, feed it OVER the mira-drain, and into our trench, and then recement over top of it. This creates an impermeable barrier that allows water to flow down the wall into the drain but does not allow water vapor or radon to escape into the home. We also install our systems to be 'Radon Ready'. This means a radon company can come in and install their system without cutting into the floor, which saves them time and can save you money. It is important to test your home for Radon, even if you never suspected a problem in the past. Radon can happen anywhere, and Pennsylvania is especially susceptible. Radon was first recognized as a health problem in the Reading area in the early 1980's. Radon is the leading cause of lung cancer in non-smokers, and overall Radon induced cancer kills more people every year than car accidents. Any Radon at all increases your chances of cancer, not just the 4ppm that is normally stated as the action level. So please take it seriously and have your home tested.

Iron Bacteria: There is a problem that occasionally affects French drains called Iron Bacteria, or sometimes Iron Ochre. Iron Bacteria can grow from the iron residue in the water. Once it starts to grow, it can multiply very quickly. At first glance, it can be confused with mud, but it isn't! Quite often the Iron Bacteria is accompanied by an unpleasant odor. This bacteria has been known to completely clog pumps and systems, rendering them useless. There are several chemicals available that can kill this bacteria, but when used in a French drain, those chemicals then end up on your lawn and eventually end up filtering down into the water supply. Currently, the only known SAFE method of killing this bacteria is to flush your system with very hot water. As of now, Iron Bacteria cannot be predicted, nor prevented, and is not covered in most waterproofing company's warranties.

Did You Know?

We are the only company **TRIPLE CERTIFIED** by the **Basement Health Association** in the entire country!
www.basementhealth.org

Pumps: The vast majority of French drains will require a sump pump. If you live at the top of a steep hill, then you might be a candidate for a gravity drain, but only a small percentage of homes qualify for this. Assuming you don't fall into that category, then the quality of your pump is every bit as important as the quality of your drain. A 5-star drain with a 2-star pump isn't going to do you much good. Any reputable waterproofing contractor will offer you a cast iron, commercial grade pump with a minimum of 1/3 hp. Common brands used in the industry are: Richtech, Zoeller (pronounced like dollar, but with

a Z), Wayne, Blue Angel (Wayne and Blue Angel are the same company. Blue Angel is the direct to contractor division of Wayne), and Champion. Brands that are NOT used by professional waterproofers. Flo-Tech, Basement Watchdog, Little Giant. The most important thing to know about pumps is what type of motor they have. There are 2 types. Shaded Pole Motors, and Permanent Split Capacitor (PSC) Motors. The important distinction here is the amps. A shaded pole motor typically runs about 9 amps for a 1/3 hp pump. A PSC motor typically runs about 4 amps. Amps = temperature. The higher the amp draws, the hotter the pump will get when it is running hard. This is an important distinction – because EVERY pump has a thermal sensor designed to shut off the pump if it overheats. That is a safety feature to prevent fires. PSC pumps never get hot enough for the sensor to shut off. They are continuous duty rated and can run 24/7 as long as water is in the crock. Shaded pole motors will shut off if they are over stressed. And of course, when would a pump get overstressed? – Right when you need it the most! During a hurricane or 100-year storm! Most waterproofing companies are not aware of this difference. Only Basement Health Association certified companies typically have this knowledge.

Most 1/3hp commercial grade pumps will output between 2500-3500 gallons/hour at an 8' system head. The system head is a combination of the height, distance, and number of corners that the water is being pumped through, although the equation is heavily weighted towards the height. In other words, if a pump is pushing water up 8', through one 90-degree elbow, and out 5 feet, the total system head is NOT 13'. Typically, lateral movement is counted on roughly a 10:1 ratio. So, if the pump pushes water up 8', through one 90-degree elbow, and out 10', then the total system head would be considered 9'. Every pump will come with a chart that shows you it's output capacity at various head levels. These are normally listed in increments of 5' or 10'. Typically, once you get past 10', you can lose as much as 20% of your output capacity for every additional 5' of head.

Backup Systems: A sump pump is only useful as long as you have electricity. But quite often people lose power in the middle of a severe storm, just when you need your sump pump the most. That is why a backup system is ALWAYS a good idea. There are several different types of backup systems, each with their own set of pros and cons.

Automatic Generator: This is by far the superior solution for a backup system. These are gas fed generators that kick on automatically when you lose power, and they can supply power to the entire house. The only drawback to these generators is the cost. It can typically run $10,000 or more to install a system like this.

Pull Cord Generator: This is the small type of generator that you can get at Lowe's or Home Depot. These will provide backup power for your sump pump, but they require you to be home when you lose power, and they require ventilation to make sure the exhaust is vented outside. Failure to do this can

cause carbon monoxide poisoning, and death. Because of these two drawbacks, we NEVER recommend using a pull cord generator for your backup needs.

Water Powered Backup Pump: A water powered backup system runs on the same premise as a siphon. Although you do not have to worry about running out of gas, or draining a battery with these systems, the drawback is that for every 3 gallons of water ejected by a water powered backup, 1 of those gallons is your city water. If that water is being ejected onto your lawn, then you are actually increasing the amount of water in the ground, thereby exacerbating the problem. Additionally, these systems require a ¾" feed, not your normal ¼' line that runs through most of the house. That means these systems typically have to be connected to the main feed where your water source enters the house. If that source is on the opposite side of the basement as the sump pump, that can require some significant plumbing, and added expense.

Power Inverters: A power inverter can be used to hook up a heavy-duty marine battery to your sump pump. This is useful when you are forced to use a small crock. The drawbacks to these are that they are typically expensive, and since they are running your primary pump, the charge doesn't last very long during a power outage.

Battery Backup Systems: If you aren't ready to invest $10,000 in an automatic generator, then our recommendation is to install a Battery Backup System. These systems have 3 components. A secondary DC powered pump, a Heavy Duty, Deep Cycle, Marine Battery, and a Trickle Charger. This pump installed in the same crock as your primary pump, although it is set up to trigger at a higher level than your primary pump. These units protect you against 3 situations. 1) if you lose power. 2) if your primary pump fails, even if you haven't lost power. 3) if your primary pump cannot keep up with the volume in a heavy storm situation. The biggest drawback to these systems is that if you lose power for several days, the battery will eventually run out. Some systems allow you to stack batteries in series, which helps reduce that risk. Some newer Backup Systems also have the ability to monitor your primary pump, backup pump, and battery – and report to you via email and text msg the status of the system. That way if a problem occurs, you'll know about it before you find water on the basement floor.

Exterior Drainage Systems:

Sometimes (but mistakenly) referred to as "Exterior French Drains", an Exterior Drainage System can be an effective means of drying up land, and keeping water away from the house before it has a chance to get to the foundation. Exterior Drainage Systems can also be used when regrading is not a practical option, or to protect the sill plate. An EDS is constructed much the same way as a French Drain. It is basically a trench about 18-24" wide and can run anywhere from 18"- 48" deep. The trench is then lined with filter

fabric, and depending on the location and particular objective, possibly lined with plastic. It is then filled with a 4" or 6" perforated PVC pipe, and then filled in with crushed stone. The bulk of the trench is usually filled in with 3/4" clean crushed stone, but a more decorative stone can be used for the top layer, if the drain is to be left exposed. But depending on the severity of the problem, the speed at which the water moves, and the location of the drain, the EDS does not always have to be left exposed. If there is a low spot in the yard where the water always collects, the EDS can be placed underneath the low spot, and covered with soil and grass. The EDS will still remain effective in such situations. Quite often we will add a second solid PVC pipe in the same trench as the EDS to carry water away from one or more downspouts. But you must never connect the pipe of an EDS into the same pipe as a buried downspout. In the event of a clog in the line downstream, all that water would back up into the drain and achieve the exact opposite of its intended purpose.

Exterior Footer Drains:

An Exterior Footer Drain is the same concept as an Exterior Drainage System, but it is all the way at the bottom of the foundation wall, and installed on the exterior, as opposed to a French Drain which is installed on the interior. Most houses are not candidates for an effective Exterior Footer Drain, because it requires being built at the top of a fairly steep hill. Exterior Footer Drains require a gravity drain, which means that pipe needs to come back out to daylight somewhere downhill from the house. Only a small percentage of homes meet this criteria. Of those homes that do meet this criteria, very few elect to install an exterior footer drain due to the expense. When installing these systems, the entire foundation has to be excavated from grade level, to footer. Trenches that deep also have to be properly secured according to OSHA standards. This means they have to either be shored up with timber or metal bracing, dug out on a 34-degree angle, or dug out using a 'benching' method. Any one of these methods leads to more time, more damage to the surrounding yard, and more money. But, every now and then an exterior footer drain does make sense.

Foundation Crack Repairs: When full depth vertical cracks occur in poured concrete walls, a foundation crack repair is required to stop water from leaking in through the crack. There are 2 basic methods available for this. Interior Crack repair through a process called Epoxy Injection. Or Exterior Crack repair through a process of excavation and sealing from the outside. There are pros and cons for each method. Interior crack repairs are quicker, easier, and cheaper. That sounds like 3 great reasons to go that route, however interior repairs are also more prone to failure. Epoxy Injection is installed via ports that are plugged into the crack approximately every 8-10". A 2 part epoxy is then pumped into the crack with either manual, air, or hydraulic pressure, starting from the bottom, and working it's way to the top. Once it cures, the epoxy is hard as a rock and fills the void in the cement. This prohibits water from getting through. However, if the foundation moves due to settlement, shifting soil, shifting loads due to heavy equipment, construction, or even earthquakes, then the crack can expand, but the epoxy does not expand with the crack. Once that happen, then water can get in again. Exterior crack repairs are done by excavating a 4x4 section of ground all the way down to the footer. The pit is then secured according to OSHA standards. Most of the time that will mean timber bracing, but if required it could mean sloping, or benching. After the pit is secured, then the wall is prepped, and the crack is sealed with multiple layers of various materials. Layer one is a silicone epoxy. Layer two is roofing cement (black tar). Layer 3 is a waterproofing membrane. Layer four is more roofing cement. Layer 5 is thick mil plastic sheeting. Layer 6 is more roofing cement. Finally layer 7 is plastic platon drainage board. After all of the layers are applied, then the bracing is removed, and the soil is put back in place, compacting by hand as we go. This method required a lot more labor and materials, and is therefore more expensive. But the end result is a method that has a certain amount of plasticity to it, so that if the house moves, and the crack widens, water will not get into the basement. This is the preferred method when protecting a finished basement, or for people with low tolerances for the ill effects of a wet basement, such as mold and mildew.

Did You Know?

1 cubic yard of dirt can weigh up to 4000 lbs! If it were to fall only 6 feet, it would hit with the impact of a truck going 35 mph!

https://www.worthingtonwaterproofing.com/pdf/basement-health.pdf

Exterior Foundation Membranes: When houses are first built, a waterproofing membrane is applied to the exterior of the foundation walls. Most of the time, the builder uses an inexpensive spray-on or roll-on membrane. Over time these membranes can dissolve. When this happens, excavating and replacing the dissolved membrane with a double sided sheet membrane is a prudent step. There are various types of sheet membranes. The type we recommend are HDPE plastic on one side, and a layer of bentonite granules on the other side. These sheets are fixed to the foundation wall using an adhesive, and attached at the top using a termination bar that is drilled into the top of the foundation wall. Foundations membranes work best when used in conjunction with an exterior footer drain.

This eBook is intended to begin your education about how water can get into your basement. It is not the entire story, and does not cover every single possibility. There are many more potential sources, potential solutions, and related consequences of a wet basement. If you want to learn more, or if you think you might have a problem, give us a call to ask us any questions you might have, or set up a free on-site inspection.

My family has been waterproofing basements in the Delaware Valley for 60 years and 3 generations. We are dedicated to providing the best-known solutions, at the best possible value. We are eager to help you protect your home and your family from the negative effects of an unhealthy basement. We look forward to hearing from you!