Design and Construction of Stormwater Management Systems at Contaminated Redevelopment Sites in Florida

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A Collection of Federal, State, and Local Regulatory Guidance Documents

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THE GOLDSTEIN
ENVIRONMENTAL LAW FIRM

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Enclosure A

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Implementing Stormwater Infiltration Practices at Vacant Parcels and Brownfield Sites

U.S. Environmental Protection Agency
Office of Water
Office of Solid Waste and Emergency Response

Introduction

This document presents information to assist communities, developers, and other stakeholders in determining the appropriateness of implementing stormwater management practices that promote infiltration at vacant parcels and brownfield sites.

A brownfield is a property where redevelopment or reuse may be complicated by the presence (or likely presence) of contamination. Vacant parcels may also be brownfield sites depending upon their prior use. Redevelopment of brownfield properties is often conducted using approaches that are specifically designed to reduce or eliminate the human and ecological health risks associated with these substances. Common risks associated with brownfield sites include:

Risk To…	Resulting From…
Human health	Direct contact, inhalation, or ingestion
Groundwater	Leaching of a contaminant(s)
Nearby surface waters or ecosystems	Runoff from the site which has picked up contaminants due to leaching or erosion

Strategies for reducing or eliminating these risks can include removing contaminated soil or waste materials, treating soils on site, placing a cap or barrier over contaminated areas, bioremediation, or monitored natural attenuation.

Many urban and suburban communities are required to develop municipal stormwater management programs to control the discharge of pollutants from their separate stormwater and sewer systems. These municipal stormwater programs typically require new development and redevelopment projects to implement best management practices (BMPs) that reduce pollutant discharges and control stormwater runoff. The specific requirements for each stormwater program can vary, but many programs require or encourage development projects to address stormwater runoff through controls that either infiltrate stormwater prior to its runoff from a property or provide for the detention and treatment of the stormwater before it is discharged.

Communities seeking to implement sustainable stormwater management frequently use rain gardens, bioswales, permeable pavement and other practices, often referred to as *green infrastructure*, to manage runoff. These stormwater infiltration practices often allow accumulated runoff water to percolate into the subsoil which reduces stormwater runoff. Projects that infiltrate stormwater runoff on-site can provide multiple benefits, including decreased stormwater infrastructure costs, increased groundwater recharge, and decreased pollutant loads in stormwater runoff.

Vacant or under-utilized parcels may appear to be promising places to locate stormwater infiltration practices. However, it is important to reconcile the goal of sustainably managing stormwater with brownfield site considerations. Infiltrating stormwater at sites where there are contaminants present may mobilize the contaminants and increase the potential for groundwater contamination.

This document was developed to assist communities, developers and stakeholders in making decisions about whether to implement green infrastructure infiltration practices at brownfield sites. With careful site analysis and planning, decision-makers can plan for stormwater management practices which promote the infiltration of stormwater while minimizing the potential for mobilizing contaminants.

Stormwater Management Approaches

Stormwater management practices are typically intended to capture, convey (through ditches or sewers) and in some cases treat stormwater which runs off of roads, parking lots, rooftops, and other impervious surfaces or areas of active construction in an urban or suburban area. Stormwater practices may also include storing wet weather flows, for example in a detention basin, to help prevent localized flooding. In addition, stormwater management approaches may include green infrastructure practices to trap pollutants and reduce the amount of stormwater to be conveyed and discharged.

Installation of a subsurface stormwater storage and infiltration gallery.

Successful implementation of stormwater management and infiltration practices at brownfield sites requires careful planning; stormwater management planning and implementation should be integrated with site investigations, state approvals, the selection of clean-up approaches and techniques, and the design and engineering of site improvements. The safe implementation of stormwater infiltration needs to be considered during the early phases of planning for site redevelopment. Locating infiltration practices so that they do not mobilize contaminants requires a collaborative effort by team members responsible for delineating and defining the contamination, remedial engineering, site planning, and site design.

When is a vacant parcel or infill redevelopment site a "brownfield," where contamination issues need to be considered?

There are a number of simple approaches to determine if a property could be characterized as a brownfield site. The history of prior use is a good indicator of brownfield potential. Prior land uses and the types of activities that took place on the site are often good predictors of whether there will be contaminants and/or waste materials in the soil that could complicate the redevelopment and reuse of the site. The following graphic illustrates the general relationship between property use/site history and the associated probability of contamination.

Low Probability of a contaminated site ←→ **High Probability of a contaminated site**

Park - Farm - Residential - Retail - Commercial - Service Station/Dry Cleaners - Industrial

Past and Present Property Use

Note that while the graphic shows the relative probability that there will be contamination at a site, each site needs to be considered individually. For example, some land presently used as park space may have had a different land use in the past. Farming areas may have past pesticide use or farm waste management issues. A residential lot may have an old oil tank buried in the yard or area where trash was burned.

Prior uses of a property can and should be identified from a review of records such as current and past zoning requirements, title search results, and deed records. Environmental records related to a specific location (address or area) can be obtained from the interactive EnviroMapper web site (http://www.epa.gov/emefdata/em4ef.home) maintained by the U.S. EPA. The EnviroMapper web site provides access to several U.S. EPA databases to provide information about environmental activities that may affect air, water, and land anywhere in the United States. Maps depicting the locations of environmental events, contamination, or other concerns also can be generated. Many states also have environmental records databases that can provide information regarding potential contamination at particular properties.

A vent for an underground storage tank is an indication that the tank is still present.

A visit to the property can provide information regarding past use and the potential for the property to be impacted by environmental contamination. Certain features at a property may be indicators of potential contamination including the presence of:

- Underground storage tank vents or fill ports.
- Monitoring wells.
- Soil piles covered with plastic sheeting or tarps.
- Staining of soils and/or dead vegetation.
- Excavations that are not backfilled with clean material.

At some properties, contaminated debris may remain from previously demolished buildings. In such cases, it is important to obtain records from the demolition to determine if environmental hazards, such as fuel oil tanks or lead based paint, were removed prior to the building demolition.

The identification of the location and size of the area where compound concentrations represent an unacceptable risk is crucial to the planning of stormwater management practices.

The site factors discussed above are typically considered as part of a site investigation (Phase I and II Environmental Site Assessments) carried out to confirm if the property is impacted from a prior use(s) or otherwise potentially contaminated.

Importance of Site Characterization

Prior to the initiation of any brownfield site reuse or redevelopment, a site investigation will normally be conducted to obtain information regarding the property's potential contamination. Knowledge regarding any potential contamination is needed to plan for any potential remediation, to make the property safe for occupation, and to address environmental and possible ecological concerns in a safe and cost-effective manner. Lenders, insurers and State and federal environmental regulations often require an environmental investigation of a commercial property at the time of property transfer to identify potential contamination and the potential environmental and health impacts from any contamination. Environmental investigations are normally conducted in the following stages:

Phase I Environmental Site Assessment

Commonly includes the identification of environmental concerns through a visual examination of the property, acquisition and review of historic environmental records and property use information, property ownership and lien records, historic aerial photographs, and other records related to the prior use and ownership of the property.

Phase II Environmental Site Assessment

Conducted to determine if the information and potential conditions identified in Phase I are evidence of contamination and if such conditions create an environmental impact. This phase can include soil borings or test pits to collect samples of surface and subsurface soils for laboratory analysis. Monitoring wells can be installed to collect groundwater samples for laboratory analysis. Environmental impacts are characterized by size and depth through sampling of subsurface materials and groundwater.

Supplemental Site Assessment

If contaminant concentrations identified during Phase II represent an unacceptable risk, a supplemental site assessment is needed to identify the horizontal and vertical extent of contamination. Once identified, risks can be further evaluated along with remedial approaches for site construction to reduce risks to an acceptable level.

Environmental conditions at brownfield properties need to be well-understood to ensure any necessary cleanup meets environmental regulatory requirements and to effectively design remedial efforts (if needed). The identification of the location and size of the area where contaminant concentrations represent an unacceptable risk is crucial to the planning of stormwater BMPs. Project stakeholders, regulators and designers need to have access to and evaluate this information in order to plan which stormwater management practices can be placed at a site.

Is Infiltration Appropriate?

Stormwater management approaches that include infiltration need to be carefully evaluated when being considered for a brownfield site, or potentially contaminated property. The following questions can be used to help determine if infiltration or other stormwater management approaches are appropriate for a specific brownfield property. To summarize key steps in the decision-making process, a decision tree is presented near the end of this document. A detailed environmental site investigation, as described above, should be completed to identify the location, limits and contaminants in soil and groundwater so the questions below can be answered and the decision tree can be used effectively.

1. Is a LNAPL, DNAPL, biodegradable waste, or leachable contaminant source present at the site?

A light non-aqueous phase liquid (LNAPL) is a liquid that has a density less than water, allowing it to float on groundwater (e.g., diesel fuel). A dense non-aqueous phase liquid (DNAPL) is denser than water, allowing it to sink or move downward through the groundwater table (e.g., tetrachloroethylene). LNAPLs and DNAPLs are considered substances that tend to flow though subsurface soils and are often the source of soil or groundwater impacts at a brownfield site. Because LNAPLs and DNAPLs are independently mobile and can produce multiple hazards, the use of infiltration or stormwater management practices in close proximity to LNAPLs or DNAPL contaminated areas should generally not be considered. Areas of the site that do not contain LNAPL or DNAPL can be considered for infiltration only if the proposed infiltration will not move or spread the LNAPL or DNAPL. More information concerning LNAPLs can be found at: http://www.epa.gov/wastes/hazard/correctiveaction/curriculum/download/lnapl.pdf.

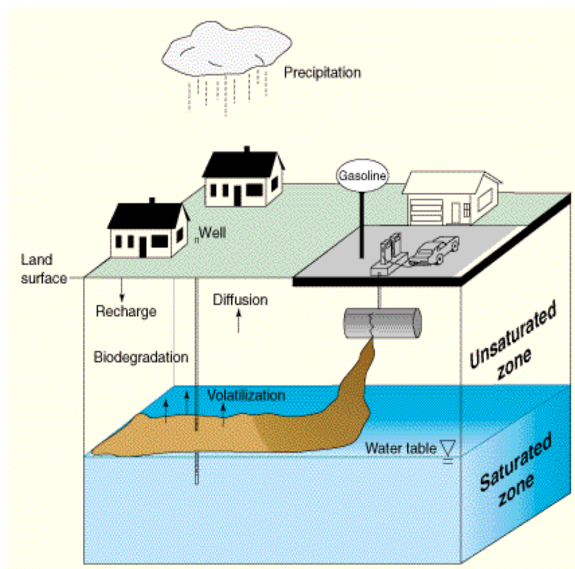


Illustration of a release from a gasoline storage tank with LNAPL floating on the groundwater table.

U.S. EPA has developed a Synthetic Precipitation Leaching Procedure (SPLP) (USEPA Method 1312) to simulate the leaching of compounds from contaminated soil and certain wastes as a result of precipitation infiltrating the ground surface. The SPLP test can be conducted on samples of soil or other materials from a brownfield site (e.g., debris). A defined amount of the material is mixed with laboratory grade water in a rotary agitator for a period of 18 hours. At the end of mixing, the water portion of the mixture is extracted for laboratory analysis to identify the resulting concentration in the leachate. These leachate concentrations or SPLP results are then compared to groundwater quality, surface water quality or to applicable site specific clean-up standards (compound concentrations that represent acceptable risk). If the SPLP result identifies compound concentrations in the leachate that are less than the clean-up standard, stormwater most likely can be infiltrated through the material as long as there were sufficient SPLP tests to properly characterize the material from a leachability standpoint.

Contaminants that are leachable or water soluble generally present relatively greater risks as compared with some other categories of contaminants, because the contaminants can be mobilized relatively easily through the soil from infiltrating stormwater and impact groundwater. Other contaminants, such as many metals, can bind to the soil and may be less likely to be mobilized by infiltrating stormwater. In considering whether infiltration practices are appropriate at a particular site, the nature of the contaminants present should be evaluated to assess if the contaminants are likely to be mobilized by the water moving through the soil. If there are leachable or water soluble contaminants present on a site, it is usually not advisable to locate infiltration practices over or near the contaminated areas. Volatile organic compounds, phenols, and herbicides are classes of compounds that are often highly water soluble.

Biodegradable waste materials (e.g., garbage) often produce gases and leachates that impact soil and groundwater. The rate in which leachates and gases are produced from biodegradable materials often is increased by the application of water. Therefore, stormwater management practices that promote infiltration are generally not advisable at sites where there are biodegradable materials in the ground.

Remedial measures are often planned at brownfield sites to prevent leachable or water soluble contaminants from spreading and impacting groundwater and/or surface waters. A common approach is to apply an impervious cap over the contaminated area. Other approaches include using the building footprint or impervious areas such as parking lots to prevent infiltration. Also, vertical barriers can be installed to prevent lateral groundwater flow and spreading leachable or water soluble compounds. If these or other remedial measures are planned, infiltration practices should only be considered if they do not negatively impact the operation of remedial measures proposed for the site (see question 5, below).

2. Is groundwater beneath the property impacted or could it become impacted?

Decisions regarding the appropriateness of implementing infiltration practices at a brownfield site must take into account if there are contaminants present on the site (question 1) and whether the groundwater beneath the site is contaminated. In some cases, groundwater under a site can be contaminated, even if those contaminants are not present on the site. This can happen for example when activities or site conditions at an upgradient property caused the groundwater to become contaminated.

Generally speaking, if the groundwater beneath a site is known to be contaminated, it is not a good idea to implement infiltration practices at the site. The movement of contaminants in groundwater can be accelerated by an infiltration practice potentially resulting in environmental impacts to neighboring properties. However, there could be situations where infiltration practices can be implemented, depending upon the specific circumstances, including the compounds and concentrations present in a groundwater plume. An example might be a situation where natural attenuation has been selected as the appropriate strategy for dealing with a groundwater plume with a low concentration of contaminants where there is little potential for off-site migration. Relatively clean rain water infiltrating down to the groundwater may have the effect of speeding up the natural attenuation process.

Following is a specific example when it could be a good idea to implement stormwater infiltration practices even though there is identified groundwater contamination in the area:

> *Stakeholders from a watershed partnership met with agency and city staff for an update on the cleanup of the Superfund sites, an area-wide groundwater problem that covers many square miles in the watershed. In response to questions about the impacts stormwater infiltration could have on the ongoing Superfund cleanup, Superfund and city staff pointed out that in some areas of the watershed stormwater infiltration and the resulting acceleration of pollutant mobilization would be beneficial for the groundwater cleanup if the pollutants are mobilized within the zone of influence of extraction wells used for groundwater remediation.*

Close coordination between those considering infiltration projects and those managing the groundwater remediation is necessary to determine if/when an infiltration project may be beneficial. Situations where infiltration could aid in the remediation of certain contaminants in some environments should be discussed with EPA and/or the state remediation program.

When evaluating a site to determine if stormwater infiltration practices may be appropriate, it is important to consider whether or not groundwater is contaminated on an adjacent property and whether that property is located upgradient from the parcel where green infrastructure is being considered. Contamination from an upgradient property may eventually travel to the parcel. Decisions about whether to infiltrate stormwater when there is known groundwater contamination in the area should be made carefully on a case-by-case basis, taking into account the type of contaminants and whether infiltrating stormwater will affect environmental or human health risks.

Other appropriate stormwater practices can be designed that provide filtration (treatment) benefits and promote evapotranspiration, but not allow for infiltration. This topic is further discussed in the section below titled, “Stormwater Management without Infiltration.”

3. Are areas or parts of the property not impacted?

Often the entire brownfield property is not impacted or problematic material can be relocated to create an area that is not impacted by contamination. In planning to implement stormwater management at a brownfield site, the volume, location and thickness of contaminated areas should be reviewed. If an area of the site is not impacted or can be remediated to remove the contaminants, it may be appropriate to plan infiltration practices in such areas (see example at right). At this case study site, impervious surfaces -- barriers to exposure and to limit downward movement of contaminants in the soil as a result of rainfall and infiltration -- are placed over the areas with contamination and green infrastructure practices are located in other uncontaminated areas of the site.

Example redevelopment plan using green infrastructure while placing barriers over contaminated soils.

4. Are there State standards I can refer to as a guide in making decisions about infiltration practices?

Many states have developed soil concentration standards for various compounds for the soil to groundwater leaching pathway. See for example Tables1 and 2 below. Standards are continuously being updated and vary from state to state. Where soil standards/criteria have been established, such standards can be helpful in evaluating whether infiltration practices may be suitable at a particular site. However, it should be noted that in most cases the standards were developed based on typical rainfall amounts entering the soil profile. The standards as established generally do not take into account the relatively larger amounts of water that would move through the soil if infiltration practices are installed.

Table I: Generic Leach-Based Soil Values for Organic Chemicals
Ohio EPA Derived Leach-Based Soil Values

Chemical (Organics)	Soil Type I (mg/kg)	Soil Type II (mg/kg)	Soil Type III (mg/kg)
Benzene	0.017	0.0090	0.015
Toluene	6.8	4.1	7.7
Ethylbenzene	12	7.9	16
Total Xylenes	156	96	191
Styrene	0.46	0.37	0.62
Naphthalene	0.27	0.28	0.36
n-Hexane	121	111	104

Methyl Ethyl Ketone	1.8	1.8	1.8
Phenol	1.1	1.1	1.2
Carbon Tetrachloride	0.25	0.25	0.28
1,2-Dichloroethane	0.0030	0.0020	0.0030
1,1,1-Trichloroethane	1.2	0.74	1.3
Vinyl Chloride	0.0090	0.0050	0.012
1,1-Dichloroethene	0.28	0.10	0.24
cis-1,2-Dichloroethene	0.12	0.070	0.12
trans-1,2-Dichloroethene	0.41	0.23	0.40
Trichloroethene	0.036	0.023	0.048
Tetrachloroethene	0.15	0.11	0.27

Table 2: Generic Leach-Based Soil Values for Inorganic Chemicals
Ohio EPA Derived Leach-Based Soil Values

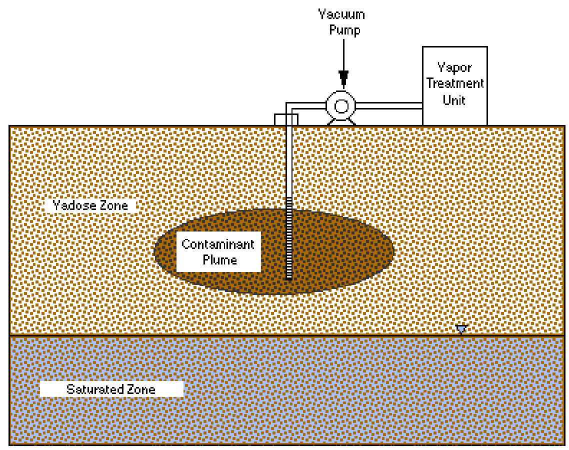
Chemical (Inorganics)	**Leach-based Value** for sources ≥ ½ acre (mg/kg)	**Leach-based Value** for sources< ½ acre (mg/kg)
Antimony	3.6	7.2
Arsenic	3	6
Barium	56,000	110,000
Beryllium	57	114
Cadmium	21	42
Chromium	56	113
Lead	89	178
Mercury	12	23
Nickel	182	363
Selenium	2.15	4.3
Silver	3120	6240
Thallium	1.5	3.0
Vanadium	130	65
Zinc	44,000	88,000

Notes on Tables 1 and 2:

1. Source: http://www.epa.ohio.gov/portals/30/vap/docs/sec-g-att.pdf
2. mg/kg – milligram of compound per kilogram of soil (by dry weight). Soil Type I is clean sand and gravel. Soil Type II is silty sand. Soil Type III is till/clay.
3. Values provided are examples only. Check the applicable requirements and criteria in your State. To learn more about practices in other states, the following website provides links to State brownfield programs: http://www.epa.gov/brownfields/state_tribal/state_map.htm.
4. Risk-based models/calculations can be used in some situations to provide information for decision-making about clean-up and re-use of brownfield sites. See for example http://www.deq.state.ok.us/factsheets/land/SiteCleanUp.pdf and/or http://www.nj.gov/dep/srp/guidance/rs/igw_intro.htm. Appropriate soil concentrations are calculated using standardized equations or models taking into account site-specific information. In certain situations allowable soil concentrations are calculated using computer models designed for modeling vadose zone contaminant migration based on relatively more extensive site-specific information on soil types, site conditions, and local climate. One of the factors normally considered in a risk-based model/analysis is the likelihood that groundwater could become contaminated. A model/analysis will oftentimes use regional rainfall data and site and soil characteristics to evaluate if it is likely contaminants will leach and groundwater could be at risk. It may be possible to adapt these methods to evaluate if implementation of infiltration practices at a brownfield site will pose a significant risk to groundwater resources. In adapting a model/method for this purpose, it will be important to take into account the fact that more stormwater would be draining through the soil if there are engineered infiltration practices, vs. what amounts would be draining through the soil just from precipitation falling on the site.

5. Will infiltration interfere with required remediation?

Decision-making about infiltration practices at a brownfield property should take into account any remedial actions planned for the site. For example, vertical barriers planned to keep contamination from moving laterally could be negatively impacted by installing infiltration practices nearby and increasing the pressure differential on the side where infiltration is increased. Increased hydraulic pressure on a vertical barrier could increase leakage through the barrier and reduce the effectiveness of the barrier over time.



Soil vapor extraction system schematic.

Stormwater infiltration practices could in some situations also interfere with a soil vapor extraction system (SVE, see http://www.epa.gov/oust/cat/sve1.htm or http://www.frtr.gov/matrix2/section4/4-7.html). Such systems are commonly installed to reduce the vapor pressure beneath buildings to evacuate any vapor risk that may be caused by contaminants beneath the building. Increased infiltration can increase the moisture content of the vadose zone, raise the groundwater table, and reduce the size of the vadose zone. These changes can prevent the SVE system from operating properly and may result in high volumes of condensate from the vapor collected, which is commonly contaminated and requires proper handling, treatment and disposal.

The planning and design of infiltration and stormwater management practices needs to be integrated with the overall site design and remediation planning at a brownfield property.

6. How does the site interact with other sites or land uses nearby?

Some brownfield sites are located near sensitive areas such as wellhead (public water supply) protection zones, rivers, lakes, fens, or wetlands. Where a site is near an area that is relatively more sensitive in terms of potential health risks or ecological risk, the need to protect these areas should be considered in making determinations about implementation of infiltration practices. For example, at a site immediately upgradient of a wetland or fen that is dependent on shallow groundwater inputs, an extra margin of safety may be appropriate in deciding whether to implement infiltration practices.

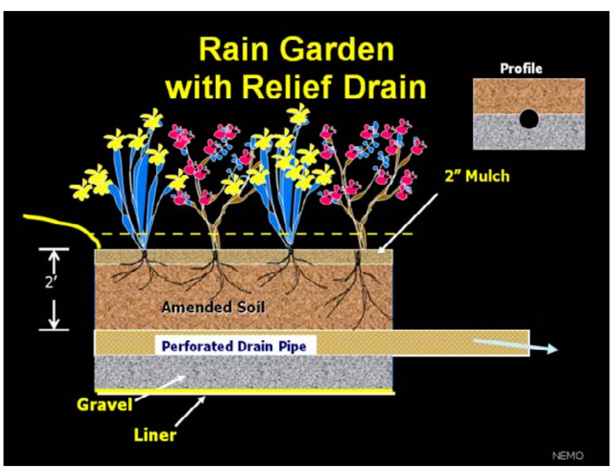

Too much stormwater routed into a forested wetland can harm the trees. Implementing infiltration practices upstream of the wetland may help protect it. (photo credit: Center for Watershed Protection)

Land use and site activities in or near areas where stormwater will drain to infiltration practices also should be evaluated. Some post-redevelopment land uses or site activities may present relatively greater risks than others. For example, if stormwater will be running off from a nearby gas station or industrial loading area and potentially draining to an infiltration practice, implementing the infiltration practice in this situation could present relatively greater risks to groundwater. Runoff from potentially contaminated areas should be routed to appropriate stormwater facilities which may include oil and water separators and other treatment facilities which do not encourage infiltration. Implementing an infiltration practice where the run-on may include dissolved contaminants is not advisable.

Understanding how the site will be redeveloped or reused in the future may affect decision-making regarding when infiltration may be appropriate or where practices should be located. For example, if the site will be used for above-ground petroleum storage tanks and dispensing fuel, this future use of the site should be taken into account in the evaluation of the appropriateness of implementing infiltration practices. For situations where there are above-ground tanks a spill prevention, countermeasure and control (SPCC) plan may be needed. SPCC plans provide for secondary containment and/or operational procedures and precautions to ensure that a spill is prevented and controlled in the event of a release. Installing infiltration practices in areas that could be impacted by a potential release, as identified in a SPCC plan, is generally not recommended.

Stormwater Management without Infiltration

When contaminants are present but at concentrations sufficiently low that they do not adversely affect site re-uses or cause risks to public health, stormwater management approaches that filter or treat stormwater, or which store and reuse stormwater, may be more appropriate vs. infiltration practices. In situations where infiltration would not be advisable, site planning and alternative BMP designs often can be used to achieve stormwater management goals.



Rain Garden with liner and underdrain. Designs such as this allow for filtration and evapotranspiration, but prevent infiltration into subsoils.

There are many methods to incorporate stormwater management at a brownfield site without directly infiltrating stormwater into the underlying soils. Typically a green infrastructure practice with plants, e.g., a rain garden, is used as a bioretention or *bioinfiltration* practice. The stormwater is treated or filtered by the soil and the plants, some water goes back into the air through evapotranspiration, and most of the water infiltrates into the soil. An alternative design that can be used when there is contamination present in subsoils is a rain garden with an impermeable liner and an underdrain or overflow pipe to convey excess water to a nearby storm sewer or point of discharge. This type of practice can be thought of as *biofiltration*. The plants and soil perform filtration and treatment functions, some evapotranspiration will occur, and the water that is conveyed to the sewer system or receiving water is cleaned. However, the water will not infiltrate through the contaminated soil toward the groundwater.

Green roofs and cisterns for rainwater harvesting can also be used at sites where there are contaminants of concern in the soil. These stormwater management practices help reduce the amount of runoff soaking into the ground or running off site, and can provide corollary benefits. For example, green roofs can help reduce urban heat island effects, and because they serve as an insulation layer can help reduce energy costs for a building. Using a cistern can provide water conservation benefits; stormwater that is collected during rain events can be used during dry weather periods to irrigate lawns and gardens, thereby helping to conserve potable water.

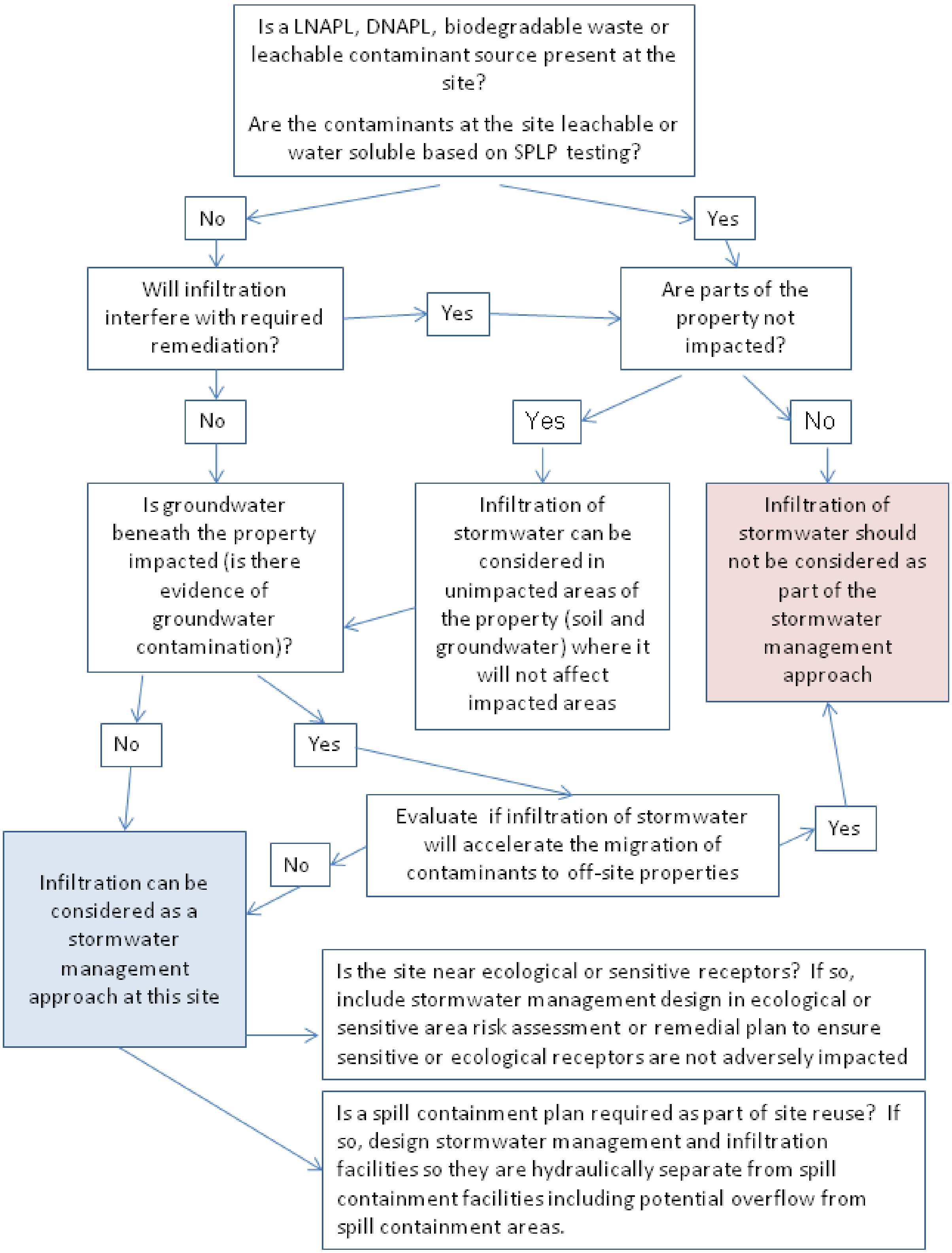
Summary

Stormwater infiltration practices can provide important benefits where implementation of such practices is feasible and environmentally protective. Benefits can include decreased stormwater infrastructure costs, increased groundwater recharge, and decreased stormwater runoff. Infiltration can be considered at infill redevelopment sites, vacant parcels, and brownfield sites, but care must be taken to evaluate the potential for stormwater infiltration to mobilize contaminants and contaminate groundwater. The decision tree presented on the following page is a graphical representation of the process for evaluating the potential to implement infiltration practices at a vacant parcel or brownfield site.

The identification of the location and size of the area where contaminant concentrations represent an unacceptable risk is crucial to the application of stormwater BMPs. The prior uses of a site and other information gathered through site assessments can provide valuable information for making decisions about the site suitability for infiltration practices. Where contaminants were or are present, soil testing can provide another layer of information valuable for decision-making.

Successful implementation of stormwater management and infiltration practices at brownfield sites requires careful planning. Stormwater management planning and implementation should be integrated with site investigation, State approvals, the selection of clean-up approaches and techniques, and the design and engineering of site improvements. Locating infiltration practices so that they do not mobilize contaminants requires a collaborative effort by team members responsible for delineating and defining the contamination, remedial engineering, site planning, and site design. At sites where infiltration practices are not advisable, it may be possible to use green infrastructure practices such as green roofs and biofiltration designs to manage stormwater and also protect groundwater.

Decision Flowchart for the Use of Stormwater Infiltration at Brownfield Sites



Resources

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Cover Image: Rendering of possible green infrastructure implementation at a vacant land parcel in Milwaukee. *Rendering courtesy of City of Milwaukee and Conservation Design Forum.*

Enclosure B

Design Principles

for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas

EPA's Brownfields Program is designed to empower states, communities, and other stakeholders in economic redevelopment to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse brownfields. A brownfield is a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. EPA's Brownfields Program provides financial and technical assistance for brownfield revitalization, including grants for environmental assessment, cleanup, and job training.

What is Green Infrastructure?

Most development and redevelopment practices cover large areas of the ground with impervious surfaces such as roads, driveways, sidewalks, and new buildings themselves, which then prevent rainwater from soaking into the ground. These hard surfaces increase the speed and amount of stormwater that runs into nearby waterways, carrying pollutants and sediment each time it rains.

Green infrastructure seeks to reduce or divert stormwater from the sewer system and direct it to areas where it can be infiltrated, reused or evapotranspirated. Soil and vegetation are used instead of, or in conjunction with, traditional drains, gutters, pipes and centralized treatment areas. In many new and redevelopment projects, green infrastructure is implemented to manage and mitigate the polluted runoff created by precipitation that falls on rooftops, streets, sidewalks, parking lots and other impervious surfaces.

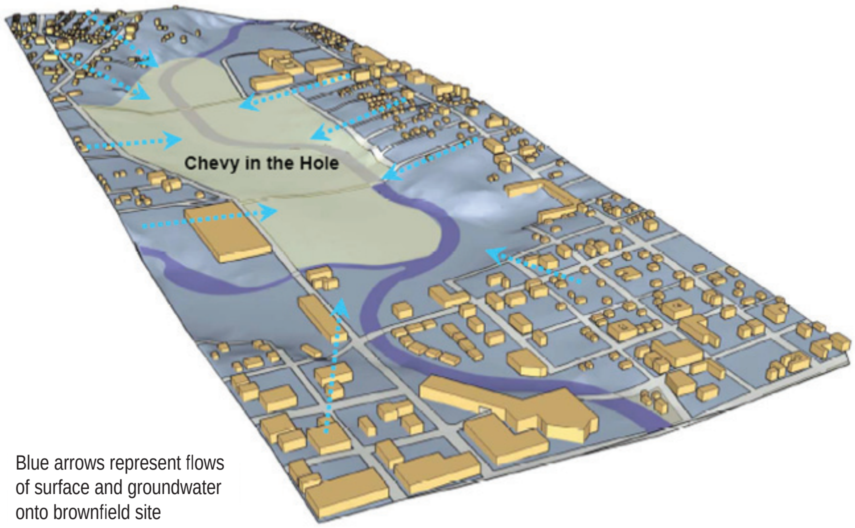
How can Green Infrastructure be Applied to Brownfield Sites?

Preparing brownfields for redevelopment often requires capping of contaminated soils, creating even larger impervious surfaces. The challenge for managing stormwater on brownfield sites is allowing this capping while mitigating the impervious surface conditions that can negatively impact local waterways.

Unlike many conventional developments, impervious footprints on brownfields cannot always be minimized through site designs that incorporate more porous surfaces to allow for infiltration. Direct infiltration on a brownfield site may introduce additional pollutant loads to groundwater and nearby surface waters. However, green infrastructure practices exist that can retain, treat and then release stormwater without it ever coming in contact with contaminated soils.

A bioswale in Wilmington, Delaware, designed to absorb and retain stormwater runoff.

The University of Michigan's School of Natural Resources and Environment developed design guidelines that use low impact development techniques on contaminated sites. Using a former industrial site in Flint, Michigan, called Chevy in the Hole, graduate students considered and refined methods to prevent residual contamination from moving with stormwater.



Blue arrows represent flows of surface and groundwater onto brownfield site

Design Considerations

A key component of using green infrastructure for brownfield sites is treatment and storage of stormwater, rather than complete infiltration. Most brownfields that have residual contamination need caps, so vegetated areas need to be located above caps and fitted with underdrain systems to remove overflow stormwater.

Development and redevelopment projects should start with keeping existing trees onsite, minimizing compaction of earth that inhibits water infiltration, and planting trees and other vegetation in areas where none exists. Retaining existing tree cover and vegetated areas helps infiltrate and evapotranspirate stormwater runoff while intercepting large amounts of rainfall that would otherwise enter waterways as runoff.

Buildings and other impervious surfaces can be strategically located to act as caps over areas with known contamination. Areas with fill caps can include soils and vegetation above the cap in the form of swales or rain gardens. If fitted with an under-drain system to release treated stormwater off site, these planted areas can safely allow filtration and evapotranspiration of stormwater. Additional features like impermeable liners or gravel filter blankets can be coupled with modified low impact development (LID) practices that safely filter stormwater without exposing the water to contaminated soils.

Green roofs are an ideal way to reduce the runoff from building roofs by encouraging evapotranspiration of rainwater. Another option for brownfield sites is the capture and reuse of stormwater for non-potable uses; this can include runoff storage in rain barrels for irrigation of green roofs or landscaped areas, or in cisterns that store rainwater for toilet flushing and other uses.

Site location within the watershed is very important. In particular, projects in groundwater recharge areas should avoid low impact development practices that promote infiltration, and use techniques that directly discharge treated stormwater instead. Furthermore, new and redeveloped sites near brownfields should use green infrastructure practices to prevent additional runoff from flowing onto potentially contaminated areas.

Overall, when developing a stormwater management plan on a brownfield, surrounding sites must be considered. *(Source: Flint Futures: Alternative Futures for Brownfield Redevelopment in Flint, Michigan.)*

The Matthew Henson Conservation Center in Washington, DC, utilizes a green roof.

General Principles for Using Green Infrastructure on Brownfield Sites

Guideline #1: Differentiate between groups of contaminants as a way to better minimize risks.

Guideline #2: Keep non-contaminated stormwater separate from contaminated soils and water to prevent leaching and spreading of contaminants.

Guideline #3: Prevent soil erosion using vegetation, such as existing trees, and structural practices like swales or sediment basins.

Guideline #4: Include measures that minimize runoff on all new development within and adjacent to a brownfield. These measures include green roofs, green walls, large trees, and rainwater cisterns.

Definitions

Bioswales are open channels with a dense cover of vegetation where runoff is directed or retained to evapotranspirate and filter.

Evapotranspiration is the return of water to the atmosphere either through evaporation or by plants.

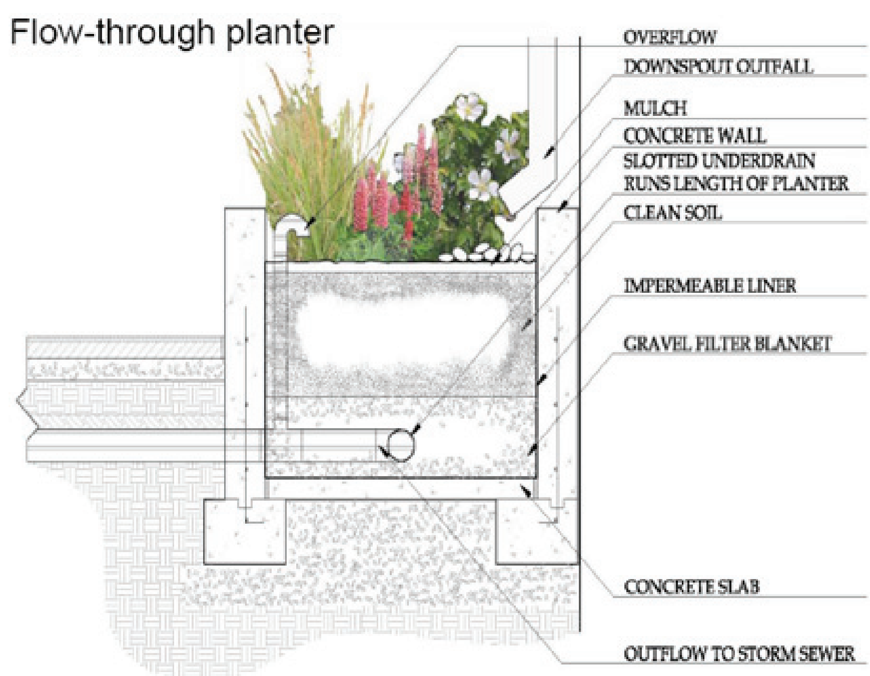
Green Infrastructure and ***Low Impact Development (LID)*** both refer to systems and practices that use or mimic natural processes to infiltrate, evapotranspirate or reuse stormwater or runoff on the site where it is generated.

Green roofs can be used to effectively reduce or eliminate runoff from small and medium sized storms. A soil mixture is placed over a waterproof membrane and drainage system and then planted with water absorbent and drought tolerant plants. Most systems also have root barriers. These roofs soak up stormwater and release it back into the atmosphere through evaporation and plant respiration, while draining excess runoff.

Rain gardens serve the same purpose as stormwater planters and are appropriate where there is more area to plant vegetation. Sizing is dependent on the area of impervious surfaces draining to the rain garden, but they can be designed to only treat a portion of the runoff so they can be placed in most situations.

Stormwater harvest and reuse. Rainwater harvested in cisterns, rain barrels, or other devices may be used to reduce potable water used for landscape irrigation, fire suppression, toilet and urinal flushing, and custodial uses. Storage and reuse techniques range from small-scale systems (e.g., rain barrels) to underground cisterns that may hold large volumes of water.

Stormwater planters. Downspouts can be directed into stormwater planters. These planters are used to temporarily detain, filter and evapotranspirate stormwater using plant uptake.



Additional Resources

The Emeryville, California *Stormwater Guidelines for Green, Dense Redevelopment* provides guidance on using vegetative stormwater treatment measures for this dense, brownfield-laden city: www.ci.emeryville.ca.us/planning/stormwater.html.

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NRDC's *Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows* is a policy guide for decision makers looking to implement green strategies in their own area, including nine case studies of cities that have successfully used green techniques to create a healthier urban environment. Available at: www.nrdc.org/water/pollution/rooftops/contents.asp

Portland's (Oregon) *Trees for Green Streets: An Illustrated Guide* is a guidebook that helps communities select street trees that reduce stormwater runoff from streets and improve water quality. Available at: www.metro-region.org/article.cfm?articleID=263

Seattle's *pilot Street Edge Alternatives Project (SEA Streets)* is designed to provide drainage that more closely mimics the natural landscape prior to development than traditional piped systems. Good information can be found at: www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.asp

EPA's *Protecting Water Resources with Higher-Density Development* report helps communities better understand the impacts of higher and lower density development on water resources. The findings indicate that low-density development may not always be the preferred strategy for protecting water resources. Available at: www.epa.gov/dced/water_density.htm.

Portland Metro's (Oregon) *Green Streets: Innovative Solutions for Stormwater and Stream Crossings* is a handbook that describes stormwater management strategies and includes detailed illustrations of "green" street designs that allow infiltration and limit stormwater runoff. Available at www.metro-region.org/article.cfm?articleID=262

EPA's *Protecting Water Resources with Smart Growth* is a report intended for audiences already familiar with smart growth concepts who seek specific ideas on how techniques for smarter growth can be used to protect water resources. The report describes 75 policies that communities can use to grow in the way that they want while protecting their water quality. Available at: www.epa.gov/dced/water_resource.htm

EPA's *Using Smart Growth Techniques as Stormwater Best Management Practices* reviews nine common smart growth techniques and examines how they can be used to prevent or manage stormwater runoff. Available at: www.epa.gov/dced/stormwater.htm

EPA's *Brownfields Program Website* (www.epa.gov/brownfields) provides information on and resources for assessing, cleaning up and redeveloping brownfields, including grant funding opportunities.

Enclosure C

Case Studies

for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas

EPA's Brownfields Program is designed to empower states, communities, and other stakeholders in economic redevelopment to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse brownfields. A brownfield is a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. EPA's Brownfields Program provides financial and technical assistance for brownfield revitalization, including grants for environmental assessment, cleanup, and job training.

What is Green Infrastructure?

Most development and redevelopment practices cover large areas of the ground with impervious surfaces such as roads, driveways, sidewalks and new buildings themselves, which then prevent rainwater from soaking into the ground. These hard surfaces increase the speed and amount of stormwater that runs into nearby waterways, carrying pollutants and sediment each time it rains.

Green infrastructure seeks to reduce or divert stormwater from the sewer system and direct it to areas where it can be infiltrated, reused or evapotranspirated. Soil and vegetation are used instead of, or in conjunction with, traditional drains, gutters, pipes and centralized treatment areas. In many new and redevelopment projects, green infrastructure is implemented to manage and mitigate the polluted runoff created by precipitation that falls on rooftops, streets, sidewalks, parking lots and other impervious surfaces.

How can Green Infrastructure be Applied to Brownfield Sites?

Brownfields redevelopment and sustainable stormwater management both produce economic and environmental benefits by improving urban areas, protecting open space and preventing further pollution of the nation's waters. However, in order to prevent further environmental damage by infiltrating precipitation through contaminated soil, onsite stormwater management must be done carefully, using particular design guidelines. There are projects across the country that have found effective solutions to the challenge of developing a brownfield site with residual contamination, by incorporating appropriate natural systems for stormwater management.

Greening Old Industrial Lands in Emeryville, California

Emeryville, California occupies just 1.2 square miles of dense, formerly industrial land along the San Francisco Bay between Berkeley and Oakland. In the 1990s, Emeryville started a comprehensive brownfields redevelopment project to address serious economic and social costs associated with large tracts of vacant or underutilized non-residential property throughout the city. The redevelopment of several targeted brownfields had many positive outcomes for the city, such as new jobs and residents, and increased income and tax revenue, but also had negative environmental impacts by increasing overall impervious surfaces contributing to runoff and non-point source pollution.

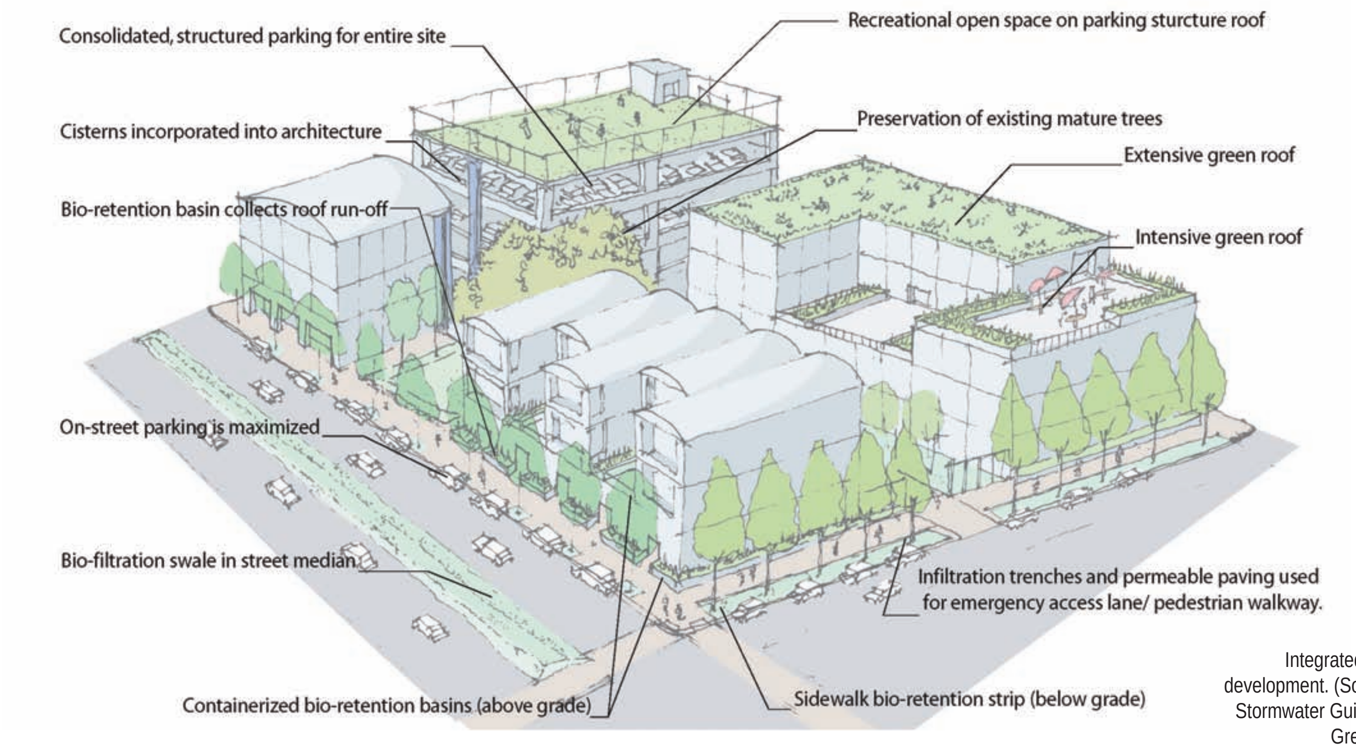
The Green City Lofts in Emeryville, California.

Stormwater solutions for brownfields with residual contamination often require that no surface water infiltrates the soil. This works fine in most settings where there is more space, particularly uncontaminated space available for diversion, retention and treatment. Emeryville was not able to adopt other cities' stormwater strategies because of the compacted, contaminated soils within its dense, high-value urban area. In 2004, Emeryville received a Smart Growth grant from the U.S. EPA to create local sustainable solutions to brownfield redevelopment. In 2005, Emeryville City Council adopted Stormwater Guidelines for Dense, Green Development that apply to development projects of 10,000 square feet or more. These guidelines emphasize site design that uses vegetated stormwater management practices and integrates parking strategies that reduce the total number of parking spaces required in the community by way of shared parking, making the best use of on-street parking, and pricing strategies. Emeryville's Stormwater Guideline's for Dense, Green Development can be found at: www.ci.emeryville.ca.us/planning/pdf/stormwater_guidelines.pdf.

Emeryville's solutions encourage minimizing total impervious area and managing stormwater onsite to prevent surface run-off. The guidelines suggest a range of design options that can stand alone or be combined into an integrated approach. Tree preservation and planting with structured soils work well within the space constraints of parking lots, sidewalks and dense development. Green roofs can either be extensive or intensive to manage rainfall through evapotranspiration and bio-filtration. Stormwater reuse is another creative way to manage stormwater in dense urban areas. Cisterns placed above or below ground are suggested for water storage and reuse of rainwater for irrigation and other non-potable uses. Green City Lofts, a 62-unit multifamily development in Emeryville, reuses stormwater for irrigation on the site of a former paint facility contaminated with petroleum hydrocarbons.

Detention, retention, and biofiltration are suitable for contaminated sites because they prevent exfiltration to underlying soils and allow adequate time for water to be in contact with plants and trees for bioremediation. Infiltration trenches and basins collect stormwater and infiltrate or attenuate runoff and may also use filter devices for pre-treatment. Permeable pavement and rain gardens are not usually suitable for sites with residual contamination, but Emeryville's Stormwater Guidelines suggest that in these circumstances, the area be capped and the stormwater retention vault below the permeable surface lined and fitted with under-drains connected to the storm sewer system.

Almost all of the solutions outlined in Emeryville's Stormwater Guidelines confer a range of additional benefits of green infrastructure beyond improved water quality and ecosystem health, including unique and attractive streetscapes, additional recreation and open space, as well as helping the city to be more competitive in attracting further housing and business development.



Integrated design for dense development. (Source: Emeryville's Stormwater Guidelines for Dense, Green Development.)

From Model A to a Model of Redevelopment in Dearborn, MI

Built by Henry Ford in the 1920s, the Rouge Truck Manufacturing Complex was a marvel of industrial efficiency. Raw materials went into one end of the plant and completed vehicles came out the other. Over time, the area devolved into a brownfield and in 2000, the Ford Motor Company began a project to redevelop the plant as a model of sustainable manufacturing.


The former Rouge Truck Factory in Dearborn, Michigan utilizes landscaped swales and wetlands containing native plants, bushes, and trees to remediate soils.

The centerpiece of stormwater management at this industrial area is a 10-acre green roof that can retain approximately 50% of precipitation falling onto it. Additionally, it decreases the building's energy costs and will likely double the roof's lifespan. Other stormwater features include collection of excess runoff and its reuse throughout the plant. Porous pavement allows water to drain through to a filter system that improves quality before being used elsewhere.

Landscaped swales and wetlands containing native plants, bushes, and trees remediate the soils surrounding the building by taking up, sequestering, and even treating pollutants that accumulated during more than 80 years of manufacturing. This vegetation also provides valuable habitat for wildlife and helps to cleanse water before it enters the nearby Rouge River. Water quality monitoring data show increased levels of dissolved oxygen necessary for fish and other species to thrive. Bacteria levels are also declining, which is beneficial not only to fish but to the increasing numbers of people who enjoy spending time on the river.

Toxic Steel Residue Gives Way to New Residences for Pittsburgh, PA

Four miles from downtown Pittsburgh, on a 238-acre parcel adjacent to Nine Mile Run, a brownfield has been redeveloped into the residential area known as Summerset at Frick Park. Over $300,000 in EPA Brownfields Assessment funds were used to survey the area, which once held piles of slag—a by-product of combusting coal to create steel.

Summerset at Frick Park features 713 housing units with 336 single-family homes, 121 townhouses, and 256 apartment units. In the process, Nine Mile Run, the last free-flowing stream in the City of Pittsburgh, was transformed as well. Degraded by sewage and high-alkaline seeps from the accumulated slag, this urban stream has undergone a renaissance. On-site soils were blended with granular slag, wood chips and fertilizers and used to plant steep slopes with grasses and legumes. Trees tolerant of high pH and compaction were also used to populate the stream banks


Summerset at Frick Park in Pittsburgh, Pennsylvania, built on a former brownfield.

The project increased the city's green space, and created new trails connecting Frick Park to the Monongahela River. It provided new housing without sacrificing natural space or resources. The community also enjoys improved river access, enhanced tax revenues, a beautified landscape, and new recreational opportunities.

Definitions

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Additional Resources

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Enclosure D

~~FINAL~~ Revised DRAFT

Considerations for Stormwater Features at Conditionally Closed ~~within Contaminated~~ Sites

Florida Department of Environmental Protection
Division of Waste Management
District & Business Support Program
Tallahassee, FL

October 19, 2019

Please Read This Disclaimer:
This document is only intended as guidance when adding or modifying a stormwater feature at a conditionally closed site when such additions or modifications are restricted as part of the closure. ~~Nothing in this guidance supersedes any Federal, State, or Local requirements.~~ This guidance is not a stormwater management system design document and does not authorize or provide design requirements for any construction of a stormwater feature. Nothing in this guidance supersedes any Federal, State, or Local requirements; nor does it create any new requirements. This guidance does not authorize dewatering or meet the requirements needed to obtain a dewatering permit. All applicable Florida Department of Environmental Protection, Water Resource Management Rules must be adhered to and are located at the following link: Water Resource Management Rules.

Problem Statement:
Conditional Site Rehabilitation Completion Orders (CSRCOs) under Rule 62-780.680(2) or (3), F.A.C. may incorporate Institutional Controls (ICs) or Engineering Controls (ECs) that may restrict construction of new and/or alteration of existing stormwater management systems (SWMS). ~~Likewise, on sites undergoing redevelopment activity with ongoing remedial actions, the design or construction of a SWMS can affect site contamination areas.~~ The State supports reuse of contaminated sites and recognizes that new construction requires placement of SWMS to appropriately manage runoff from impervious surfaces. Conditionally closed ~~Contaminated~~ sites may require expansion of the impervious areas (new building foundations, parking, pavement, access roads, etc.) which~~and~~ may trigger a requirement for a new SWMS or modification of the existing SWMS.

In the case of contaminated sites that qualify for a conditional site rehabilitation completion order (CSRCO), the planning for potential areas ~~on the site~~ for ~~future~~ SWMS is important so as not to violate the possible institutional or engineering control, or otherwise cause contamination to circumvent the control and spread ~~contamination~~ to either previously uncontaminated areas or offsite. If such a spread or impact occurred, it could result in requirements for additional site assessment and potentially lead to rescission of the CRSCO~~would render the CSRCO void~~.

Goal of this guidance document:
The construction, ~~or~~ modification, or operation of SWMS should not cause contaminated media to potentially spread or leach.~~not affect contamination at the site (cause leaching from soil or mobilize the groundwater contaminant plume).~~ ~~In some cases, the construction of SWMS may be addressed prior to closure and the restriction removed from the CSRCO.~~ ~~Please note that a~~A reasonable~~dequate~~ demonstration should~~must~~ be provided that neither the currently proposed or any future modification of the SWMS will alter the risk mitigation strategies used to satisfy the conditional closure requirements. If an adequate demonstration is not made, it may be necessary to alter the I~~E~~Cs or E~~I~~Cs used to close the site and amend the CSRCO. ~~exacerbate the contamination at the site.~~ ~~Potential future development including the type and location of the SWMS should be evaluated. Guidance on addressing SWMS construction prior to closure is provided below.~~

Potential future or conceptual development plans including the type and location of the SWMS can ~~should~~ be evaluated as part of the ~~prior to~~ closure and the restriction can be removed from or modified in the CRSCO accordingly. ~~In some cases, the construction of SWMS may be addressed prior to closure and the restriction removed from the CSRCO.~~ For situations where prior SWMS evaluation is not possible, this guidance can also assist in evaluating criteria ~~obtaining approval~~ for the construction of a new or modification of an existing SWMS on a contaminated site following closure.

SWMS - Design & Best Practices at Contaminated Soil and/or Groundwater Sites in Relation to CSRCOs

The placement, design and use of stormwater structures, ponds, and pathways is a critical part of a plan to prevent the spread of pollution at known contaminated sites due to the potential to cause leaching

Commented [DB1]: Commented [LLH1]: Would this problem not be sufficiently mitigated with improved communication between the FDEP (between the Waste Cleanup and Water Resource Mgmt Divisions) and WMDs via GIS information that flags Active Cleanup sites or Closed sites with CRSCO that involves stormwater restriction? Let data management and technology be the precursor for this solution looking for a problem.

Commented [DB2R1]: This guidance is intended to facilitate those discussions.

Commented [DB3]: Comments received by the FBA membership:

Spreading a plume within the property boundary would not be an issue as long as there are proper controls that prevent/reduce or altogether eliminate groundwater access and a model shows that the plume stays within the property boundary.

As per rule, the point of compliance for verification is the property boundary so the wording "previously uncontaminated areas" is unclear. Conceivably, and in the case of stormwater injected into a groundwater plume, a plume can expand or contract as long as it is done within the property boundary and model shows such is the case.

Commented [DB4R3]: DEP does not agree that spreading a plume is allowable even if only done within the property boundary. That would seem to be an unstable plume at that point and the location of the groundwater plume would be unknown.
The rule does not restrict the point of compliance to the property line.

from soils or to create a hydraulic head to spread contamination in groundwater across the site or off site to previously uncontaminated areas.

In general, efforts should be made to plan stormwater structures, ponds and other conveyance featurespathways shouldare to be placed in previously non-contaminated areas of a site to prevent and/or reduce the mitigate the risk of exposure to contaminated mediapossibility of causing the contamination to spread or increase due to leaching or hydraulic head conditions.

SWMS design requirements are subject to the requirements of the SWMS reviewing agencies and are subject to change. The appropriate reviewing agency should be consulted for current requirements and nothing in this guidance document alters those requirements.

Dry Pond vs Wet Pond. Pond design requirements are sSubject to thecomments and requirements of the SWMS reviewing agencies and are subject to change. The appropriate reviewing agency should be consulted for current requirements and nothing in this guidance document alters those requirements., as appropriate, Generally speaking, as of the time of this guidance, dry ponds are those where the bottom of the pond is above the Seasonal High-Water Table (SHWT) (typically ≥ 2 feet) and areshould be designed to drawdownempty, often through infiltration,recover within 72 hours of a rain event. Dry ponds with underdrains are expected to drawdownempty should recover within 36 hours. It is recommended that the bottom of the dry pond be at least 2 ft above the Seasonal High-Water Table (SHWT). Wet ponds are those where the pond bottom is below the SHWT and are designedhave to recover to their static elevation within a certain timeframe (usually noted in the construction application) and the pond bottom is below the SHWT.

SWMS shouldmust be designed with site groundwater elevation data in mind so as not to cause migration of the plumeto not adversely affect the contaminated areas of the site. A sufficient number of wells or piezometers must be used, and GGroundwater elevation contour maps that developed to accurately demonstrate the direction of groundwater flow at the site are useful in making this evaluation. If adequate groundwater elevation data are not available to accurately demonstrate the direction of groundwater flow, supplemental data collection from additional wells or piezometers may be warranted. The SWMS should stormwater design may only be placed in specific areas in such a way as to not impact or cause movement of contamination.

Further consideration may also beis needed into evaluate the placement of engineering controls, so as to not interfere with or to clearly define the appropriate or available locations for the construction of SWMS.

The following questions should be considered during the planning stages of the SWMS either prior to closure or at a site where a CSRCO already exists:.

- What will be the type of the future development:, residential, or commercial, recreational or some other use? Note that an institutional or engineering control may be required to reduce or eliminate exposure to impacted soil and/or groundwater Note that a deed restriction may be required to limit future land use. Other existing controls on the property may affect the placement or design of the SWMS.
- Based on Because of the land use and size, as well as the underlying lithology, what type of stormwater system will work better?:
    a. Wet detention system

Commented [DB5]:
Commented [LLH2]: Leaching how? By infiltration, or specifically by stormwater induced head beneath the SWMS? Either way, if leachable soils exists and have been proven to be a risk to groundwater, Engineering Controls (ie, impervious cap) would have been invoked in this situation. Right?

Commented [DB6R5]: Yes, and that EC would have to be addressed as part of the SWMS plans.
A second concern would be construction of an SWMS in an area of the site which had not previously been a leaching concern, but the construction of an SWMS in that area could cause leaching to begin.

Commented [DB7R5]: FBA Comments:
- An EC is not necessarily required if soil exceeds leachability SCTL. For instance, unconditional closure can be obtained with L-SCTL exceedances if the site was uncovered for two years with no impacts to groundwater evident.
-Recommended language may be slightly changed to state: "…due to the potential to cause *verified* leaching from soils…"

Commented [DB8R5]: It is true an EC is not necessarily required, however the potential for leaching should still be evaluated.

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Commented [DB9]: FBA Comments:
-Land use restrictions are not tied to groundwater impacts…direct exposure only. I would not make that tie in where it does not currently exist.
-Subtle for substantial point: groundwater use restrictions are not land-use restrictions. The property can be used for any purpose if access to groundwater is limited.
-Alternative wording: *"Note that an institutional or engineering control may be required to reduce or eliminate exposure to impacted soil and/or groundwater".*

Commented [DB10R9]: Good point, change made.

b. Detention with effluent filtration
c. Lined detention pond or vault
d. Dry system (retention pond)
e. Underground exfiltration (subterranean gallery)
f. Sand chimney

- What is the extent and depth of the groundwater plume in the restrictive area?
- What is the nature of the contamination?
- Is there a restriction for the use of groundwater and/or irrigation wells?
- Is soil contamination under an engineering control (EC) and will the EC be breached?
- How wWill potential dewatering during construction of the SWMS affect plume migration?
- How will the water from the dewatering operations SWMS construction be disposed (e.g., onsite management, sanitary sewer, generic permit, NPDES)?

Groundwater:

A mounding model can be used to support that a SWMS such that it installed some distance or location away from the plume will not cause vertical or horizontal movement of the groundwater plume(s)the plume to migrate. Approved models and design requirements must be consistent with the agencies responsible for reviewing the SWMS application. A link to the models accepted for Chapter 62-780, Florida Administrative Code purposes can be found here: https://floridadep.gov/waste/waste/content/guidance-documents-referenced-waste-management-rules

Prior to Closure

a. Depth to contaminant - Iif a demonstration is provided that groundwater is at a depth and that the infiltration from the SWMS will not cause the plume to migrate, then it may be possible to remove the stormwater restriction from the CSRCO. The demonstration or modeling and the use of any other supplemental factors should be based upon the appropriate design storm event usually 100-yr/24-hour or 25-year/24-hour depending on the type of system (open or closed) and the reviewing agency requirements. Engineering tThe SWMS should be engineered to impact only the upper surficial aquifer may assist in this demonstration.

b. Plume in relationship to confining layer – If groundwater contamination is below a competent confining layer, stormwater restrictions should not be necessary. However, language may need to be included in the CSRCO that the confining unit cannot be breached in the construction of the SWMS.

c. If construction of the SWMS will occur on top of the plume and cannot be addressed by a. or b. above, then the CSRCO can specify that any SWMS construction maywill require use of a liner thereby eliminating the need for subsequent Department (Waste Management) approval. Lined ponds will typically have outflow structures because the liner prevents direct infiltration. Please note that lined ponds are for storage/evaporation and need to have outflow structures. AnyThe outflow should direct runoff to areas away from the contamination and be designed so that the runoff does not remain or pond on the site where it could negatively impact the groundwater plume.

Subsequent to Closure

If the SWMS is proposed to be constructed above a groundwater plume where there are demonstrable concerns with regard to inducing contaminant migration, a liner is an option to address these concerns if

Commented [DB11]: **Commented [LLH6]:** The guidance document needs to be clear what resulting information is being sought here to come to a conclusion in support of the effects (or lack of) of siting a SWMS in or near a contaminated area. To simply state that a model can used to support that a plume will not move is sending a practitioner down a rabbit hole.

Commented [DB12R11]: Agreed, this is a topic for further discussion.

Commented [DB13]: Greg Dever: Are there dry season conditions that should be evaluated for wet detention systems where the pond is dry or lower than the surrounding water table and acts as a sink and causes a reversal in the groundwater flow?

Commented [DB14]: It's not clear that these extreme events which are understandably used to establish overall design criteria are the right events for evaluating possible effects on contaminant plumes. While these extreme events would be expected produce the most pronounced effects, those effects should be relatively transient. It could be possible that looking at more long-term patterns would be more useful.

Commented [DB15]: Comments
-Unlined ponds also typically have outflow structures.

Commented [DB16R15]: Noted, language deleted.

the conditions in a. or b. from the "Prior Closure Section" above cannot be demonstrated.SWMS constructed on top of the groundwater plume should generally have will require a liner unless a. and b. from "Prior Closure Section" above can be demonstrated.

If the SWMS for a conditionally closed site will be within 500 feet of the groundwater plume subject to the conditional closure, a mounding analysis should be conducted to evaluate the possible effect of the SWMS mounding on the existing plume.
SWMS constructed upgradient, cross-gradient or downgradient, and within 500 feet of the plume will require a mounding analysis be submitted to determine the effect of if the mounding on the contaminant intersects the plume(s).

Soil:
If soil contamination is present, the impact of the proposed SWMS on potential leaching or direct exposure shouldmust be consideredaddressed.

If soils exceed the Leachability-based Soil Cleanup Target Level (L-SCTL), Synthetic Precipitation Leachate Procedure (SPLP, EPA Method SW-846-1312) testing can be conducted prior to closure to demonstrate that the contamination will not leach and the restriction on SWMS is not requiredcan be removed. An appropriate number of samples should be collected from different lithologies and the highest concentrations within those lithologic units used in the SPLP analysis. A minimum of three samples per lithologic unit is recommended, but additional samples may be required depending on the size of the impacted area and the consistency of the SPLP results.

If soil exceeds the Leachability-based Soil Cleanup Target Level (L-SCTL), Synthetic Precipitation Leachate Procedure (SPLP, EPA method SW 846-1312) testing can be conducted under the footprint of the pond to demonstrate that contaminated soil will not leach and additional planning on SWMS is not necessary. A minimum of three samples per lithological unit is recommended.

Alternatively, conditional site closure may be achieved as long as any constituent shown to exceed L-SCTL under a SWMS footprint is demonstrated by groundwater sampling to not exceed GCTLs, or to not migrate beyond the property boundary and proper institutional controls are emplaced to reduce or eliminate access to groundwater.

If a dry pond is to be constructed on top of soil that exceeds the default direct exposure soil cleanup target level, the pond bottom shouldmust have an engineering control for the pond bottomin place to mitigate the exposure risk should be considered. This could be in the form of an appropriate barrier to eliminate exposure such as a 2-foot clean fill barrier or, impermeable liner. Alternatively, establish an alternative soil cleanup target level for an appropriate exposure scenario appropriate to a dry pond in lieu of a barriermay be established.a 2-foot clean fill barrier, impermeable liner, or the use of an alternative soil cleanup target level for an appropriate exposure scenario. The control would be included in the Institutional Control Registry and documented in the CSRCO.

Designers and/or engineers should check if a dry pond is to be constructed on top of contaminated soil and if available analytical data exceeds the FDEP SCTL trespasser scenario for specific contaminants.

Dewatering
Pursuant to Rule 62-621.300(2), F.A.C., coverage under this generic permit constitutes authorization to discharge groundwater from dewatering operations through a point source to surface waters of the

Commented [DB17]: Commented [LLH7]: This reads like a mandate, contrary to the Disclaimer

Commented [DB18]: FBA Comments:
-The "500 feet" element of the guidance sounds like a mandate and arguably may need to be both in the Water ERP and Waste Rules under rulemaking as it creates unintended consequences for practicing stormwater engineers. It needs to be thought of thoroughly.
-Part of the issue with the "500 feet" mandate is that civil engineers working on a development are not aware or know what contaminated sites may be located 500 feet away from a contaminated plume. For instance, in developing a small footprint Zaxby's, we do not know what contaminated sites are a block and-a-half away (~500 feet).
-Is this guidance stating that now we must check the FDEP database to investigate the presence of a site/plume within 500 feet of a property with a planned SWMS? If so, this is a cost that has never been placed on a client and it appears it must be imposed through rulemaking.
-Where do the 500 feet originate? What is the basis for such distance? Empirically, in S Florida and due to they extreme nature of a transmissive aquifer, an influx or slug of water into a plume should attain equilibrium or steady-state within 80-100 feet of the centerline of a SWMS without accounting for additional dissolution of the contaminant. ...

Commented [DB19]: Commented [LLH8]: They all are! This seems like a catch-all. What about small footprint sites were an adjacent site is undergoing a planned SWMS?

Commented [DB20]: Replaced with alternative language below.

Formatted: Strikethrough

Commented [JC21]: Comment
Alternative language submitted by members.

Commented [DB22]: FBA Comments
-It is unclear what "direct exposure risk" the FDEP is aiming to reduce. A stormwater dry pond is absolutely neither a residential nor an industrial scenario. A pond ...

Commented [DB23R22]: These are valid points. The direct exposure risk is not just from direct contact however, it is also from airborne dust. Admittedly, that is still a different exposure scenario. However, alternative exposu ...

Commented [DB24]: This is the alternative language suggested by FBA for the above paragraph. Included here for further discussion. The re-write above is an attempt to address this specific concern and allows for development ...

Commented [DB25]: Commented [LLH10]: Dewatering is an independent activity from SWMS design/permitting/construction. This activity has its own litany of considerations but should not be tucked into the ...

Commented [DB26R25]: Agreed, this is a separate issue.

State. Please ensure that the parameters of concern in the groundwater restricted area are below the surface water criteria. See Chart 1 below.

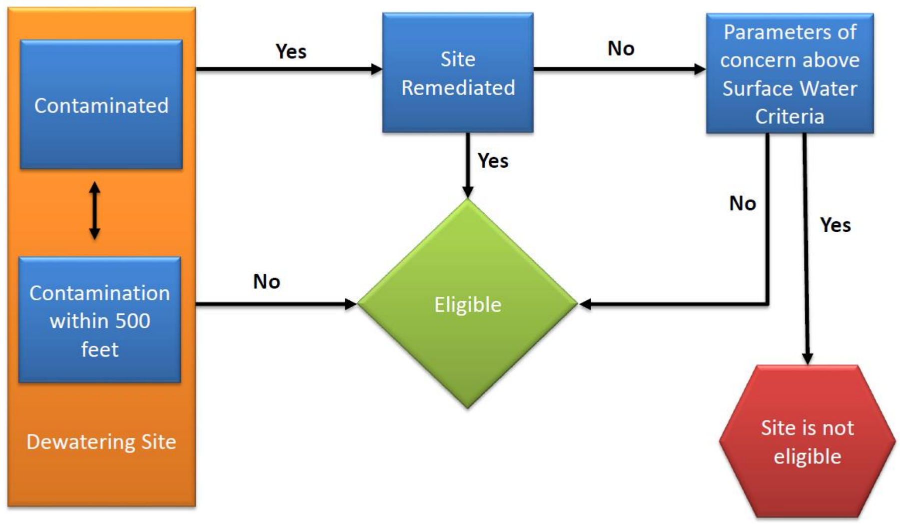

Chart 1. Decision tree for dewatering at contaminated sites. Provided by the Southwest District.

If the site does not qualify for a non-contaminated site permit, then an option is to contact the appropriate lead government agency for approvals to discharge to the sanitary sewer. The Dewatering permit is processed by DEP District Offices.

Further Consideration

On some sites it may be possible to identify portions of the property that do not need to be restricted with regard to stormwater construction. In such cases, the extent of stormwater restrictions could be documented in the CSRCO. The extent of the area with (or without) stormwater restrictions should be surveyed in and shown on the closure maps. It may be prudent to label areas acceptable and non-acceptable to stormwater structures, ponds, and pathways as part of the draft CSRCO Process. This in effect would be a secondary restrictive area(s) for non-acceptable future stormwater structure construction zones. The primary restrictive area would be the contaminated area(s) itself. Each CSRCO site would have specific maps which specifically designates these areas and defines the extent of contamination and the restricted area(s). The secondary restrictive area map would create a future stormwater use map for each site.

Acknowledgements:
The following people were instrumental in the development and drafting of this guidance: , Lanita "Lynn" Walker, P.E., Alex Webster, P.G., Yanisa G. Angulo, P.E., Simone Core, P.E., John R. Sego, P.G., Dale Melton, ES III, Indar Jagnarine, P.E., Missy Palcic, P.E., Craig Parke, P.G., Florida Brownfields Association.

Commented [DB27]:
Commented [LLH11]: The flow chart needs to be expanded and some clarification added to make it more usable. For instance, will you be ineligible just because the groundwater contaminants exceed surface water criteria? Dewatering treatment can reduce those concentrations or the water can be trucked offsite instead of being discharged.

Commented [DB28R27]: Also agreed, that can be taken up with dewatering guidance.

Commented [DB29]:
Commented [LLH12]: A more ominous and potentially legal issue is the one below:
A non-contaminated property located adjacent to a contaminated plume is to be redeveloped and analysis shows that dewatering will cause plume migration to the non-contaminated property. What is the Department's position? To not permit the construction of a SWMS on the noncontaminated property thus affecting an innocent land owner of their rights to develop the property? Would this not result in a property rights and takings issue? Also, would the dewatering by itself constitute an act of creating a "Site" (defined as the lateral extent of contamination by FDEP) on their previously non-contaminated property? Who is then responsible to remediate the "new "site?
This issue needs to be discussed further with FDEP as it may lead to litigation.

Commented [DB30R29]: Agreed discussion is needed.

Commented [DB31]:
Commented [LLH13]: We respectfully disagree with this. The acceptability or not of any area is a highly subjective matter subject to land availability, IC availability, engineering, etc. Creation of a secondary restrictive area creates another layer of regulatory input and verification and whose costs are not defined.

Commented [DB32R31]: Intent was to attempt to minimize areas of the property that may be restricted for stormwater use. Especially on larger sites, it may be possible to identify a perimeter beyond which the stormwater control would not be needed. This would be done as part of the closure as so subsequent regulatory involvement would not be required. See if rewrite helps.

~~For additional information please contact Lynn Walker at Lynn.Walker@floridadep.gov or 850-245-7502. You may also contact the contributors listed below.~~

~~References:~~

- *~~a. Operating Agreement Concerning Regulations under Part IV, Chapter 373 F.S. between SWFWMD and DEP~~*
- *~~b.~~ a. ~~SWFWMD Environmental Resource Permit Applicant Handbook Volume II, effective June 1, 2018~~*
- *~~c. DEP-NWFWMD ERP References and Design Aids~~*

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Commented [DB33]: **Commented [LLH14]:** Why is no one in the FDEP Water Resource Management Division included here?

Commented [DB34R33]: Good question. I know we did consult with them during the drafting and some of the folks listed have some stormwater experience. Overall, our stormwater staff did not feel comfortable offering an opinion on what might or might not be acceptable at a waste cleanup site. Preferring to defer to DWM as knowledgeable with regard to the wastes.

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~~*Not currently working with the agency~~

Enclosure E

MIAMI-DADE COUNTY
Carlos A. Gimenez, Mayor

Department of Regulatory and Economic Resources
Environmental Resources Management
701 NW 1st Court, 4th Floor
Miami, Florida 33136-3912
T 305-372-6700 F 305-372-6982
miamidade.gov

RER/ERM
POLLUTION REMEDIATION SECTION
TECHNICAL GUIDANCE

DRAINAGE PLANS FOR CONTAMINATED SITES

MINIMUM REQUIREMENTS

The appropriate location of drainage structures is essential in preventing the movement of contaminant plumes into previously uncontaminated areas. All drainage installations at contaminated sites shall be reviewed and approved by the RER/ERM's Pollution Remediation Section prior to construction. The scope of work provided by the PRS review is limited to evaluate the location of the proposed drainage system in reference to the contaminated areas. Approval from other departments, and/or sections and other governmental agencies having jurisdiction over the scope of work must be obtained prior to the implementation of the project. The following information is required:

1) The location of the contaminant plume(s) in reference to the area of the proposed drainage structures must be included on the site plan. The plume(s) must be delineated both horizontally and vertically to applicable target cleanup levels in the drainage area. Monitoring wells, including identification numbers, must be shown on the plan.

2) Groundwater analytical results must be submitted with the plan including copies of laboratory analyses sheets. An updated groundwater sampling event may be required if sample results are greater than nine (9) months old. The sampling event must include all applicable parameters associated with the site's type of contamination.

3) The groundwater flow direction must be shown on the plan.

4) The location and detailed construction drawings of the proposed drainage structure must be included on the plan (e.g., piping depth, drainage well depth, etc.). Plans must specify the locations of solid and perforated sections of piping. Details of the existing system must be provided if the proposed drainage system ties into the existing drainage system.

5) A minimum of two (2) plan sets that include all of the information requested are to be submitted for the review (1 set will be placed in the PRS RER/ERM file). All applicable pages of the drainage plan must be signed and sealed by a Professional Engineer registered in the State of Florida. The appropriate review fee (see below), made out to Miami-Dade County, must be included with the plans.

PRS REVIEW FEES
(See Fee Schedule at http://www.miamidade.gov/development/library/fees/schedule-environmental.pdf). All fees include a 7.5% RER surcharge.

- Site under one acre in size: $300.00+$22.50 = **$322.50**
- Sites over one acre in size or projects that encompassed multiple contaminated sites: $300.00+$22.50 **= $322.50** plus $100.00+$7.50 = **$107.50** per additional acre or site encompassed by the project

Enclosure F

Carlos A. Gimenez, Mayor

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miamidade.gov

TECHNICAL GUIDANCE
RER/ERM
POLLUTION REMEDIATION SECTION

DEWATERING AT CONTAMINATED SITES
3-10-10

MINIMUM REQUIREMENTS

Dewatering activities are often conducted at contaminated sites (or in their vicinity) in order to perform aquifer pumping tests, underground utilities installation, underground tank and piping installations and repairs, among other construction related activities. All dewatering activities at contaminated sites must be coordinated with the RER/ERM's Pollution Remediation Section prior to implementation. The scope of work provided by PRS review is limited to the predicted influent concentrations, treatment of the recovered groundwater and discharge. The PRS review does not evaluate the predicted flow rates or dewatering procedures and groundwater extraction equipment. Approval from other departments, and/or sections and other governmental agencies having jurisdiction over the scope of work must be obtained prior to the implementation of the project. Please contact the Water Control Section (WCS) of RER/ERM at (305) 372-6681 pertaining to Class V Permit requirements for Temporary Dewatering Projects.

PRS PLAN REQUIREMENTS

A dewatering proposal must be submitted to RER/ERM's Pollution Remediating Section (PRS) accompanied by a review fee (refer below for applicable review fees), when disposal into the ground, groundwater, surface waters of the sanitary sewers system is intended. The proposal must include the following:

a. A scaled site diagram showing the water withdrawal location(s) and the effluent disposal location(s).
b. The groundwater extraction rates, operating schedule and overall duration of dewatering at each location.
c. The radius of influence (ROI) of the dewatering operations (e.g., based on flow rate(s), duration, etc.).
d. Current contaminant concentrations (within 9 months) from the areas to be encompassed by the dewatering operations and the groundwater disposal areas, when disposal into the ground or groundwater is intended.
e. The method of contaminant treatment (when applicable) including technical specifications of the treatment system and expected system influent and effluent concentrations. Supporting calculations, bench or pilot test results, or data from similar applications may be submitted to support the treatment system removal efficiency. The design must be signed and sealed by a professional engineer registered in the State of Florida under Chapter 471, F.S.
f. The effluent sampling frequency and analysis turnaround time. The treated water must be sampled at the beginning and throughout the operation of the dewatering activities to ensure that applicable standards are not exceeded.

2. Only a notification to the PRS is required if off-site disposal using a tanker tuck is intended. A RER/ERM approved waste hauler must be used for disposal. No review fee will apply in this instance.

I. **ON SITE DISPOSAL**:

1. For on site recharge of dewatering effluent (infiltration gallery, swale etc.), contaminated water must be treated to the applicable cleanup target levels (CTLs) specified in Chapter 62-777, Florida Administrative

Code (F.A.C), Chapter 24, the Miami - Dade County Environmental Protection Ordinance, or any other more stringent standards applicable to the site prior to disposal.

2. The treated dewatering effluent shall be discharged to an on-site area out of the contaminant plume to avoid dispersing the plume. If the contaminant plume encompasses the entire site, then alternative disposal locations must be considered. Returning contaminated water to original excavation is not an option.

3. The treated effluent must be sampled throughout the dewatering operations to ensure that applicable standards are not exceeded. A 24-hour turnaround time may be required for the processing of the samples in some instances. If at any time the effluent sampling results show levels of contaminants exceeding any of applicable CTLs, the groundwater discharge should be immediately ceased and PRS notified.

II. **OFF SITE DISPOSAL**:

1. Discharge through off-site storm drainage structures or to surface waters:

    a. If discharging to a surface water body, a United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permit must also be obtained. Further information regarding NPDES permitting for effluents impacted by petroleum contaminants, may be found in the FDEP Remedial Action Guideline BPSS-3. For effluents impacted by other than petroleum contaminants, the Florida Department of Environmental Protection must be contacted for the NPDES requirements.
    b. The dewatering effluent must be treated to the applicable cleanup target levels (CTLs) specified in Chapter 62-777, Florida Administrative Code (F.A.C.), Chapter 24, the Miami – Dade County Environmental Protection Ordinance, or any other more stringent standards applicable to the site prior to disposal.
    c. The treated effluent must be sampled throughout the dewatering operations to ensure that applicable standards are not exceeded. A 24-hour turnaround time may be required for the processing of the samples in some instances. If at any time the effluent sampling results show levels of contaminants exceeding any of the applicable CTLs, the groundwater discharge should be immediately ceased and the RER/ERM notified.

2. Discharge to the sanitary sewer system:

    a. Approval from the appropriate municipality's water and sewer department (i.e., MDWASA) must be obtained.
    b. The effluent must be treated to the appropriate sanitary sewer standards, specified in Chapter 24 the Miami – Dade County Environmental Ordinance.
    c. A Sewer Capacity Certification Letter Application must be completed and approved by RER/ERM Plan Review Section.

3. Discharge to tanker truck:

    a. At the conclusion of the activities, disposal receipts must be submitted to the Pollution Remediation Section.

PRS REVIEW FEES (see Fee Schedule at http://www.miamidade.gov/derm/paying_fees.asp)

$300.00+$22.50 = **$322.50** For a plan not including groundwater modeling or a contaminant treatment system
$750.00+$56.25 = **$806.25** For a plan including groundwater modeling or a contaminant treatment system

Enclosure G

BROWARD COUNTY FLORIDA
Environmental Protection and Growth Management Department
ENVIRONMENTAL ENGINEERING AND PERMITTING DIVISION
1 North University Drive, Mailbox 201, Plantation, Florida 33324 • 954-519-1483 • FAX 954-519-1412

STANDARD OPERATING PROCEDURE FOR DEWATERING
(Revision 3, Effective December 1, 2009)

INTRODUCTION

As required by Broward County Code (Code), any person(s) wishing to conduct dewatering activities at or within a one-quarter-mile radius of a contaminated[1] site must notify and receive approval from the Broward County Environmental Protection and Growth Management Department (Department) prior to implementation. The County's notification requirements for these dewatering activities are outlined in Section 27-355(4) of the Code, which states:

> "Prior to any persons conducting dewatering operations at or within a one-quarter-mile radius of a contaminated site, written notification shall be given to [the Department] and shall include, at a minimum:

- Justification for the need for dewatering;
- Water treatment and disposal plans;
- Effect of the dewatering and disposal procedures on the contaminant plume;
- Monitoring program; and
- Where required and authorized by Chapter 471, F.S. [Florida Statutes] or Chapter 492, F.S., applicable portions of dewatering plans shall be signed and sealed by a registered professional engineer or a registered professional geologist."

Approval of such activities is required by Section 27-353(i) of the Code, which states:

> "Dewatering operations at or within a one-quarter-mile radius of a contaminated site shall not be conducted without [Department] approval."

APPLICABILITY

This Standard Operating Procedure (SOP) and the requirements detailed herein are applicable to dewatering operations within Broward County. "Dewatering" refers to any technique that is employed to lower groundwater level. These requirements apply solely to reviews that are conducted by Broward County Cleanup and Waste Regulation (CWR) Staff for the purpose of ensuring that dewatering operations at or within one-quarter mile of contaminated sites will not result in the exacerbation, migration, or improper treatment of contamination. Please note that additional requirements for dewatering have been established by other agencies and may be established by other Sections within the Department.

<u>Tank Upgrade Exemption</u>

Dewatering operations conducted to facilitate underground storage tank upgrades and replacements necessary to meet the Performance Standards for Category-A and Category-B Storage Tanks of Section 27-307(b), Broward County Code, and Section 62-761.510, Florida Administrative Code (F.A.C.), are exempt from the CWR Section Dewatering Plan review and approval process. To qualify for this exemption, a **Notice of Intent to Dewater** must be provided to CWR Section staff at least five (5) business days prior to dewatering. The Notice of Intent to Dewater must agree to the following conditions:

1. Dewatering duration must not exceed a total of three (3) calendar days (72 hours). If intermittent dewatering

[1] "Contaminant" is defined in Section 27-352, Broward County Code

is performed, this duration is be considered to be the sum of all actual pumping periods, however clarification should be provided in the Notice of Intent to Dewatering with respect to the overall period that dewatering will be performed;

2. Sheetpile must be installed to a depth not less than 8 feet below the bottom of wellpoint screens;
3. Effluent must be monitored to ensure compliance with turbidity standards, as applicable; and
4. If conducted within a tank farm area known to be contaminated, dewatering effluent must be properly treated and monitored to comply with water quality standards or applicable Cleanup Target Levels of Chapter 62-777, Florida Administrative Code, prior to discharge. Treatment system specifications, laboratory analytics, field notes, and other relevant documentation should be maintained by the party responsible for performing the dewatering.

Any exceptions to conditional items 1 and 2 of this exemption will require the Department's approval of a Dewatering Plan submitted per this SOP. If contamination is encountered during the tank upgrade which has not been previously reported to the Department, dewatering must cease and the Department must be notified in accordance with the requirements of Code Section 27-355.

PROCEDURE

A flow chart which demonstrates this SOP is depicted in Exhibit I, attached. Please note that Exhibit I does not address the tank upgrade exemption as detailed in the previous section.

I. Need for CWR Section Approval of Dewatering Operations

A. For sites located beyond one-quarter mile of a contaminated site in Broward County, the Department does not include a "No Dewatering Permitted" clause in construction plan approvals. Dewatering may proceed at such sites; however, it is recommended that CWR Section staff be notified for confirmation.

B. In instances where dewatering is proposed within a contaminated area (i.e., where it is known that groundwater contains contaminants above applicable standards) but where no other contaminated sites are located within one-quarter mile, a Dewatering Plan must be submitted to the CWR Section of the Department for review and approval prior to implementation of dewatering activities; however, the Dewatering Plan should only contain the following:
   1. The contaminated site information outlined in Section II.A. of this SOP for the dewatering location,
   2. The information outlined in Section II.B. of this SOP, and
   3. Proper certification as required by Section II.E. of this SOP.

   A Dewatering Report to document the dewatering is also required by Section IV of this SOP.

C. For sites that are located within one-quarter mile of a contaminated site, a Dewatering Plan in accordance with Section II of this SOP must be submitted to the CWR Section of the Department for review and approval prior to implementation of dewatering activities. Dewatering will not be approved under any conditions for operations that may create a drawdown greater than 0.1 foot at a contaminant plume boundary. The Dewatering Plan must meet the requirements established in Section II of this SOP.

II. Dewatering Plan Requirements

A. **Contaminated locations at and/or within one-quarter mile of the proposed dewatering project must be identified**. At the time of this writing, the Broward County contaminated sites database and corresponding interactive map are available on the internet at http://www.broward.org/environment/contaminatedsites/Pages/Default.aspx.

   The following items should be included in the Dewatering Plan:
   1. Site Number and address for each contaminated site,

2. Contaminant type for each contaminated site,
3. Most recent contaminant plume maps for all groundwater-contaminated sites located within a quarter-mile radius from the proposed dewatering location (if available),
4. Tables of the most recent groundwater analytical data for the nearest groundwater-contaminated site (if available), and
5. A map, drawn to scale, that depicts the particular dewatering location on the site (designation of the site boundaries in general is not adequate) and the locations of identified contaminant plumes.

If contaminant plume maps and data are not available through hardcopy file review with the Department, the Florida Department of Environmental Protection, or the OCULUS petroleum document website (at the time of this writing, located at https://depedms.dep.state.fl.us/Oculus/servlet/login), then document this fact in the Dewatering Plan and assume that the contaminant plume is confined to the property boundary of the particular contaminated site.

B. The following information must be provided regarding the scope of the proposed dewatering activities:

1. Purpose of dewatering (i.e., an explanation of why dewatering is necessary),
2. Dewatering technique (i.e., wellpoint, deep well, open hole, etc.),
3. Anticipated dewatering flow rate,
4. Total dewatering duration,
5. Method of effluent discharge,
6. Controls (i.e., settling tank, turbidity curtain, etc.) and a monitoring program employed to ensure that effluent will comply with applicable water quality standards, including turbidity.
7. If conducted in a contaminated area, engineering specifications for dewatering effluent treatment (i.e. air-stripper, carbon filtration, etc.) and details for an analytical monitoring program to ensure that effluent will meet water quality standards established by Section 27-195, Broward County Code. Please note that Certification by a Florida-registered Professional Engineer, specifically, is required for treatment specifications by Section II.E. of this SOP.
8. A description of any proposed controls, including engineering specifications for sheetpile or recharge system. Certification by a Florida-registered Professional Engineer is required for applicable sheetpile specifications by Section II.E. of this SOP.

C. Dewatering plans must contain a technical justification that is adequate to demonstrate the proposed scope of dewatering (as required in Section II.B.) will not affect contaminant plumes. There are two (2) acceptable methods for providing this technical justification:

1. **Manual estimations of the dewatering radius of influence by utilizing SFWMD data or approved aquifer test data to calculate Sichardt's equation.** As a "first pass" of technical justification, Sichardt's equation may be used to determine the radius of influence associated with the dewatering project as discussed in Section II.C.1.b. of this SOP. Details of Sichardt's equation, including an example calculation, are also included as **Exhibit III** to this SOP. The calculation must utilize 1) data from South Florida Management Water District's (SFWMD) Technical Publication 92-05 entitled "A Three Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida" (1992), or 2) data provided by an aquifer test conducted in accordance with Section II.C.1.a. of this SOP.

   a. Aquifer test performance and data collection must be consistent with the following guidance: Freeze and Cherry (1979), Fetter (1980), Kruseman and Derrider (1990), or Driscoll (1986). CWR Staff will use AQTESOLV (for Windows) to verify aquifer parameters that are generated from hand calculations and/or computer modeling analysis of aquifer tests. Aquifer Test Data may be collected in one of three (3) ways:
      (1) Historical aquifer test data from the CWR Section's in-house database may be obtained by contacting David Vanlandingham, P.E., at (954) 519-1478 or dvanlandingham@broward.org. The information contained in the CWR Aquifer Test database has been reviewed by CWR Section staff

for quality assurance.

(2) Other historical aquifer test data may be submitted if the test was performed within one-quarter mile of the proposed dewatering location and:

(a) Groundwater elevations were measured in at least three (3) observation wells (not including the test well) with varying distances from the recovery well,

(b) Data is collected from the beginning of the test until near steady-state conditions are achieved, and

(c) Unconfined aquifer conditions and partially penetrating wells were considered in analysis of the aquifer test data[2].

(3) Perform an aquifer test at the proposed dewatering location. Notification must be provided using Exhibit II and written approval must be obtained from CWR staff prior to implementation of the aquifer test. Approvals may be granted through email or facsimile. The test data will be acceptable if the conditions of Section II.C.1.a.(2) are met; in addition,

(a) observation wells are to be installed in a line between the dewatering locations and the nearest identified contaminant plume[3], and

(b) one of the observation wells is located at the edge of the proposed dewatered area.

b. Utilizing Sichardt's equation, a manual (hand) calculation may be performed to determine the projected radius of influence associated with the proposed dewatering activity and the flow rate necessary to produce the required drawdown. This calculation is detailed in Exhibit III accompanying this SOP.

(1) If the estimated value of radius of influence is less than the distance to the edge of the nearest contaminant plume, the Dewatering Plan may be approved (an example approval letter is provided in Exhibit IV).

(2) **If the estimated radius of influence is greater than the distance to the edge of the nearest contaminant plume, then groundwater modeling is required pursuant to Section II.C.2. of this SOP**. The dewatering scope of work may also be revised or hydraulic controls (for instance, sheetpile or artificial groundwater mounding via recharge trenches or wells) may be proposed; however, any hydraulic controls proposed must still be justified through the use of computer modeling in accordance with Section II.C.2. of this SOP, as manual calculations which consider hydraulic controls are not available[4].

2. **Groundwater modeling within a three-dimensional computer model utilizing SFWMD data or approved aquifer test data.** The model framework must utilize 1) data from South Florida Water Management District's (SFWMD) Technical Publication 92-05 entitled, "A Three Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida" (1992), or 2) aquifer test data obtained in accordance with in Section II.C.1.a. of this SOP.

All models, regardless of the software used to construct them, are to be properly documented. The Division will use Visual MODFLOW Pro to verify all modeling analyses. Any Dewatering Plan that includes computer modeling must also contain the following information, as applicable:

a. A compact disc with a copy of all model data including all necessary input, support, and output files.

b. Map file used as base coverage in .dxf or .bmp format.

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[2] If these conditions are not met, the test data may be reanalyzed by the applicant via a method that will consider unconfined aquifer and partially penetrating well scenarios.

[3] These observation points may also be used to meet the requirements of groundwater monitoring, as outlined in Section II.D. of this SOP.

[4] The manual calculation method cannot be used for sites where artificial groundwater mounding is proposed as a hydraulic control. Artificial groundwater mounding as a means of hydraulic control may only be justified through computer modeling as outlined in Section II.C.2. of this SOP.

c. Model domain including the number of columns, rows, and layers. Grid spacing must also be documented for areas of the model with increased cell resolution.
d. Model extent including X-axis, Y-axis, and Z-axis minimum and maximum. Also include coordinates (Lat/Lon, UTM, State Plane) if the model extent are referenced to specific geographic locations. The model should cover a sufficient area as to allow for a true representation of ground water flow during dewatering without undue influence from boundary conditions.
e. Model units for length, time, conductivity, pumping rate, mass, and concentration as applicable.
f. Surface elevation and bottom elevation of all layers. If layer elevation is not a constant, then submit a spreadsheet containing x, y, z data in either .txt or .xls format or as a Surfer▲ .grd file.
g. Conductivity values of all layers including Kx, Ky, and Kz. If conductivity data vary within a layer then submit a file in .txt, .xls, or .shp format. Also include all data interpolation information as applicable. If layer elevation is not a constant, then submit a spreadsheet containing x, y, z data in either .txt or .xls format or as a Surfer▲ .grd file.
h. Specific Storage (Ss) and Specific Yield (Sy) values of all layers. If Ss and/or Sy data vary within a layer, then submit a file in .txt, .xls, or .shp format. Also include all data interpolation information as applicable.
i. Porosity and effective porosity values of all layers. If porosity and/or effective porosity data vary within a layer, then submit a file in .txt, .xls, or .shp format. Also include all data interpolation information as applicable.
j. Pumping well specifications including exact map coordinates, screened interval, pump rate, and pumping duration.
k. Head observation well specifications including exact map coordinates, screened interval, observation point elevation, and all water table elevation measurements.
l. Concentration well specifications including exact map coordinates, screened interval, contaminant being monitored, observation point elevation, and all concentration measurements.
m. The type (constant head, rivers, general head, drains, walls, etc.) and model-grid location for all boundary conditions including an explanation of their selection and description of their input parameters. Boundary conditions should be defined as to not artificially influence ground water flow in the dewatering area or nearby contaminated sites.
n. Acknowledgment that the model ignores recharge to maintain a conservative estimate of dewatering influence.
o. Particle tracking information including number of particles, initial particle locations, and release times if applicable. All particles are to be tracked in the forward direction.
p. If Zone Budget is used to estimate a dewatering flow rate, then the number and model-grid location of zones and output information must be included, as applicable. The type of model run (Steady State Flow or Transient Flow) must also be specified. The Division recommends running the model using only documented boundary conditions under Steady State Flow to determine initial heads. Transient Flow should be used for the duration of proposed dewatering.
q. The time steps utilized during Transient Flow model runs.
r. Figures showing model output as both Head Equipotentials and Drawdown at the end of the proposed dewatering period for each modeled layer.
s. A figure identifying the 0.1-foot and 0.01-foot drawdown contours at the end of dewatering.

D. The Dewatering Plan must propose a groundwater monitoring program subject to the following:

1. Should a manual estimation of the radius of influence performed in accordance with Section II.C.1. of this SOP indicate that the radius of influence is less than the distance to the nearest contaminant plume, no monitoring program is required (an example approval letter is provided in Exhibit IV).
2. Should modeling performed in accordance with Section II.C.2. of this SOP indicate that the closest groundwater contaminant plume is outside of the 0.01-foot drawdown contour, no monitoring program is required (an example approval letter is provided in Exhibit IV).
3. Should modeling performed in accordance with Section II.C.2. of this SOP indicate the closest groundwater contaminant plume lies between the 0.01-foot and 0.1-foot drawdown contours, a monitoring program is

required (Exhibit IV will be modified by the Division to reflect specific requirements). The monitoring program must include:

a. A table of groundwater elevation data collected from a minimum of three observation points, placed on a line between the dewatering location and the nearest contaminant plume. Data shall be collected:
   (1) Prior to initiating dewatering activities to establish baseline elevations. Locations that are tidally influenced may require more than one baseline monitoring event.
   (2) Daily during the first week of dewatering activities, and weekly thereafter until dewatering operations cease. The applicant should make every effort to collect data at the same time of day to reduce the influence of daily fluctuations.
b. A map, drawn to scale, detailing the observation point locations relative to the dewatering project, and
c. A map, drawn to scale, including water table elevations from observation points and an indication of ground water flow direction.

4. Should a manual estimation of the radius of influence performed in accordance with Section II.C.1. of this SOP indicate that the radius of influence is greater than the distance to the nearest contaminant plume, or should modeling performed in accordance with Sections II.C.2. of this SOP indicate that the closest contaminated plume lies within the 0.1-foot drawdown contour, dewatering will **not** be approved by the Division. The Dewatering Plan may be revised or hydraulic controls (i.e., sheetpile cofferdam or artificial groundwater mounding via recharge) must be proposed and justified. If, in this event, hydraulic controls are proposed, computer modeling must be performed in accordance with Section II.C.2. of this SOP, as manual calculations that consider hydraulic controls are not available[5].

E. **All applicable portions of Dewatering Plans must be certified by a registered Professional Engineer or a registered Professional Geologist, as provided in Chapter 471, F.S., or Chapter 492, F.S.**

F. **The Dewatering Plan must contain the contact information for the entity that is assuming responsibility for the specified conditions of the Department's approval. The company name, a representative name, address, and phone number should be included, as applicable.**

G. **There is no review fee or "application" for the Dewatering Approval.** Simply submit one (1) certified original of the Dewatering Plan to the Department, to the attention of David Vanlandingham, P.E., at this letterhead address.

III. **CWR staff shall have a period of ten (10) business days to review Dewatering Plans submitted pursuant to this SOP and to provide comment and/or approval.**

IV. **A Dewatering Report must be submitted within thirty (30) days of completion of approved dewatering activities** to document actual flow rates and field monitoring data, including any monitoring conducted pursuant to Sections II.B.6., II.B.7, and II.D. of this SOP.

[5] The manual calculation method cannot be used for sites where artificial groundwater mounding is proposed as a hydraulic control. Artificial groundwater mounding as a means of hydraulic control may only be justified through computer modeling as outlined in Section II.C.2. of this SOP.

References

Chapter 27 of the Code of Ordinances of Broward County, Florida. Tallahassee, Florida: Municipal Code Corporation, 2001.

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Fetter, C.W. *Applied Hydrogeology* (Third Edition). New York, New York: Macmillian College Publishing Co., 1994.

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Freeze, R. Allan, and Cherry, John A. *Groundwater*. Englewood Cliffs, New Jersey: Prentice Hall, 1979.

Kruseman, G.P., and De Ridder, N.A., Analysis and Evaluation of Pumping Test Data. Wageningen, The Netherlands: International Institute for Land Reclamation and Improvement/ILRI, 1990.

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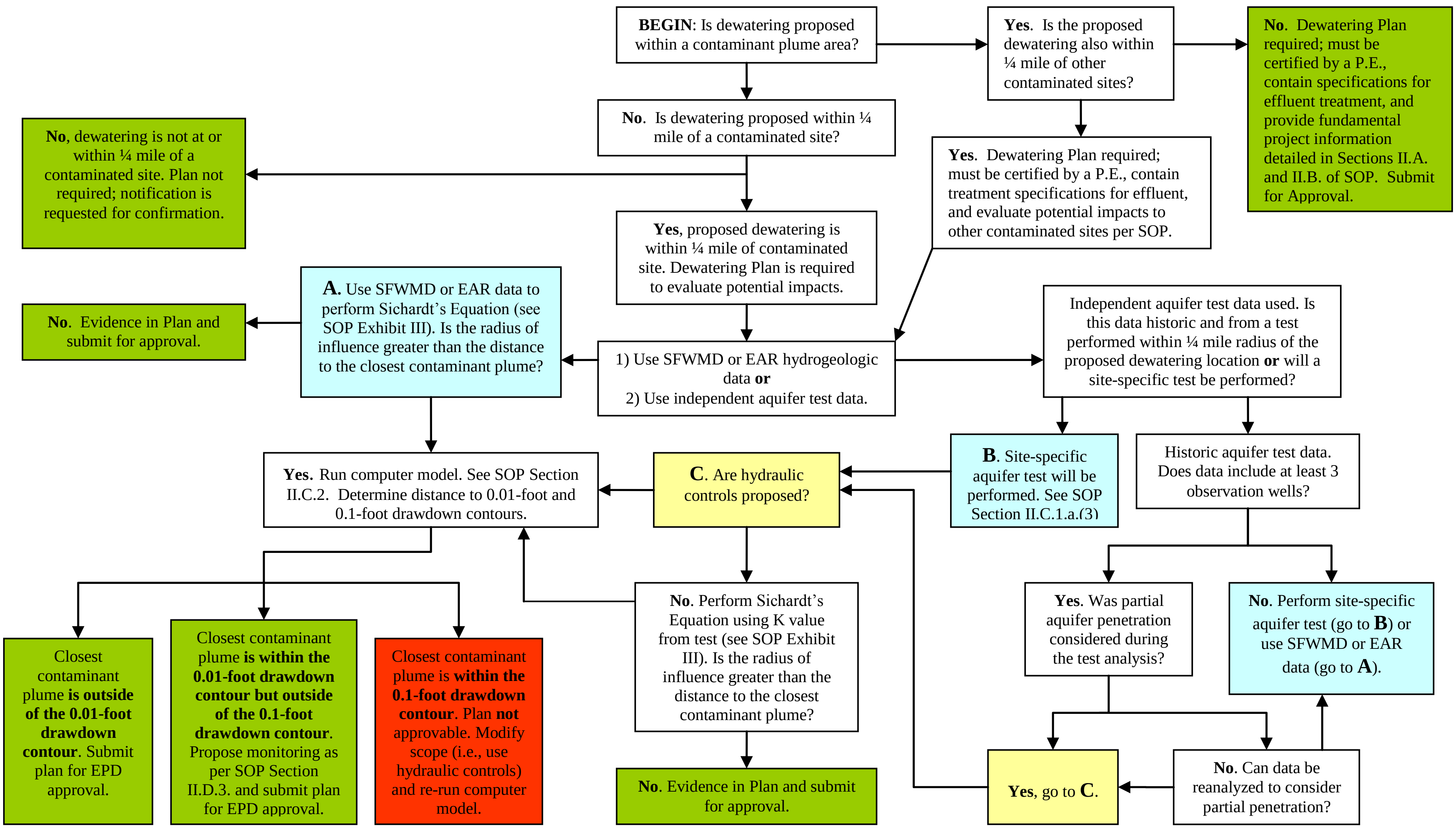
South Florida Water Management District (SFWMD). *A Three Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida*. West Palm Beach, Florida: Technical Publication 92-05, 1992.

Waterloo Hydrogeologic. Visual MODFLOW Pro (v.3.0.0). Waterloo, Ontario, Canada.

Environmental Protection and Growth Management Department
POLLUTION PREVENTION, REMEDIATION AND AIR QUALITY DIVISION
One North University Drive, Suite 203, Plantation, Florida 33324
954-519-1260 • FAX 954-765-4804

EXHIBIT I: Decision Flow Chart for SOP



Environmental Protection and Growth Management Department
ENVIRONMENTAL ENGINEERING AND PERMITTING DIVISION
1 North University Drive, Mailbox 201, Plantation, Florida 33324 • 954-519-1483 • FAX 954-519-1412

Date

Addressee Name
Company Name
Company Address
City, State ZIP

RE: Approval for Construction Dewatering Activity
[Project Name]
[Project Address, City, FL ZIP]
Broward County Dewatering Project ID [YYSSTTRR}

Dear Addressee:

Environmental Engineering and Permitting Division (Division) has reviewed the *[Name of Dewatering Plan]* (Dewatering Plan), dated [date] (received [date]), prepared and submitted by your consultant, [consultant name]. [Optional: The Dewatering Plan also contains Specifications for Sheetpile Wall design.] The Dewatering Plan was submitted to evaluate the impact of construction dewatering on pollutant migration, as required by Section 27-355(4), Broward County Code (the Code).

The Division hereby approves the referenced Dewatering Plan. This approval is based upon and subject to the following conditions:

1. The Dewatering Plan proposed is specific to [Description of construction activity] at the referenced site.

2. The dewatering depth and duration are approved as proposed and should not be exceeded. In the event that it becomes necessary to exceed the approved scope of work, you must contact this office immediately for approval. Please be advised that additional permits that are outside the scope of this review may be required by other regulatory authorities and must be obtained prior to commencing dewatering activities.

3. The technical review performed by the Division is limited to the investigation of the possibility of contaminant plume migration from the following nearby contaminated sites:

   Contaminated Site Number, Name, Address, City, FL (FDEP ID No. 06XXXXXXX, if applicable)
   [LIST ALL CONTAMINATED SITES CONSIDERED IN PLAN IN THIS MANNER]

4. [Optional: Steel cofferdams are to be placed in the locations designated in the Dewatering Plan. The steel cofferdams must extend to a depth of XX feet below the base of the excavation.

5. [Optional: paragraph specifying specific engineering controls such as recharge trench]

6. [Optional: The Division requires that the monitoring wells specified in the Dewatering Plan be utilized for groundwater monitoring. Each well must be sampled and the water level gauged no more than one week prior to the initiation of dewatering activities. The Division will require that samples be obtained [daily, weekly] from designated wells during dewatering activities for analysis via [insert EPA Methods as appropriate]. These results shall immediately be provided to the Division (facsimile is adequate) when they become available. A site map showing the location of the designated monitoring wells sampled should be provided with the results.]
7. [Optional on a case-by-case basis: Samples collected from dewatering discharge shall be analyzed by [insert EPA methods as appropriate] for the constituents specified in the Dewatering Plan. The Division will require that samples be

obtained [daily, weekly] from dewatering discharge (effluent) during dewatering activities for analysis via [insert EPA Methods as appropriate]. These results shall immediately be provided to the Division (facsimile is adequate) when they become available.]

8. Upon discovery of previously undocumented contamination in monitoring wells or excavated soils, whether by the presence of staining, free product, or by receipt of [any available] analytical results exceeding applicable Cleanup Target Levels (CTLs) of Chapter 62-777, Florida Administrative Code (F.A.C.), the Division will be notified and dewatering activities shall cease immediately. Similarly, if [any available] analytical results indicate that dewatering discharge (effluent) contains contaminants at concentrations exceeding applicable Groundwater CTLs of Chapter 62-777, F.A.C., the Division shall be notified and dewatering activities shall cease immediately. If contamination is discovered subsequently at the neighboring properties adjoining the contaminated site, and if it is established that the contamination discovered is a result of dewatering at the [name of project], [Addressee company name], agrees to conduct, with the property owner's permission, site investigations to ascertain the degree of the contamination and, based upon the results of such investigations, ensure cleanup of the contamination to the extent required by existing regulations. Costs of site investigations and cleanup of the contamination, if required, shall be borne by [Addressee company name].

9. Effluent is to be monitored for the purposes of ensuring compliance with applicable turbidity standards. [Optional: The Dewatering Plan indicates that certain preventative measures will be employed (TYPE OF CONTROLS HERE) during these dewatering activities to ensure that applicable water quality standards are met. OR The Division recommends that certain preventative measures be employed (i.e., sedimentation tank, turbidity curtain, etc.) during these dewatering activities to ensure that applicable water quality standards are met.] Should the water quality standards be exceeded, the Division shall be notified and dewatering activities shall cease immediately.

10. Please note that the Division requires advance written notification a minimum of three (3) days prior to the initiation of dewatering operations (facsimile is adequate).

11. A Dewatering Report is to be submitted to the Division within thirty (30) days of completing the activities approved herein. The Dewatering Report should contain a summary of all activities and groundwater monitoring results in tabular form.

As acceptance of these conditions, please sign, notarize, and return page X of the Dewatering Approval. If you do not agree to the terms of this Conditional Approval, please notify this office in writing within 3 working days of receipt. If you have any questions or require additional information, please contact the undersigned at (954) 519-XXXX or xxxxxxxxxxxx@broward.org.

Sincerely,
ENVIRONMENTAL ENGINEERING AND PERMITTING DIVISION

Signing Professional Engineer Name
Florida Professional Engineer No. XXXXX

Date

cc: Lorenzo Fernandez, P.E., EAR Section Manager
Ashok Raichoudhury, P.E., Broward County EEPD
Copy as appropriate

I, ______________________________, do hereby agree to the terms and conditions of the Dewatering Plan Approval Letter, as specified in the preceding pages 1 and 2 and in the Code (for and on behalf of Company, signed by an authorized representative).

____ (signature and title)

STATE OF FLORIDA
COUNTY OF ______________

Subscribed and sworn to (or affirmed) before me this day,

(Date)

by ____, who (Check one):

___ is personally known to me OR

___ has produced ____________________ as identification.
(type of identification)

____ Commission No.
(signature of Notary)

____
(SEAL ABOVE)

(name of Notary typed, printed or stamped)