Albany, Georgia

Stormwater Management Program

Green Infrastructure and Low Impact Development Program (GI/LID)

February, 2020

Prepared in Partial Fulfillment of the Requirement of Georgia Municipal Storm Sewer System NPDES Permit No. GAG610000, effective December 6, 2017.

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1 BACKGROUND

GENERAL

Albany is located in Southwest Georgia, in the Coastal Plain region of Georgia. It occupies a bluff that is split by the Flint River, at a point approximately 150 miles below its headwaters, in Dougherty County. It is approximately 160 miles south of Atlanta, 60 miles north of the Florida Line, and 50 miles east of the western Georgia border. The City encompasses approximately 55 square miles and had a 2010 population of approximately 77,000. The region has substantial traditional industry, agricultural facilities, and higher education facilities in Albany State University. Albany is the municipal center for Southwest Georgia.

PHYSICAL FEATURES

The primary hydrologic features of Albany are the Flint River and the Floridan aquifer. The Flint begins approximately 150 miles north near Hartsfield Airport in Atlanta, and has an average flow rate of 2800 cfs. The river is bounded on both sides through the City by a large earthen levee. The river flooded out of its banks during a 1994 event when Tropical Storm Alberto dumped 28 inches of rain on the receiving watershed above Albany, resulting in widespread flooding in the areas above and below the bluff. The Flint River continues south to the Georgia-Florida border where it joins with the Chattahoochee and forms the Apalachicola which empties into the Gulf of Mexico. The area is a substantial recharge zone for the Floridan aquifer, which supplies groundwater for potable water and agricultural irrigation throughout southwest Georgia.

The elevation in the City varies between 150 and 225 ft above mean sea level (MSL), while the overall land slopes from West to East or East to West along the river at an average grade of 0.4%. The soils in the area range from Grady clay loams to Greenville and Orangeburg sandy loams. They are primarily of hydrologic group B and C and are considered moderately well-drained with the exception of clay and limestone lenses found through the area. Figure 1 shows a representative soil map of the Albany area. In addition, due to the geology, much of the area is karst, and limestone formations are common throughout the region, including numerous shoals present in the river. The topography of the City is affected by this limestone, as the bluff is characterized by rolling depressions caused by limestone subsidence. In many cases, this results in local drainage features which have no outlet. Several canals were excavated during early City development to facility drainage in the City.

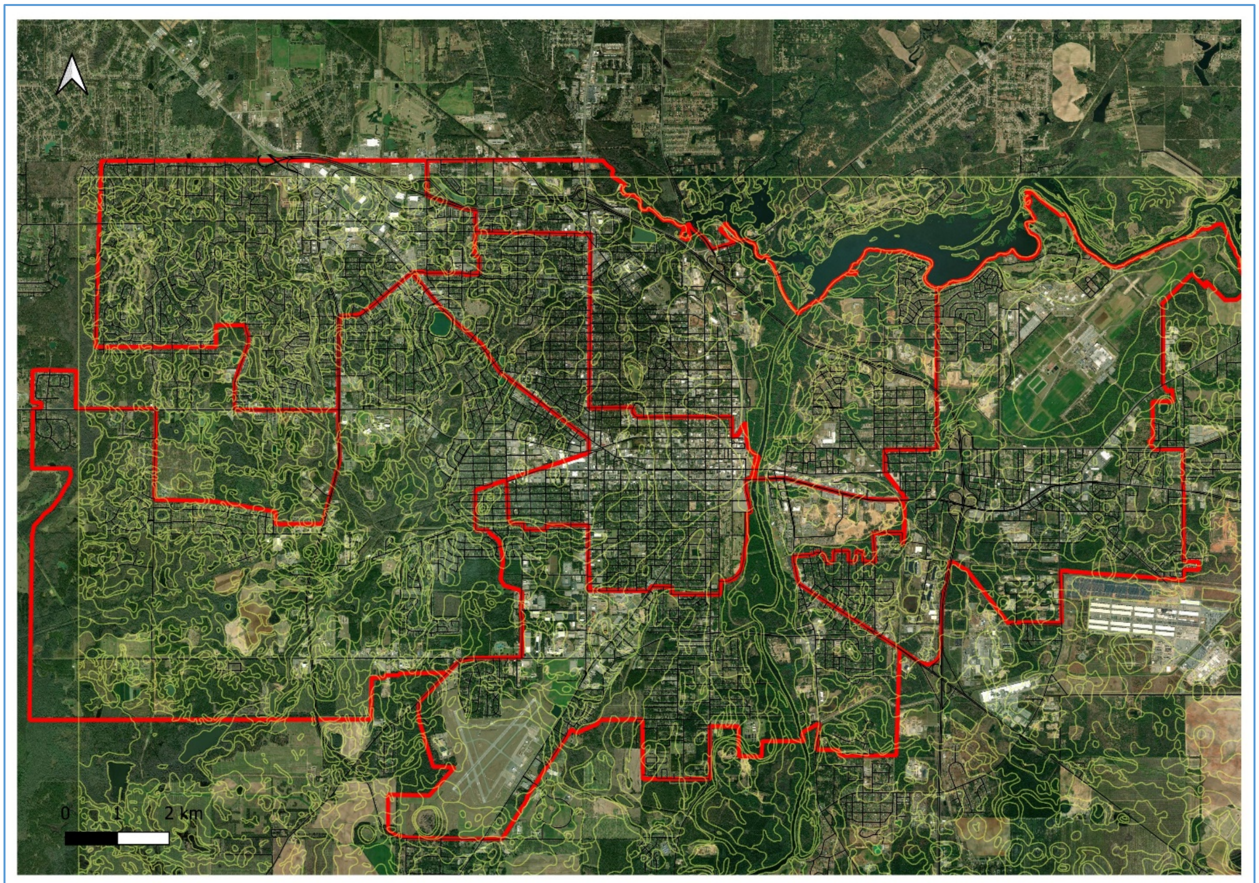


Figure 1: Representative Soil Map of Albany, USDA.

Legal Authority

Permit Requirement

The 2017 Phase II MS4 Permit requires the permittee to "continue to review and revise building codes, ordinances, and other regulations to ensure they do not prohibit or impede the use of GI/LID practices, including infiltration, reuse, and evapotranspiration." The Ga EPD describes GI/LID practices as those that include better site planning techniques, and better site design techniques. In addition, several structural Best Management Practices (BMPs) are considered to be GI/LID techniques and promote the overall program objective. Table 4.2.5(a).6 defines the GI/LID program requirements to include:

Procedures for evaluating the feasibility and site applicability of different GI/LID techniques and practices to be considered

The GI/LID structures allowed to be constructed within the permittee's jurisdiction

Procedures for the inspection and maintenance of the GI/LID structures, including who is responsible for public and private structures, as well as their method of documentation and enforcement.

The GI/LID provisions of the permit are incorporated as a subset of section 4.2.5 on Post Construction Stormwater Managements in New Development and Redevelopment.

Ordinance

Albany's ordinance 06-128 governs stormwater managemenent, as well as soil erosion and sedimentation control. The ordinance includes amendments for Post Construction Stormwater Management Practices, and does not preclude the inclusion of GI/LID practices.

Plan Review

Albany's governing ordinance defines that all site development plans shall include:

- A Stormwater concept plan and consultation meeting certification if required
- A Stormwater Management Plan
- An Inspection and Long-term Maintenance Agreement
- A Performance Bond, if applicable,
- A Site Development Permit application

As part of the plan review process, Albany will work with current applicants to ensure that any GI/LID components that can be implemented are incorporated early on in the conceptual phase. The preliminary site concept will be reviewed to determine that the proposed design meets the objectives of the GI/LID program, and that the Stormwater Management Plan properly accounts for any positive impacts created by the techniques. Any additional improvements that are specific to Albany can be recommended during this phase. In addition, a site-specific inspection plan and maintenance plan can be incorporated into the plan to ensure long-term compliance of any proposed improvements. Early coordination is key to the success of the implementation of these strategies, as multi-disciplinary teams share their experiences with ideas and techniques that have been successful on similar projects.

GI/LID Practices

Albany will encourage good GI/LID practices, including conservation of existing natural resources and features on a site, in addition to design techniques which encourage "building with the land". While Albany will consider all GI/LID practices recommended in the GSMM or the LDM, however specific practices will be encouraged. Practices that will be encouraged include:

1. Bioretention
2. Enhanced Dry Swale
3. Enhanced Wet Swale
4. Grass Channels
5. Infiltration Practices
6. Vegetative Filter Strips
7. Permeable Pavers

Each practice will be evaluated based on the performance criteria set forth during plan development. If the practice is derived from the GSWMM or the LDM, the performance metrics will be stipulated during design. In addition, performance of the structure will be evaluated during routine inspections.

Feasibility

Site Development Projects

Feasibility of individual components will begin during the plan review process. Techniques and structures which have been successfully installed and maintained will be given priority for new installations, while also not limiting new and novel techniques. In addition, the overall project and plan need to fit into the surrounding environment and be consistent with the existing land use and ecological features. While the primary components of GI/LID are infiltration, reuse, and evapotranspiration, each of these components will be considered during the plan review process. Beneficial reuse of retained water on the site for irrigation purposes will be encouraged, and evapotranspiration accounted for if it can be presented in a quantitative manner. Infiltration can be a key component of GI/LID practices if it can be sustainably encouraged on a site. The following criteria will be evaluated to determine feasibility for usage of GI/LID components on a site. The presence of any of these criteria, or a multiple of these criteria, may result in a designation of infeasibility of a site, at the discretion of the Engineering Director or their designee.

Performance Feasibility Criteria:

1. Native Soils on the site have an effective infiltration rate of less than 0.5"/hr. These rates must be supported by an approved infiltration rate test at the proposed depth of the practice, and certified by an approved professional as indicated by the Engineering Director.
2. A separation distance of 2 feet is required between the bottom of the infiltration practice and the top of the seasonal high water table.
3. The improvements to the site would result in worsened flooding risk that would impact neighbors and can't be mitigated. This would be certified by a Professional Engineer licensed in GA.
4. The following setback criteria can't be met under normal conditions. A variance may be filed in writing to the Engineering Director based on the site specific conditions as evaluated by a Professional Engineer licensed in GA:
    a) From a property line: 10 feet (variance possible)
    b) From a building foundation (25 feet)
    c) From a private well (100 feet)
    d) From a public water supply (1200 feet)
    e) From a septic tank leach field (100 feet)
    f) From surface waters (100 feet)
    g) From known groundwater contamination where the additional infiltration might spread the pollution plume.
    h) Fixed utility depths cannot be resolved on the site.

Each criteria may be evaluated to determine if an engineering modification to the plan can overcome the specific criteria, such as the inclusion of underdrains in the BMPs to enhance the filtration practice while limiting the impact to nearby facilities.

Additional criteria may be evaluated in the LDM as the program develops.

Linear Projects

Linear projects present their own difficulties as the impacts are spread over long distances and can have variable impacts along their distance. In addition, the nature and type of linear projects can vary substantially. In order to maximize the beneficial usage of GI/LID practices, several criteria will be evaluated to determine feasibility. If the project meets the following criteria, then GI/LID practices are encouraged to be employed to the maximum degree practical:

1. If the project has an impact for a duration of longer than a year;
2. If the project has an impact on areas that have an existing stormwater management issue;
3. If the project involves significant upgrades or expansion beyond routine maintenance to preserve the original function.

Inspection & Maintenance

Level of Service

Albany Engineering Department is responsible for all MS4 structures in the ROW and on easements, while there are several public, non-city owned entities that own and maintain existing GI/LID components, as well as private entities that own and maintain their structures. Currently there are no GI/LID structures and facilities in the City. Per the existing Post-Construction ordinance, each private existing structure will have an access easement, maintenance agreement and schedule to ensure proper operation of the facility. Each agreement shall have language that obligates the current and subsequent property owners for perpetual maintenance per the original level of service for which the structure was developed.

Inspection Protocol

Each public GI/LID component will be incorporated into the City maintenance schedule to be inspected on a periodic basis per the original design criteria. Each private GI/LID component will have a pre-defined inspection schedule as dictated by the maintenance agreement filed with the City. In the event that a site is inspected by the City and found to not be in compliance with the established requirements, the City reserves the right to bring the system to compliance with the original requirements and bill the owner for the work per the Post Construction Ordinance. The inspections performed each year will be reported on an annual basis per the requirements of the MS4 permit.

Appendix A: Karst Areas

A-1: Sources

Portions of this document borrow heavily from published federal and state resources on designing stormwater features in karst terrain. In particular, the Tennessee Stormwater Design Guidelines for Karst Terrain and the Virginia Stormwater Management Handbook, are referenced extensively. A full list of references is included at the end of this section.

A-2: Feasibility

The intent of this appendix is to detail steps that should be taken when designing stormwater controls to meet runoff reduction requirements or Green Infrastructure / Low Impact Development (GI/LID) components in karst terrain. The document gives an overview of the extent of karst terrain in the Albany area, and a rationale for why karst landforms may be incompatible with infiltration components or GI/LID components. A flowchart is then included to detail the steps that should be taken to assess the feasibility of including these controls on property with karst landforms. It is the responsibility of the developer to assess each of these feasibility steps and confer with Albany staff to determine if any problems on the site can be mitigated through alternative engineering design. If runoff reduction, and GI/LID controls are not feasible for a site, then water quality performance measures will still apply, and alternative controls may be warranted, including series application of measures to meet the water quality criteria.

A-2: Definition

Karst areas are defined by carbonate soil formations that can be present in surficial outcrops or can range several hundred feet deep. The carbonate formations can contain limestone, dolomite, or a combination of soluble rocks. The carbonate formations are soluble in varying degrees in groundwater and rainwater, and can form large and small depressions in the ground when the limestone degrades to the point that it can no longer support itself and the overlying soil burden. The karst geography around Albany, GA has been studied in detail and the results published in a variety of reports. In 1962, Robert Wait of the United States Geologic Survey (USGS), published the *Geology of the Albany West Quadrangle*, detailing the cross-section of the soil bulk matrix profile and the depth to the Ocala limestone that underlays the entire area. According to Wait, the Ocala limestone is relatively uniform almost entirely calcium carbonate. The limestone is exposed by the Flint River throughout the area, and includes benches and shelves that appear at outcrops along the river bank. The entire area is karst and contains many sinkholes. Figure 1 shows an aerial photograph from the United States Department of Agriculture (USDA) from 1948 that was taken after substantial rainfall and shows the spatial extent of the sinkholes throughout the area (Georgia Aerial Photographs Database). According to Wait's Geology and Ground-Water Resources of Dougherty County, Georgia (1963):

> The area is generally considered to have two varieties of sinkholes: older and younger sinkholes, with the older being domes that collapsed after dissolution and which are typically 20-25′ deep and 500′-1000′ wide. The younger sinkholes are considered to occur from occlusions of limestone or pillars present in the underlying strata which then collapse and open up holes and drains that connect the underlying karst system. Review of the Ocala formation indicates that the fracture lines appear to run northwest to

southeast, although as a general trend the actual orientation of the sinkholes in and around Albany varies.

The residents of the lower coastal plain of Georgia utilize groundwater almost exclusively for their water supply, and Albany is no different. Albany withdraws several million gallons per day (MGD) from the Upper Floridan aquifer, which is the name given to the water bearing strata that covers most of coastal Georgia and Florida and includes the Ocala limestone formation. The Upper Floridan is highly productive and has very good water quality. Because it is a limestone aquifer, excessive pumping of individual wells or wellfields can exacerbate sinkholes in the surrounding area (Gordon, 2011), which can risk introduction of foreign materials into the water source. Any development activities near water production facilities should be thoroughly coordinated with Albany staff prior to submitting a development plan.

Figure 1 shows the aerial photograph from the USDA flyover in 1948, while Figure 2 shows the Western Quadrangle analyzed by Wait in 1962. Figure 3 shows the different geologic layers, including the Ocala limestone formation and its relevant location to the Flint River (Wait, 1962). Figure 4 shows the limestone outcrop along the Flint River underneath the Broad Avenue / King Bridge.

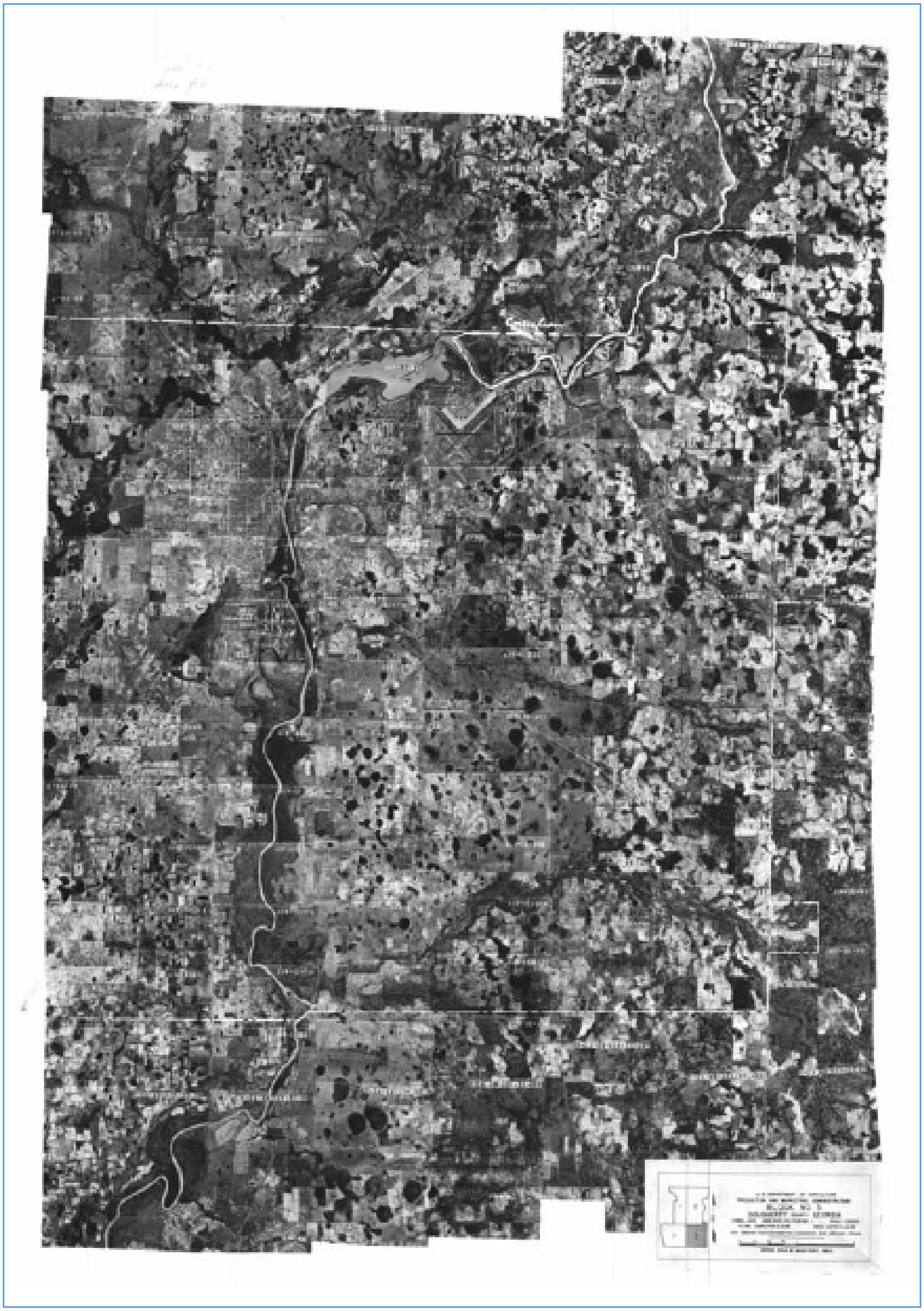


Figure 2: Aerial Photo from 1948 showing the extensive number of sinkholes in the Albany area (USDA, 1948).

Figure 3: Albany west quadrangle showing geology of the karst landscape (Wait, 1962).

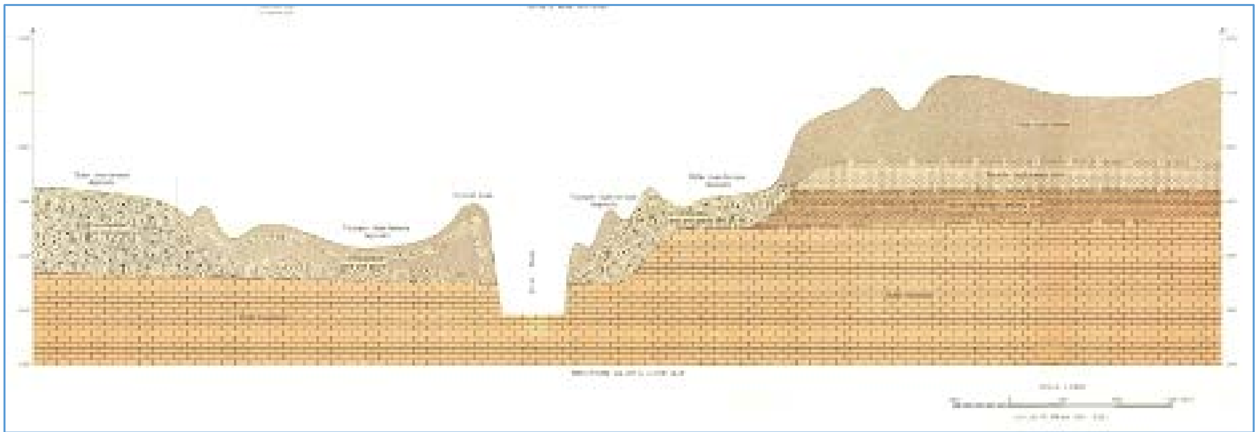


Figure 4: Cross-section A-A showing the Ocala limestone and the Flint River (Wait, 1962).

Figure 5: Limestone outcrop along the Flint in downtown Albany.

A-3: Stormwater Management Issues in Karst Areas

The principal concerns with stormwater infiltration that is encouraged by Green Infrastructure / Low Impact Development (GI/LID) in the karst regions of Albany are the prevention of sinkholes, and the minimization of potential contamination to the aquifer or other surface water resources including the Floridan aquifer and the Flint River.

A-3.1: Groundwater and Surface Water Contamination Risks

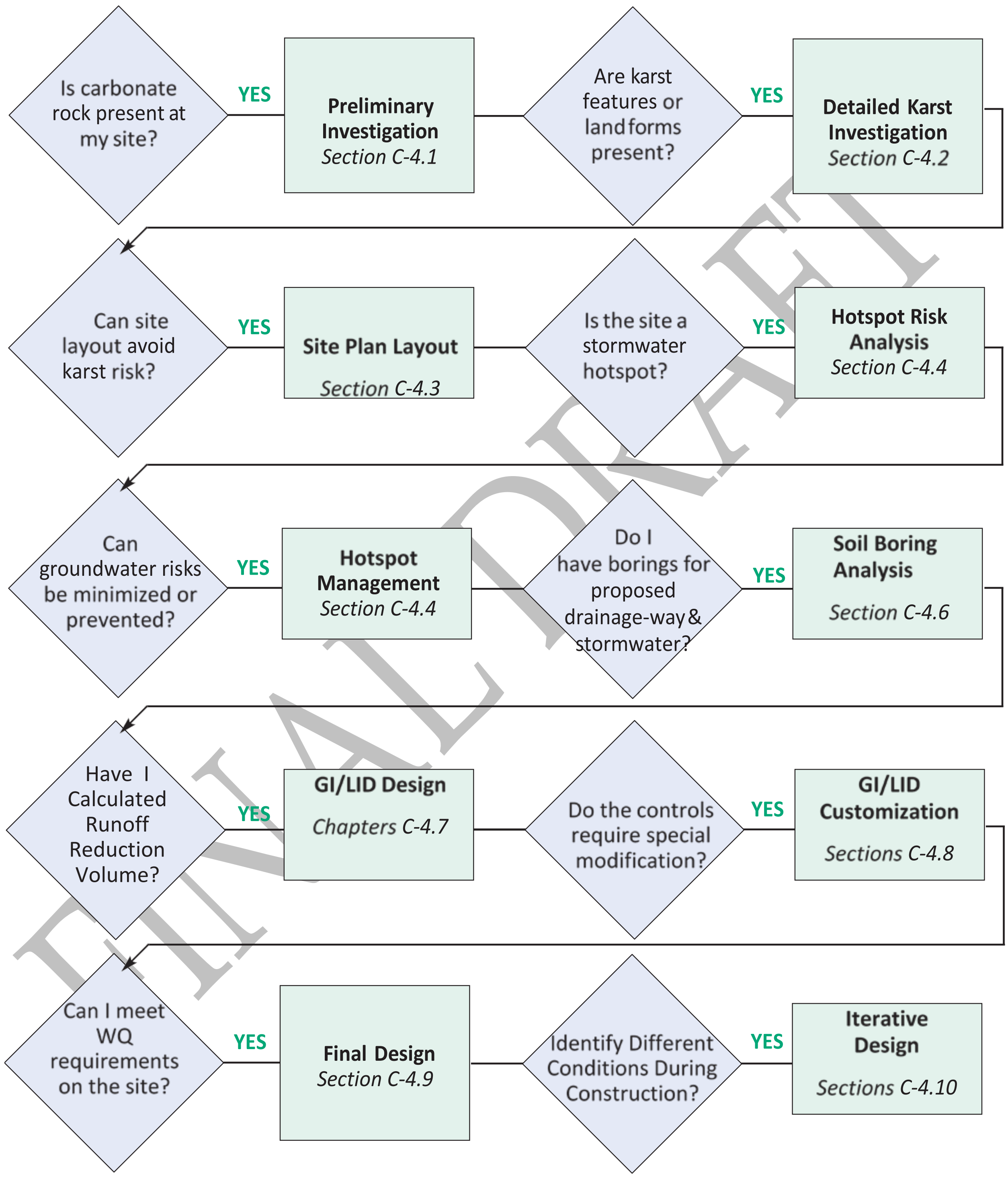
In karst terrain, contaminants in runoff and can pass rapidly from the surface into groundwater, with little or no filtration or modification. In other cases, contaminants can be perched by restrictive layers present in and around the downtown area, and can release pollutants into the groundwater more gradually. The strong interaction between surface runoff and groundwater can pose risks to the drinking water quality, upon which residents in karst terrain rely. Albany's principal wellfields are south of the City in the upper Floridan. Depending on the quantity and type of pollutants that can be discharged directly to groundwater sources, it is possible to render the water unsuitable for consumption by humans and farm animals. In addition, as the Flint River cuts through the upper layers of the overlying limestone, there exists ample opportunity for direct interaction and discharge of the unfiltered flows to the river. As a result, designers need to consider groundwater and surface water protection as a first priority when they are considering how to dispose of stormwater. The extensive combinatorial interaction of the complex karst system in Albany indicates that there is always a risk that contaminants will end up in places where they were not intended, and can be difficult to remove.

A-3.2: Increased Sinkhole Formation

Several items can compound the increased risk of sinkhole formation. First, the increased runoff from developed property can increase the dissolution rate of underlying carbonate materials. Also, the decreased infiltration rate under impervious areas can adversely impact the soil-water matrix, removing buoyancy provided by the water and resulting in increased likelihood of subsidence. Finally, concentration of water in larger centralized stormwater practices can place additional pressure on existing sinks and accelerate failure. Consequently, designers need to carefully assess the entire stormwater conveyance and treatment system at the site to minimize the risk of sinkhole formation. In most cases, this means installing a series of small, shallow runoff reduction practices across the site, rather than using the traditional all-in-one pond approach.

The flow chart in **Section A-4** was synthesized from several sources, and borrows directly from the VA DCR (1999) Appendix on development in karst terrain (VA Stormwater Management Handbook, 2013). As in those documents, it is important to note that the flow chart is a guideline for evaluating and minimizing risk for developing stormwater infiltration practices on karst terrain, and not a guideline for plan approval in Albany. If karst conditions exist on a site, then each of these steps should be evaluated to determine the feasibility of installing traditional GI/LID controls on the site.

A-4: Flow Chart



A-4.1: Preliminary Investigation

Preliminary site investigations are targeted toward gathering historical knowledge about a site from a variety of sources. These sources can include, but should not be limited to:

1. Existing soil surveys
2. Existing geologic maps,
3. Existing physiographic maps,
4. Existing elevation information, including USGS DEMs and current LiDAR or contour information,
5. Existing well borehole information in the area,
6. Previous development plans,
7. Any existing hydrologic maps,
8. Aerial photographs of the site and surrounding area.

At the conclusion of the preliminary investigation, the designer should have all available resources necessary to describe the conditions on the site to the degree possible to conduct a detailed investigation. From the preliminary information, any site limitations should be identified and shown on the plans, as well as any special conditions which may enhance the treatment, or reuse of the stormwater in addition to the infiltration components.

A-4.2: Detailed Karst Investigation

A more detailed investigation of the site will require an in-person review of the conditions on the site, in particular looking for karst features that are present. Those may include sinkholes, caverns, openings, subsidence of the ground, or hydrologic features that disappear or have no apparent outlet. In addition, the developer should talk to any existing or historical property owners who are available to determine if any active karst formations have been present or recorded on the site. Any of these features should be recorded and evaluated in a complete data analysis of the site in order to determine if they would indicate an increased risk at the site. Shallow penetration testing with hand-augers may be sufficient if there is no history or indication of karst formations in the area. If karst formations are found then more extensive analysis should be performed, including test pit excavation and soil borings along with a complete report of material encountered at each depth. In addition, geophysical methods may be required, including electric resistive tomography, or seismic analysis. These geophysical analyses are more suitable for infill data between known boring or test-pit locations, and should be conducted and interpreted by a qualified professional. All of the data discovered during the detailed investigation should be documented on the site plan layout, or a note included detailing tests which were completed and which indicated suitable conditions.

A-4.3: Site Plan Layout

The site plan layout should contain all pertinent information for managing stormwater, that was collected in the preliminary and detailed site investigations. In particular, the plan should include all elements, including any karst features, all structures, proposed stormwater management controls, and water features present, including depth to the seasonal high water table. In addition, all relevant calculations should be shown and any GI/LID structures that required alternative design components to make them function on the site.

A-4.4: Hotspot: Risk Analysis

Per the Georgia Stormwater Management Manual, Volume 2 (GSMM, 2016), a hotspot is defined as a land use or activity on a site that produces higher concentrations of trace metals, hydrocarbons or other priority pollutants than are normally found in urban stormwater runoff. Examples of hotspots include:

1. Gas Stations,
2. Vehicle Service and Maintenance Areas,
3. Salvage Yards,
4. Material Storage Sites,
5. Garbage Transfer Facilities,
6. Commercial Parking Lots with high-intensity use,
7. Commercial Car Washes,
8. Home Improvement Stores,
9. Nurseries,
10. Kennels, and
11. Veterinarians' offices.

If karst features are present on the site, and it is proposed to have a landuse that's considered a hotspot, then hotspot management strategies should be employed to minimize contamination risks.

It should be noted that the State of Georgia prohibits permanent storm water infiltration basins in areas having high pollution susceptibility, where pollution susceptibility means the relative vulnerability of an aquifer to being polluted from spills, discharges, leaks, impoundments, applications of chemicals, injections and other human activities in the recharge area (Ga Municipal Code, current). Therefore, hotspot landuses may require additional stormwater control components such as underdrains for infiltration recovery while minimizing contamination risk.

A-4.5: Hotspot Management

In the event that the site will contain a hotspot landuse, and contains karst formations, then special management conditions may be required. In particular, infiltration may be limited by structural controls, or bio-engineered GI/LID components with recovery components to allow shallow ground infiltration and biological treatment while minimizing deep infiltration and pollution risk. In addition, water quality criteria should be met to the maximum extent practicable. The water quality criteria should be to remove 80% of the average annual TSS for the runoff generated from the first 1.2” of rainfall on the site. It may be appropriate to place several controls in series around the site to achieve this level of performance.

A-4.6: Soil Boring Analysis

If karst conditions are found or suspected on the site, then sufficient soil borings should be conducted to characterize the nature of the karst system. Specifically, a full description and boring log should be recorded through the entire depth of the test hole. In addition, any voids, water lenses, or low-penetration value soils should be clearly identified during the analysis. Any of these conditions should facilitate additional exploration to determine if they are isolated or part of a larger system of underground features that may impact site design.

Alternative assessments on the site may include borehole electrical resistivity analyses from existing wells, soil exploration pits, seismic refraction, or ground penetrating radar. All of these subsurface alternatives should be evaluated by a certified geotechnical engineer having experience in karst terrain in order to provide an opinion for suitability in a GI/LID system.

All pertinent subsurface monitoring results should be noted on the plans, including the locations of borings or exploratory work.

A-4.7: GI/LID Design

At this stage in the design, the plans should indicate whether the runoff reduction requirements can be met on the existing site and which GI/LID components can be utilized to maximize infiltration, reuse, and evapotranspiration. On the design plans, indicate whether the components are from the GSMM, the Albany Local Design Manual (LDM), or from an approved alternative source. Ensure that all calculations are published on the plans in compliance with each source.

A-4.8: GI/LID Customization

If traditional GI/LID structures can’t be used in treatment on the site, detail how are they modified to fit into the space provided and still provide a function necessary for runoff reduction and water quality improvement. If the BMP is modified, provide the detailed design calculations for how it meets the performance requirements. If an alternative measure is required by modifying the BMP, has the system been constructed so that several components are functioning in series to provide redundancy or the prescribed level of treatment? In the event that infiltration capacities are limited, additional reuse options such as storage for irrigation may be evaluated, given that the storage volume be balanced with evapotranspiration needs on the site.

A-4.9: Final Design

Final design should include an evaluation of all included design components, and should include a comprehensive solution to the problem of infiltrating stormwater in karst geology, along with meeting water quality requirements. The final design should clearly document the rationale for selection of the appropriate controls, in addition to why modifications are made to accommodate site conditions, if required. Any additional components required to meet the necessary treatment volumes should be provided in the plans and details of the set.

A-4.10: Iterative Design

If karst element is discovered during construction, immediately bring the element to the attention of the review agencies as this may materially change the function of the project controls. Construction should stop while the responsible personnel determine whether the original intent of the design plan can be met given the constraints of the system, or whether an overhaul or upgrade of the plan will be required. In addition, if any design component cannot be constructed as designed, it is the responsibility of the owner to notify Albany staff in writing that the plan will require modification, and Albany staff shall reply in writing as to whether the proposed modifications are appropriate for the project scope. Any field modifications approved by Albany shall be recorded on red-line drawings which are submitted to the City, and marked as received in writing, prior to issuance of a Certificate of Occupancy for the property.

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