130 ENVIRONMENTAL PARK
CALDWELL COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 2383

TYPE I PERMIT APPLICATION

VOLUME 2 OF 5

Prepared for

130 ENVIRONMENTAL PARK, LLC

Technically Complete October 28, 2014

Biggs & Mathews, Inc.
Firm Registration No. F-834

Prepared by

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PART III
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CALDWELL COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 2383

TYPE I PERMIT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN

ATTACHMENT A
SITE DEVELOPMENT PLAN NARRATIVE

Prepared for

130 ENVIRONMENTAL PARK, LLC

Technically Complete October 28, 2014

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1 INTRODUCTION

30 TAC §330.63(a)

Consistent with 30 TAC §330.63(a), this site development plan narrative is included as Attachment A – Site Development Plan Narrative. Attachment A provides the criteria used in the design of this facility for safeguarding the health, welfare, and physical property of the public and environment. The site development plan narrative includes discussion of the geology, soil conditions, drainage, land use, zoning, adequacy of access roads and highways, and other considerations specific to this facility.

1.1 Site Location and History

130 Environmental Park, LLC intends to permit and operate a new municipal solid waste facility in northern Caldwell County east of State Highway 130 (SH130). The 130 Environmental Park includes a proposed Type I municipal solid waste disposal facility. The site entrance will be located approximately 1,500 feet north of the intersection of US Highway 183 (US183) and Farm to Market Road 1185 (FM1185), on the east side of SH130. US183 serves as the frontage road for SH130 in the general vicinity of the facility. The proposed facility is intended to provide waste disposal for residences and businesses in Caldwell County and surrounding Texas counties. The facility is designed to protect the health and safety of the people in the region.

130 Environmental Park, LLC has entered into an agreement with Cathy Moore Hunter for the purchase of a tract of land consisting of 1,229.076 (approximately 1,229) acres ("the property"). 130 Environmental Park, LLC will locate the proposed 130 Environmental Park, consisting of a facility boundary of approximately 520 acres ("the site"), within this tract of land. The overall property consists of gently undulating grasslands with limited forest cover.

130 Environmental Park is located in the San Marcos River drainage basin. Dry Creek traverses the property, east and southeast of the site, in a northeast to southwest direction, and enters Plum Creek approximately five miles south of the property. Plum Creek flows generally in a northwest to southeast direction, and enters the San Marcos River about 23 miles downstream from the property.

1.2 Facility Description

The proposed 130 Environmental Park site will encompass about 520 acres out of the approximately 1,229-acre property. The landfill facility will be accessed from northbound US183 through an entrance road. A gatehouse and scales will be provided within the facility boundary. Additional facilities located within the facility boundary will include a maintenance area, citizen convenience center, reusable materials staging area, large item storage area, used/scrap tire storage area, woodwaste processing area, leachate storage facility, and truck wheel wash. A Type V transfer station (Registration No. 40269, application pending) will also be located within the facility boundary.

The landfill footprint will cover approximately 202 acres and is intended to provide about 44 years of site life. The landfill method will be below-grade fill with 4H:1V liner sidewall

slopes and aerial fill with 4H:1V final cover side slopes, with a maximum 6 percent final cover top slope. The drainage system is designed to meet or exceed TCEQ and EPA requirements for runon and runoff. The landfill liner, leachate collection, final cover, gas monitoring, and groundwater monitoring systems are designed to meet the Subtitle D and/or TCEQ requirements, whichever are more stringent.

The proposed landfill will have a capacity of approximately 33.1 million cubic yards of waste and daily/intermediate cover, or approximately 26.5 million tons of waste.

The landfill will receive an estimated 429,000 tons of waste (approximately 1,500 tons per day) in the initial year following construction of the facility. The waste acceptance rate will vary over the life of the facility depending on market conditions. The maximum rate of waste disposal is expected to be approximately 841,803 tons per year (approximately 2,943 tons per day). The facility is expected to receive waste five and one half (5.5) days per week.

The following table provides a summary of the current proposed permit conditions:

PERMIT CONDITION SUMMARY

Description	Proposed Condition
Permitted Area (site)	520 acres
Waste Disposal Unit Area	202 acres
Buffer/Other Areas	318 acres
Total Permitted Capacity	33.1 million cubic yards
Total Projected Site Life	44 years
Maximum Elevation of Final Cover (msl)	736 feet

The major classifications of solid waste to be accepted for disposal at 130 Environmental Park include municipal solid waste, special waste, and Class 2 and 3 industrial wastes as defined by §330.3. Special wastes accepted at the facility per §330.171(c) include regulated asbestos-containing materials (RACM), nonregulated asbestos-containing materials (non-RACM), and empty containers. In addition, other special wastes may be accepted based on a waste-specific approval as authorized by §330.171(b) and the facility.

130 Environmental Park is proposed to include facilities for storage and processing of waste materials. Facilities include the proposed Type V transfer station, large item storage area, reusable materials staging area, citizens convenience center, used/scrap tire storage area, and wood waste processing area. Materials accepted for storage or processing include construction and demolition wastes, white goods, inert materials, asphalt pavement or asphaltic concrete, source-separated recyclable materials, used or scrap tires, brush, and yard waste. In addition, municipal solid waste may be temporarily stored at the citizens convenience center.

130 Environmental Park will not accept medical waste, sewage, dead animals and/or slaughterhouse waste, sludge, grease trap waste, grit trap waste, liquid waste from municipal sources, municipal hazardous waste from conditionally exempt small quantity generators, or out-of-state wastes. The facility will not accept Class 1 industrial solid

wastes, except for wastes that are Class 1 only because of asbestos content. The waste classifications are defined in §330.3.

Consistent with §330.15, the facility will not accept for disposal lead acid storage batteries; used motor vehicle oil; used oil filters; whole used or scrap tires; refrigerators, freezers, air conditioners or other items containing chlorinated fluorocarbons (CFC); bulk or noncontainerized liquid waste from nonhousehold sources; regulated hazardous waste; polychlorinated biphenyls (PCB) waste; radioactive materials; or other wastes prohibited by TCEQ regulations.

1.3 Land Use and Zoning

An analysis of land use and potential impact on the area surrounding the facility was prepared by John Worrall Consulting. The Land Use Analysis is included in Part II, Appendix IIB. The proposed 130 Environmental Park is not located within the limits of any city, and is not within the limits of extraterritorial jurisdiction of any city. The facility does not require zoning or other approval from any local government nor does it require a special use permit.

1.4 Adequacy of Access Roads and Highways

A transportation study was prepared by Lee Engineering to provide information related to access roads and vehicular traffic with respect to the facility expansion. The transportation study is included in Part II, Appendix IIC. There are no existing or planned restrictions on the main access roadways within one mile of the site that would preclude safe and efficient operations for landfill vehicles and other traffic in the area.

Access will be provided to 130 Environmental Park via US Highway 183 (US183). The primary local and regional access routes to the facility will be US183 and State Highway 130 (SH130). There are no known weight restrictions on the local or regional roads in the proximity of the facility other than the maximum legal weight limit of 80,000 pounds. Refer to Part II, Appendix IIC, Transportation Study for full traffic analysis and TxDOT coordination letter.

2 GENERAL FACILITY DESIGN

30 TAC §330.63(a)

Consistent with 30 TAC §330.63(b), the general facility design information is included in Attachment B – General Facility Design. Attachment B includes narrative and drawings that provide the required general facility design information including a discussion on facility access control as required by §330.63(b)(1), a generalized process design and working plan of the facility that describes waste movement as required by §330.63(b)(2), a description of how solid waste processing facilities will be designed to facilitate proper cleaning as required by §330.63(b)(3), a description of how all liquids resulting from the operation of solid waste processing facilities will be disposed of in a manner that will not cause surface water or groundwater pollution as well as the treatment of wastewaters resulting from the process or from cleaning and washing as required by §330.63(b)(4), and a general discussion of how the facility is designed to protect endangered and threatened species as required by §330.63(b)(5).

3 FACILITY SURFACE WATER DRAINAGE DESIGN

Consistent with 30 TAC §330.63(c), the facility surface water drainage design information is included in Attachment C – Facility Surface Water Drainage Report. Attachment C includes a narrative discussion, drawings, and calculations that demonstrate how the facility is designed to meet the drainage and flood control requirements of §330.63(c) and §§330.303, 330.305, and 330.307. The surface water drainage design report includes analyses of the existing conditions, postdevelopment conditions, and design of the surface water management system including final cover drainage facilities, perimeter drainage channels, and detention and sedimentation ponds; and also includes an erosion and sediment control plan for all phases of landfill development. The facility surface water drainage design report demonstrates that existing drainage patterns will not be adversely altered. In addition, a demonstration that the proposed landfill footprint and proposed processing facilities are not located within the 100-year floodplain is included.

4 WASTE MANAGEMENT UNIT DESIGN

Consistent with 30 TAC §330.63(d), the waste management unit design information is included in Attachment D – Waste Management Unit Design. Attachment D includes a narrative, drawings, and calculations that demonstrate how the facility is designed to meet §330.63(d)(1) for storage and transfer units and §330.63(d)(4) for landfill units.

The storage and transfer units located within the facility boundary will include a large item storage area, reusable materials staging area, citizen's convenience area, used/scrap tire storage area, wood waste processing area, leachate storage facility, and truck wheel wash. Attachment B – General Facility Design provides details on these storage and transfer units. Attachment B also includes a narrative and drawings that demonstrate how the facility is designed to meet §330.63(b) and §330.63(d)(1) for general facility design and waste management unit design.

The landfill unit has been designed to meet the requirements of §330.63(d)(4), §330.331(a)(2) and §330.331(b) for a composite liner and the requirements of §330.333 for a leachate collection system. The landfill unit design includes provisions for all-weather operations, proposed landfill method, elevation of deepest excavation, maximum elevation of waste and final cover, waste disposal rate and operating life of the landfill, landfill unit cross sections, and construction and design details of the landfill unit. In addition, Attachment D includes the geotechnical design report for the facility, the liner quality control plan, the leachate and contaminated water management plan, and the final cover quality control plan.

5 GEOLOGY REPORT

Consistent with 30 TAC §330.63(e), the geology and soil information is included in Attachment E – Geology Report. Attachment E includes a narrative discussion, evaluations, and figures that provide the information required by §330.63(e). The geology report includes descriptions of the regional geology and hydrogeology, geologic process, regional aquifers, subsurface investigations, geotechnical properties of subsurface soils, and fault and seismic conditions. The geology report includes the evaluation and demonstrations which confirm that the geology and soil conditions are suitable for operations as a municipal solid waste disposal facility.

6 GROUNDWATER SAMPLING AND ANALYSIS PLAN

Consistent with 30 TAC §330.63(f), the groundwater sampling and analysis plan is included as Attachment F – Groundwater Monitoring Plan. Attachment F includes a narrative discussion, evaluations, and figures that provide the information required by §330.63(f) and §§330.401 through 330.421. The groundwater monitoring plan includes, among other things, the point of compliance, contaminant pathway analysis, groundwater monitoring program, detection monitoring program, and groundwater sampling and analysis plan.

7 LANDFILL GAS MANAGEMENT PLAN

Consistent with 30 TAC §330.63(g), the landfill gas management plan is included as Attachment G – Landfill Gas Management Plan. Attachment G includes narrative, evaluations, and drawings that provide the information required by §330.63(g) and §330.371. The landfill gas management plan includes the requirements for landfill gas monitoring at the landfill perimeter and in on-site structures, a landfill gas control system, and procedures to be implemented in the event that concentrations of methane in excess of the regulatory limits are measured at the facility boundary or in on-site structures.

8 CLOSURE PLAN

Consistent with 30 TAC §330.63(h), the closure plan is included as Attachment H – Closure Plan. Attachment H includes narrative, evaluations, and maps and drawings that provide the information required by §330.63(h), §330.457, §330.459 and §330.461. The closure plan includes the procedures to be taken for ongoing closure of the facility and following final acceptance of waste and certification of final closure. The closure plan describes the final cover system, closure procedures, and a closure schedule.

9 POSTCLOSURE PLAN

Consistent with 30 TAC §330.63(i), the postclosure plan is included as Attachment I – Postclosure Plan. Attachment I includes a narrative discussion that provides the information required by §330.63(i), §330.463 and §330.465. The postclosure plan includes the procedures to be taken for postclosure care maintenance of the facility following closure including postclosure care certification. The postclosure plan describes the postclosure care activities, persons responsible for conducting postclosure care activities, and postclosure land use.

10 COST ESTIMATES FOR CLOSURE AND POSTCLOSURE CARE

Consistent with 30 TAC §330.63(j), the cost estimates for closure and postclosure care are included as Attachment J – Cost Estimates for Closure and Postclosure Care. Attachment J includes a narrative discussion, evaluations, calculations, and drawings that provide the information required by §330.63(j). The detailed cost estimate for closure meets the requirements of §330.503. The detailed cost estimate for postclosure care meets the requirements of §330.507. This plan also provides procedures to adjust the cost estimates during the life of the facility and describes the evidence of financial assurance, as required.

130 ENVIRONMENTAL PARK
CALDWELL COUNTY, TEXAS
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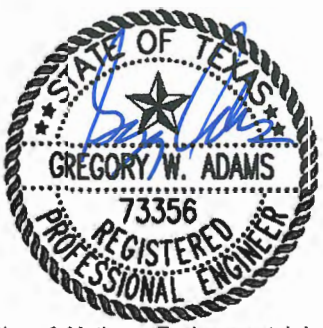
PART III – FACILITY INVESTIGATION AND DESIGN

ATTACHMENT B
GENERAL FACILITY DESIGN

Prepared for

130 ENVIRONMENTAL PARK, LLC

Technically Complete October 28, 2014



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1 FACILITY ACCESS

30 TAC §330.63(b)(1)

Access to 130 Environmental Park will be controlled by a perimeter fence located along the facility boundary and a locking gate at the site entrance. The fence and gate will prevent the entry of livestock, protect the public from exposure to potential health and safety hazards, discourage unauthorized public access to the disposal operations, and discourage unauthorized entry or uncontrolled disposal of solid waste or prohibited materials. Perimeter fencing consisting of barbed wire, woven wire, wooden fencing, plastic fencing, pipe fencing, or other suitable material will be provided.

A gate constructed of suitable fencing materials will be located on the entrance road. The gate will be locked when the landfill is not accepting waste. The perimeter fence and gate will be inspected monthly. Maintenance will be performed as necessary. Should a breach be detected during inspection or at any other time, every reasonable effort will be made to make repairs within 24 hours of detection. Should repairs require more than 24 hours, temporary repairs will be performed within the time specified to the TCEQ region office following notification. The TCEQ region office will be notified of the breach within 24 hours of detection unless permanent repairs are made within eight hours of detection.

Access to 130 Environmental Park is provided from US Highway 183 (US183) and is limited to the entrance road through the gatehouse area. Access control to the facility is provided by the perimeter fencing and gated site entrance. Entrance to the landfill is monitored by the gate attendant during site operating hours. Beyond waste acceptance hours, the gate to the site will be locked.

Entry to the active portion of the site will be restricted to designated personnel, approved waste haulers, properly identified persons whose entry is authorized by site management, and regulatory personnel. Visitors may be allowed on the active area only when accompanied by a site representative. Signs will be located along the entrance road directing traffic to the gatehouse. The gate attendant will restrict site access to authorized vehicles and direct these vehicles appropriately.

Waste hauling vehicles will be directed to appropriate fill areas by signs located along the landfill haul road and access road. These vehicles will deposit their loads and depart the site. Private, commercial, or public solid waste vehicles will not be allowed access to any areas other than the active portion of the landfill. Site personnel will provide traffic directions as necessary to facilitate safe movement of vehicles. Within the site, signs will be placed along the landfill haul road and access road at a frequency adequate for users to be able to determine the disposal area locations and which roads are to be used. Roads not being used for access to disposal areas will be blocked or otherwise marked for no entry.

2 WASTE MOVEMENT

30 TAC §330.63(b)(2)

The major classifications of solid waste to be accepted at 130 Environmental Park include municipal solid waste, special waste, and Class 2 and 3 industrial wastes. Special wastes accepted at the facility authorized by §330.171(c) include regulated asbestos-containing materials (RACM), nonregulated asbestos-containing materials (non-RACM), and empty containers. In addition, other special wastes may be accepted based on a waste-specific approval as authorized by §330.171(b) and the facility.

Waste disposal facilities include the municipal solid waste disposal area and RACM disposal area. Waste processing and/or storage facilities include the large item storage area, reusable materials staging area, citizen's convenience center, used/scrap tire storage area, wood waste processing area, leachate storage facility, and truck wheel wash. Appendix B1 includes schematic drawings and details that depict disposal, waste processing, and storage activities that are part of 130 Environmental Park.

Drawing B.1 is a flow diagram that provides the storage, processing, and disposal sequences for the various wastes accepted. Drawing B.2 is a schematic drawing of the facility that depicts the various phases of collection, processing, and disposal for the types of wastes accepted at the facility. Drawing B.3 depicts the location of processing and/or storage facilities that are located near the entrance facilities. Schematic details of the processing and/or storage facilities are depicted on Drawings B.4, B.5, and B.6. The details include generalized construction details of slab and subsurface components for each processing facility.

Waste enters the facility via the site entrance road. The gate attendant observes the incoming waste at the gatehouse, conducts waste screening and weighing, and documents the incoming waste. The gate attendant is familiar with the rules and regulations governing the various types of waste that can or cannot be accepted into this facility and will direct the waste hauler to the appropriate waste disposal, storage, or processing area. These gatehouse personnel will also have the authority to reject prohibited wastes and have the rejected waste removed by the waste haul vehicle or transporter immediately upon discovery.

Trained personnel will observe waste unloading at the active working face and large item storage area, and will have the authority and responsibility to reject loads that contain prohibited wastes. These working face personnel will also have the authority to have prohibited waste removed by the waste haul vehicle or transporter immediately upon discovery.

Waste Disposal

The proposed landfill liner, leachate collection, and final cover systems will meet all applicable Subtitle D requirements and TCEQ rules and guidelines. Provisions addressing

design and construction are addressed in the liner quality control plan, the leachate and contaminated water management plan, and the final cover quality control plan.

The waste disposal area will be excavated with side slopes no steeper than 4H:1V. The liner system will be constructed following excavation of a new waste disposal area. The proposed liner system for the facility is generally described below with layers listed from top to bottom.

COMPOSITE LINER SYSTEM (TOP TO BOTTOM)
24-inch Soil Protective Cover
Drainage Geocomposite LCS Layer (275-mil)
HDPE Geomembrane Liner (60-mil)
24-inch Compacted Clay Liner ($\leq 1 \times 10^{-7}$ cm/sec)

Information regarding materials and construction quality assurance are included in Attachment D7 – Liner Quality Control Plan. Liner system details are included in Attachment D3 – Construction Design Details.

A leachate collection system (LCS) has been designed with a geocomposite drainage layer, leachate collection trenches, and leachate collection sumps to remove leachate from the landfill. The LCS layout and details are shown in Part III, Attachment D3 – Construction Design Details. Design of the LCS is discussed in Part III, Attachment D6 – Leachate and Contaminated Water Management Plan. Information regarding materials and construction quality assurance are included in Part III, Attachment D7 – Liner Quality Control Plan.

The proposed landfill development method for the site is a combination of the area-excavation fill followed by aerial fill to the proposed landfill completion height. Landfill development will generally follow the sequence of development as shown on Drawing B.2, which will be in the order the cells are numbered.

Waste accepted for disposal will be directed to the active working face. Waste will be unloaded within the active working face, spread in layers and thoroughly compacted. Daily cover of waste will be applied to control disease vectors, windblown waste, odors, fires, scavenging, and to promote runoff from the fill area. Daily cover consisting of a minimum of six inches of soil will be placed over wastes at the end of each working day for odor control.

The aerial fill side slopes will not be steeper than 4H:1V, and the aerial fill top slope will be approximately six percent. A composite final cover will be constructed over the entire landfill. As shown in Part III, Attachment D3 – Construction Design Details, the final cover is generally described below with layers from top to bottom.

COMPOSITE FINAL COVER SYSTEM (TOP TO BOTTOM)
24-inch Erosion Layer
Drainage Geocomposite Layer – Sideslope Only (200-mil)
Cushion Geotextile Layer – Topslope only (6 oz/sy)
LLDPE Geomembrane Cover (40-mil)
18-inch Infiltration Layer (≤1 x 10^{-5} cm/sec)

Final cover placement will generally follow the sequence of development as shown on Drawing B.2 and will be ongoing as the site is developed. Sectors will be closed according to the closure plan provided in Part III, Attachment H – Closure Plan.

RACM

Regulated asbestos-containing material (RACM) may be accepted at 130 Environmental Park as defined in 40 Code of Federal Regulations Part 61 in accordance with 30 TAC §330.171(c)(3). 130 Environmental Park, by inclusion of the requirements of §330.171(c)(3) in the Site Operating Plan, is providing written notification to the executive director of the intent of the facility to accept RACM. The landfill, in accordance with §330.171(c)(3)(A), dedicates all of the Subtitle D landfill units as potentially receiving RACM. On days when RACM is accepted, a RACM unloading and disposal area will be provided separate from the active waste disposal area. Control will be used to confine the RACM area to a size consistent with the rate of incoming RACM, while allowing for safe and efficient operation. After unloading, RACM waste will be covered with a minimum of three feet of other solid waste or one foot of earthen material. Daily cover consisting of a minimum of six inches of soil will be placed over RACM wastes at the end of each working day. The procedures for recordkeeping, acceptance, and disposal of RACM at the facility are addressed in Part IV – Site Operating Plan.

Large Item Storage Area

A storage area for large items and white goods may be provided near the active working face, or may be provided near the citizen's convenience center. Large items and white goods include ovens, dishwashers, freezers, air conditioners, scrap metal and other large items. Typically, large items and white goods are received in source-separated loads. Should large items or white goods be received in mixed loads, they will be removed from the active face and staged on the ground near the active working face, or citizen's convenience center. The large items and white goods are unloaded and then transferred into steel roll-off containers for storing until transport to an off-site recycler. The roll-off containers will be covered with tarps to prevent rainfall from accumulating inside the containers and to prevent generation of contaminated water. The elimination of contaminated water within the roll-off containers will limit the potential for generating odors within the area. These items may be recycled to prevent a nuisance and to preclude discharge, but will not be stored in excess of 180 days. Large items that are not recycled will be disposed of at the working face.

The large item storage area, when located within the waste disposal footprint will be placed only over areas that have received intermediate cover. Surface water runoff will be diverted around the storage area. Surface water from the large item storage area will be contained by containment and diversion berms consistent with Part III, Attachment D6 – Leachate and Contaminated Water Plan.

Reusable Materials Staging Area

Inert materials such as brick, concrete, etc., and non-inert materials such as asphalt may be stockpiled for use on facility access roads and staging areas or for erosion control in drainage structures. Asphalt will not be used for erosion control in drainage structures. The reusable materials staging area will be located within the waste disposal footprint and will be relocated periodically as the active working face moves. The size of the stockpiles may vary depending on the amount of materials received at any given time. Typical details for the reusable materials staging area are provided on Drawing B.6. Since the brick and concrete materials are inert, runon and runoff from rainfall will not be controlled in a special manner and odor control measures are not required for these materials. Since asphalt is not an inert material, it will be managed in a manner that will prevent runoff of contaminated water, discharge of waste, or the creation of nuisance conditions. These inert and non-inert materials will continuously be reused for site operations, and there is no time limit on the storage of these materials.

Citizen's Convenience Center

A citizen's convenience center for waste drop-off will be located within the site entrance facilities, as shown on Drawings B.2 and B.3. General construction details of the Citizen's Convenience Center are provided on Drawing B.5. Thirty- to forty-cubic yard roll-off containers, as well as containers for recycled goods, may be provided. Containers with waste will be emptied at the active working face at the end of each day. Containers that are empty will be covered with a tarp at the end of the day to prevent rainfall from accumulating inside the containers and to prevent generation of contaminated waters. The control of contaminated water within the roll-off containers will minimize the potential for generating odors within the area. Containers with waste will be emptied at the end of each day, also minimizing the potential for odors. Recycle containers will periodically be transported to an appropriate recycling facility. Large items and white goods may be stored at the citizen's convenience center in steel roll-off containers and will be periodically transported to an appropriate recycling facility.

Used/Scrap Tire Storage Area

130 Environmental Park will not intentionally or knowingly accept whole used or scrap tires for disposal unless processed prior to disposal in a manner acceptable to the executive director. Scrap tires will be accepted from the public or from community clean-up efforts and stored in containers or trailers prior to shipment. Scrap tires identified during landfill operations and generated through maintenance will be accumulated on site by placing them in containers or trailers prior to shipment. The total quantity of tires will not exceed 500 scrap tires (or weight equivalent tire pieces) on the ground, or 2,000 scrap tires in containers. Tire containers will be kept within the facility boundary, near

the active working face, or citizen's convenience center. Manifests will be used for shipment of scrap tires offsite.

Wood Waste Processing Area

The wood waste processing area will be located within the landfill footprint and will process incoming yard trimmings, clean wood materials and vegetative materials, including trees and brush, into wood chips and mulch. The wood chips and mulch will only be used on-site and will be stored in the processing area for a maximum time of 60 days. The wood chips and mulch will be stored in small piles and will be managed to prevent fire, safety, or health hazards in accordance with 30 TAC §330.209(a). The wood waste processing area will not be larger than approximately 125 feet by 100 feet.

Leachate Storage Facility

Primary leachate storage will be provided by the leachate sumps, which will be located within each landfill cell. Leachate and landfill gas condensate will be pumped from the sumps directly into transport trucks or through a dual contained leachate forcemain to the leachate storage facility. The leachate storage facility will be located near the maintenance shop as shown on Drawings B.2 and B.3 to allow access for transport trucks. General construction details of the leachate storage facility are provided on Drawing B.7. The storage facility will consist of up to two 250,000-gallon storage tanks within a secondary containment structure, which will be installed individually as needed based on leachate generation. The secondary containment structure will provide containment, with 12 inches of freeboard, for volume from one leachate storage tank and precipitation from the 25-year, 24-hour storm event or 110 percent of the volume from one leachate storage tank. Secondary containment volume calculations are provided in Attachment D6, Section 2.3 – Leachate Storage and Appendix D6-D.

Truck Wheel Wash

The truck wheel wash will be located near the scalehouse, as shown on Drawing B.3. The wheel wash is a drive-through structure with a series of metal grates and water nozzles. As vehicles drive across the grates, the nozzles spray the undercarriage and sides with water, and the mud drops through the grates into a settling basin. The accumulated mud will be periodically removed from a settling basin and placed in the active working face. The periodic removal of mud and contaminated water will provide odor controls for the truck wheel wash. The water removed from the system will be treated as contaminated water in accordance with Attachment D6 – Leachate and Contaminated Water Plan.

3 SANITATION

30 TAC §330.63(b)(3)

The solid waste processing and/or storage facilities include the large item storage area, reusable materials staging area, citizen's convenience center, used/scrap tire storage area, wood waste processing area, leachate storage facility, and truck wheel wash. Each of the solid waste processing facilities has been designed to facilitate proper cleaning. Refer to Section 2 – Waste Movement for a discussion of each of the solid waste processing facilities. Operational requirements for each facility are described in Part IV – Site Operating Plan, including a discussion of surface water controls, cleaning facilities, and contaminated water.

Large Item Storage Area

Large items and white goods received are transferred into steel roll-off containers for storage. Each steel roll-off container is tarped to prevent rainfall from accumulating inside the containers. Containers will be cleaned by removing loose material for disposal at the working face and washing down the containers with water. Wash water will be treated as contaminated water and disposed of in accordance with Part III, Attachment D6, Section 3.

Reusable Materials Staging Area

Inert and non-inert materials will be stockpiled and reused for site operations. Surface water runon and runoff controls are not required for inert materials such as brick and concrete, but will be required for non-inert materials such as asphalt. Stockpiles of non-inert materials will be located in areas with positive drainage away from the stockpiles to prevent runon of surface water. Runoff of contaminated water will be prevented by containment berms as shown on Drawing B.6. Any contaminated water that is collected will be disposed of in accordance with Part III, Attachment D6, Section 3.

Citizen's Convenience Center

The citizen's convenience center will receive municipal solid waste from the public. Any waste received will be loaded into steel roll-off containers. Each container is tarped to prevent rainfall from accumulating inside the containers. Full containers will be disposed of at the working face. Containers will be cleaned as needed by washing down the containers with water. The citizen's convenience center is constructed of reinforced concrete. Should waste materials spill onto the concrete surface, the materials will be picked up and disposed of at the working face. The concrete surfaces will be cleaned as needed by washing down with water. Wash water from the steel roll-off containers or concrete surfaces will be treated as contaminated water and disposed of in accordance with Part III, Attachment D6, Section 3.

Used/Scrap Tire Storage Area

Used/scrap tires received are transferred into containers or trailers for storage. Each container or trailer is tarped to prevent rainfall from accumulating inside. After used/scrap tires are shipped offsite, containers or trailers will be cleaned by removing loose material for disposal at the working face and washing down the containers with water. Wash water will be treated as contaminated water and disposed of in accordance with Part III, Attachment D6, Section 3.

Wood Waste Processing Area

Wood wastes received will be chipped and stockpiled only to be used for site operations. The area will consist of small piles managed to prevent litter and control fire, health hazards and safety in accordance with §330.209(a). There are no water runon and runoff control, or additional sanitation controls required.

Leachate Storage Facility

The leachate storage facility consists of two steel storage tanks in a reinforced concrete containment structure. Leachate storage and disposal will be in accordance with Part III, Attachment D6, Section 2.3 and 2.4. The secondary containment concrete structure will be periodically cleaned by removing loose materials from the concrete surface and disposing of materials at the working face. The concrete surfaces will be cleaned as needed by washing down with water. Wash water will be treated as contaminated water and disposed of in accordance with Part III, Attachment D6, Section 3.

Truck Wheel Wash

The truck wheel wash is constructed of metal and reinforced concrete. Accumulated mud will be periodically removed from the settling basin for disposal at the working face. The concrete surfaces will be periodically cleaned by washing down with water. Wash water will be considered contaminated water and disposed of in accordance with Part III, Attachment D6, Section 3.

4 WATER POLLUTION CONTROL

30 TAC §330.63(b)(4)

The processing and/or storage facilities will be maintained and operated to manage runon and runoff during the peak discharge from the 25-year, 24-hour storm event to prevent the off-site discharge of waste and feedstock material, including, but not limited to, processed or stored materials. Surface water in and around each processing and/or storage facility will be controlled to minimize surface water running onto, into, and off the processing and/or storage area. Since all contaminated water will be managed in a controlled manner, as discussed above, groundwater will be protected. Should the discharge of contaminated water become necessary, the facility will obtain specific written authorization from the TCEQ prior to discharge. The landfill and its processing and/or storage facilities will be operated consistent with §330.15(h)(1)-(4) regarding discharge of solid wastes or pollutants into waters of the United States or waters of the state.

The design of the landfill itself and the surface water management system for the facility will prevent the discharge of solid waste, pollutants, dredged or fill material and nonpoint source pollution that would violate any of the provisions referenced in 30 TAC §330.15(h). The facility has been designed to keep contaminated surface water (water that may have come into contact with waste at the landfill) separated from uncontaminated stormwater runoff. The contaminated water will be discharged to the surface water management system to be constructed at the site. The site entrance road will be constructed pursuant to a Section 404 nationwide permit, as authorized by the US Army Corps of Engineers. Prior to commencing operations, a Notice of Intent (NOI) under the stormwater permitting requirements of TCEQ's rules will be filed, qualifying the facility to operate pursuant to a general stormwater discharge permit (Permit No. 050000) for industrial activity.

Refer to Section 2 – Waste Movement for a discussion of the solid waste processing and/or storage facilities and Part IV – Site Operating Plan for a discussion of operational requirements. Refer to Part III, Attachment D6 – Leachate and Contaminated Water Plan for a discussion of contaminated water management.

5 ENDANGERED SPECIES PROTECTION

30 TAC §330.63(b)(5)

A detailed threatened and endangered species survey and assessment was conducted by a qualified biologist at Halff Associates. The survey and assessment along with coordination with the United States Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD) regarding endangered and threatened species is provided in Part II, Appendix IIE – Endangered or Threatened Species Documentation.

Development of the facility shall be conducted to minimize potential impacts to endangered or threatened species. The facility and the operation of the facility will not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of any endangered or threatened species.

Halff identified five threatened or endangered species that have the potential to occur within the study area. A species protection plan has been developed and shall be followed during facility development and operation. No adverse impact to threatened or endangered species is anticipated as a result of construction or operation of 130 Environmental Park. Refer to Part II, Appendix IIE and Part IV, Appendix IVC for the species protection plan.

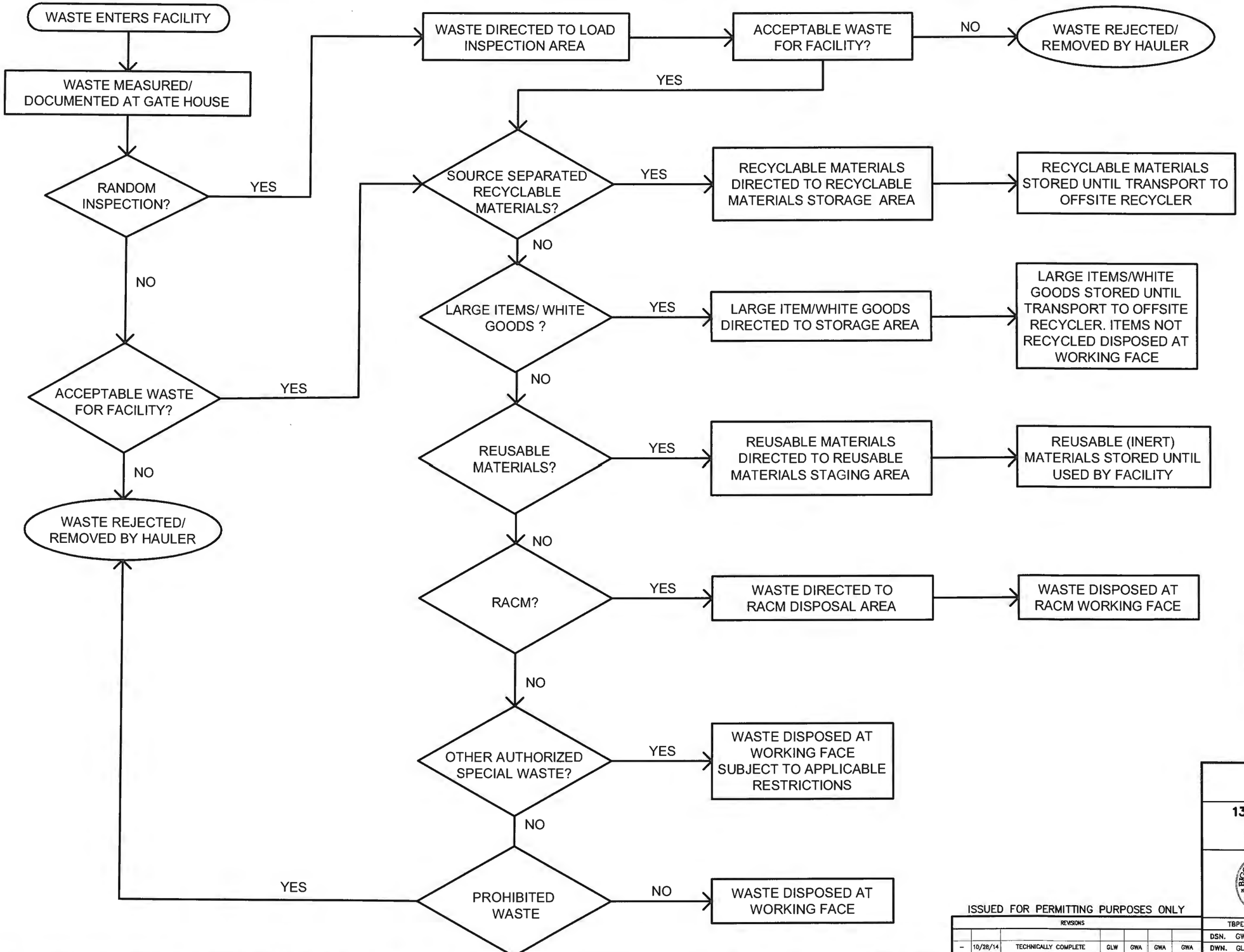
130 ENVIRONMENTAL PARK

APPENDIX B1

DRAWINGS

Technically Complete October 28, 2014

CONTENTS



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STATE OF TEXAS
GREGORY W. ADAMS
73356
LICENSED
PROFESSIONAL ENGINEER
11/6/2014

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REVISIONS						
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–	10/28/14	TECHNICALLY COMPLETE	GLW	GWA	GWA	GWA

WASTE MOVEMENT FLOW CHART

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK
TYPE I PERMIT APPLICATION

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD ◆ WICHITA FALLS
817-563-1144
TBPE FIRM NO. F-256 | TBPG FIRM NO. 50222

DSN. GWA	DATE : 12/13	DRAWING B.1
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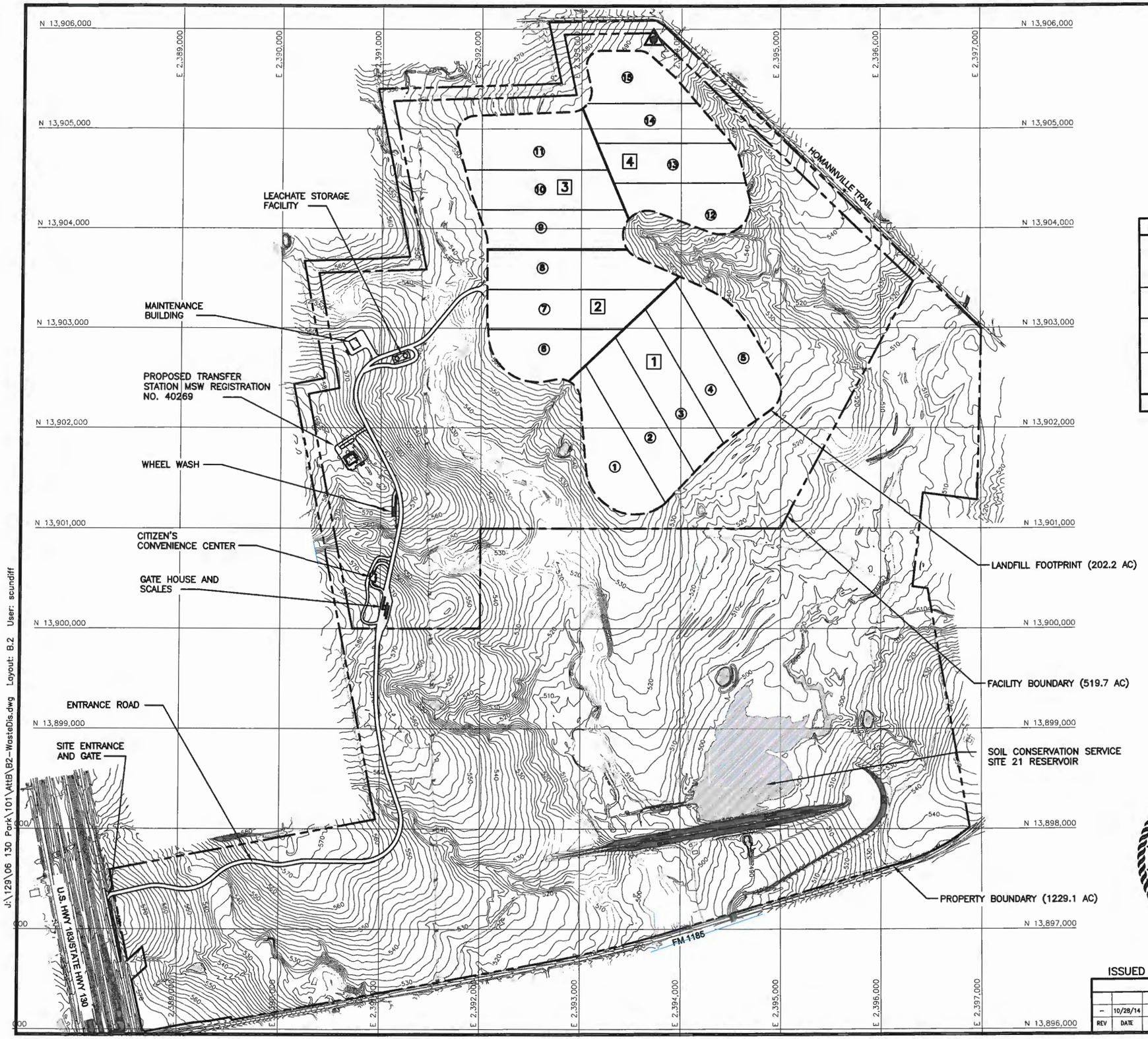
CHK. GWA	DWG : B1_WasteFlow.dwg	



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	3	14.2
	4	14.5
	5	13.1
2	6	11.7
	7	14.6
	8	15.0
3	9	13.1
	10	13.5
	11	17.2
4	12	12.1
	13	12.3
	14	12.2
	15	10.6
TOTAL		202.2

0 500 1000
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- FACILITY BOUNDARY
- LANDFILL FOOTPRINT
- SITE BENCHMARK
- 510 EXISTING 2' CONTOUR
- N 13,904,000 STATE PLANE GRID
- [1] PHASE DESIGNATION
- (1) CELL DESIGNATION

NOTES:

1. CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SERVICE FROM AERIAL PHOTOGRAPHY FLOWN MAY 13, 2013. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83). ELEVATIONS ARE RELATIVE TO NAVD88 – GEOID 12A.
2. PROPERTY BOUNDARY, FACILITY BOUNDARY, EASEMENT LOCATIONS, AND PERMANENT BENCHMARK PROVIDED BY HODDE & HODDE LAND SURVEYING, INC.
3. LARGE ITEM STORAGE AREA WILL BE PROVIDED WITHIN THE LANDFILL FOOTPRINT NEAR THE WORKING FACE OR NEAR THE CITIZEN'S CONVIENIENCE CENTER.
4. REUSABLE MATERIALS STAGING AREA WILL BE PROVIDED WITHIN THE LANDFILL FOOTPRINT.
5. USED/SCRAP TIRE STORAGE AREA WILL TYPICALLY BE PROVIDED NEAR THE WORKING FACE OR NEAR THE CITIZEN'S CONVENIENCE CENTER.
6. WOOD WASTE PROCESSING AREA WILL BE PROVIDED WITHIN THE LANDFILL FOOTPRINT.

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WASTE DISPOSAL PROCESSING AND STORAGE PLAN

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK
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817-563-1144

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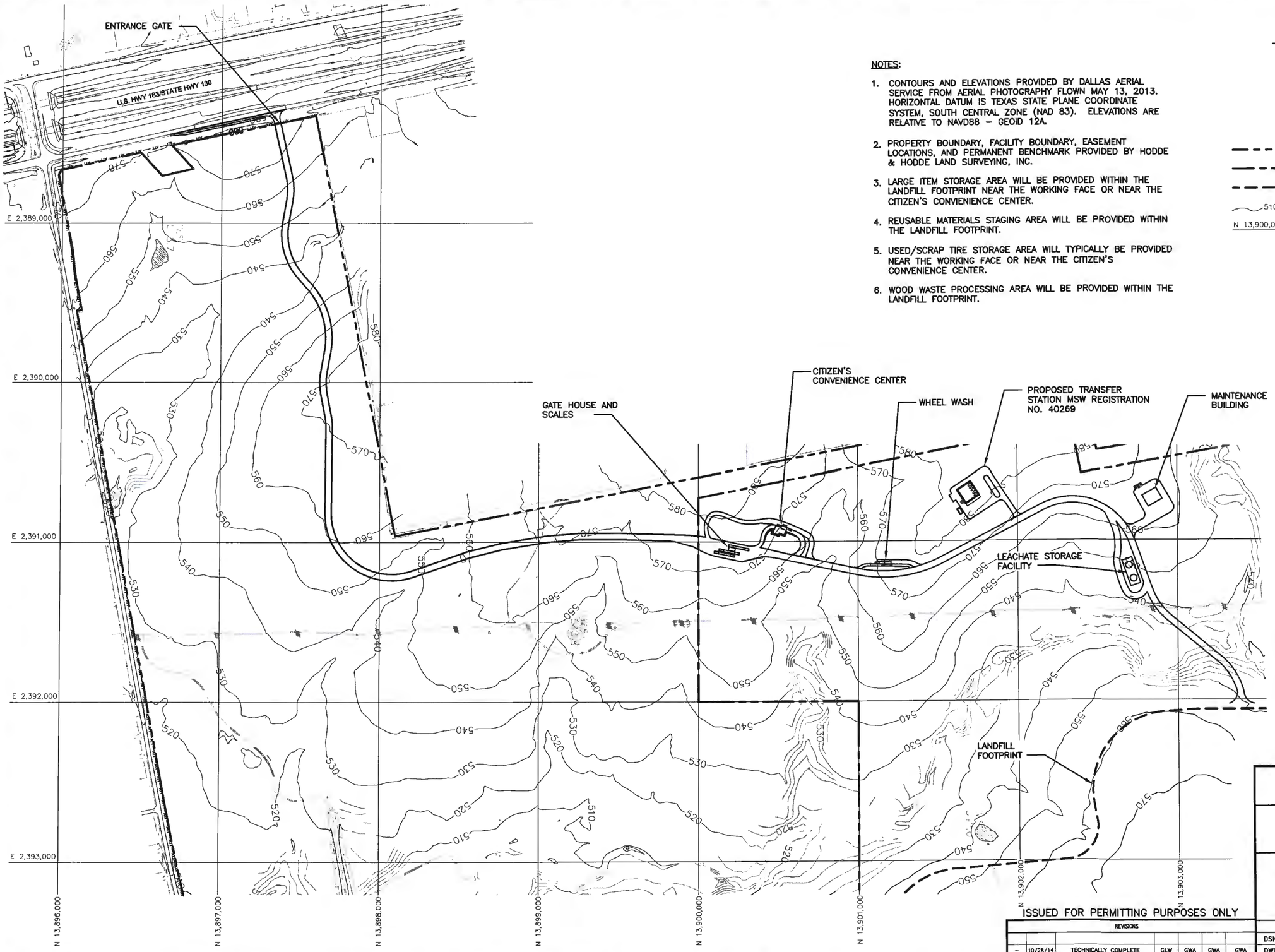

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5. USED/SCRAP TIRE STORAGE AREA WILL TYPICALLY BE PROVIDED NEAR THE WORKING FACE OR NEAR THE CITIZEN'S CONVENIENCE CENTER.
6. WOOD WASTE PROCESSING AREA WILL BE PROVIDED WITHIN THE LANDFILL FOOTPRINT.

0 300 600
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- FACILITY BOUNDARY
- LANDFILL FOOTPRINT
- 510 EXISTING 10' CONTOUR
- N 13,900,000 STATE PLANE GRID

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WASTE PROCESSING AND STORAGE FACILITIES PLAN

130 ENVIRONMENTAL PARK, LLC
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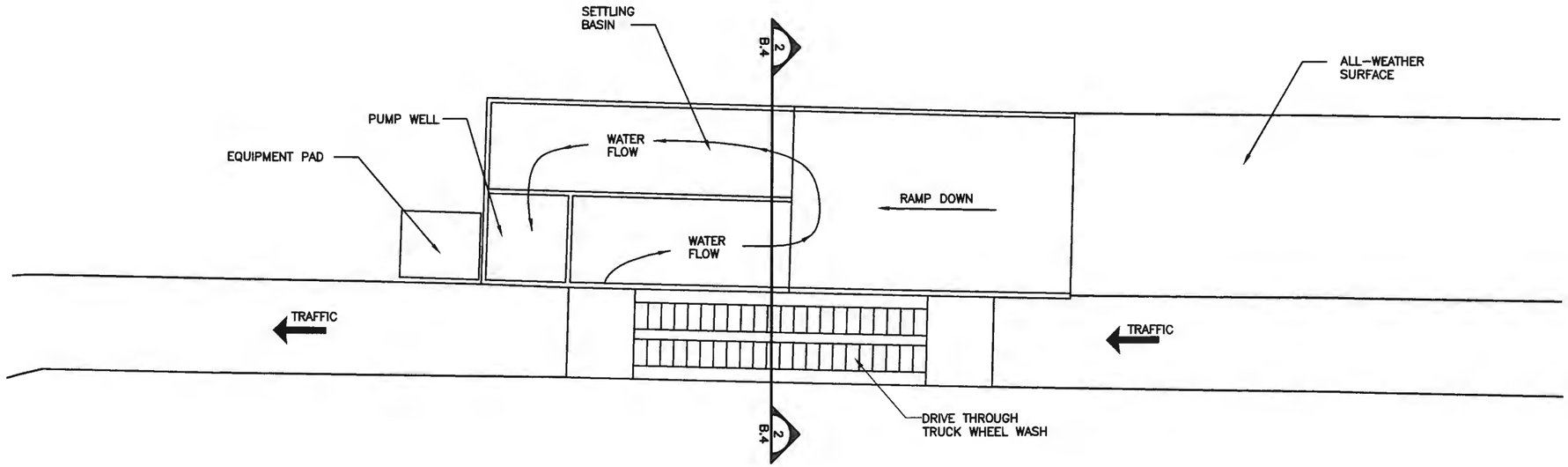

WHEEL WASH 1 B.4

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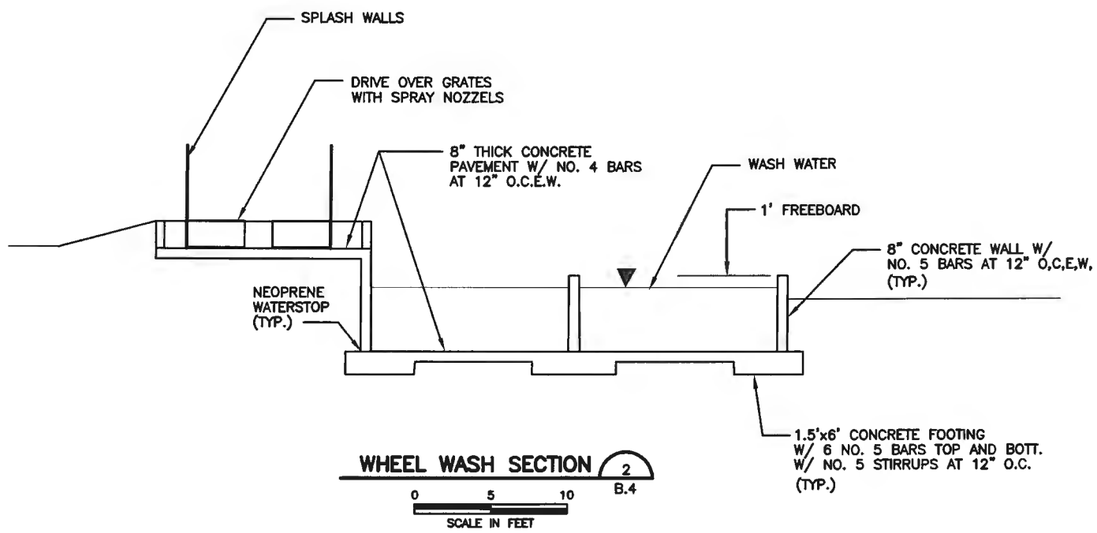

WHEEL WASH SECTION 2 B.4

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SCALE IN FEET

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TRUCK WHEEL WASH

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK
TYPE I PERMIT APPLICATION

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MANSFIELD ◆ WICHITA FALLS
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TBPE FIRM NO. F-256 TBPG FIRM NO. 50222

DSN. GWA	DATE : 12/13	DRAWING	
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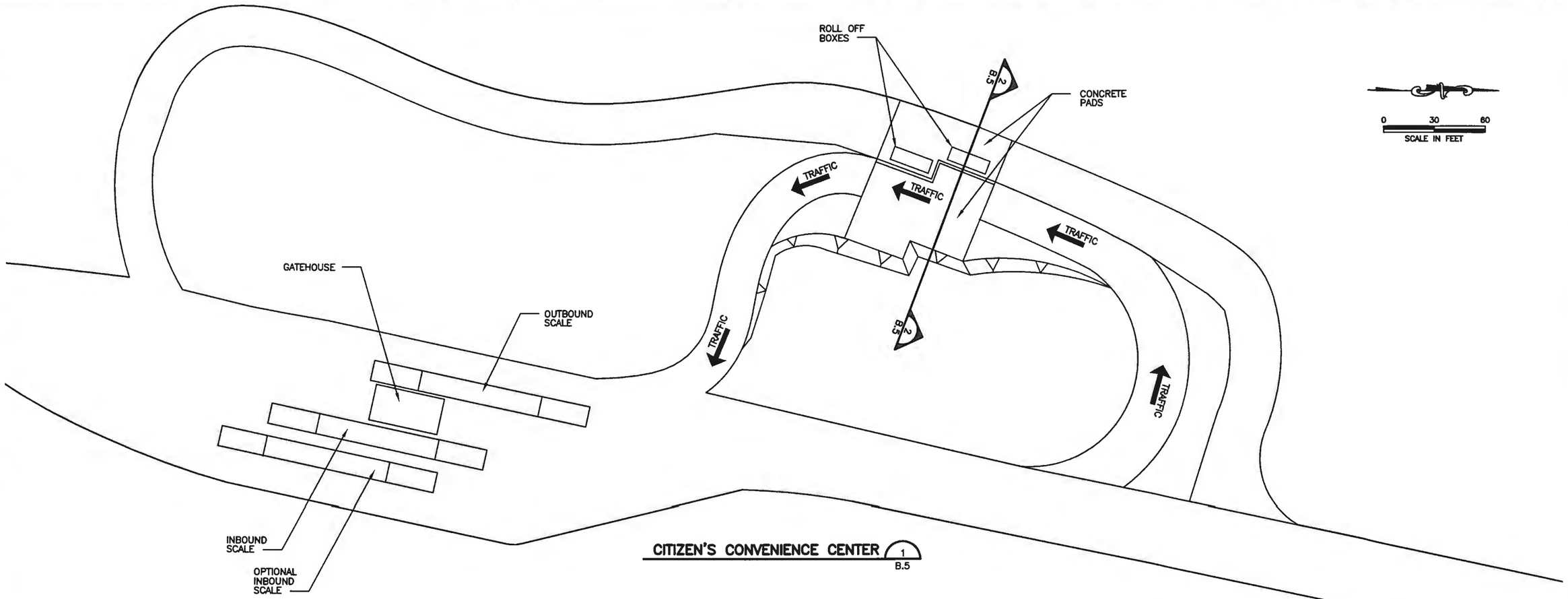
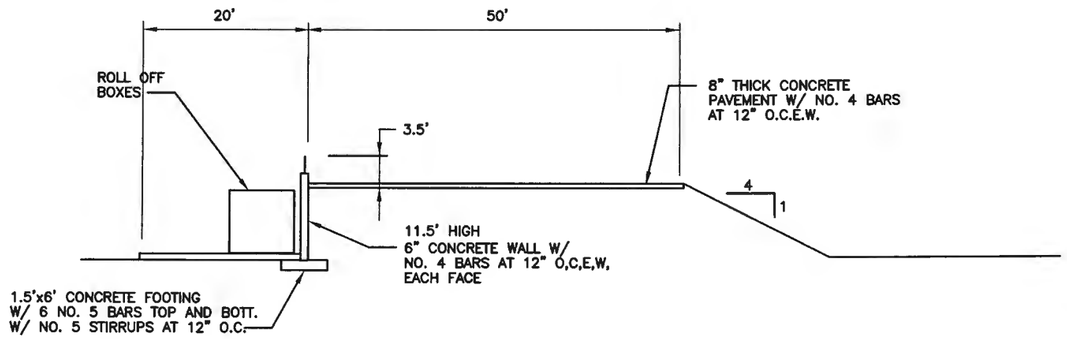


CITIZEN'S CONVENIENCE CENTER 1 B.5



CITIZEN'S CONVENIENCE CENTER SECTION 2 B.5

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CITIZEN'S CONVENIENCE CENTER

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK
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TBPE FIRM NO. F-256 TBPG FIRM NO. 50222

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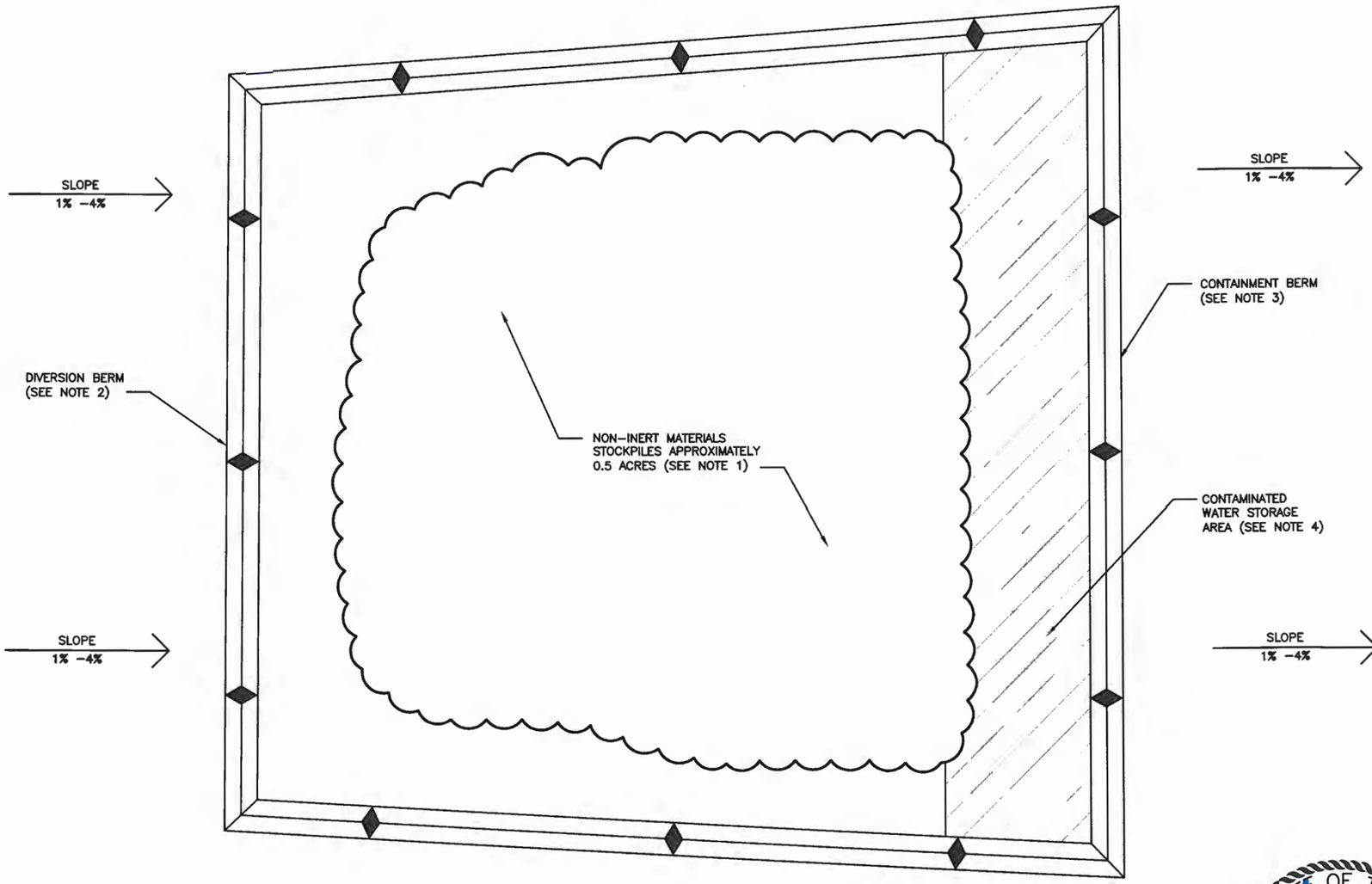

NON-INERT MATERIALS STAGING AREA

0 15 30
SCALE IN FEET

NOTES:

1. INERT (CONCRETE, BRICK, ECT.) AND NON-INERT PAVEMENT AND ASPHALTIC CONCRETE MATERIALS WILL BE STORED IN STOCKPILES WITHIN LANDFILL DISPOSAL FOOTPRINT. NON-INERT MATERIALS WILL BE STOCKPILED SEPARATELY FROM INERT MATERIALS AND WILL BE PROVIDED WITH RUN ON AND RUN OFF CONTROLS FOR THE 25 YEAR 24 HOUR RAINFALL EVENT.
2. WHEN PRACTICLE NON-INERT MATERIALS WILL BE STOCKPILED IN AREAS WITH POSITIVE DRAINAGE AWAY FROM THE STOCKPILE. WHEN NECESSARY DIVERSION BERMS WILL BE PROVIDED TO DIVERT SURFACE WATER AWAY FOM THE STOCKPILES. DIVERSION BERMS WILL BE CONSTRUCTED OF SOIL. REFER TO PART III, ATTACHMENT D6, APPENDIX D6-C FOR DIVERSION BERM SIZING.
3. CONTAINMENT BERMS WILL BE CONSTRUCTED OF SOIL. REFER TO PART III, ATTACHMENT D6, APPENDIX D6-C FOR CONTAINMENT BERM SIZING.
4. CONTAMINATED WATER STORAGE WILL BE PROVIDED DOWNGRADIENT OF THE NON-INERT MATERIALS STOCKPILES. REFER TO PART III, ATACHMENT D6, APPENDIX D6-C FOR CONTAMINATED WATER AREA SIZING.

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REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

REUSABLE MATERIALS STAGING AREA

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DSN. GWA	DATE : 6/14	DRAWING	
DWN. GLW	SCALE : GRAPHIC	B.6	
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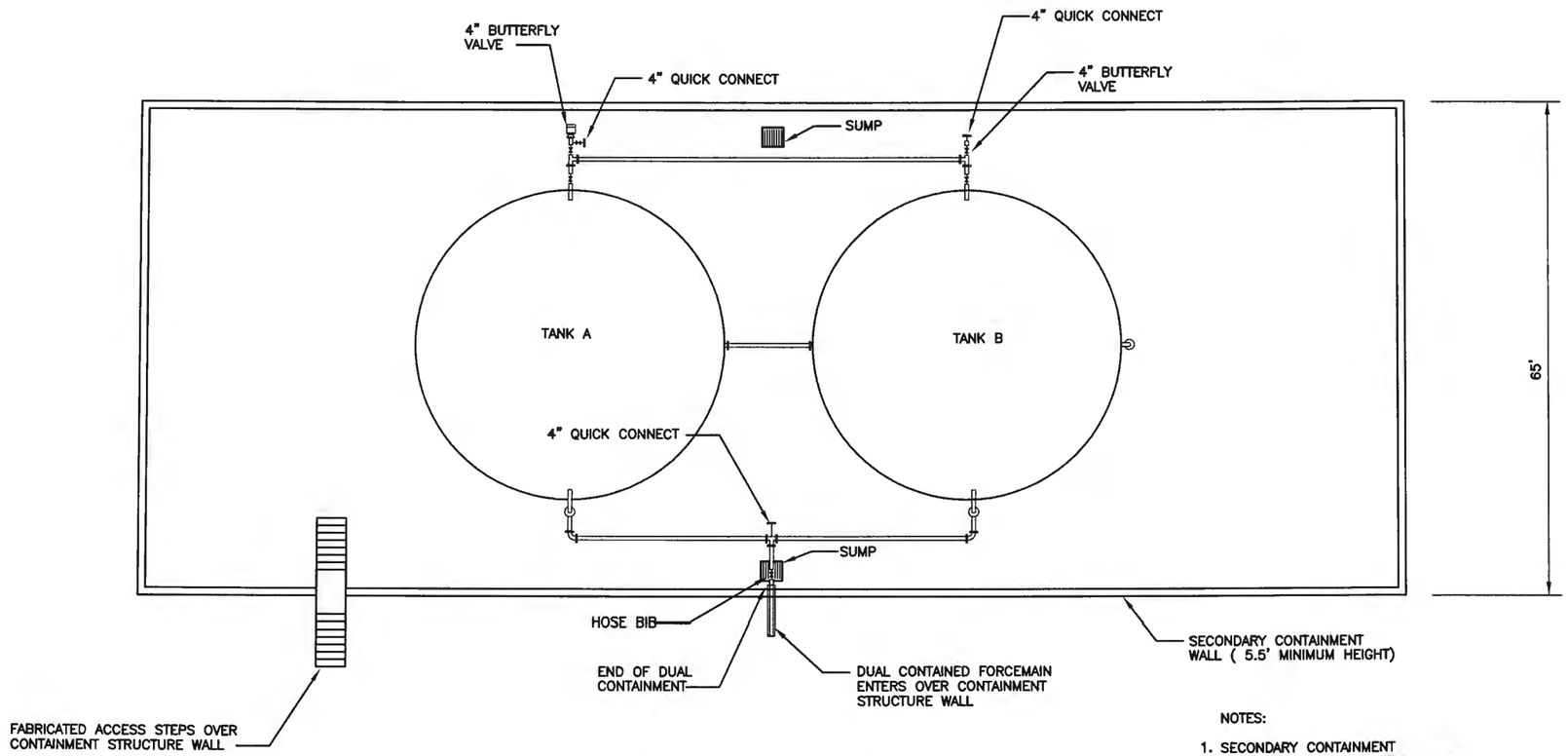
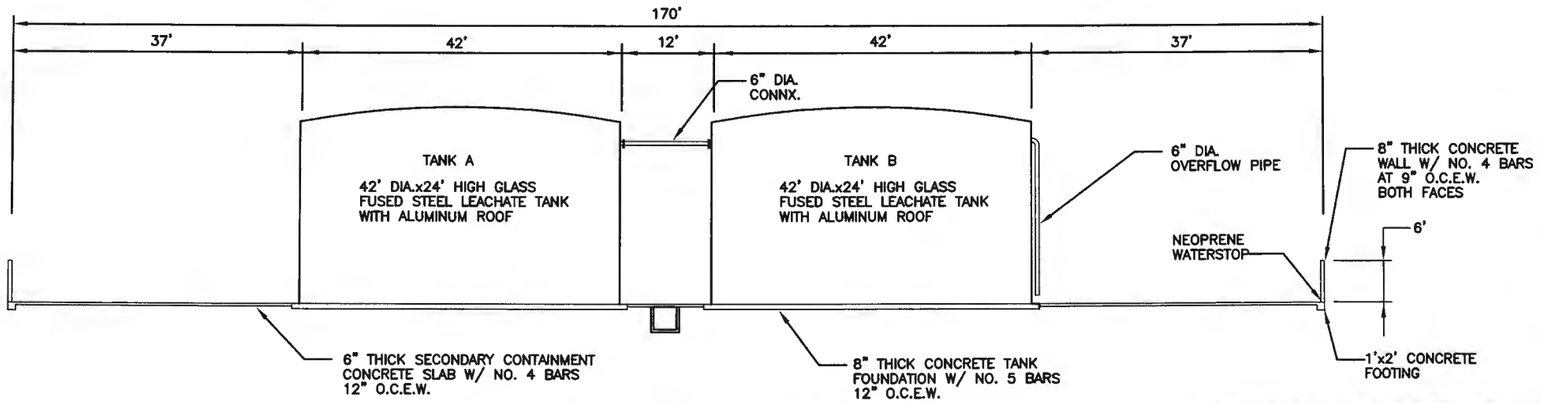


LEACHATE STORAGE FACILITY PLAN

0 10 20
SCALE IN FEET

NOTES:

1. SECONDARY CONTAINMENT STRUCTURE WILL BE INSTALLED WITH TANK A. TANK B MAY BE INSTALLED AT A LATER DATE WHEN NEEDED.
2. STEEL SECONDARY CONTAINMENT STRUCTURE MAY BE USED INSTEAD OF CONCRETE.



LEACHATE STORAGE FACILITY SECTION

0 10 20
SCALE IN FEET

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LEACHATE STORAGE FACILITY

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK
TYPE I PERMIT APPLICATION

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CONSULTING ENGINEERS
MANSFIELD • WICHITA FALLS
817-563-1144

TBPE FIRM NO. F-256 | TBPG FIRM NO. 50222

DSN. GWA	DATE : 6/14	DRAWING	B.7
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CHK. GWA	DWG : D3.4_5-LeaDet.dwg		

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130 ENVIRONMENTAL PARK
CALDWELL COUNTY, TEXAS
TCEQ PERMIT NO. MSW 2383

TYPE I PERMIT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN

ATTACHMENT C
FACILITY SURFACE WATER DRAINAGE REPORT

Prepared for

130 ENVIRONMENTAL PARK, LLC

Technically Complete October 28, 2014

Biggs & Mathews, Inc.
Firm Registration No. F-834

Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road, Suite 100 • Mansfield, Texas 76063 • 817-563-1144

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-256

TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

And

BIGGS & MATHEWS, INC.
2500 Brook Avenue • Wichita Falls, Texas 76301 • 940-766-0156

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-834

CONTENTS

11-6-14

STATE OF TEXAS
T. Traw
103797
LICENSED
PROFESSIONAL ENGINEER

Biggs & Mathews, Inc.
Firm Registration No. F-834

1 NARRATIVE

30 TAC §330.63(c) and §§330.301-330.307

The facility surface water drainage report is prepared as part of a permit application for 130 Environmental Park. This facility surface water drainage report has been prepared consistent with the requirements of §330.63(c) and §§330.301 through 330.307. Attachment C – Facility Surface Water Drainage Report is organized to include the drainage analysis and design, flood control and analysis, and drainage system plans and details. The facility design complies with the requirements of §330.303(a)-(b) concerning the management of runon and runoff during peak discharge of a 25-year rainfall event, the prevention of off-site discharge of waste and feedstock materials, and the control of surface water discharge in and around the facility. Surface water drainage in and around the facility will also be controlled to minimize surface water running onto, into and off the treatment area. The following is a brief description of each of the attachments.

Attachment C1 – Drainage Analysis and Design

Attachment C1 is the drainage analysis and design of the facility, which includes calculations and demonstrations consistent with the requirements of §330.63(c), and §§330.301-330.307. This attachment includes a comparison of surface water runoff from the existing condition to the postdevelopment condition at each location where surface water enters or exits the facility and property boundaries for the 25-year and 100-year, 24-hour rainfall event. The comparison between the existing condition and the postdeveloped condition demonstrates that the proposed development of 130 Environmental Park will not adversely alter the existing drainage patterns. In addition, this attachment includes the drainage design for the final cover system, drainage swales, chutes, perimeter channels, and detention ponds. The drainage design will also provide effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, closure, and post-closure care in accordance with these rules.

Attachment C2 – Flood Control Analysis

Attachment C2 is the flood control analysis, which includes demonstrations consistent with the requirements of §330.63(c)(2). The flood control analysis demonstrates that the proposed development of 130 Environmental Park will not adversely impact the flooding conditions of the receiving channel and that the landfill footprint will not be located within the 100-year floodplain.

Attachment C3 – Drainage System Plans and Details

This attachment includes the permit level site plans and details for the drainage system consistent with §330.63(c) and §§330.301-330.307.

130 ENVIRONMENTAL PARK
CALDWELL COUNTY, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 2383

TYPE I PERMIT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN

ATTACHMENT C1
DRAINAGE ANALYSIS AND DESIGN

Prepared for

130 ENVIRONMENTAL PARK, LLC

Technically Complete October 28, 2014

11-6-14

Biggs & Mathews, Inc.
Firm Registration No. F-834

Prepared by

BIGGS & MATHEWS ENVIRONMENTAL
1700 Robert Road, Suite 100 • Mansfield, Texas 76063 • 817-563-1144

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FIRM REGISTRATION NO. F-256

TEXAS BOARD OF PROFESSIONAL GEOSCIENTISTS
FIRM REGISTRATION NO. 50222

And

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TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NO. F-834

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1 INTRODUCTION

30 TAC §330.63(c) and §§330.301-330.307

1.1 Purpose

The drainage analysis and design is prepared as part of a permit application for 130 Environmental Park and includes the demonstrations consistent with the requirements of 30 TAC Chapter 330, §330.63(c) and §§330.301-307. The drainage analysis and design is organized to include a narrative description of the existing and postdevelopment conditions, the proposed drainage system design, effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, and a discussion of the existing/postdevelopment comparison at the facility and property boundaries. Drainage calculations are included in the appendices. Drainage design plans and details are included in Attachment C3. The following is a brief description of each of the appendices.

Appendix C1-A – Drainage Maps and Existing/Postdevelopment Comparison

Appendix C1-A includes drainage area maps that delineate the drainage areas that contribute surface water runon and runoff at the facility and property boundaries and provide a summary of the peak flow rates, runoff volumes, and runoff velocities at locations along the facility and property boundaries for the existing and postdevelopment conditions. Appendix C1-A also includes a table summarizing the existing/postdevelopment drainage analysis comparison.

Appendix C1-B – Existing Hydrologic Calculations

The existing hydrologic and hydraulic evaluation is included in Appendix C1-B. The existing analysis includes delineations of drainage areas that contribute surface water runon and runoff at comparison locations along the facility and property boundaries.

The results of the existing hydrologic evaluation are provided on the existing conditions drainage analysis summary, which shows the 25- and 100-year peak flow rates, runoff volumes, and runoff velocities at comparison locations along the proposed facility and property boundaries.

Appendix C1-C – Postdevelopment Hydrologic Calculations

The postdevelopment hydrologic and hydraulic evaluation included in Appendix C1-C represents the proposed final closure landfill configuration. The postdevelopment analysis includes delineations of drainage areas that contribute surface water runon and runoff at comparison points along the proposed facility and property boundaries.

The results of the postdevelopment hydrologic evaluation are provided on the postdevelopment boundary analysis summary, which shows the 25- and 100-year peak

flow rates, runoff volumes, and runoff velocities at the comparison locations along the proposed permit and property boundaries.

Appendix C1-D – Perimeter Drainage System Design

Appendix C1-D presents the hydraulic design of the perimeter drainage system. The perimeter drainage plan shows the locations of the perimeter drainage channels and detention ponds. The detention ponds are designed to provide the necessary storage and outlet control to mitigate impacts to the receiving channels downstream of 130 Environmental Park. The perimeter channels are designed to convey the 25-year and 100-year, 24-hour storm event. The detention ponds are designed to not overtop if back-to-back 100-year, 24-hour storm events were to occur.

Appendix C1-E – Final Cover Drainage Structure Design

Appendix C1-E is limited to the design of the permanent final cover drainage structures (i.e., chute and swale system). The calculations demonstrate that the structures are designed to convey runoff produced from a 25-year storm event, to provide erosion protection, and to minimize sediment loss from the final cover condition.

Appendix C1-F – Intermediate Cover Erosion and Sedimentation Control Plan

Appendix C1-F provides a detailed erosion and sediment control plan during the intermediate cover phase of development.

Appendix C1-G – Intermediate Cover Erosion Control Structure Design

Appendix C1-G provides the supporting documentation to evaluate and design temporary erosion and sediment control structures for the intermediate cover phase of landfill development.

2 METHODOLOGY

30 TAC §330.305(f) and §330.307

2.1 Concepts and Methods

The hydrologic and hydraulic methods employed in this study are consistent with the TCEQ regulations. The United States Army Corps of Engineers (COE) HEC-HMS computer program was used to compute peak flow rates and runoff volumes. The HEC-HMS peak flow rates, the Rational Method, the Universal Soil Loss Equation, and the methods defined in the TxDOT *Hydraulic Design Manual*, October 2011, were used to design the final cover drainage system and erosion control features. The drainage analysis proceeded in the following sequence:

- Maps were prepared that provided information about the surface runoff characteristics based on the existing conditions. These maps are included in Appendix C1-B.

- Surface water runoff hydrographs for the existing condition were developed using HEC-HMS. The existing HEC-HMS evaluation is included in Appendix C1-B.

- Maps were prepared that provide information about the surface water runoff characteristics of the postdeveloped final cover drainage conditions for 130 Environmental Park. These maps are included in Appendix C1-C.

- Surface water hydrographs for the postdeveloped condition, including the perimeter drainage channel and detention ponds, were evaluated using HEC-HMS. The postdeveloped evaluation is included in Appendix C1-C.

- The final cover system was evaluated for soil loss using the Natural Resources Conservation Service (NRCS) Universal Soil Loss Equation. Final cover drainage systems were evaluated for capacity using the peak flow rates from HEC-HMS, the Rational Method, and the methods defined in the TxDOT *Hydraulic Design Manual*, October 2011. Final cover drainage systems calculations are included in Appendix C1-E.

- The intermediate cover system was evaluated for soil loss using the Universal Soil Loss Equation. Intermediate cover erosion and sediment control plan and structure design were evaluated for capacity using the Rational Method and the methods defined in the TxDOT *Hydraulic Design Manual*, October 2011. Intermediate cover erosion and sediment control plans are included in Appendix C1-F and C1-G.

2.2 Hydrologic and Hydraulic Modeling

2.2.1 HEC-HMS

The COE HEC-HMS program was developed to simulate the surface water runoff response of a watershed. The HEC-HMS model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of stream-flow hydrographs at desired locations in the watershed. HEC-HMS v3.5 was used to perform the hydrologic modeling. Refer to Appendix C1-B for a detailed discussion of the input parameters used for the existing conditions analysis and Appendix C1-C for a detailed discussion of the input parameters used for the postdeveloped condition.

2.3 Hydrologic Elements Naming Convention

The following naming convention was used in the existing and postdeveloped hydrologic evaluations:

A – drainage area within the facility boundary, existing condition (examples: A1, A5)

P – drainage area within the facility boundary, postdeveloped condition (examples: P4, Pond 2A)

OS – drainage area outside of the facility boundary (examples: OS4, OS12)

R – designates a reach that conveys runoff through a given drainage area (examples: Reach-1, Reach-CP7)

CP – comparison point where surface water runoff enters or exits the facility or property boundaries (examples: CP1, CP12)

J – junction (example: J-2)

3 EXISTING CONDITIONS

The 130 Environmental Park includes a proposed Type I municipal solid waste facility located in northern Caldwell County approximately one mile east of State Highway 130 (SH130) and approximately one mile north of Farm to Market Road 1185 (FM 1185). The 130 Environmental Park site entrance is approximately 1,500 feet north of the intersection of US Highway 183 (US183) and FM1185, on the east side of SH130.

The proposed 130 Environmental Park facility boundary will encompass about 520 acres out of the approximately 1,229-acre property boundary. The overall property consists of gently undulating grasslands with limited forest cover. The property has been historically used as ranchland dating back at least to the mid-1930s. The property generally slopes to the south. The major topographic feature of the property is the Soil Conservation Service (SCS) Site 21 Reservoir on Dry Creek, which traverses the property in a northeast to southwest direction, entering Plum Creek approximately five miles south of the property. Plum Creek eventually flows in a southeast direction, entering the San Marcos River about 23 miles downstream from the property.

The facility boundary is located in the northern portion of the property, northwest of Dry Creek and north of the SCS Site 21 Reservoir. The landfill footprint is located west of Dry Creek, and east of an unnamed tributary to Dry Creek. The entrance facilities are located west of the unnamed tributary to Dry Creek; topography in the entrance area generally slopes to the east to this unnamed tributary. A topographic ridge traverses the middle of the proposed landfill footprint, such that surface topography within the facility boundary generally slopes both to the southeast towards Dry Creek and to the southwest to the unnamed tributary.

As shown on Drawing C1-B-1, surface water enters the facility boundary through three branches of the unnamed tributary of Dry Creek along the west facility boundary (CP2, CP3, and CP4). Surface water from these three points exits the facility boundary at two points along the south facility boundary (CP5 and CP6). Surface water exits the facility boundary at one point along the north facility boundary (CP1), this runoff flows to the west entering an existing small tributary that flows to the west-southwest and re-enters the facility boundary at CP 2. Surface water also exits the facility boundary along the east facility boundary (CP7 and CP8). Surface water from these two locations enters Dry Creek, east of the facility boundary. In addition, surface water enters the property boundary through Dry Creek, located east of the facility boundary. All surface water that enters or exits the facility boundary, flows to the south into the SCS Site 21 Reservoir. Surface water entering the SCS Site 21 Reservoir is controlled by a primary outlet control structure located at about the mid-point of the reservoir. Flow exiting the reservoir outlet exits the southern property boundary (CP12), and flows through existing culverts at FM 1185.

Surface water enters the property boundary at three locations along the west property boundary. This surface water does not enter the facility boundary, or the SCS Site 21 Reservoir. Surface water exits the property boundary at three additional locations on the

southern boundary (CP 9, CP10, and CP11). Surface water exiting the property boundary at these three locations flows through culverts at FM1185.

Appendix C1-B includes the existing condition hydrologic calculations. Appendix C1-B includes drawings that depict the existing condition drainage areas and comparison points. Refer to Drawing C1-B-1 for the existing condition drainage area map, including all offsite drainage areas. Refer to Drawing C1-B-2 for a more detailed drainage area map of the property which includes the area, peak flow rate, and volume for the 25-year and 100-year 24-hour rainfall event for each drainage area. Refer to Drawing C1-B-3 for the existing condition runoff summary for each comparison point.

The following table includes a summary of the existing conditions drainage analysis, providing the peak flow rate, volume, and velocity at each comparison point for the 25-year, 24-hour rainfall event. The table also identifies the contributing drainage areas, and states that surface water either enters (runon) or exits (runoff) at each comparison point.

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Table 1 - Existing Conditions Drainage Analysis Summary

Comparison Point	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft)	Peak Velocity (fps)	Runon / Runoff	Drainage Areas
CP1	37.9	4.3	0.62	Runoff	A1
CP2	1214.1	361.8	3.10	Runon	A1, OS2
CP3	706.2	201.8	2.65	Runon	OS3
CP4	170.0	39.0	3.16	Runon	OS4
CP5	255.5	58.5	2.48	Runoff	A3, OS4
CP6	2121.3	659.3	3.91	Runoff	A1, A2, OS2, OS3
CP7	243.4	38.5	2.65	Runoff	A4
CP8	372.4	63.8	4.79	Runoff	A5
CP9	795.7	156.7	4.78	Runoff	OS5
CP10	117.5	15.4	4.03	Runoff	OS6
CP11	293.6	53.5	4.09	Runoff	OS7
CP12	230.9	2524.1	2.05	Runoff	A1, A2, A3, A4, A5, OS1, OS2, OS3, OS4, OS8, OS9, OS10, OS11, OS12, OS13, OS14, OS15, OS16, OS17

4 POSTDEVELOPMENT CONDITIONS

The existing condition discussion relates to surface water entering and exiting the facility and property boundary, and the comparison points along the facility and property boundary identified in the existing conditions remain unchanged in the postdeveloped condition. The offsite drainage areas and runoff characteristics outside the 130 Environmental Park property boundary remain unchanged from the existing conditions. Offsite drainage areas and runoff characteristics that are located within the property boundary and outside the facility boundary remain unchanged from existing conditions, except those that are affected by the location of the facility entrance road. All drainage areas within the facility boundary are revised to consider the facility development including the entrance facilities, storage and processing facilities, and the landfill development.

The total drainage areas contributing to comparison points CP9, CP10, and CP11 remain unaffected by the facility development. However, these drainage areas have been sub-divided where appropriate and runoff characteristics adjusted as appropriate to evaluate the effect the facility entrance road may have on these comparison points located along the south property boundary and FM 1185.

The drainage area configurations and runoff characteristics within the facility boundary have been revised as appropriate to evaluate the effect the facility development may have on comparison points CP5, CP6, CP7, and CP8 located along the south and east facility boundary; and on comparison point CP12 which is located downstream of the SCS Site 21 Reservoir on the south property boundary and FM 1185.

The locations where surface water enters and exits the facility and property boundary in the postdevelopment conditions remains unchanged from existing conditions.

Appendix C1-C includes the postdeveloped hydrologic calculations. Appendix C1-C includes drawings that depict the postdeveloped drainage areas and comparison points. Refer to Drawing C1-C-1 for the postdeveloped drainage area map, including all offsite drainage areas. Refer to Drawing C1-C-2 for a more detailed drainage area map of the property which includes the area, peak flow rate, and volume for the 25-year and 100-year 24-hour rainfall event for each drainage area. Refer to Drawing C1-C-3 for the postdeveloped runoff summary for each comparison point.

The following table includes a summary of the postdevelopment conditions drainage analysis, which provides the peak flow rate, volume, and velocity at each comparison point for the 25-year, 24-hour rainfall event. The table also identifies the contributing drainage area, and states that surface water either enters (runon) or exits (runoff) at each comparison point.

130 Environmental Park

Table 2 - Postdeveloped Conditions Drainage Analysis Summary

Comparison Point	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft)	Peak Velocity (fps)	Runon/ Runoff	Drainage Areas
CP1	8.0	0.7	0.33	Runoff	P1
CP2	1205.3	358.2	3.09	Runon	OS2, P1
CP3	706.2	201.8	2.65	Runon	OS3
CP4	170.0	39.0	3.16	Runon	OS4
CP5	257.5	59.4	2.48	Runoff	OS4, P3
CP6	2033.6	676.0	3.87	Runoff	OS2, OS3, P1, P2, P2A, Pond 1A, Pond 3A, Pond 4A
CP7	141.8	61.8	2.32	Runoff	Pond 2A, P4
CP8	327.2	53.3	4.64	Runoff	Pond 5A, Pond 6A, Pond 7A, P5
CP9	795.7	156.7	4.78	Runoff	OS5
CP10	117.5	15.4	4.03	Runoff	OS6
CP11	293.6	53.5	4.09	Runoff	OS7
CP12	231.0	2554.5	2.05	Runoff	OS1, OS2, OS3, OS4, OS8, OS9, OS10, OS11, OS12, OS13, OS14, OS15, OS16, OS17, P1, P2, P2A, P3, P4, P5, Pond 1A, Pond 2A, Pond 3A, Pond 4A, Pond 5A, Pond 6A, Pond 7A

5 PROPOSED DRAINAGE SYSTEM DESIGN

30 TAC §330.63(c)(1), §330.303 and §330.305(a)–(f)

The proposed drainage system for 130 Environmental Park will consist of drainage swales, downchutes, perimeter channels, detention ponds and outlet structures.

The facility has been designed to prevent discharge of pollutants into waters in the state or waters of the United States, as defined by the Texas Water Code and the Federal Clean Water Act, respectively. 130 Environmental Park, LLC will receive authorization from the TCEQ to discharge stormwater runoff consistent with Texas Pollutant Discharge Elimination System General Permit No. TXR050000 relating to stormwater discharges associated with industrial activity. Landfills are authorized under the General Permit.

5.1 Perimeter Drainage System Design

The perimeter drainage system is designed to convey the 25-year runoff from the developed landfill consistent with TCEQ regulations. In addition, the perimeter channels have been designed to convey the runoff from a 100-year rainfall event. The perimeter channel system design calculations are referenced in Appendix C1-D. The perimeter drainage structure plans are included in Attachment C3.

The detention ponds are designed to provide the necessary storage and outlet control to mitigate impacts to the receiving channels downstream of 130 Environmental Park. Detention pond design parameters are included in the hydrologic modeling for postdeveloped conditions in Appendix C1-C. The detention pond details are shown in Attachment C3. The detention pond outlet structures are designed as energy dissipators to reduce the velocity and turbulence of the flow leaving the detention ponds.

5.2 Final Cover Drainage Structure Design

Stormwater runoff will be collected in swales located near the upper grade break on the landfill and on the 4:1 (horizontal to vertical) side slopes, leading to drainage letdown structures or chutes and to the perimeter drainage system. The perimeter drainage system will be constructed as each sector is developed.

The final cover drainage system swales and chutes are designed to convey the 25-year peak flow rate. These swales, channels, and chutes will also reduce maintenance at the site after closure by minimizing erosion. The final cover erosion control design calculations are included in Appendix C1-E. The final cover design, showing the locations of the drainage swales, downchutes, and final cover drainage structure details, is illustrated in Appendix C1-E.

The chute/letdown structures are designed to convey the 25-year, 24-hour peak flow rate. The chutes are designed using reno mattresses or articulating concrete blocks to minimize

erosive conditions along the chute and at swale/chute confluences. There is a slope transition between the chute and perimeter road low water crossing. A hydraulic jump occurs at the chute/low water crossing transition that dissipates the energy and reduces the velocity across the perimeter road. Concrete is used at the chute/low water crossing transitions to minimize erosion. The letdown structures continue and convey stormwater into the perimeter channels or directly into the detention ponds. The letdown structures are designed using reno mattresses or articulating concrete blocks to provide erosion protection at the letdown/perimeter channel confluence and where letdowns convey stormwater directly into the detention ponds. The chute design calculations are included in Appendix C1-E. Final cover drainage system details, including the chute details, are shown in Attachment C3. A typical detail of the low water crossing depicting where the chute crosses the perimeter road is also shown in Attachment C3.

6 EROSION AND SEDIMENTATION CONTROL

30 TAC §330.305

6.1 Final Cover Stormwater System Control Plan

Perimeter drainage channels and detention ponds will be constructed as the subsequent phased development of the landfill progresses. Erosion will be minimized in these structures by establishment of vegetation or with rock riprap, gabions, or other materials as provided for in the drainage design calculations for these permanent structures as found in Appendix C1-E – Final Cover Drainage Structure Design.

Swales and chutes will be constructed upon placement of the final cover. The final cover includes an erosion layer that is a minimum of 24 inches of earthen material with the top 6 inches capable of sustaining native plant life and will be seeded with native and introduced grasses immediately following the application of final cover in order to minimize erosion. A soil loss demonstration for the erosion layer is included in Appendix C1-E of this attachment. The swales and chutes include establishment of vegetation, rock riprap, gabions, and other materials as provided in the drainage calculations for these permanent structures.

6.2 Final Cover Stormwater System Maintenance Plan

130 Environmental Park will inspect, restore, and repair constructed permanent stormwater systems such as channels, drainage swales, chutes, and flood control structures in the event of wash-out or failure from extreme storm events. Excessive sediment will be removed, as needed, so that the drainage structures, such as the perimeter channels and detention ponds, function as designed. Site inspections by landfill personnel will be performed weekly or within 48 hours of a rainfall event of 0.5 inches or more. The time frame for correction of damaged or deficient items under normal conditions will be within five days after the inspection identifying these items. Normal conditions are weather, ground and other site-specific conditions that do not impede access to the item, result in additional damage to the site attempting to access or repair the item, or risk equipment or personnel safety. Documentation of the inspection will be included in the site operating record.

The following items will be evaluated during the inspections:

- Erosion of final cover areas, perimeter ditches, chutes, swales, detention ponds, berms, and other drainage features
- Settlement of final cover areas, perimeter ditches, chutes, swales, and other drainage features
- Silt and sediment build-up in perimeter ditches, chutes, swales, and detention ponds

- Obstructions in drainage features
- Presence of erosion or sediment discharge at perimeter stormwater discharge locations
- Presence of sediment discharges along the site boundary in areas that have been disturbed by site activities

Maintenance activities will be performed to correct damaged or deficient items noted during the site inspections. These activities will be performed as soon as reasonably possible after the inspection. The time frame for correction of damaged or deficient items will vary based on weather, ground conditions, and other site-specific conditions.

Maintenance activities will consist of the following, as needed:

- Placement of additional temporary or permanent vegetation
- Placement, grading, and stabilization of additional soils in eroded areas or in areas that have experienced settlement
- Replacement of riprap or other structural lining
- Placement of additional riprap in eroded areas or in areas that have experienced settlement
- Removal of obstructions from drainage features
- Removal of silt and sediment build-up from drainage features
- Repairs to erosion and sedimentation controls
- Installation of additional erosion and sedimentation controls

6.3 Intermediate Cover Erosion and Sedimentation Control Plan

Erosion and sediment controls have been designed for the intermediate cover phase of landfill development. The intermediate cover erosion and sedimentation control plan includes temporary structures and establishment of vegetation to minimize erosion of the intermediate cover and documentation requirements. Refer to Appendix C1-F – Intermediate Cover Erosion and Sedimentation Control Plan, and Appendix C1-G – Intermediate Cover Erosion Control Structure Design.

6.4 Daily Cover Erosion and Sedimentation Control Plan

Erosion and sediment controls for the daily cover phase of landfill development will be consistent with the requirements of Part IV – Site Operating Plan, Section 8.18 – Landfill Cover. Daily cover will be placed over all solid waste at the end of each operating day

as required by Part IV, Section 8.18.2 – Daily Cover. The daily cover will be sloped to drain. Runoff from areas that have intact daily cover constructed of a well-compacted earthen material is considered uncontaminated stormwater runoff. Erosion and sediment controls for daily cover will include the following procedures:

- Areas with daily cover will be inspected daily for erosion that may cause contaminated runoff from the daily cover.

- After each rainfall event all daily cover areas will be inspected for erosion or other damage and repaired as necessary. Runoff from damaged or eroded areas will be handled as contaminated water until repairs are completed.

- Erosion and sediment controls will be implemented within daily cover areas, including compaction of daily cover to minimize infiltration of stormwater.

- Should erosion of daily cover be observed, the daily cover will be replaced so that no solid waste is exposed at the end of the operating day. In the event that additional soil stabilization or erosion control measures are deemed necessary, one or more of the following measures will be constructed: temporary sediment control fence, silt fence, swales, or filter berms.

7 EXISTING/POSTDEVELOPMENT COMPARISON

30 TAC §330.63(c)(1)(D)(iii) and §330.305(a)

Consistent with 30 TAC §330.63(c)(1)(D)(iii) and §330.305(a), the proposed facility development will not adversely alter existing drainage patterns. Refer to Appendix C1-A for a summary of the existing conditions, postdeveloped conditions, and a comparison of the peak flow rate, volume, and velocity for each comparison point evaluated. Comparisons are provided for the 25-year and 100-year, 24-hour rainfall events. The comparison points established in the existing condition evaluation remain unchanged in the postdeveloped condition.

At CP1, a permit boundary discharge point, the peak discharge, runoff volume, and peak velocity are reduced as a result of facility development. However, these changes are not adverse alterations of existing drainage patterns because: (1) In both the existing and postdeveloped conditions, the discharge from CP1 enters a small drainage ditch along the south side of Homannville Trail right-of-way that flows to the west and includes culverts for driveways on adjacent properties. The referenced reductions at CP1 will improve drainage conditions in this ditch. (2) After approximately 375 linear feet, this roadside ditch drains into an excavated, but otherwise unimproved, larger drainage ditch that flows generally to the southwest and west from the corner where Homannville Trail turns nearly north. A large portion of the flow in this ditch originates in offsite drainage areas to the north and northeast, along and across Homannville Trail. The referenced reductions at CP1 will be insignificant through this port of the natural drainage. (3) Near a northwest corner of the 130 Environmental Park site, this ditch turns to the south and is joined by a drainageway for runoff from the largest portion of the 2,883-acre off-site drainage area OS2 (for comparison, the area of existing conditions on-site drainage area A1, from which flows at CP1 originate, is approximately 10.2 acres). The referenced reductions at CP1 will be insignificant through this portion of the natural drainage. (4) Approximately 900 feet south of the above-referenced northwest corner of the 130 Environmental Park site, this drainageway flows onto the site. It then flows generally to the south, exiting the permit boundary at CP6, where the postdevelopment 25-year peak flow rate and volume are within 4% of the existing conditions values.

Development of the 130 Environmental Park Landfill will result in minor changes in 25-year peak discharge and volume at comparison points CP5, CP6, CP7, and CP8 (all of which are permit boundary discharge points), but none of these changes will be an adverse alteration of the existing drainage patterns. Each of these points is in a drainage channel and discharges from each point will flow into SCS Reservoir Site 21. The discharge from the reservoir enters the Dry Creek channel and flows south to a culvert under FM 1185. The 25-year storm peak discharge rate at this culvert (CP12) will be essentially unchanged from the existing conditions to the postdeveloped condition (230.9 cfs to 231.0 cfs). The runoff volume at CP12 will increase slightly (approximately 1.2%, from 2524.1 acre feet to 2554.5 acre feet) and that volume release will be distributed over a relatively long time period and, therefore, will not result in an adverse alteration of existing drainage patterns.

At CP5 the peak discharge will increase from 255.5 cfs to 257.5 cfs, a change of less than 0.8%, and at CP6 the peak discharge will decrease from 2121.3 cfs to 2033.6 cfs, a change of approximately 4%. At CP5, the runoff volume will increase from 58.5 acre-feet to 59.4 acre-feet, a change of only 1.5%, and at CP6, the runoff volume will increase from 659.3 acre-feet to 676.0 acre-feet, a change of less than 2.5%. CP5 and CP6 are located in channels of unnamed tributaries on the west side of the 130 Environmental Park site. These tributaries merge approximately 350 feet south of the permit boundary and flow into SCS Reservoir Site 21. CP5 and CP6 are both located within the 100-year floodplain, as are the tributaries that flow from them in to the SCS reservoir site. The slight decreases in peak flow rates and CP5 and CP6, and in the stream channels between them and the reservoir site will not result in an adverse alteration of existing drainage patterns. The slight increases in runoff volumes at and below CP5 and CP6 will occur in stream channels and within the reservoir site, all of which are located within the 100-year floodplain, will not reduce total streamflows or increase the 100-year flood water surface elevation. The changes at CP5 and CP6 will not result in adverse alterations of existing drainage patterns.

At CP7 the 25-year storm peak discharge will decrease from 243.4 cfs to 141.8 cfs, a reduction of approximately 42%, and at CP8 the peak discharge will decrease from 372.4 cfs to 327.2 cfs, a reduction of approximately 12.1%. At CP7, the 25-year storm runoff volume will increase from 38.5 acre-feet to 61.8 acre-feet, an increase of approximately 60.5%, and at CP8 the runoff volume will decrease from 63.8 acre-feet to 53.3 acre-feet, a decrease of approximately 16.5%. CP7 and CP8 are both located within the same water body, SCS Reservoir Site 21, during the 25-year storm event. The reductions in peak flow rates at CP7 and CP8 will not result in adverse alterations of existing drainage patterns. The 25-year storm runoff volume will increase at CP7; however, because the peak discharge rate will be reduced and the runoff volume will be distributed over a longer time period, that increase will not result in an adverse alteration of existing drainage patterns. And, while the 25-year storm runoff volume will increase at CP7 and decrease at CP8 (a net increase of 12.8 acre feet, approximately 12.5%), these changes will be insignificant compared to the receiving body, SCS Reservoir Site 21. For example, the peak storage volume of the SCS Reservoir Site 21 and peak inflow to the reservoir from Dry Creek exceed 2,300 ac-ft and 3,800 cfs, respectively, during the 25-year storm event. Considering the proposed net changes within the water body of less than 4% decrease in peak discharge rate and less than 1% increase in volume, the changes at CP7 and CP8 will not result in adverse alterations of existing drainage patterns.

Drawing C1-A-2 – Existing Condition Runoff Summary: This drawing depicts the existing locations (comparison points) where surface water enters or exits the facility and property boundaries. Each comparison point is shown on the drawing and the peak flow rate and runoff volume is provided in the summary table for each comparison point.

Drawing C1-A-4 – Postdeveloped Runoff Summary: This drawing depicts the locations (comparison points) where surface water enters or exits the facility and property boundaries. Each comparison is shown on the drawing and the peak flow rate and runoff volume is provided in the summary table for each comparison point.

A table comparing the existing condition runoff summary and the postdeveloped runoff summary is provided on page C1-A-5. The existing condition and postdeveloped peak flow rate, runoff volume, and velocity at each comparison point for both the 25- and 100-year, 24-hour rainfall event is provided. The difference, if any, between the existing and postdeveloped runoff results is also provided in the table.

Conclusion

Because: (1) the postdevelopment stormwater discharge points are consistent with the existing site configuration, and (2) development of the 130 Environmental Park Landfill will not adversely alter peak flow rates, velocities, or runoff volumes, the proposed landfill development will not adversely alter existing drainage patterns consistent with §330.305(a).

8 CONCLUSIONS

The following conclusions summarize the results of the drainage analysis and design:

- The drainage design criteria and analyses used for these drainage calculations meet and exceed the requirements of 30 TAC Chapter 330.
- The final cover drainage structures (swales, chutes) are designed in accordance with the rules to convey peak flow rates from the 25-year rainfall event.
- Perimeter channels are designed in accordance with the rules for the 25-year rainfall event and will also accommodate the peak flow rate from the 100-year rainfall event.
- Detention pond capacities and outlets are designed in accordance with the rules for the 25-year rainfall event, will also accommodate the peak runoff from the 100-year rainfall event, and will not overtop if back-to-back 100-year, 24-hour rainfall events were to occur.
- Erosion will be minimized by using Best Management Practices.
- The proposed landfill development will not adversely alter existing drainage patterns at the facility and property boundaries.

130 ENVIRONMENTAL PARK

ATTACHMENT C1

APPENDIX C1-A

EXISTING/POSTDEVELOPMENT COMPARISON

Biggs & Mathews, Inc.
Firm Registration No. F-834

Includes pages C1-A-1 through C1-A-5

Technically Complete October 28, 2014

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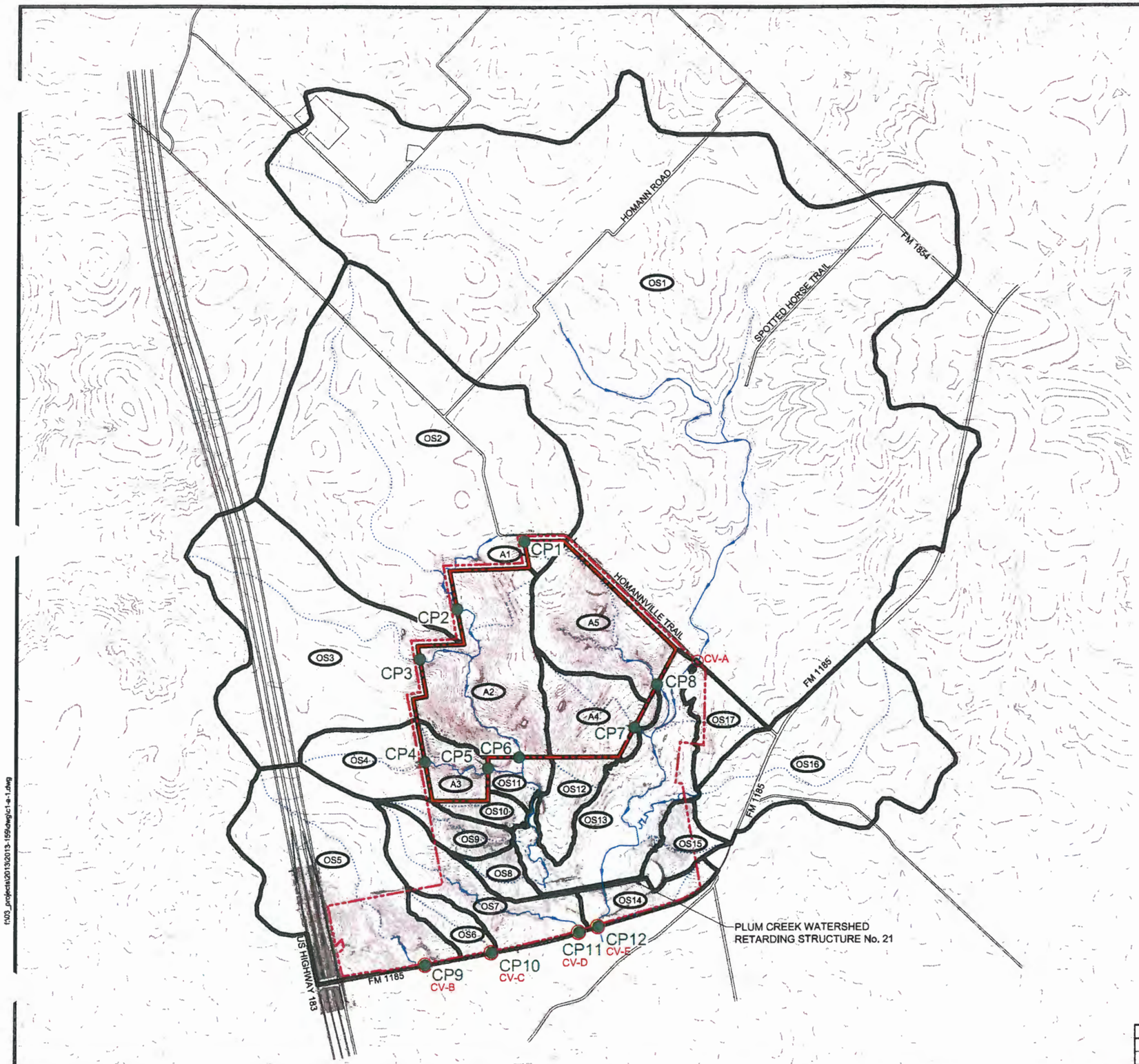
Firm Registration No. F-834



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SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- FACILTY BOUNDARY
- PRIMARY REACH
- SECONDARY REACH
- DRAINAGE AREA BOUNDARY
- A1 DRAINAGE AREA DESIGNATION
- CP1 COMPARISON POINT
- CV-# CULVERT LOCATION

CULVERT INFORMATION				
CULVERT ID	DESCRIPTION	SIZE	FL (IN)	FL (OUT)
CV-A	CV HOM - 1	2 - 60" STEEL PIPE	503.82	503.48
CV-B	CV HWY 1185 - 74	2 - 5'x5' CONC. BOXES	512.1	511.61
CV-C	CV HWY 1185 - 67	30" RCP	515.45	513.59
CV-D	CV HWY 1185 - 58	2 - 10'x10' CONC. BOXES	487.13	486.99
CV-E	CV HWY 1185 - 57	3 - 10'x10' CONC. BOXES	484.35	484.04

NOTES:

1. CONTOURS AND ELEVATIONS WITHIN THE PROPERTY BOUNDARY PROVIDED BY DALLAS AERIAL SERVICE FROM AERIAL PHOTOGRAPHY FLOWN MAY 13, 2013. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83). ELEVATIONS ARE RELATIVE TO NAVD88 – GEOID 12A.
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EXISTING CONDITION OFFSITE DRAINAGE AREAS

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD • WICHITA FALLS
817-563-1144

TBPE FIRM NO. F-256 & F-834 | TBPG FIRM NO. 50222

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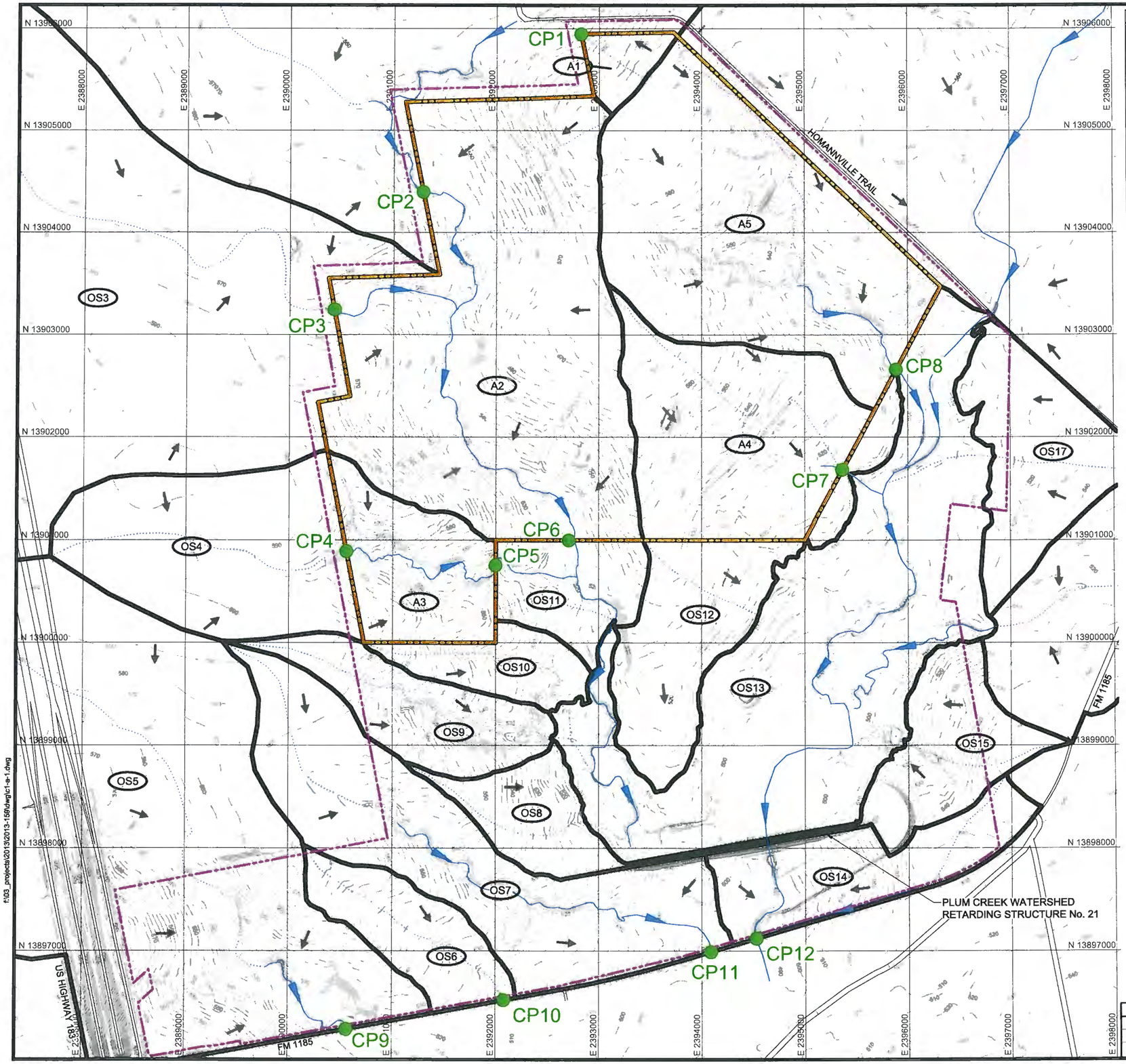

Existing Condition Runoff Summary					
Comparison Point	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft.)	100-Year Peak Discharge (cfs)	100-Year Volume (ac-ft.)	Type of Flow
CP1	37.9	4.3	56.3	6.4	Runoff
CP2	1214.1	361.8	1789.6	537.9	Runon
CP3	706.2	201.8	1028.7	296.9	Runon
CP4	170.0	39.0	252.0	58.3	Runon
CP5	255.5	58.5	379.5	87.3	Runoff
CP6	2121.3	659.3	3123.5	977.9	Runoff
CP7	243.4	38.5	359.8	57.5	Runoff
CP8	372.4	63.8	550.5	95.4	Runoff
CP9	795.7	156.7	1149.3	229.4	Runoff
CP10	117.5	15.4	171.4	22.8	Runoff
CP11	293.6	53.5	431.5	79.6	Runoff
CP12	230.9	2524.1	974.1	3726.8	Runoff

0 500 1000
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- FACILTY BOUNDARY
- EXISTING CONTOUR
- N 13,900,000 STATE PLANE GRID
- DRAINAGE AREA BOUNDARY
- PRIMARY REACH
- SECONDARY REACH
- A1 DRAINAGE AREA DESIGNATION
- CP1 COMPARISON POINT
- FLOW DIRECTION

NOTES:

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EXISTING CONDITION RUNOFF SUMMARY

130 ENVIRONMENTAL PARK, LLC
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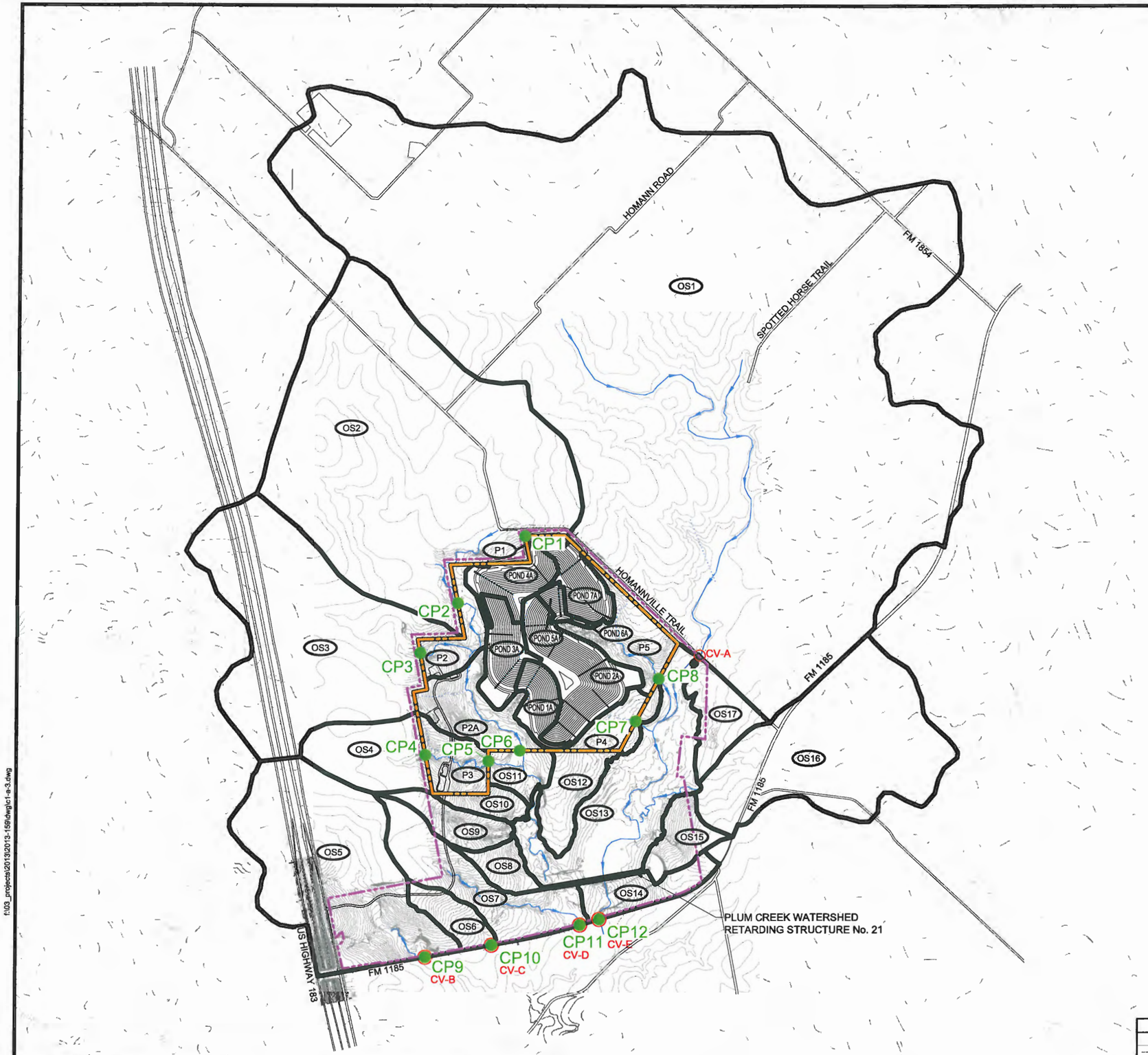

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SCALE IN FEET

LEGEND

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- PRIMARY REACH
- SECONDARY REACH
- DRAINAGE AREA BOUNDARY
- A1 — DRAINAGE AREA DESIGNATION
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- CV-# — CULVERT LOCATION

CULVERT INFORMATION				
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POSTDEVELOPED OFFSITE DRAINAGE AREAS

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130 ENVIRONMENTAL PARK

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD • WICHITA FALLS
817-563-1144

TBPE FIRM NO. F-256 & F-834 | TBPG FIRM NO. 50222

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0 500 1000
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- FACILTY BOUNDARY
- EXISTING CONTOUR
- N 13,900,000 STATE PLANE GRID
- DRAINAGE AREA BOUNDARY
- PRIMARY REACH
- SECONDARY REACH
- A1 DRAINAGE AREA DESIGNATION
- CP1 COMPARISON POINT
- FLOW DIRECTION
- POND OUTLETS

Postdeveloped Runoff Summary

Comparison Point	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft.)	100-Year Peak Discharge (cfs)	100-Year Volume (ac-ft.)	Type of Flow
CP1	8.0	0.7	11.2	0.9	Runoff
CP2	1205.3	358.2	1777.7	532.4	Runon
CP3	706.2	201.8	1028.7	296.9	Runon
CP4	170.0	39.0	252.0	58.3	Runon
CP5	257.5	59.4	379.6	88.3	Runoff
CP6	2033.6	676.0	2976.1	997.2	Runoff
CP7	141.8	61.8	206.8	88.8	Runoff
CP8	327.2	53.3	454.7	77.5	Runoff
CP9	795.7	156.7	1149.3	229.4	Runoff
CP10	117.5	15.4	171.4	22.8	Runoff
CP11	293.6	53.5	431.5	79.6	Runoff
CP12	231.0	2554.5	904.4	3760.5	Runoff

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103797
LICENSED PROFESSIONAL ENGINEER
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POSTDEVELOPED RUNOFF SUMMARY

130 ENVIRONMENTAL PARK, LLC
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BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD ◆ WICHITA FALLS
817-563-1144
TBPE FIRM NO. F-256 & F-834 TBPG FIRM NO. 50222

DSN. TLT DATE : 2/14
DWN. MNG SCALE : GRAPHIC
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130 Environmental Park
Existing/Postdeveloped Drainage Analysis Summary

Boundary	Comparison Point	25-Year Peak Discharge (CFS)			100-Year Peak Discharge (CFS)		
		Existing	Post-Developed	Difference	Existing	Post-Developed	Difference
Facility Boundary	CP1	37.9	8.0	-29.9	56.3	11.2	-45.1
	CP2	1214.1	1205.3	-8.8	1789.6	1777.7	-11.9
	CP3	706.2	706.2	0.0	1028.7	1028.7	0.0
	CP4	170.0	170.0	0.0	252.0	252.0	0.0
	CP5	255.5	257.5	2.0	379.5	379.6	0.1
	CP6	2121.3	2033.6	-87.7	3123.5	2976.1	-147.4
	CP7	243.4	141.8	-101.6	359.8	206.8	-153.0
	CP8	372.4	327.2	-45.2	550.5	454.7	-95.8
Property Boundary	CP9	795.7	795.7	0.0	1149.3	1149.3	0.0
	CP10	117.5	117.5	0.0	171.4	171.4	0.0
	CP11	293.6	293.6	0.0	431.5	431.5	0.0
	CP12	230.9	231.0	0.1	974.1	904.4	-69.7

130 Environmental Park
Existing/Postdeveloped Volume Summary

Boundary	Comparison Point	25-Year Volume (Ac-ft)			100-Year Volume (Ac-ft)		
		Existing	Post-Developed	Difference	Existing	Post-Developed	Difference
Facility Boundary	CP1	4.3	0.7	-3.6	6.4	0.9	-5.5
	CP2	361.8	358.2	-3.6	537.9	532.4	-5.5
	CP3	201.8	201.8	0.0	296.9	296.9	0.0
	CP4	39.0	39.0	0.0	58.3	58.3	0.0
	CP5	58.5	59.4	0.9	87.3	88.3	1.0
	CP6	659.3	676.0	16.7	977.9	997.2	19.3
	CP7	38.5	61.8	23.3	57.5	88.8	31.3
	CP8	63.8	53.3	-10.5	95.4	77.5	-17.9
Property Boundary	CP9	156.7	156.7	0.0	229.4	229.4	0.0
	CP10	15.4	15.4	0.0	22.8	22.8	0.0
	CP11	53.5	53.5	0.0	79.6	79.6	0.0
	CP12	2524.1	2554.5	30.4	3726.8	3760.5	33.7

130 Environmental Park
Existing/Postdeveloped Velocity Summary

Boundary	Comparison Point	25-Year Velocity (fps)			100-Year Velocity (fps)		
		Existing	Post-Developed	Difference	Existing	Post-Developed	Difference
Facility Boundary	CP1	0.6	0.3	-0.3	0.7	0.4	-0.4
	CP2	3.1	3.1	0.0	3.4	3.4	0.0
	CP3	2.7	2.7	0.0	2.9	2.9	0.0
	CP4	3.2	3.2	0.0	3.5	3.5	0.0
	CP5	2.5	2.5	0.0	2.7	2.7	0.0
	CP6	3.9	3.9	0.0	4.3	4.3	0.0
	CP7	2.7	2.3	-0.3	2.9	2.5	-0.4
	CP8	4.8	4.6	-0.2	5.3	5.0	-0.3
Property Boundary	CP9	4.8	4.8	0.0	5.3	5.3	0.0
	CP10	4.0	4.0	0.0	4.4	4.4	0.0
	CP11	4.1	4.1	0.0	4.5	4.5	0.0
	CP12	2.1	2.1	0.0	3.0	2.9	-0.1

130 ENVIRONMENTAL PARK

ATTACHMENT C1

APPENDIX C1-B

EXISTING CONDITION HYDROLOGIC CALCULATIONS

11-6-14

Biggs & Mathews, Inc.
Firm Registration No. F-834

Includes pages C1-B-1 through C1-B-33

Technically Complete October 28, 2014

CONTENTS

11-6-14

Biggs & Mathews, Inc.
Firm Registration No. F-834

EXISTING CONDITION NARRATIVE

30 TAC §330.305

This existing condition site evaluation represents the hydrologic calculations for 130 Environmental Park, in accordance with §330.305.

EXISTING CONDITION DRAINAGE AREA DRAWINGS

The existing condition drainage area maps depict the 130 Environmental Park property, facility boundary, and surrounding contributing areas. These maps reflect each individual drainage area, peak runoff, and volume for the 25-year and 100-year rainfall events. Further, the existing condition runoff summary provides the peak flow rate, volume, and velocity at each comparison point along the facility and property boundary. Offsite drainage areas are designated by the prefix "OS". Drainage areas within the facility boundary are designated by the prefix "A". Refer to Drawing C1-B-1 for the existing condition offsite drainage areas map. Refer to Drawing C1-B-2 for the existing condition facility boundary area map. Refer to Drawing C1-B-3 for the existing condition runoff summary map.

Drawing C1-B-4 is a soils map that depicts 130 Environmental Park drainage areas and the existing soil types. The Soil Survey of Caldwell County, Texas, published by the Natural Resource Conservation Service is the reference for the base map and soils information.

WATERSHED CHARACTERISTICS

Watershed characteristics have been developed for the existing condition hydrologic evaluation. The watershed characteristics address drainage area runoff characteristics, unit hydrograph data, and reach characteristics. This information is included on pages C1-B-10 through C1-B-12.

The first table, Existing Condition Watershed Characteristics – pages C1-B-11 and C1-B-12, provides the summary of drainage areas, soil types, Curve Numbers (CN) values, initial loss, reach slope calculations, and determination of Manning's "n" values. The Soil Conservation Service (SCS) CN were derived from watershed characteristic tables from the Urban Hydrology for Small Watersheds, Technical Report 55 (TR-55), which included evaluation of soil and surface cover/condition characteristics.

In order to accurately simulate the rainfall/runoff relationship, drainage area OS13 was delineated based upon a flood pool elevation of 512 ft. msl. In addition, a CN value was applied to drainage area OS13 that would simulate all rainfall on this basin being converted to runoff.

RAINFALL DATA

The rainfall depth, duration, and frequency relationships for the storm event for the facility was taken from the United States Geological Society (USGS) Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas (USGS 2004) and U.S. Weather Bureau, Technical Paper 49 (TP-49). Return periods of 25 and 100 years and a duration of 24 hours was used for the design storm. The synthetic rainfall distribution is the SCS 24-hour Type III storm. The rainfall data for the facility located in Caldwell County, Texas is depicted in the table on page C1-B-14.

EXISTING SURFACE WATER IMPOUNDMENTS DESIGN PARAMETERS

Pages C1-B-15 through C1-B-17 includes pond and outlet structure data for the existing SCS Site 21 Reservoir that is incorporated into the hydrologic model.

HEC-HMS SCHEMATIC

The schematic for the HEC-HMS model is included on Drawing C1-B-5. The schematic provides the hydrologic element number and routing used for evaluating the existing condition in HEC-HMS.

HYDROLOGIC ANALYSIS

For the hydrologic evaluation, HEC-HMS was used for the precipitation-runoff simulation for the existing condition. The following describes the various modeling components. The HEC-HMS hydrologic analysis results begin on page C1-B-20.

Watershed Subareas and Schematization

The drainage areas that contribute flow to 130 Environmental Park were delineated into subareas to derive peak flows to determine existing entering and exiting flows. Hydrographs are developed for each subarea and appropriately combined and routed through existing surface drainage features. The subareas are shown on Drawing C1-B-1 – Existing Condition Offsite Drainage Areas, page C1-B-6, and Drawing C1-B-5 – HEC-HMS Schematics Existing Condition, page C1-B-19 for the HEC-HMS schematic of the existing condition.

In order to account for future changes to watershed characteristics due to landfill development, some sub-basin boundaries needed to be drawn along the facility boundary, which encompasses all landfill development. While these sub-basin boundaries may be idealized, this approach allows for one to simply compare changes in peak discharge and runoff volume at comparison points since both the existing and postdeveloped analysis use the same boundaries.

Time Step

The time step, or the program computation interval, selected for the analysis is 1 minute, which results in 1441 hydrograph ordinates in 24 hours.

Hypothetical Precipitation

Return periods of 25 and 100 years and duration of 24 hours were used for the design storm. The rainfall data used is shown in the rainfall data table on page C1-B-14. The precipitation is assumed to be evenly distributed over the entire basin for each time interval.

Precipitation Losses

Precipitation losses (the precipitation which does not contribute to the runoff) are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. CN is a function of soil cover, land use, and antecedent moisture conditions. The CN values used for each drainage area are shown in the Watershed Characteristics tables on pages C1-B-11.

Synthetic Unit Hydrographs and Flow Routing

The rainfall/runoff transformation was performed with the Unit Hydrograph Method. The synthetic unit hydrographs for each watershed used a single peak unit hydrograph model developed by the SCS and described in detail in Urban Hydrology for Small Watersheds (TR-55). The parameters and input values for this model are included in the Watershed Characteristics tables on pages C1-B-12.

The Kinematic Wave Method was used for routing of the flood wave through the existing drainage channels. This method is capable of accounting for hydrograph attenuation based on physical channel properties such as length, bottom slope, channel shape, bottom width, and channel roughness.

EXISTING CONDITION FLOW SUMMARY

The existing condition flow summary table on page C1-B-27 lists the peak flow rate and volume of runoff for each drainage area for the 25- and 100-year rainfall event. This table summarizes the results of the hydrologic evaluation.

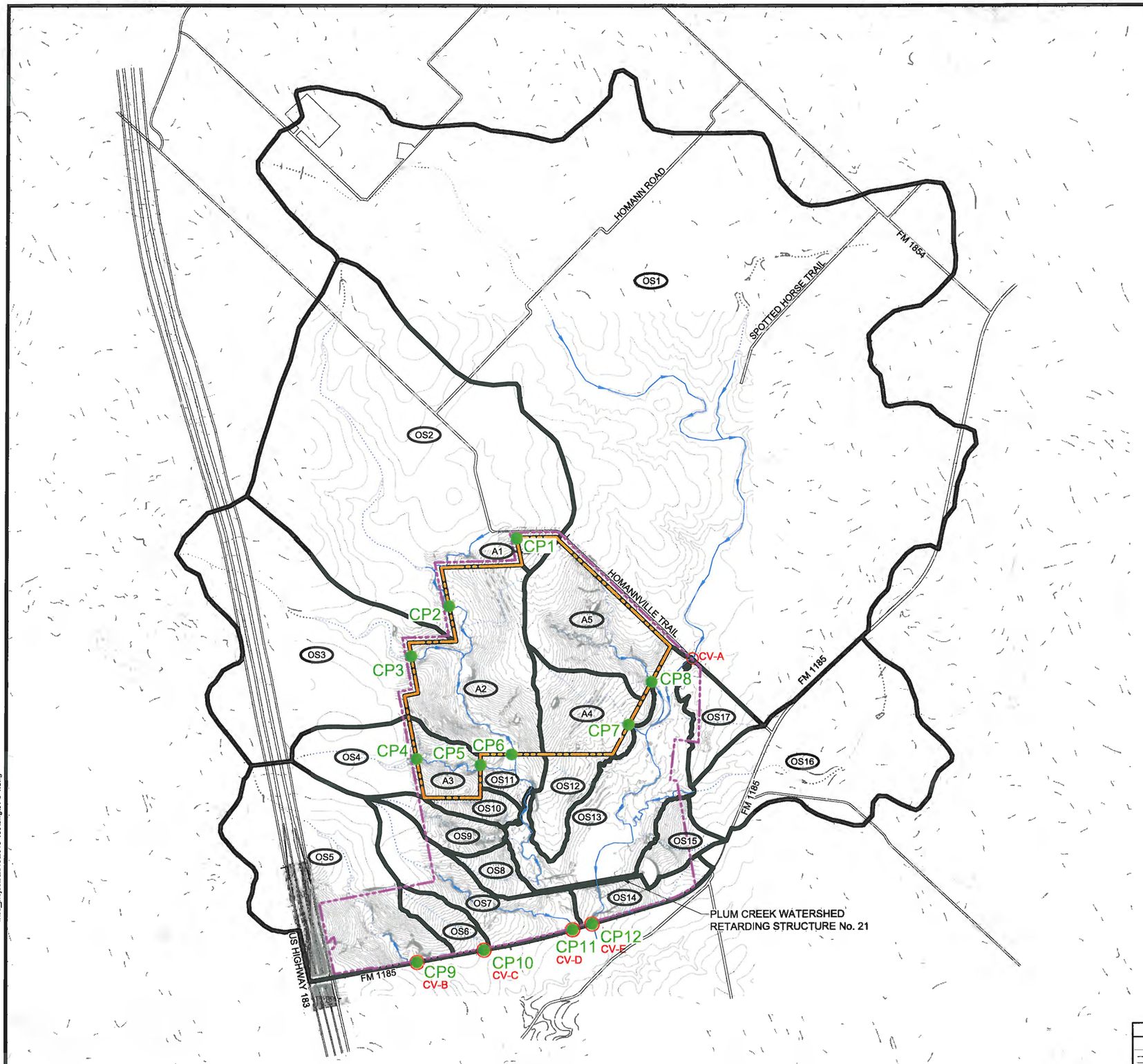
EXISTING CONDITION VELOCITY SUMMARY

Surface water velocities were determined for each discharge point where the surface water exits the facility boundary. The 25- and 100-year, 24-hour peak flow rates were used to determine the velocity at the facility boundary. Manning's Equation was used to evaluate the velocities. Refer to Drawing C1-B-3 for the locations of the discharge points and peak flow rate. Refer to pages C1-B-28 through C1-B-31 for the existing condition velocity calculations.

EXISTING CONDITION DRAINAGE ANALYSIS SUMMARY

The analysis summary for the existing condition is provided on page C1-B-33. The table provides for each comparison point (CP1 through CP12) the peak flow rate, velocity, and volume resulting from the HEC-HMS evaluation for the 25- and 100-year, 24 hour rainfall.

EXISTING CONDITION DRAINAGE AREA DRAWINGS



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EXISTING CONDITION OFFSITE DRAINAGE AREAS

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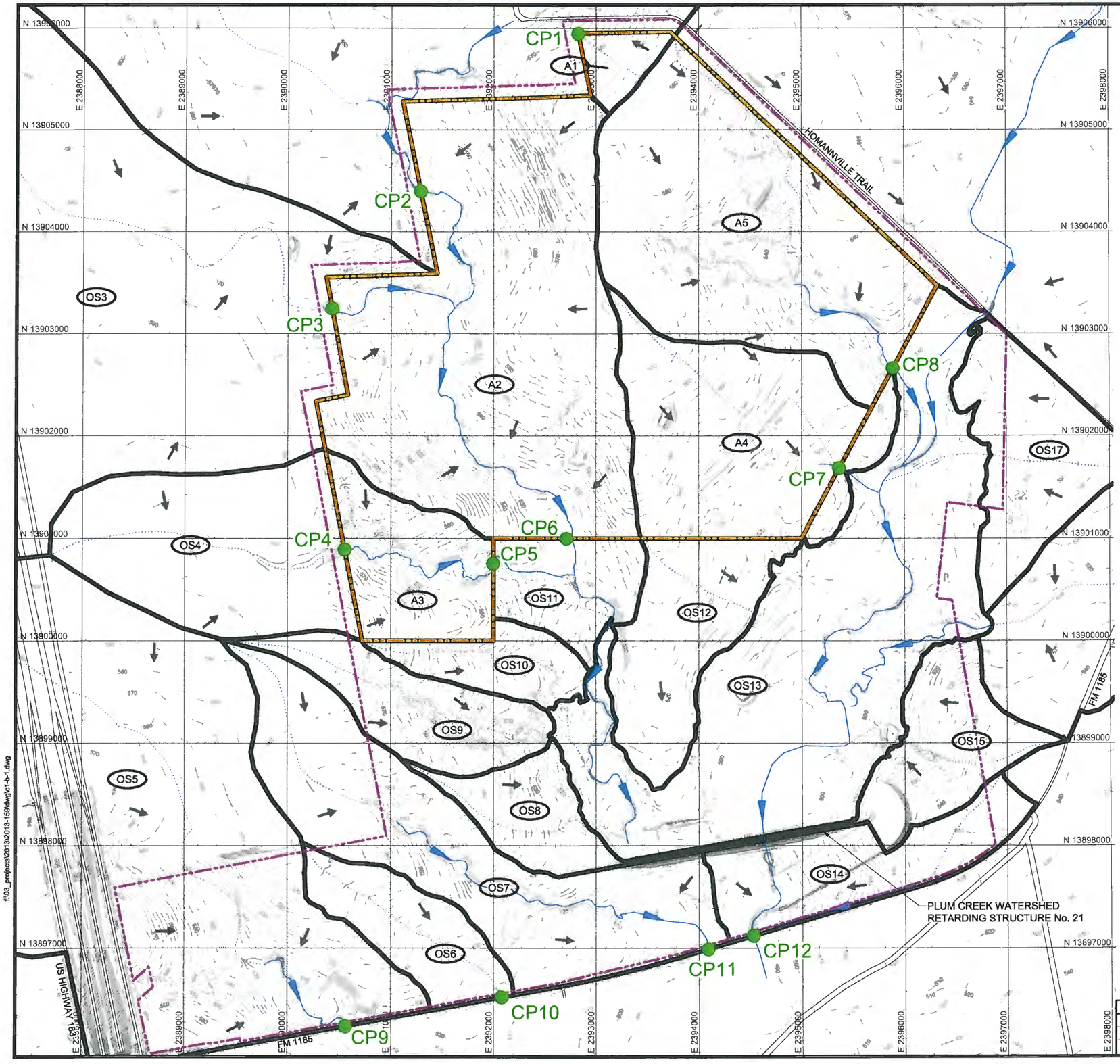

LEGEND

- PROPERTY BOUNDARY
- FACILITY BOUNDARY
- EXISTING CONTOUR
- N 13,900,000 STATE PLANE GRID
- DRAINAGE AREA BOUNDARY
- PRIMARY REACH
- SECONDARY REACH
- (A1) DRAINAGE AREA DESIGNATION
- ● CP1 COMPARISON POINT
- → FLOW DIRECTION

0 500 1000
SCALE IN FEET

Existing Condition Drainage Boundary Areas

Drainage Area	Area (Ac.)	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft.)	100-Year Peak Discharge (cfs)	100-Year Volume (ac-ft.)
OS1	2882.56	3725.1	1283.8	5467.9	1898.7
OS2	820.48	1203.4	357.5	1775.3	531.5
OS3	443.52	706.2	201.8	1028.7	296.9
OS4	91.52	170	39	252	58.3
OS5	337.28	795.7	156.7	1149.3	229.4
OS6	34.56	117.5	15.4	171.4	22.8
OS7	122.88	293.6	53.5	431.5	79.6
OS8	28.80	100.5	12.6	147.4	18.7
OS9	42.88	116.1	18.7	170.5	27.8
OS10	23.68	90.7	10.5	132.2	15.6
OS11	30.72	94.4	13.4	138.5	19.9
OS12	64.64	150.1	28.2	220.6	41.9
OS13	208.00	1424.9	129.3	1926.7	176.1
OS14	49.92	121.7	22.2	177.7	32.9
OS15	44.80	95.9	19.5	141	29
OS16	333.44	626.6	142.1	928.4	212.4
OS17	56.96	150.5	23.7	223.8	35.7
A1	10.24	37.9	4.3	56.3	6.4
A2	224.64	518.2	95.7	766.5	143.1
A3	44.80	104	19.5	152.9	29
A4	90.24	243.4	38.5	359.8	57.5
A5	149.76	372.4	63.8	550.5	95.4

NOTES:

1. CONTOURS AND ELEVATIONS WITHIN THE PROPERTY BOUNDARY PROVIDED BY DALLAS AERIAL SERVICE FROM AERIAL PHOTOGRAPHY FLOWN MAY 13, 2013. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83). ELEVATIONS ARE RELATIVE TO NAVD88 – GEOID 12A.
2. ROADWAYS IN THE IMMEDIATE VICINITY OF THE SITE TAKEN FROM TNRIS AERIAL PHOTOGRAPHY FLOWN JUNE 11, 2012. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).
3. CONTOURS AND ELEVATIONS OUTSIDE THE PROPERTY BOUNDARY PROVIDED BY CAPCOG. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).

11-6-14
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—	10/28/14	TECHNICALLY COMPLETE	MNG	TLT	TLT	TLT

EXISTING CONDITION FACILTY BOUNDARY AREAS

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD ◆ WICHITA FALLS
817-563-1144
TBPE FIRM NO. F-256 & F-834 | TBPG FIRM NO. 50222

DSN. TLT | DATE : 2/14
DWN. MNG | SCALE : GRAPHIC
CHK. TLT | DWG : C1-B-1.DWG

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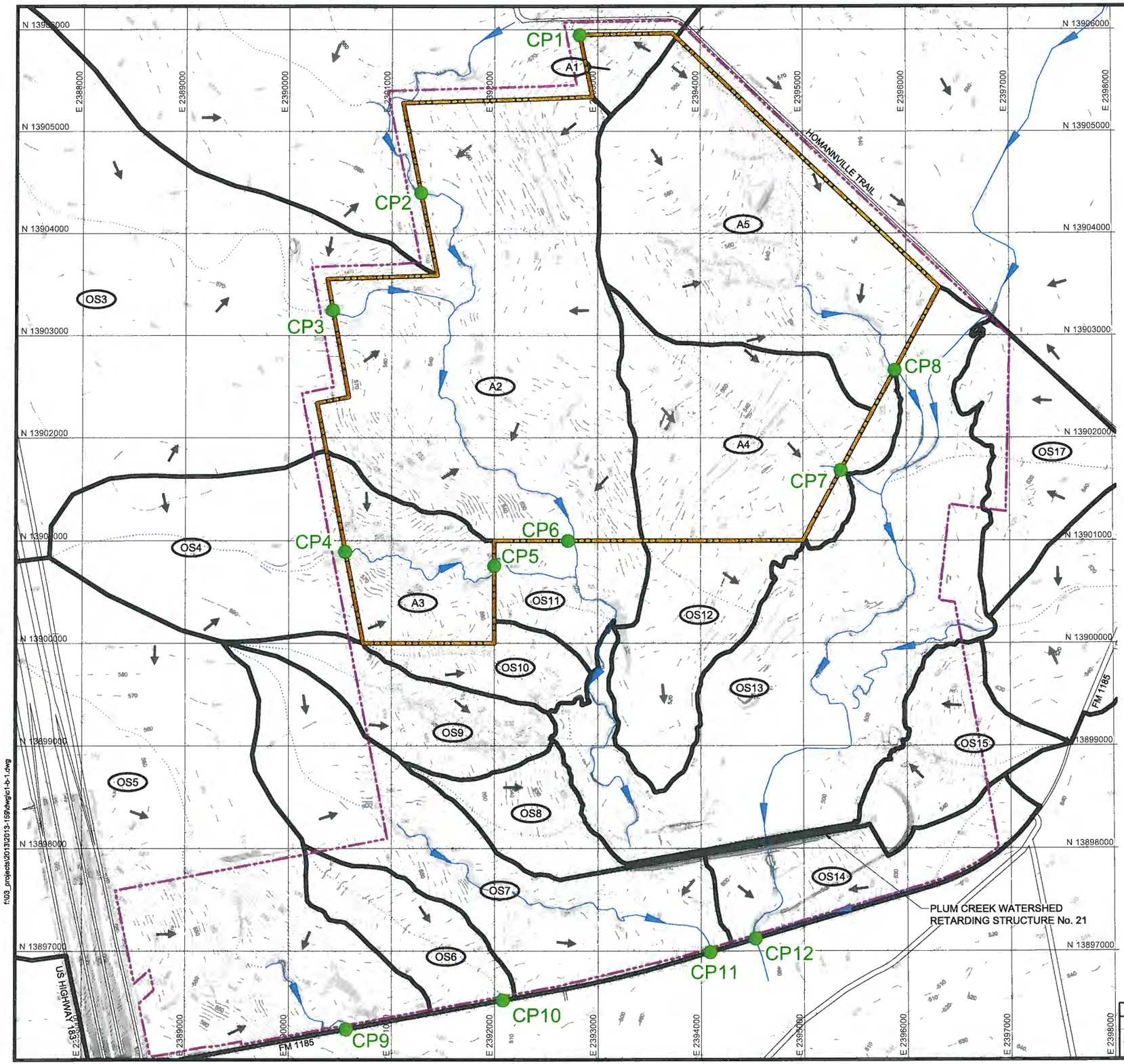

LEGEND

- PROPERTY BOUNDARY
- FACILITY BOUNDARY
- EXISTING CONTOUR
- N 13,900,000 STATE PLANE GRID
- DRAINAGE AREA BOUNDARY
- PRIMARY REACH
- SECONDARY REACH
- (A1) DRAINAGE AREA DESIGNATION
- ● CP1 COMPARISON POINT
- → FLOW DIRECTION

0 500 1000
SCALE IN FEET

Existing Condition Runoff Summary					
Comparison Point	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft.)	100-Year Peak Discharge (cfs)	100-Year Volume (ac-ft.)	Type of Flow
CP1	37.9	4.3	56.3	6.4	Runoff
CP2	1214.1	361.8	1789.6	537.9	Runon
CP3	706.2	201.8	1028.7	296.9	Runon
CP4	170.0	39.0	252.0	58.3	Runon
CP5	255.5	58.5	379.5	87.3	Runoff
CP6	2121.3	659.3	3123.5	977.9	Runoff
CP7	243.4	38.5	359.8	57.5	Runoff
CP8	372.4	63.8	550.5	95.4	Runoff
CP9	795.7	156.7	1149.3	229.4	Runoff
CP10	117.5	15.4	171.4	22.8	Runoff
CP11	293.6	53.5	431.5	79.6	Runoff
CP12	230.9	2524.1	974.1	3726.8	Runoff

NOTES:

1. CONTOURS AND ELEVATIONS WITHIN THE PROPERTY BOUNDARY PROVIDED BY DALLAS AERIAL SERVICE FROM AERIAL PHOTOGRAPHY FLOWN MAY 13, 2013. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83). ELEVATIONS ARE RELATIVE TO NAVD88 – GEOID 12A.
2. ROADWAYS IN THE IMMEDIATE VICINITY OF THE SITE TAKEN FROM TNRIS AERIAL PHOTOGRAPHY FLOWN JUNE 11, 2012. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).
3. CONTOURS AND ELEVATIONS OUTSIDE THE PROPERTY BOUNDARY PROVIDED BY CAPCOG. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).

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EXISTING CONDITION RUNOFF SUMMARY

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD ◆ WICHITA FALLS
817-563-1144

TBPE FIRM NO. F-256 & F-834 | TBPG FIRM NO. 50222

DSN. TLT | DATE : 2/14 | DRAWING
DWN. MNG | SCALE : GRAPHIC | C1-B-8
CHK. TLT | DWG : C1-B-1.DWG

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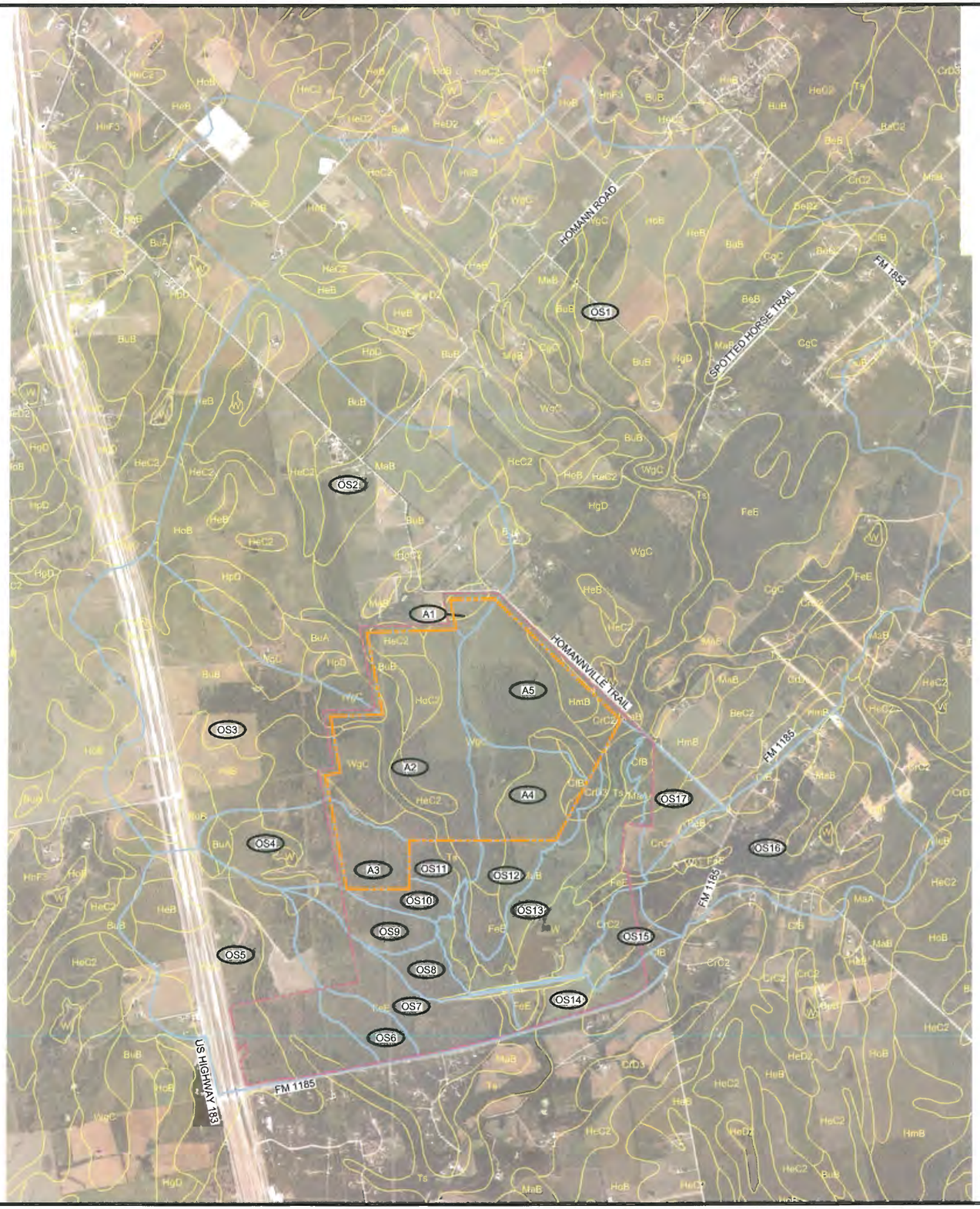

LEGEND

- PROPERTY BOUNDARY
- FACILITY BOUNDARY
- DRAINAGE AREA BOUNDARY
- A1 DRAINAGE AREA DESIGNATION

0 1200 2400
SCALE IN FEET

SOIL SYMBOL	SOIL NAME	HYDROLOGIC SOIL GROUP
BeB	BEHRING clay loam (1-3% slopes)	D
BeC2	BEHRING clay loam (3-5% slopes)	D
BeD2	BEHRING clay loam (5-8% slopes)	D
BuA	BURLESON clay (0-1% slopes)	D
BuB	BURLESON clay (1-3% slopes)	D
CfB	CROCKETT fine sandy loam(1-3% Slopes)	D
CgC	CROCKETT gravelly sandy loam(1-5% slopes)	D
CrC2	CROCKETT soils (2-5%Slopes)	D
CrD3	CROCKETT soils severely eroded (3-8% slopes)	D
DAM	Dams	N/A
FeE	FETT gravelly soils (1-12% slopes)	D
HeB	HEIDEN clay (1-3% slopes)	D
HeC2	HEIDEN clay (3-5% slopes) eroded	D
HeD2	HEIDEN clay (5-8% slopes) eroded	D
HgD	HEIDEN gravelly clay (3-8% slopes)	D
HmB	HEIDEN-WILSON complex (1-3% slopes)	D
HoB	HOUSTON BLACK clay (3-5% slopes)	D
HoC2	HOUSTON BLACK clay (3-5% slopes) eroded	D
HpD	HOUSTON BLACK gravelly clay (3-8% slopes)	D
MaA	MABANK loam (0-1% slopes)	D
MaB	MABANK loam (1-3% slopes)	D
Ts	TINN soils, frequently flooded	D
W	WATER	N/A
WgC	WILSON gravelly loam (1-5% slopes)	D

NOTES:

1. AERIAL PHOTOGRAPHY FROM TEXAS NATURAL RESOURCE INFORMATION SYSTEM (TNRIS) FLOWN JUNE 11, 2012. HORIZONTAL DATUM IS TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).
2. SOIL TYPES & LOCATIONS WERE PROVIDED BY NATURAL RESOURCES CONSERVATION SERVICE (NRCS) DATED SEPTEMBER 20, 2012. HORIZONTAL DATUM IS UTM ZONE 14N (NAD83).

11-6-14

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SOILS MAP

130 ENVIRONMENTAL PARK, LLC
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BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD ◆ WICHITA FALLS
817-563-1144

TBPE FIRM NO. F-256 & F-834 | TBPG FIRM NO. 50222

DSN. TLT | DATE : 2/14 | DRAWING
DWN. MNG | SCALE : GRAPHIC | C1-B-9
CHK. TLT | DWG : C1-B-1.DWG

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WATERSHED CHARACTERISTICS

130 Environmental Park

Watershed Runoff Curve Numbers

Existing Watershed Characteristics

				Partial Areas of Cover Type and Soil Group (ac)						
Watershed Name	Watershed Area (ac)	Watershed Area ($Mi.^2$)	CN (Weighted)	Brush (fair), Soil Group D, CN = 77	Pasture (good), Soil Group D, CN = 80	Pasture (fair), Soil Group D, CN = 84	Paved (w/ROW), Soil Group D, CN = 93	Residential (1 ac), Soil Group D, CN = 84	Woods (fair), Soil Group D, CN = 79	Water, CN = 98
OS1	2882.43	4.504	80	665.40	1613.46		57.53	70.87	455.85	19.32
OS2	820.33	1.282	79	244.96	545.10	1.22	11.02		13.92	4.11
OS3	443.55	0.693	81	170.58	105.08	2.73	91.85		73.33	
OS4	91.50	0.143	78	82.26		2.35	0.32		3.91	2.66
OS5	337.35	0.527	82	194.35		27.24	81.07		32.09	2.62
OS6	34.67	0.054	80	4.57		2.28	1.57		26.26	
OS7	122.85	0.192	79	30.13	5.77	8.04	3.33		75.58	
OS8	28.88	0.045	79	0.62	1.72	0.38			26.16	
OS9	42.91	0.067	79	14.01		2.38			26.25	0.27
OS10	23.37	0.037	80	0.55		4.70			18.12	
OS11	30.74	0.048	79			2.70			28.04	
OS12	64.36	0.101	79	20.74		3.66			39.96	
OS13	208.13	0.325	98							208.13
OS14	49.92	0.078	80		42.13		2.31		5.48	
OS15	44.52	0.070	79	17.66	14.61				12.24	
OS16	333.38	0.521	78	190.38	11.95		3.91		122.98	4.17
OS17	56.96	0.089	77	51.45	4.86		0.43		0.21	
A1	10.32	0.016	77	10.32						
A2	224.40	0.351	78	105.68	0.01	7.68			110.87	0.16
A3	44.58	0.070	79	0.34		2.68			41.56	
A4	90.32	0.141	78	65.63		1.01			23.35	0.33
A5	150.04	0.234	78	91.03					58.71	0.31

130 Environmental Park

SCS Unit Hydrograph Lag Time

Existing Watershed Characteristics

Watershed Name	Sheet Flow					Shallow Conc. Flow				Channel Flow			Time of Conc. (hr)	Lag Time (min)
	Manning's Roughness	Water Course Length (ft)	Precipitation 2yr Total (in.)	Water Course Slope (ft/ft)	Time (hr)	Water Course Length (ft)	Roughness Coefficient	Water Course Slope (ft/ft)	Time (hr)	Avg. Bank Full Velocity (fps)	Water Course Length (ft)	Time (hr.)		
OS1	0.24	240	3.60	0.03	0.38	8,945	16.13	0.01	1.62	4.08	13,252	0.90	2.91	105
OS2	0.24	250	3.60	0.03	0.40	8,589	16.13	0.01	1.78	2.00	1,207	0.17	2.35	85
OS3	0.24	275	3.60	0.01	0.88	6,501	16.13	0.01	1.34	0.00	0	0.00	2.22	80
OS4	0.40	280	3.60	0.01	1.17	2,882	16.13	0.01	0.45	0.00	0	0.00	1.62	58
OS5	0.24	250	3.60	0.03	0.41	5,240	16.13	0.01	0.76	4.60	1,278	0.08	1.25	45
OS6	0.13	275	3.60	0.02	0.35	2,276	16.13	0.03	0.25	0.00	0	0.00	0.59	21
OS7	0.13	260	3.60	0.00	0.53	2,758	16.13	0.02	0.36	4.82	3,654	0.21	1.10	40
OS8	0.13	280	3.60	0.01	0.36	1,732	16.13	0.03	0.18	0.00	0	0.00	0.54	19
OS9	0.13	260	3.60	0.01	0.51	3,384	16.13	0.03	0.37	0.00	0	0.00	0.88	32
OS10	0.13	250	3.60	0.03	0.25	2,029	16.13	0.03	0.20	0.00	0	0.00	0.45	16
OS11	0.40	250	3.60	0.03	0.58	967	16.13	0.03	0.11	0.00	0		0.69	25
OS12	0.40	270	3.60	0.01	1.03	1,078	16.13	0.02	0.13	0.00	0	0.00	1.15	42
OS13	0.00	0	3.60	0.00	N/A	0	0.00	0.00	N/A	0.00	0	N/A	0.10	4
OS14	0.24	280	3.60	0.01	0.78	1,162	16.13	0.01	0.17	2.72	1,687	0.17	1.12	40
OS15	0.40	280	3.60	0.01	1.17	1,452	16.13	0.02	0.17	0.00	0	0.00	1.34	48
OS16	0.13	270	3.60	0.01	0.40	6,467	16.13	0.01	1.17	0.00	0	0.00	1.57	57
OS17	0.24	250	3.60	0.01	0.71	1,373	16.13	0.03	0.14	0.00	0	0.00	0.85	31
A1	0.13	250	3.60	0.01	0.38	517	16.13	0.03	0.05	0.00	0	0.00	0.43	15
A2	0.13	265	3.60	0.01	0.48	3,071	16.13	0.02	0.41	3.50	3,058	0.24	1.13	41
A3	0.40	250	3.60	0.01	0.93	1,146	16.13	0.03	0.12	3.26	1,357	0.12	1.16	42
A4	0.13	250	3.60	0.01	0.43	3,362	16.13	0.02	0.43	0.00	0	0.00	0.87	31
A5	0.13	250	3.60	0.01	0.43	2,932	16.13	0.02	0.33	1.83	1,486	0.23	0.99	36

130 Environmental Park
Kinematic Wave Routing Parameters
Existing Watershed Characteristics

Reach Name	Water Course Length (ft)	Water Course Slope (ft/ft)	Manning's Roughness	Shape	Bottom Width (ft)	Side Slope (xH:1V)
Dry Creek	1000	0.002	0.065	Trapezoid	12.00	6
Reach-1	2496	0.006	0.065	Trapezoid	10.00	4
Reach-1A	1015	0.004	0.065	Trapezoid	6.00	8
Reach-2	1437	0.008	0.065	Trapezoid	13.00	25
Reach-3	1723	0.003	0.065	Trapezoid	8.00	3
Reach-4	3090	0.004	0.065	Trapezoid	6.00	3
Reach-5	368	0.005	0.065	Trapezoid	7.00	10
Reach-6	971	0.013	0.065	Triangle	N/A	30
Reach-7	1977	0.016	0.065	Trapezoid	7.00	10
Reach-8	686	0.009	0.065	Trapezoid	12.00	10
Reach-CP7	100	0.010	0.065	Trapezoid	5.00	5
Reach-CP8	100	0.010	0.065	Trapezoid	5.00	5

RAINFALL DATA

130 Environmental Park
Hypothetical Storm Data

Duration	15 min.	30 min.	1 hr.	2 hr.	3 hr.	6 hr.	12 hr.	24 hr.	2 day	3 day	5 day	7 day	10 day*
	25 Year Return Period												
Precipitation Depth (in.)	1.90	2.50	3.35	4.33	4.71	5.31	6.09	7.70	9.00	9.60	10.00	10.80	13.40
	100 Year Return Period												
Precipitation Depth (in.)	2.46	3.13	4.42	5.80	6.38	7.00	8.34	10.40	11.70	13.00	13.20	14.20	16.80

Precipitation Depths from: Asquith, W.H., and Roussel, M.C., 2004, Atlas of depth-duration frequency of precipitation annual maxima for Texas: U.S. Geological Survey Scientific Investigations Report 2004-5041, 106 p. (TxDOT Implementation Report 5-1301-01-1)

*Precipitation Depths from: Technical Paper No. 49; Two- to Ten-Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States

EXISTING SURFACE WATER IMPOUNDMENTS
DESIGN PARAMETERS

130 Environmental Park
Pond Data for HEC-HMS
Site 21

Reservoir

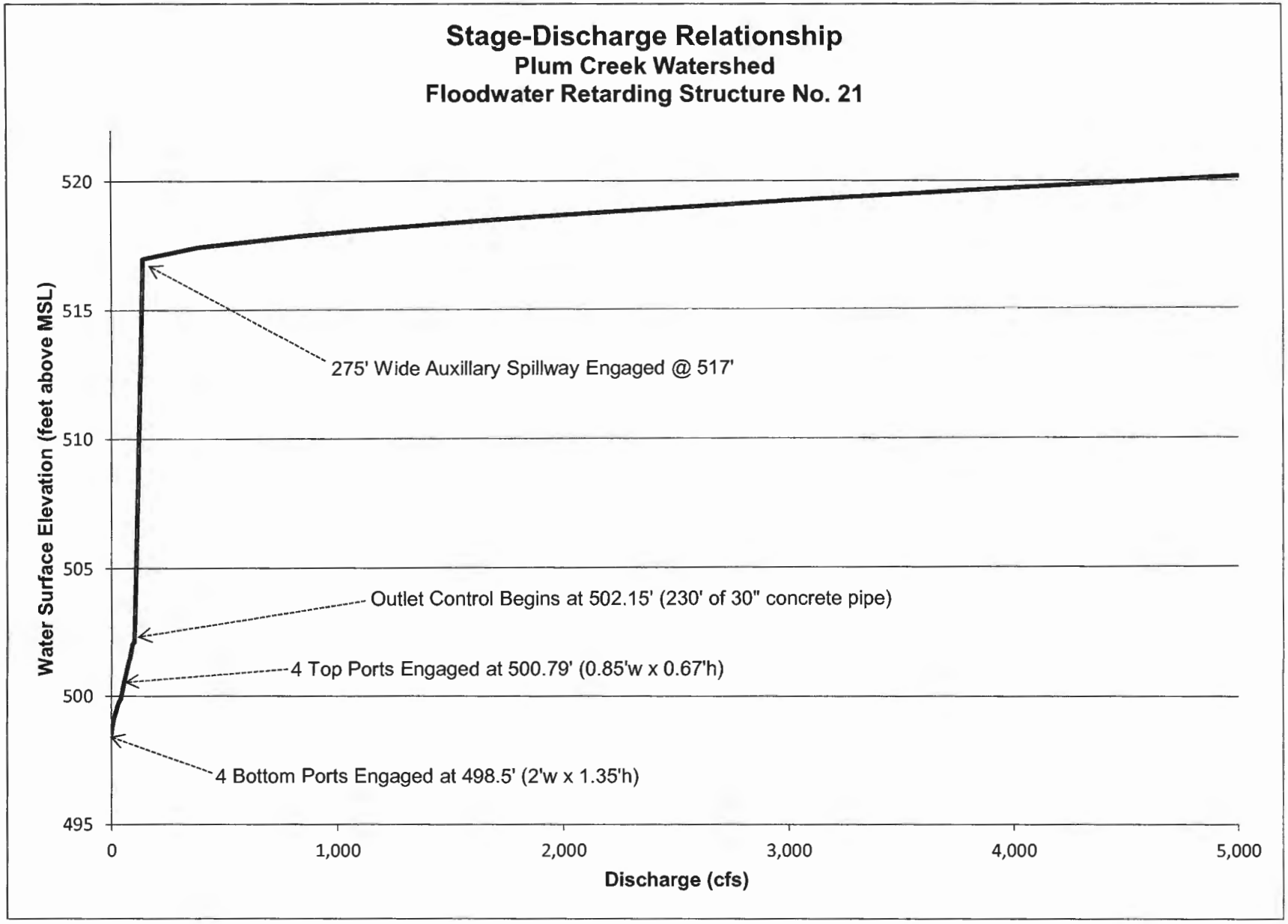
Description:	
Downstream:	CP12
Method:	Outflow Structures
Storage Method:	Elevation-Area-Discharge
Elev-Area Function:	Site 21 Elev Area
Elev-Dis Function	Site 21 Elev-Discharge
Primary:	Elevation-Discharge
Initial Condition:	Elevation
Initial Elevation:	498.5 ft

Paired Data
Elevation Storage Functions
Site 21 Elev Area

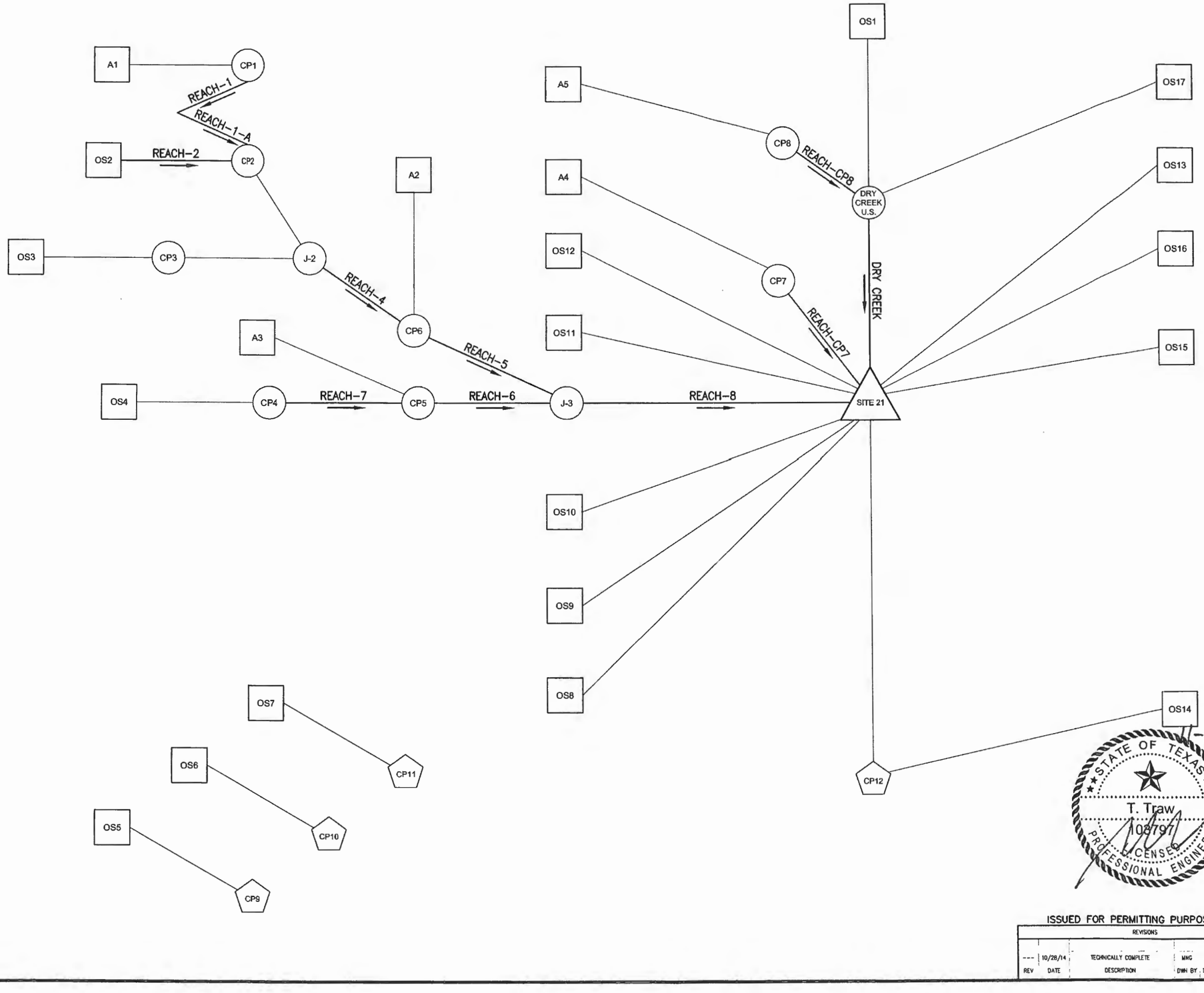
Elevation (ft)	Area (ac-ft)	Volume (ac-ft)
498.10	22.00	0.00
502	54.75	149.66
504	81.00	285.41
506	113.05	479.45
508	141.47	733.97
510	173.17	1048.60
512	204.87	1426.65
514	256.45	1887.97
516	296.24	2440.66
518	343.69	3080.59
520	411.10	3835.38
522	455.40	4701.88

Paired Data
Elevation Discharge Functions
Site 21 Elev-Discharge

Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)	Elevation (ft)	Discharge (cfs)
498.50	0.02	500.20	48.50	501.90	88.33	516.32	137.50
498.60	0.83	500.30	50.78	502.00	90.35	516.98	139.00
498.70	2.18	500.40	52.97	502.10	92.31	517.43	382.71
498.80	3.91	500.50	55.08	502.15	100.00	517.87	839.48
498.90	5.94	500.60	57.10	502.96	102.50	518.10	1134.54
499.00	8.25	500.70	59.06	503.78	105.00	518.32	1447.38
499.10	10.79	500.80	60.96	504.62	107.50	518.56	1819.62
499.20	13.54	500.90	63.11	505.49	110.00	518.78	2187.12
499.30	16.50	501.00	65.43	506.37	112.50	519.23	3010.38
499.40	19.65	501.10	67.84	507.28	115.00	519.70	3963.76
499.50	22.98	501.20	70.33	508.20	117.50	520.16	4981.12
499.60	26.48	501.30	72.88	509.16	120.00	520.63	6100.01
499.70	30.13	501.40	75.49	510.12	122.50	520.86	6675.17
499.80	33.95	501.46	77.08	511.10	125.00	521.10	7293.83
499.84	39.16	501.50	79.45	512.10	127.50	521.57	8558.14
499.90	40.87	501.60	81.82	513.13	130.00	522.04	9889.19
500.00	43.56	501.70	84.07	514.17	132.50		
500.10	46.09	501.80	86.24	515.24	135.00		


Stage-Discharge Relationship
Plum Creek Watershed
Floodwater Retarding Structure No. 21
Water Surface Elevation (feet above MSL)
520
515
510
505
500
495
0
1,000
2,000
3,000
4,000
5,000
Discharge (cfs)
275' Wide Auxillary Spillway Engaged @ 517'
Outlet Control Begins at 502.15' (230' of 30" concrete pipe)
4 Top Ports Engaged at 500.79' (0.85'w x 0.67'h)
4 Bottom Ports Engaged at 498.5' (2'w x 1.35'h)

HEC-HMS SCHEMATIC



LEGEND

- SUB-BASIN
- RESERVOIR
- JUNCTION
- OUTLET
- REACH-CP8 — REACH
- CONNECTION

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REVISIONS						
REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY
---	10/28/14	TECHNICALLY COMPLETE	MNG	TLT	TLT	TLT

HEC-HMS SCHEMATICS EXISTING CONDITION

130 ENVIRONMENTAL PARK, LLC
130 ENVIRONMENTAL PARK

BIGGS & MATHEWS ENVIRONMENTAL
CONSULTING ENGINEERS
MANSFIELD • WICHITA FALLS
817-563-1144

TBPE FIRM NO. F-256 & F-834 | TBPG FIRM NO. 50222

DSN. TLT	DATE : 2/14	DRAWING
DWN. MNG	SCALE : GRAPHIC	C1-B-5
CHK. TLT	DWG : C1-B-1.DWG	

HYDROLOGIC ANALYSIS

25-YEAR, 24-HOUR STORM EVENT
100-YEAR, 24-HOUR STORM EVENT

Project: 130 Environmental Park Simulation Run: Existing 25yr 24hr SCS

Start of Run: 01Jan2014, 00:00 Basin Model: Existing
End of Run: 04Jan2014, 00:00 Meteorologic Model: 25 yr 24hr (SCS)
Compute Time: 22Jan2014, 10:41:52 Control Specifications: 72 hr

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A1	0.016	37.9	01Jan2014, 12:17	4.3
A2	0.351	518.2	01Jan2014, 12:45	95.7
A3	0.070	104.0	01Jan2014, 12:46	19.5
A4	0.141	243.4	01Jan2014, 12:35	38.5
A5	0.234	372.4	01Jan2014, 12:40	63.8
CP1	0.016	37.9	01Jan2014, 12:17	4.3
CP10	0.054	117.5	01Jan2014, 12:23	15.4
CP11	0.192	293.6	01Jan2014, 12:44	53.5
CP12	8.815	230.9	01Jan2014, 12:45	696.4
CP2	1.298	1214.1	01Jan2014, 13:31	361.8
CP3	0.693	706.2	01Jan2014, 13:26	201.8
CP4	0.143	170.0	01Jan2014, 13:03	39.0
CP5	0.213	255.5	01Jan2014, 13:00	58.5
CP6	2.342	2121.3	01Jan2014, 13:36	659.3
CP7	0.141	243.4	01Jan2014, 12:35	38.5
CP7 Reach	0.141	243.4	01Jan2014, 12:35	38.5
CP8	0.234	372.4	01Jan2014, 12:40	63.8
CP8 Reach	0.234	372.3	01Jan2014, 12:40	63.8
CP9	0.527	795.7	01Jan2014, 12:49	156.7
Dry Creek	4.827	3852.3	01Jan2014, 13:54	1371.4
Dry Creek U.S.	4.827	3852.6	01Jan2014, 13:50	1371.3
J-2	1.991	1918.5	01Jan2014, 13:34	563.6
J-3	2.555	2323.6	01Jan2014, 13:33	717.8
OS1	4.504	3725.1	01Jan2014, 13:53	1283.8
OS10	0.037	90.7	01Jan2014, 12:18	10.5
OS11	0.048	94.4	01Jan2014, 12:28	13.4

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
OS12	0.101	150.1	01Jan2014, 12:46	28.2
OS13	0.325	1424.9	01Jan2014, 12:05	129.3
OS14	0.078	121.7	01Jan2014, 12:44	22.2
OS15	0.070	95.9	01Jan2014, 12:52	19.5
OS16	0.521	626.6	01Jan2014, 13:02	142.1
OS17	0.089	150.5	01Jan2014, 12:35	23.7
OS2	1.282	1203.4	01Jan2014, 13:31	357.5
OS3	0.693	706.2	01Jan2014, 13:26	201.8
OS4	0.143	170.0	01Jan2014, 13:03	39.0
OS5	0.527	795.7	01Jan2014, 12:49	156.7
OS6	0.054	117.5	01Jan2014, 12:23	15.4
OS7	0.192	293.6	01Jan2014, 12:44	53.5
OS8	0.045	100.5	01Jan2014, 12:21	12.6
OS9	0.067	116.1	01Jan2014, 12:35	18.7
Reach-1	0.016	37.8	01Jan2014, 12:35	4.3
Reach-1A	0.016	37.7	01Jan2014, 12:45	4.3
Reach-2	0.693	706.1	01Jan2014, 13:32	201.8
Reach-3	1.298	1214.0	01Jan2014, 13:36	361.8
Reach-4	1.991	1918.1	01Jan2014, 13:42	563.6
Reach-5	2.342	2121.2	01Jan2014, 13:37	659.3
Reach-6	0.213	255.5	01Jan2014, 13:05	58.5
Reach-7	0.143	169.9	01Jan2014, 13:11	39.0
Reach-8	2.555	2323.4	01Jan2014, 13:35	717.8
Site 21	8.737	135.9	02Jan2014, 02:22	674.1

Project: 130 Environmental Park Simulation Run: Existng 100yr 24hr SCS

Start of Run: 01Jan2014, 00:00 Basin Model: Existing
End of Run: 04Jan2014, 00:00 Meteorologic Model: 100 yr 24hr (SCS)
Compute Time: 22Jan2014, 10:43:21 Control Specifications: 72 hr

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A1	0.016	56.3	01Jan2014, 12:17	6.4
A2	0.351	766.5	01Jan2014, 12:44	143.1
A3	0.070	152.9	01Jan2014, 12:45	29.0
A4	0.141	359.8	01Jan2014, 12:34	57.5
A5	0.234	550.5	01Jan2014, 12:39	95.4
CP1	0.016	56.3	01Jan2014, 12:17	6.4
CP10	0.054	171.4	01Jan2014, 12:23	22.8
CP11	0.192	431.5	01Jan2014, 12:43	79.6
CP12	8.815	974.1	01Jan2014, 20:14	1488.5
CP2	1.298	1789.6	01Jan2014, 13:30	537.9
CP3	0.693	1028.7	01Jan2014, 13:25	296.9
CP4	0.143	252.0	01Jan2014, 13:02	58.3
CP5	0.213	379.5	01Jan2014, 12:59	87.3
CP6	2.342	3123.5	01Jan2014, 13:33	977.9
CP7	0.141	359.8	01Jan2014, 12:34	57.5
CP7 Reach	0.141	359.7	01Jan2014, 12:34	57.5
CP8	0.234	550.5	01Jan2014, 12:39	95.4
CP8 Reach	0.234	550.3	01Jan2014, 12:39	95.4
CP9	0.527	1149.3	01Jan2014, 12:48	229.4
Dry Creek	4.827	5653.8	01Jan2014, 13:52	2029.7
Dry Creek U.S.	4.827	5654.1	01Jan2014, 13:49	2029.7
J-2	1.991	2816.0	01Jan2014, 13:33	834.9
J-3	2.555	3427.1	01Jan2014, 13:30	1065.3
OS1	4.504	5467.9	01Jan2014, 13:51	1898.7
OS10	0.037	132.2	01Jan2014, 12:18	15.6
OS11	0.048	138.5	01Jan2014, 12:28	19.9

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
OS12	0.101	220.6	01Jan2014, 12:45	41.9
OS13	0.325	1926.7	01Jan2014, 12:05	176.1
OS14	0.078	177.7	01Jan2014, 12:43	32.9
OS15	0.070	141.0	01Jan2014, 12:52	29.0
OS16	0.521	928.4	01Jan2014, 13:01	212.4
OS17	0.089	223.8	01Jan2014, 12:34	35.7
OS2	1.282	1775.3	01Jan2014, 13:30	531.5
OS3	0.693	1028.7	01Jan2014, 13:25	296.9
OS4	0.143	252.0	01Jan2014, 13:02	58.3
OS5	0.527	1149.3	01Jan2014, 12:48	229.4
OS6	0.054	171.4	01Jan2014, 12:23	22.8
OS7	0.192	431.5	01Jan2014, 12:43	79.6
OS8	0.045	147.4	01Jan2014, 12:21	18.7
OS9	0.067	170.5	01Jan2014, 12:35	27.8
Reach-1	0.016	56.2	01Jan2014, 12:33	6.4
Reach-1A	0.016	56.1	01Jan2014, 12:42	6.4
Reach-2	0.693	1028.5	01Jan2014, 13:31	296.9
Reach-3	1.298	1789.2	01Jan2014, 13:35	537.9
Reach-4	1.991	2815.3	01Jan2014, 13:40	834.8
Reach-5	2.342	3123.4	01Jan2014, 13:34	977.9
Reach-6	0.213	379.4	01Jan2014, 13:04	87.3
Reach-7	0.143	251.8	01Jan2014, 13:09	58.3
Reach-8	2.555	3427.0	01Jan2014, 13:32	1065.3
Site 21	8.737	967.1	01Jan2014, 20:15	1455.6

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EXISTING CONDITION FLOW SUMMARY

130 Environmental Park

Existing Condition Flow Summary

Watershed Name	Drainage Area (ac)	Drainage Area (sq mi)	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft)	100-Year Peak Discharge (cfs)	100-Year Volume (ac-ft)
OS1	2882.43	4.50	3725.1	1283.8	5467.9	1898.7
OS2	820.33	1.28	1203.4	357.5	1775.3	531.5
OS3	443.55	0.69	706.2	201.8	1028.7	296.9
OS4	91.50	0.14	170	39	252	58.3
OS5	337.37	0.53	795.7	156.7	1149.3	229.4
OS6	34.67	0.05	117.5	15.4	171.4	22.8
OS7	122.85	0.19	293.6	53.5	431.5	79.6
OS8	28.88	0.05	100.5	12.6	147.4	18.7
OS9	42.91	0.07	116.1	18.7	170.5	27.8
OS10	23.37	0.04	90.7	10.5	132.2	15.6
OS11	30.74	0.05	94.4	13.4	138.5	19.9
OS12	64.36	0.10	150.1	28.2	220.6	41.9
OS13	208.13	0.32	1424.9	129.3	1926.7	176.1
OS14	49.92	0.08	121.7	22.2	177.7	32.9
OS15	44.52	0.07	95.9	19.5	141	29
OS16	333.38	0.52	626.6	142.1	928.4	212.4
OS17	56.96	0.09	150.5	23.7	223.8	35.7
A1	10.32	0.02	37.9	4.3	56.3	6.4
A2	224.40	0.35	518.2	95.7	766.5	143.1
A3	44.58	0.07	104	19.5	152.9	29
A4	90.32	0.14	243.4	38.5	359.8	57.5
A5	150.04	0.23	372.4	63.8	550.5	95.4

EXISTING CONDITION VELOCITY SUMMARY

130 Environmental Park

Existing Condition 25-Year Velocity Calculations at Comparison Points

Required: Determine the 25-year flow depths and velocities at each comparison point.

Method: Calculate the flow depths and velocities using Manning's Equation.

Solution: Manning's Equation, Q = 1.486 * R^(2/3) * S^(1/2) * A / n, was used to calculate the flow depth and velocity. See page C1-B-31 for example calculations.

		Velocity Calculations						
Comparison Point	Q (cfs)	Width[1] (ft)	Bottom Slope[2] (%)	Side Slopes[3] (h:v)	Manning's n	Depth (ft)	Velocity (fps)	Shear Stress (psf)
CP1	37.9	500	2.90	0.0	0.100	**0.12**	**0.62**	**0.22**
CP2	1214.1	6	0.35	8.0	0.065	**6.63**	**3.10**	**1.45**
CP3	706.2	13	0.70	25.0	0.065	**3.02**	**2.65**	**1.32**
CP4	170.0	7	1.60	10.0	0.065	**2.00**	**3.16**	**1.99**
CP5	255.5	1	1.30	30.0	0.065	**1.84**	**2.48**	**1.49**
CP6	2121.3	7	0.52	10.0	0.065	**7.02**	**3.91**	**2.28**
CP7	243.4	1	2.10	20.0	0.085	**2.12**	**2.65**	**2.78**
CP8	372.4	4	1.60	4.0	0.065	**3.94**	**4.79**	**3.93**
CP9*	795.7	20	1.30	6.0	0.065	**3.86**	**4.78**	**3.13**
CP10*	117.5	3	2.80	6.0	0.065	**1.97**	**4.03**	**3.44**
CP11*	293.6	12	1.40	4.5	0.065	**2.88**	**4.09**	**2.51**
CP12*	230.9	10	0.20	3.0	0.065	**4.68**	**2.05**	**0.58**

Notes:

1. Comparison points where surface water runoff enters or exits the permit or property boundaries in established natural or constructed channels; width refers to the bottom width of the channel.
   Comparison points where surface water runoff enters or exits the permit or property boundaries as sheet flow or not well established channels; width refers to the sheet flow width.
2. For channels, bottom slope is the slope of the channel bottom where surface water enters or exits the permit or property boundaries.
   For sheet flow, bottom slope is the slope of the ground where surface water enters or exits the permit or property boundaries.
3. For channels, side slope is the average side slope of the channel where surface water enters or exits the permit or propery boundaries.
   For sheet flow, there are no side slopes and are represented by "0" in this table.

* Comparison points where surface water runoff enters or exits the property boundary at a culvert, the velocity is calculated downstream of the culvert.

130 Environmental Park
Existing Condition 100-Year Velocity Calculations at Comparison Points

Required: Determine the 100-year flow depths and velocities at each comparison point.

Method: Calculate the flow depths and velocities using Manning's Equation.

Solution: Manning's Equation, Q = 1.486 * R^(2/3) * S^(1/2) * A / n, was used to calculate the flow depth and velocity. See page C1-B-31 for example calculations.

		Velocity Calculations						
Comparison Point	Q (cfs)	Width[1] (ft)	Bottom Slope[2] (%)	Side Slopes[3] (h:v)	Manning's n	Depth (ft)	Velocity (fps)	Shear Stress (psf)
CP1	56.3	500	2.90	0.0	0.100	**0.15**	**0.73**	**0.28**
CP2	1789.6	6	0.35	8.0	0.065	**7.73**	**3.42**	**1.69**
CP3	1028.7	13	0.70	25.0	0.065	**3.51**	**2.91**	**1.53**
CP4	252.0	7	1.60	10.0	0.065	**2.36**	**3.49**	**2.36**
CP5	379.5	1	1.30	30.0	0.065	**2.13**	**2.73**	**1.73**
CP6	3123.5	7	0.52	10.0	0.065	**8.17**	**4.31**	**2.65**
CP7	359.8	1	2.10	20.0	0.085	**2.46**	**2.92**	**3.22**
CP8	550.5	4	1.60	4.0	0.065	**4.63**	**5.29**	**4.62**
CP9*	1149.3	20	1.30	6.0	0.065	**4.59**	**5.27**	**3.72**
CP10*	171.4	3	2.80	6.0	0.065	**2.30**	**4.43**	**4.02**
CP11*	431.5	12	1.40	4.5	0.065	**3.45**	**4.53**	**3.02**
CP12*	974.1	10	0.20	3.0	0.065	**8.93**	**2.97**	**1.11**

Notes:

1. Comparison points where surface water runoff enters or exits the permit or property boundaries in established natural or constructed channels; width refers to the bottom width of the channel.
   Comparison points where surface water runoff enters or exits the permit or property boundaries as sheet flow or not well established channels; width refers to the sheet flow width.
2. For channels, bottom slope is the slope of the channel bottom where surface water enters or exits the permit or property boundaries.
   For sheet flow, bottom slope is the slope of the ground where surface water enters or exits the permit or property boundaries.
3. For channels, side slope is the average side slope of the channel where surface water enters or exits the permit or propery boundaries.
   For sheet flow, there are no side slopes and are represented by "0" in this table.

* Comparison points where surface water runoff enters or exits the property boundary at a culvert, the velocity is calculated downstream of the culvert.

130 Environmental Park
Example Velocity Calculation at Comparison Point

Required: Determine the depths and velocities at each comparison point.

Method: Calculate the flow depths and velocities using Manning's Equation.

Solution: Manning's Equation was used to calculate the flow depth and velocity.

Given: Comparison Point 6 and the 25-year, 24-hour flow rate are used for this example.

Comparison Point	Q (cfs)	Width (ft)	Bottom Slope (%)	Side Slopes (h:v)	Manning's n	Depth (ft)	Velocity (fps)	Shear Stress (psf)
CP6	2121.3	7	0.52	10.0	0.065	**7.02**	**3.91**	**2.28**

Given Values

Q = Flow rate
W = Bottom width of flow
S = Bottom slope
SS = Side slope
n = Manning's roughness coefficient

Calculated Values

D = Depth of Flow
V = Flow Velocity
Flow Area (A) = (W+SS*D)*D
Wetted Perimeter (WP) = W+2*(D^2+(SS*D)^2)^(0.5)
Hydraulic Radius (R) = A/WP

Manning's Equation

Calculated Flow Rate (Q) = 1.486*R^(2/3)*S^(1/2)*A/n

Depth was varied until the correct flow rate obtained.

Assume D =	4.0000	ft
A =	188.00	sf
WP =	87.40	ft
R =	2.1511	
Calculated Q =	516.5	cfs

Assume D =	7.0196	ft
A =	541.89	sf
WP =	148.09	ft
R =	3.6591	
Calculated Q =	2121.3	cfs

The calculated flow rate matches the given flow rate.

Calculate flow velocity.

Flow Velocity (V) = Q/A
V = **3.91** fps

Shear stress was calculated for erosion control purposes.

Shear Stress = 62.4*D*S/100
Shear Stress = 2.28 psf

EXISTING CONDITION DRAINAGE ANALYSIS SUMMARY

130 Environmental Park

Table 1 - Existing Conditions Drainage Analysis Summary

Comparison Point	25-Year Peak Discharge (cfs)	25-Year Volume (ac-ft)	Peak Velocity (fps)	Runon/ Runoff	Drainage Areas
CP1	37.9	4.3	0.62	Runoff	A1
CP2	1214.1	361.8	3.10	Runon	A1, OS2
CP3	706.2	201.8	2.65	Runon	OS3
CP4	170.0	39.0	3.16	Runon	OS4
CP5	255.5	58.5	2.48	Runoff	A3, OS4
CP6	2121.3	659.3	3.91	Runoff	A1, A2, OS2, OS3
CP7	243.4	38.5	2.65	Runoff	A4
CP8	372.4	63.8	4.79	Runoff	A5
CP9	795.7	156.7	4.78	Runoff	OS5
CP10	117.5	15.4	4.03	Runoff	OS6
CP11	293.6	53.5	4.09	Runoff	OS7
CP12	230.9	2524.1	2.05	Runoff	A1, A2, A3, A4, A5, OS1, OS2, OS3, OS4, OS8, OS9, OS10, OS11, OS12, OS13, OS14, OS15, OS16, OS17