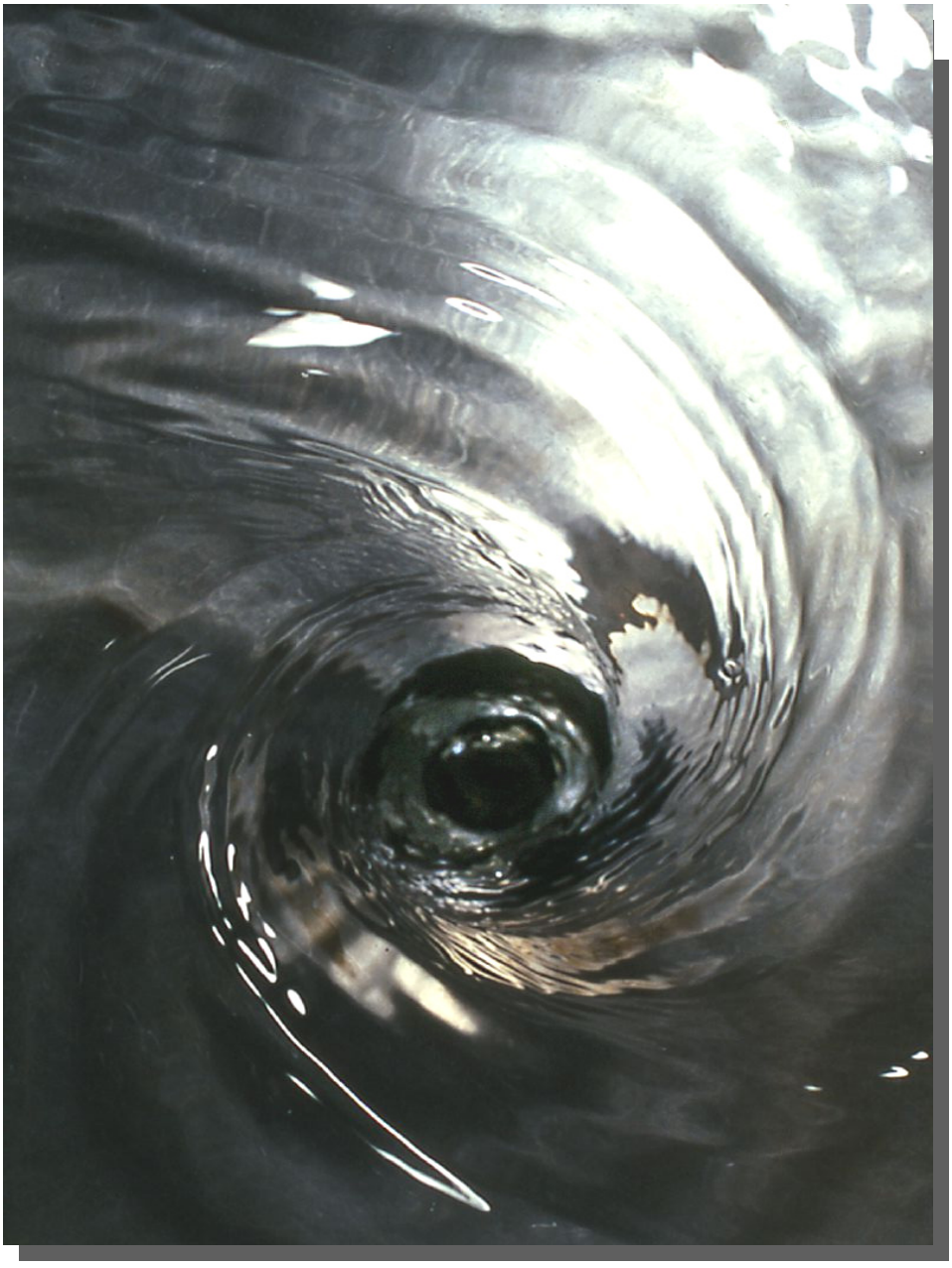
Stormwater Management Guidelines

Grand Cayman



Prepared By:

Planning Department

NRA NATIONAL ROADS AUTHORITY

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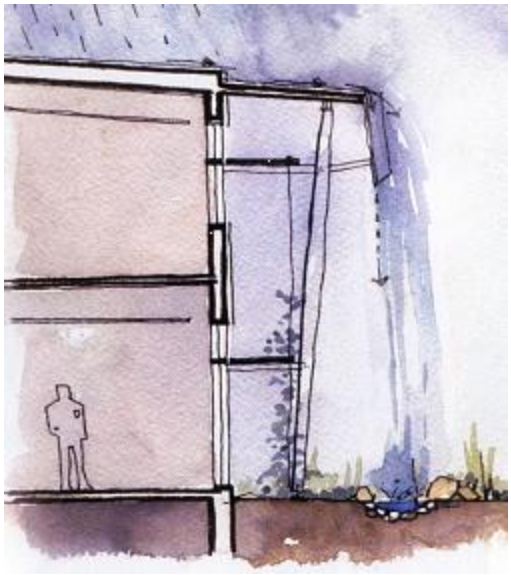
Section 1 - Purpose

1.1. Introduction

Grand Cayman's rapid rate of development has put an increased burden on the island's infrastructure. Stormwater management has been one of the items that has been affected by this rapid growth. The National Roads Authority and the Planning Department have continuously updated the Stormwater Management Standards to minimize the negative impacts of flash flooding and other drainage issues created by new developments. However, these requirements have never been formally adopted as policy. The following guidelines will establish a clear policy outlining the authority, applicability, submittal requirements, and review processes for developing and implementing Stormwater Management Plans for individual developments.



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Section 2 - Goals & Objectives

2.1. Overview

The following are the goals and objectives of these Guidelines, as identified by the National Roads Authority and the Planning Department.

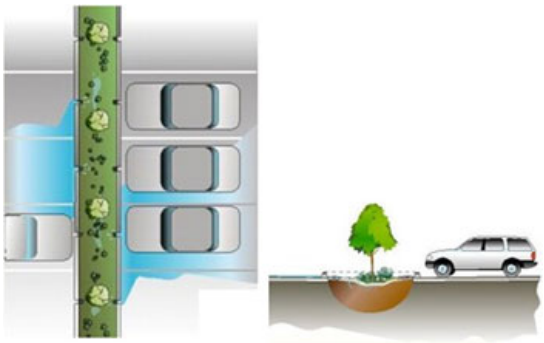
1. Minimize negative impacts of new development on adjacent existing uses.

2. Officially establish standard guidelines in order to get consistent information submitted for all required projects.

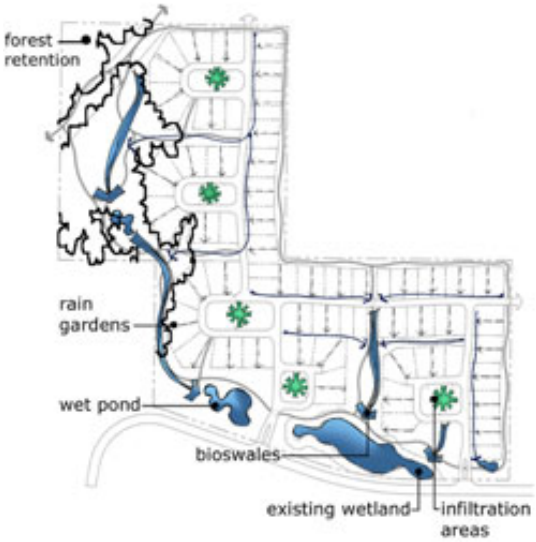
3. Educate the development community about Best Drainage Design Practices that will minimize negative impacts and, in some cases, reduce construction and/or irrigation costs.

4. Implement drainage requirements to reduce the negative environmental effects caused by new development.

5. Create master drainage plans for major subdivisions to ensure a properly functioning drainage system for all lots.



Alternative storwmater management methods in a parking lot.



Neighbourhood scale stormwater management planning.

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Section 3 - Authority

3.1 Major developments

Section 15 (1) of the *Development and Planning Law (2005 Revision)* states that "…Where (an) application is made to the Authority for outline planning or permission to develop land, the Authority may grant permission either unconditionally **or subject to such conditions as it thinks fit** (emphasis added), or may refuse permission."

The Authority has declared that the developments identified in *Section 4 - Applicability* shall be subject to the standard condition of requiring the preparation and approval of a Stormwater Master Plan prior to final approval of planning permission.

3.2 Subdivisions

Section 23 (6) of the *Development and Planning Regulations (2006 Revision)* states that subdivision applications "… Shall be accompanied by a statement as to … (d) Drainage."

These guidelines are intended to clarify what shall be included in this statement.

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Section 4 - Applicability

The following types of developments will be subject to the requirements of the *Stormwater Management Guidelines*.

4.1. Subdivisions

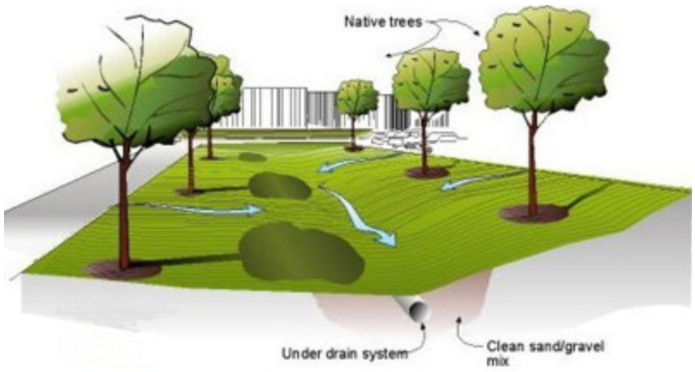
4.1.1. Any subdivision application creating more than 6 lots is considered a "Major Subdivision" and will require the submittal of a Drainage Master Plan (DMP) prior to approval. This threshold is consistent with the "Major Subdivisions" standards established in Section 23 (2) and (3) of the *Development and Planning Regulations (2006 Revision)*.

4.1.2. "Minor Subdivisions", or those creating 6 or fewer lots, do not require a DMP. However, the applicant is still required to demonstrate how drainage will be accommodated and show the location of all drainage infrastructure and facilities. The NRA and the Planning Department strongly encourage all minor subdivisions to utilize alternatives to deep wells for drainage. Some of the acceptable methods are provided in *Appendix C - Alternative Drainage Tools*.

4.2. Developments with impervious site coverage of 4,000 square feet or greater

4.2.1. For any development, regardless of type, with impervious site coverage of 4,000 square feet or greater.

4.2.2. Any addition to an existing building complex or building making the total footprint 4,000 square feet or greater, applicants will be required to prepare a Stormwater Management Plan (SWMP).

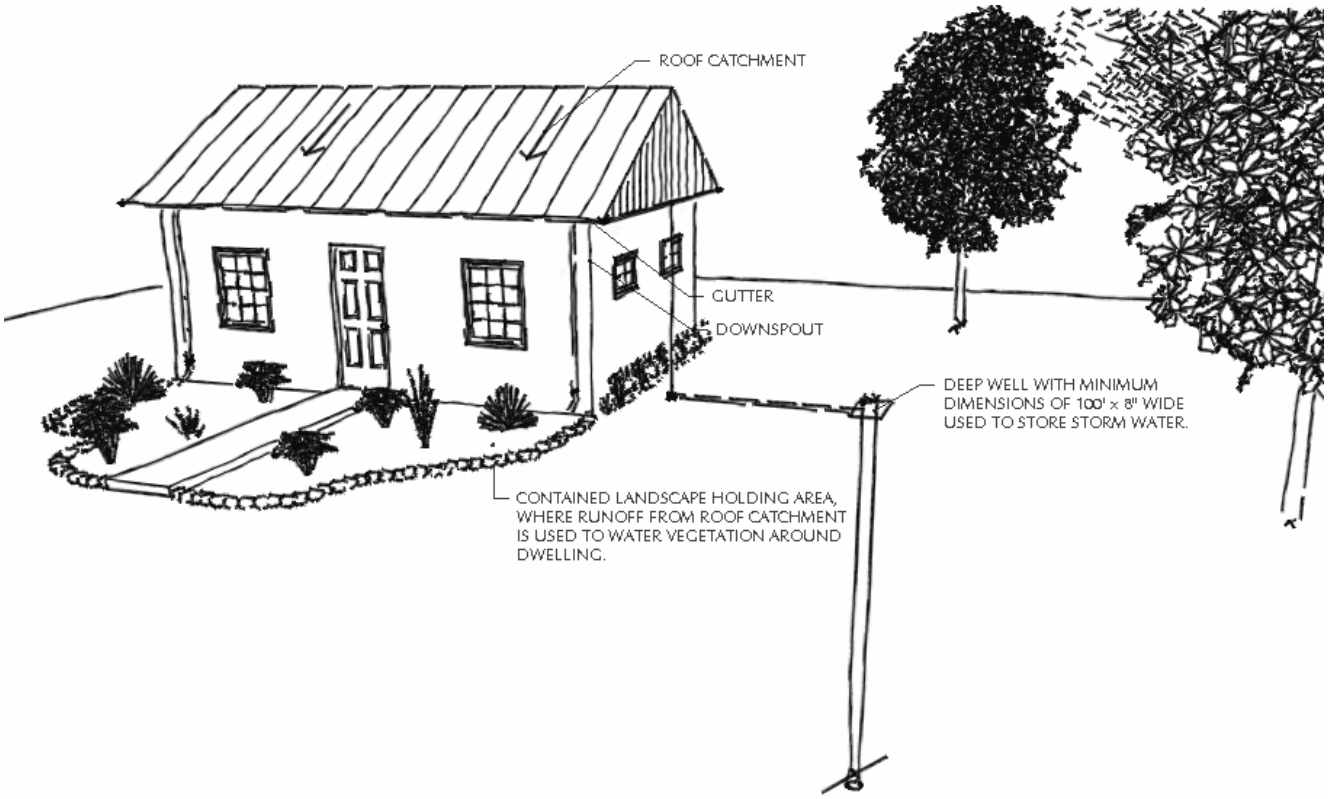


Alternative storwmater management methods include the use of open swales in conjunction with locally appropriate plantings.

4.3. Developments with impervious site coverage under 4,000 square feet

4.3.1. For all developments with less than 4,000 square feet of impervious site coverage, no SWMP is required. However, the applicant is still required to demonstrate how drainage will be accommodated and demonstrate that the proposed development will not negatively impact adjacent properties or roadways.

4.3.2. The applicant may elect to address the site's drainage conveyance system by a deep well. When locating drains in parking areas, the drain should not be located in the vehicle parking spaces, which shall drain towards the circulation areas.



4.3.3. The preferred method of stormwater management for smaller lots are to incorporate on-site retention areas within the landscaped areas of the site. Other alternatives such as water harvesting are also encouraged, *see Appendix C - Alternative Drainage Methods.*

4.3.4. The minimum specifications of the wells shall be one hundred (100) feet deep and eight (8) inches in diameter.

4.3.5. Instead of the traditional deep well method of containing runoff on individual sites, the NRA and Planning Departments strongly encourage all developments to utilize alternatives methods, some of which are provided in *Appendix D* of this document.

Section 5 - Submittal Requirements

This section contains information about the submittal requirements for stormwater and drainage plans.

5.1. Stormwater Management Plan (SWMP)

Applicants will be required to demonstrate in the SWMP that the Stormwater Management system can be designed to include storm water runoff produced from a rainfall intensity of 2 inches per hour for one hour of duration, ensuring that surrounding properties that are lower and nearby public roadways are not subject to stormwater runoff from the subject site. If necessary, applicants may submit the information on two separate drawings, one with existing conditions, and one with post-construction conditions.

In preparing a SWMP, the following is required. See *Appendix A - Sample Stormwater Management Plan* for sample.

5.1.1. Site Plan, including:

- Location of proposed building's
- Location of existing buildings on the site and on adjacent land
- Front, rear, and side setbacks
- Adjacent roads, including names and widths
- Existing water lines and sanitary drainage systems
- North arrow
- Scale
- Spot Grades (Applicant may use the Land and Survey Department's 1 foot topographic information).
- Existing conditions
- Finished grades
    - Located at all major topographic features (high points, low points, peaks and valleys on the site) and at a minimum of 1 every 250 square feet for entire subject site plus an additional 50 feet around the perimeter of the site.

- Finished floor elevations of all buildings
- Pre- and post-development flow arrows
- Location, size, and type of drainage facilities including on-site basins, swales/ ditches, deep wells, grass-crete, etc.
- Location and types of roof drains with flow arrows
- Square footage and percentage of total impervious surface coverage including roof area (not building footprint), concrete, pavement, solid decking, etc.
- Location of other existing and proposed barriers such as curbs, walls, etc. preventing the natural flow of runoff.
- 2 inches x 1 hour runoff volume calculation

Imp x 12 x 12 x 2 = Runoff Volume (cu. in.)

Where Imp = Impervious surface square footage;

12 x 12 = conversion from square feet to square inches; and,

2 = inches of rainfall

- To convert runoff volume from cubic inches to cubic feet, divide by 1,728 (the number of cubic inches in a cubic foot)

5.2. Drainage Master Plan (DMP)

5.2.1. Applicants will be required to demonstrate in the DMP the following information:

The Stormwater Management system can be designed to include storm water runoff produced from a rainfall intensity of 2 inches per hour for one hour of duration upon full build-out of the subdivision;

5.2.2. Ensure that surrounding properties that are lower and nearby public roadways are not subject to stormwater runoff from this site;

5.2.3. The DMP shall show general drainage direction and finished floor elevations of individual lots, showing a comprehensive drainage plan for the entire subdivision upon build-out. When individual lots are developed, they will be required to demonstrate that they comply with the original DMP or request an amendment through the NRA.

5.2.4. In preparing a DMP, the following is required (See *Appendix B - Sample Drainage Master Plan* for sample):

- Subdivision site plan
- Entire subdivision on one 24" x 36" sheet required (An index sheet style may be used for larger sites)
- Additional sheets should be used to show greater detail of the site when necessary, typically a 1"=50' scale or similar architectural or surveyors scale ratio, that clearly shows the following required elements.
- Existing 2 foot minimum topography or spot elevations (applicants may use Lands and Survey Department's topographic) for the entire subdivision plus a 100' perimeter surrounding the site

- Pre- and post-development run-off direction arrows
- Proposed average lot grade's (centre of parcel) for each new parcel
- Typical lot drainage detail
- Spot elevations at minimum 50 lineal foot intervals along all roadways
- Vegetation clearing boundaries
- Location, type, and size of existing and proposed drainage conveyance systems
- Existing and proposed runoff flows (Use different symbols if construction alters direction of existing flow)
- Maintenance and ownership statements for drainage facilities and open space.
- Location of any on-site or nearby existing drainage channels, lakes, or other drainage facilities.
- Existing drainage runoff rates
- Proposed run-off calculations
- Sizing calculations for stormwater facilities
- Contributing drainage area (on and off-site)
- Storage capacity
- Outlet configuration

Section 6 - Process

This section provides an overview of the application review process conducted by the Planning Department and other relevant agencies.

6.1.1. When a Stormwater Management Plan (SWMP) or a Drainage Master Plan (DMP) is required, the applicant shall submit three (3) copies to the Planning Department. This plan must be approved before building, electrical, and plumbing plans can be submitted to the Building Control Unit for their review.

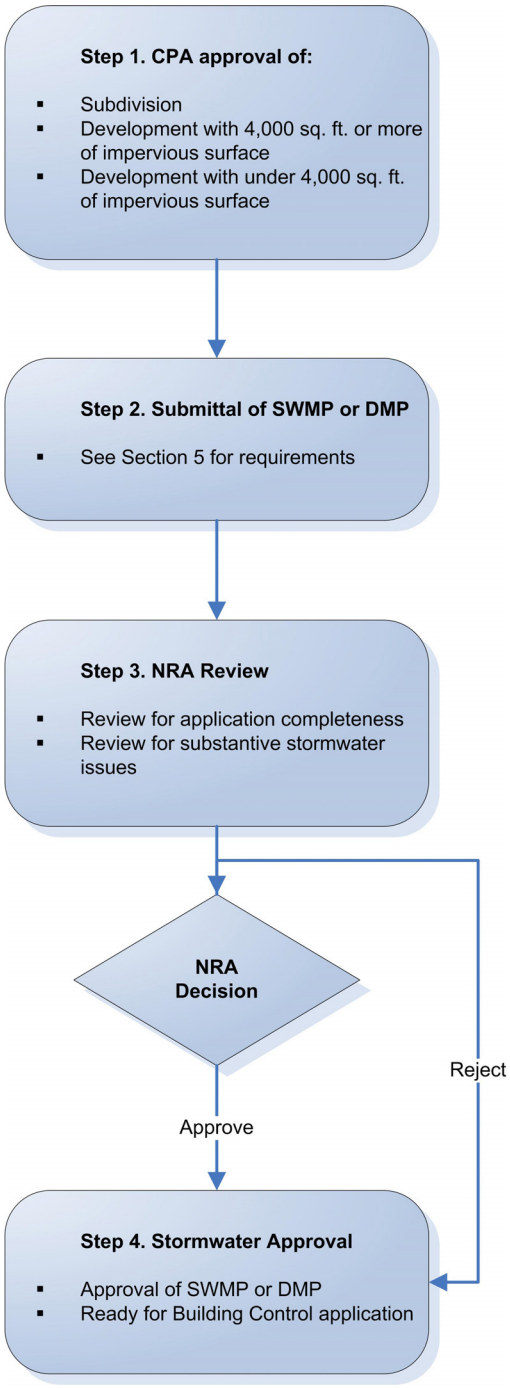
6.1.2. Applicants may submit their SWMP or DMP after Central Planning Authority approval, but it is recommended that the applicant submit these plans at the same time of application for planning permission to expedite the review process. However, if the applicant is required to make significant modifications to the originally submitted plans to obtain planning permission, the SWMP or DMP will need to be revised at the applicant's expense to match the new plans.

6.1.3. The NRA will review the plan for completeness. The applicant will be advised by the NRA if additional information or revisions are needed. If approved, the conditions for the drainage plan will be satisfied and the application can proceed to the next review upon completion of all requirements.

6.1.4. The Applicant will be responsible for constructing the site in accordance with the SWMP or DMP in addition to all other approved plans for the site. If the site is not developed according to the plan, the Planning Department has the right to deny occupancy or final approval of a subdivision map until;

1. The drainage features are installed and constructed as approved, at the expense of the developer, or

2. The Applicant submits a revised SWMP or DMP that meets the approval of the NRA and the Planning Department and is consistent with the "as-built" design of the site.



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Section 7 - Definitions

The following definitions apply to this document only. All words or terms not listed here are interpreted as standard English-language dictionaries and/or standard development community definitions. Any discrepancy over the meaning or intent of a word or phrase will be resolved by the Director of Planning.

As-Built: The condition of all features on a development site including building, street, pipe, utility line, drainage channel, etc. as it is actually installed or constructed, including any modifications or adjustments from the approved working drawings.

Development, Major: The construction of any structure on a single parcel or project on multiple parcels that has a total impervious surface area of 4,000 square feet or greater, or an addition of new impervious surface areas to an existing development that makes the total project have 4,000 square feet or greater of total impervious surface area.

Development, Minor: The construction of impervious surfaces on a single parcel or a project on multiple parcels that has a total impervious surface area of less than 4,000 square feet , or an addition of new impervious surface areas to an existing development that keeps the total project under 4,000 square feet or greater of total impervious surface area.

Drainage Master Plan (DMP): See Section 5.2 of these Stormwater Management Guidelines.

Impervious Surface(s): A hard surface area which either prevents or retards the entry of water into the soil as under natural conditions prior to development, and/or a hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to:

- Paved areas such as walkways, patios, decks, driveways, and parking lots;
- Rooftops of buildings and accessory structures;
- Other surfaces which similarly impede the natural infiltration of surface and storm water.

Stormwater Management Plan (SWMP): See Section 5.1 of these Stormwater Management Guidelines.

Subdivision, Major: Any subdivision of one or more existing parcels, regardless of zoning classification, creating a total of more than 6 (7 or greater) parcels

Subdivision, Minor: Any subdivision of one or more existing parcels, regardless of zoning classification, creating a total of 6 or fewer parcels

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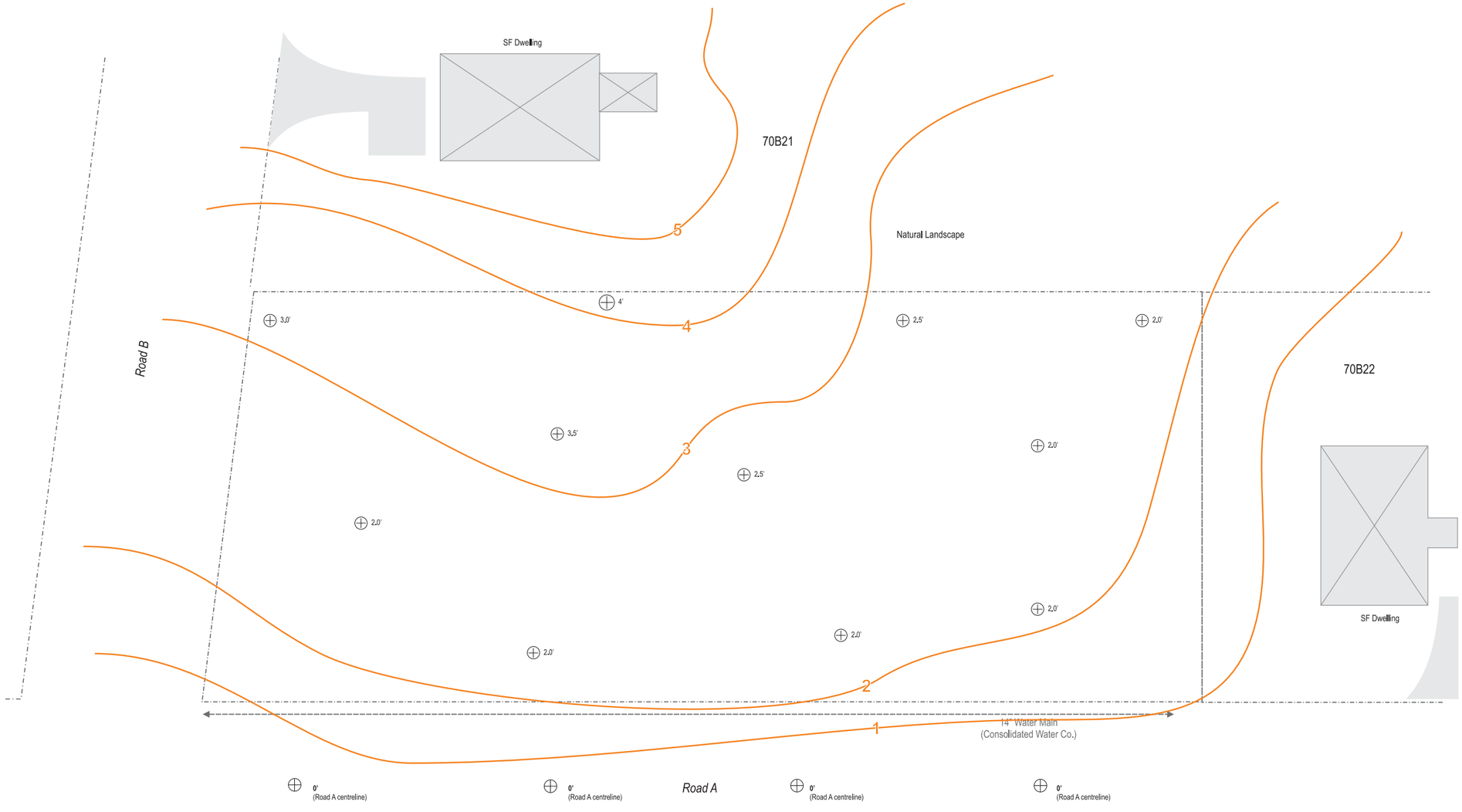
Appendix A: Sample Stormwater Master Plan

Appendix A contains a sample Stormwater Master Plan (SWMP). Applicants should use this example as a guide when preparing their plans for their site. The minimum submittal requirements are outlined in *Section 5.1* of this document.



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Key

- Pre Construction Spot Elevation
- Property Line
- Pre Construction Flow Direction

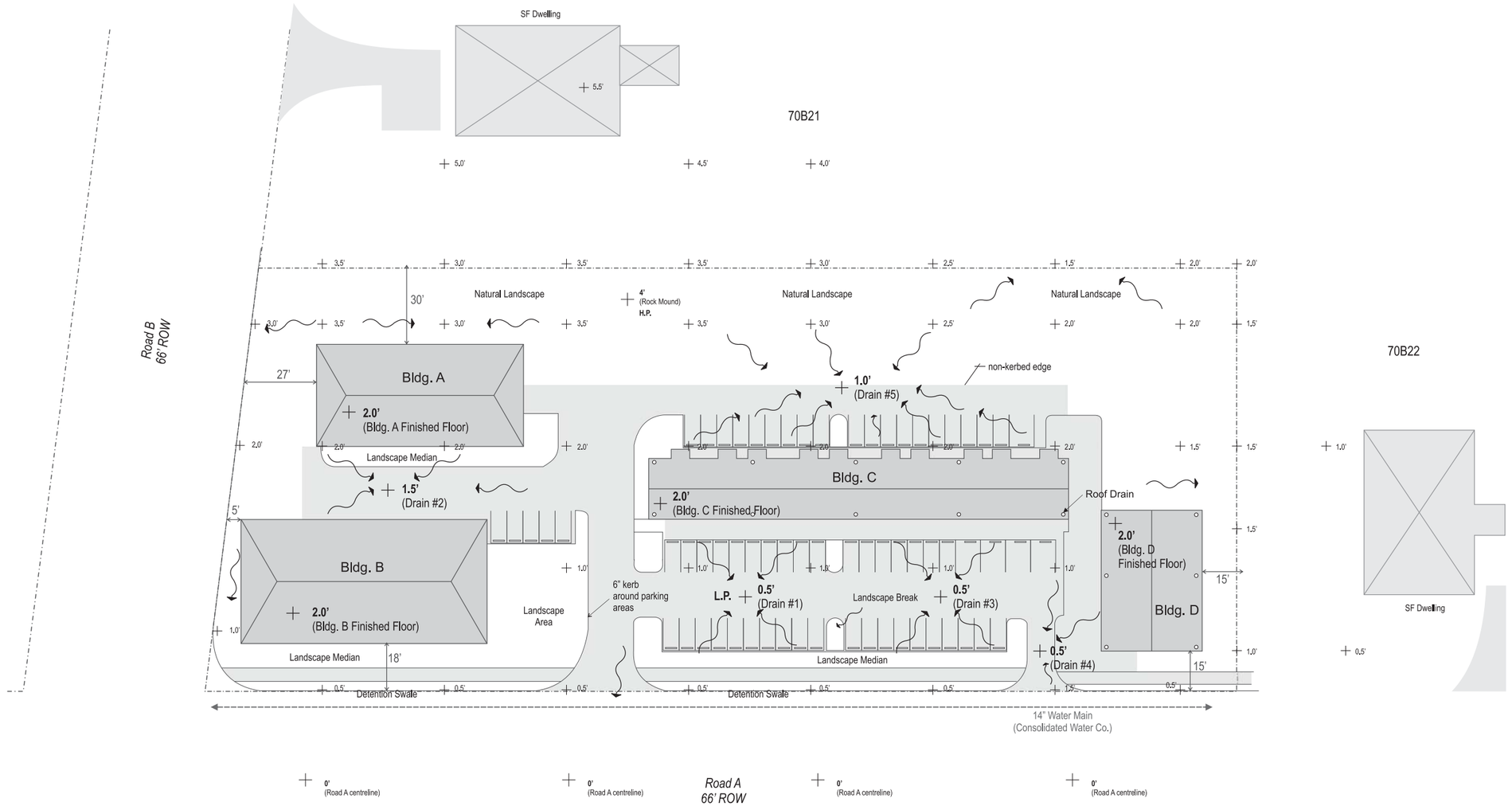
1" equals 20'

COMMERCIAL SHOPPING CENTRE

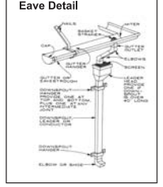
BLOCK 70B
PARCEL 16

Stormwater Plan
Pre-Construction

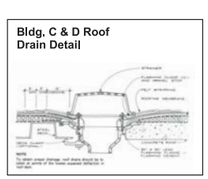
Drawing S-01



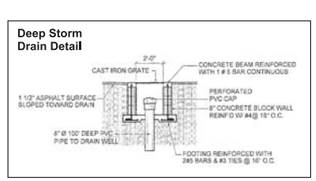
Bldg. A & B Roof Eave Detail



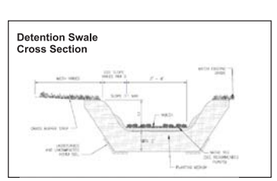
Bldg, C & D Roof Drain Detail



Deep Storm Drain Detail



Detention Swale Cross Section



Impervious Area Calculation

Building A	2,900 sq. ft.
Building B	4,050 sq. ft.
Building C	3,750 sq. ft.
Building D	2,000 sq. ft.
Parking Areas	22,000 sq. ft.
Total Impervious Area	**34,700 sq. ft.**

Stormwater Runoff Calculation

Total Impervious Area	34,700 sq. ft.
x 2" Rainfall per hour	x 2
Total Runoff Volume per Hour	**5,784 cu. ft.**

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Key

- Post Construction Spot Elevation
- Roof Drain
- Property Line
- Building Setback
- Post Construction Flow Direction
- Impervious Surfaces

1" equals 20'

COMMERCIAL SHOPPING CENTRE

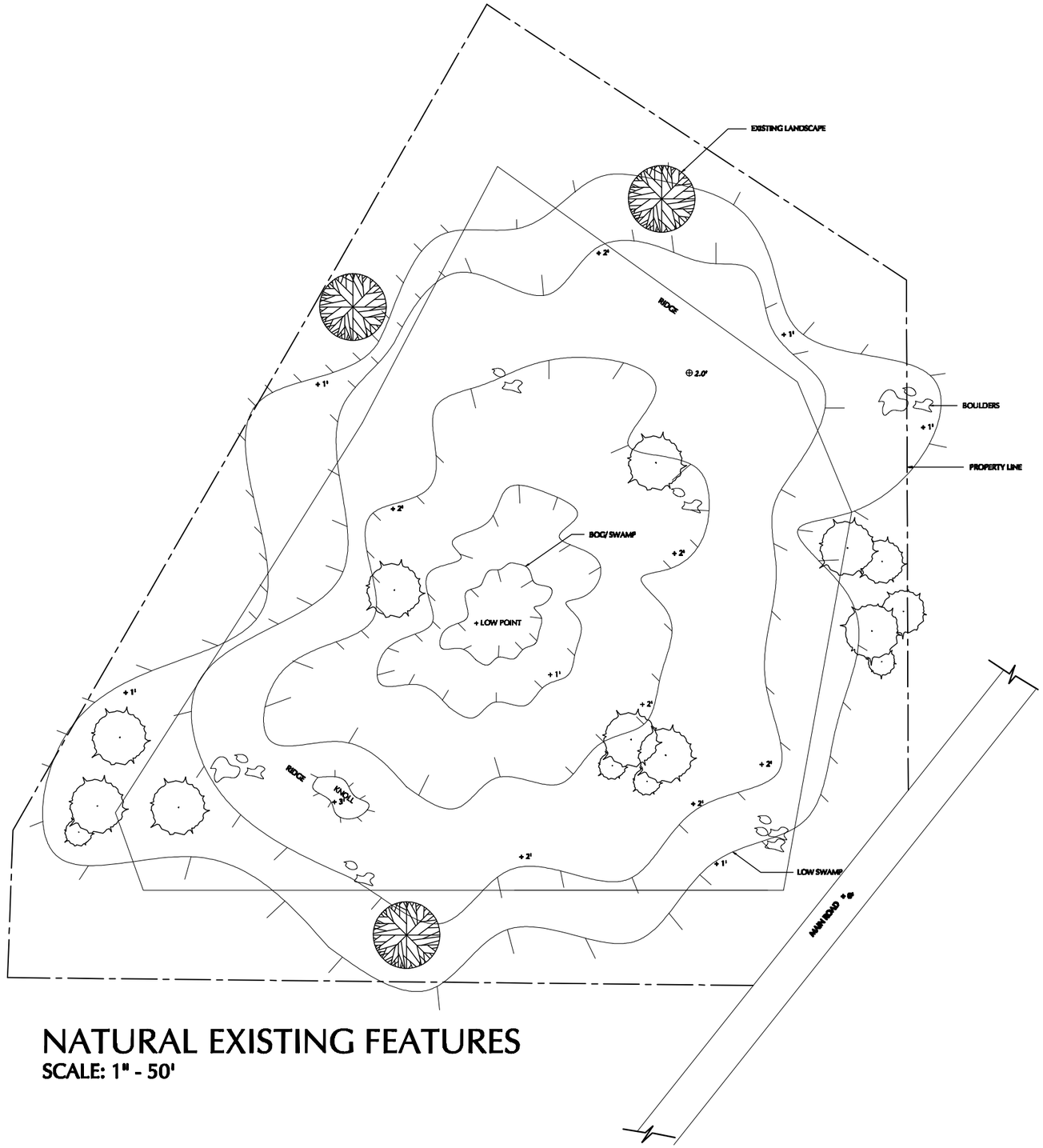
BLOCK 70B
PARCEL 16

Stormwater Plan
Post-Construction

Drawing S-02

Appendix B: Sample Drainage Master Plan

Appendix B contains a sample Drainage Master Plan (DMP). Applicants should use this example as a guide when preparing their plans for their site. The minimum submittal requirements are outlined in *Section 5.2* of this document.



NATURAL EXISTING FEATURES

SCALE: 1" - 50'

GENERAL NOTES

EXISTING RUNOFF FLOWS

TOTAL AREA .....500,000 SQ.FT

TOTAL RUN OFF ..... 80,000 CU.FT

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KEY

⊕ PRE-CONSTRUCTION SPOT ELEVATION

——— PROPERTY LINE

DRAINAGE MASTER PLAN

BLOCK 15 B
PARCEL 87

PRE-CONSTRUCTION

S-1

GENERAL NOTES

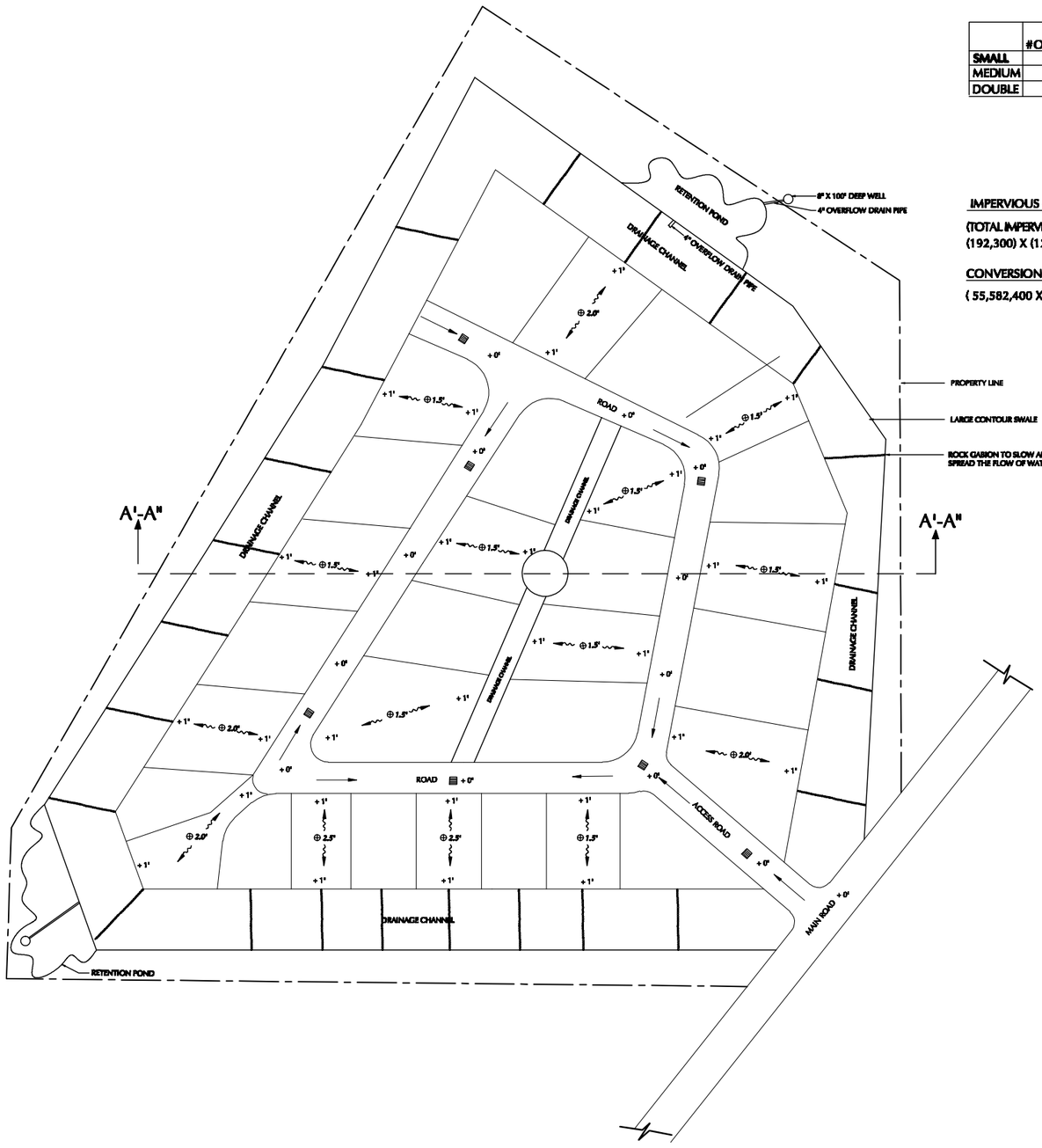
	# OF LOTS	APPROX. HOUSE FOOTPRINT	DRIVEWAY FOOTPRINT	IMPERVIOUS LOT AREA CALCULATION
SMALL	10	1,000 SQ.FT	600 SQ.FT	10 x (1000 + 600) = 16,000 SQ.FT
MEDIUM	16	1,500 SQ.FT	800 SQ.FT	16 x (1500 + 800) = 36,800 SQ.FT
DOUBLE	4	2,200 SQ.FT	1,000 SQ.FT	4 x (2200 + 1000) = 12,800 SQ.FT
			SUBTOTAL	65,600 SQ.FT
			ROAD PAVED AREA	61,100 SQ.FT
			TOTAL IMPERVIOUS AREA	192,300 SQ.FT

IMPERVIOUS AREA CALCULATION

(TOTAL IMPERVIOUS AREA) X (12 X 12) X INCHES OF RAINFALL PER HOUR = RUNOFF VOLUME IN CUBIC INCHES
(192,300) X (12 X 12) X 2 = 55,582,400 CU.IN

CONVERSION TO CUBIC FEET

(55,582,400 X .16) = 8,861,184 CU.FT



PRELIMINARY SITE GRADING PLAN

SCALE: 1" - 50'

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KEY

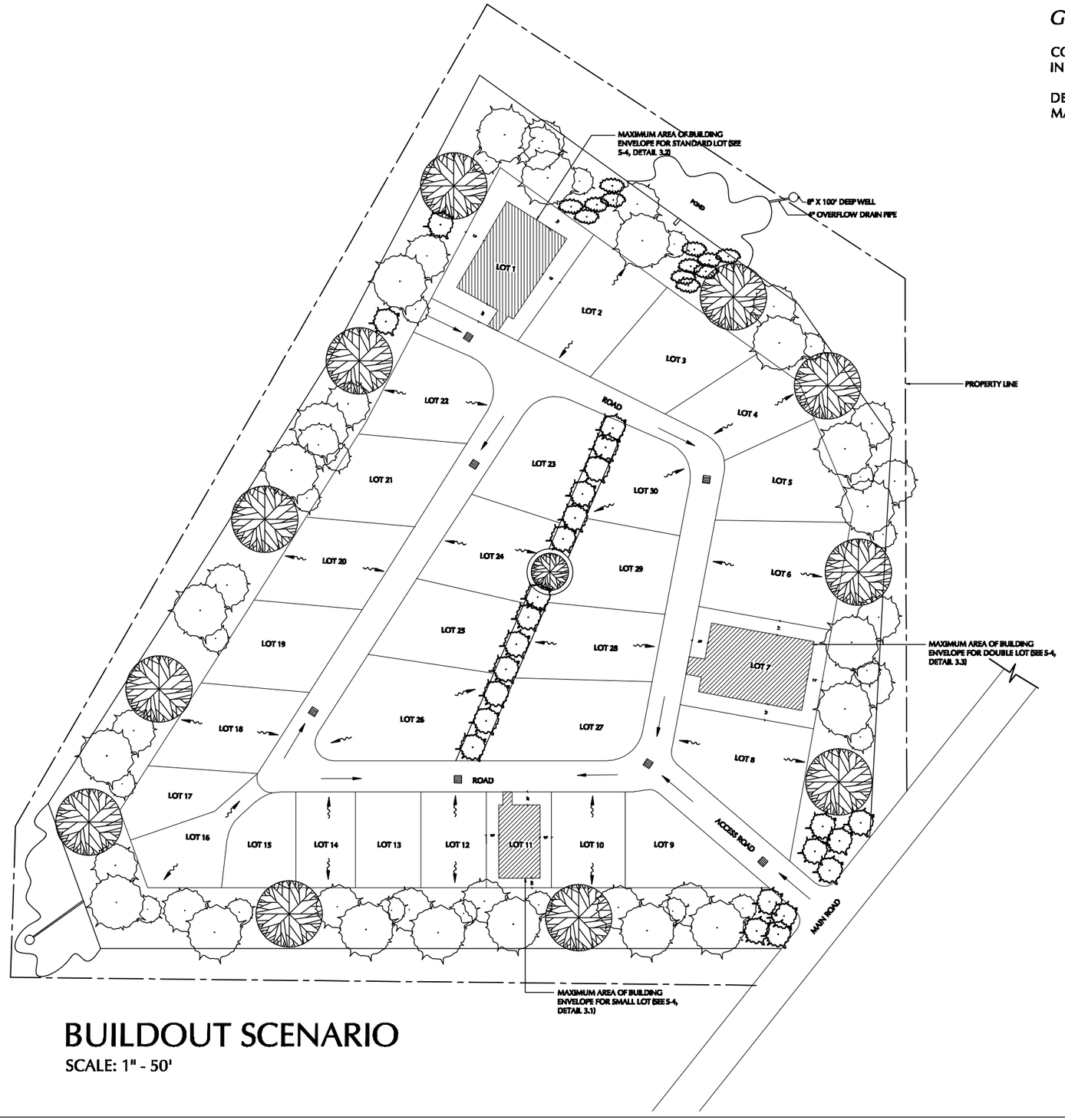
- + POST-CONSTRUCTION SPOT ELEVATION
- ⊕ CENTER OF PARCEL
- PROPERTY LINE
- POST- CONSTRUCTION FLOW DIRECTION
- DEEP WELL WITH OVERFLOW DRAIN PIPE
- STORM DRAIN

DRAINAGE MASTER PLAN

BLOCK 15 B
PARCEL 87

POST CONSTRUCTION FLOW

S-2



BUILDOUT SCENARIO

SCALE: 1" - 50'

GENERAL NOTES

CONVEYANCE SYSTEMS TO BE OWNED & MAINTAINED BY INDIVIDUAL PROPERTY OWNERS.

DEEP WELLS AND DENTENTION PONDS TO BE OWNED & MAINTAINED BY THE STRATA.

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KEY

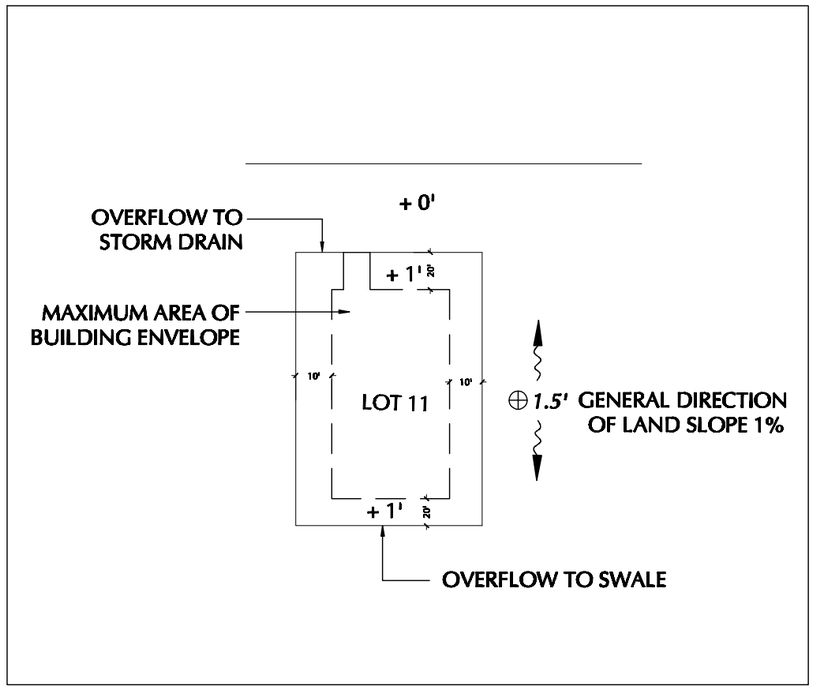
- PROPERTY LINE
- DEEP WELL WITH OVERFLOW DRAIN PIPE
- STORM DRAIN

DRAINAGE MASTER PLAN

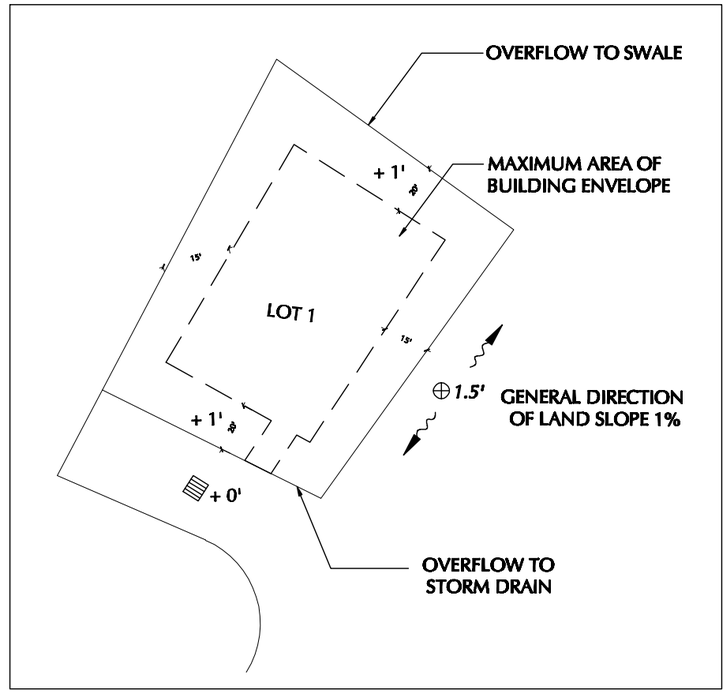
BLOCK 15 B
PARCEL 87

POST CONSTRUCTION

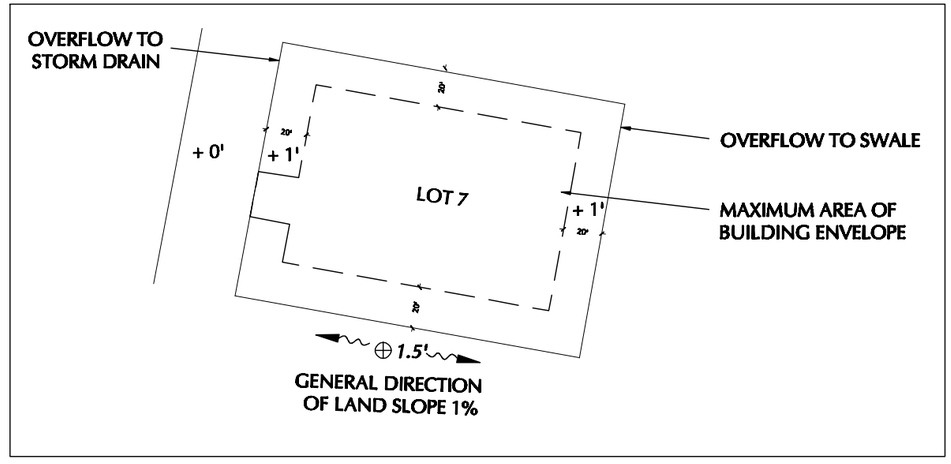
S-3



S 3.1 TYPICAL SMALL LOT DETAIL
SCALE: 1" - 50'



S 3.2 TYPICAL STANDARD LOT DETAIL
SCALE: 1" - 50'



S 3.3 TYPICAL DOUBLE LOT DETAIL
SCALE: 1" - 50'

DETAILS
SCALE: 1" - 50'

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KEY

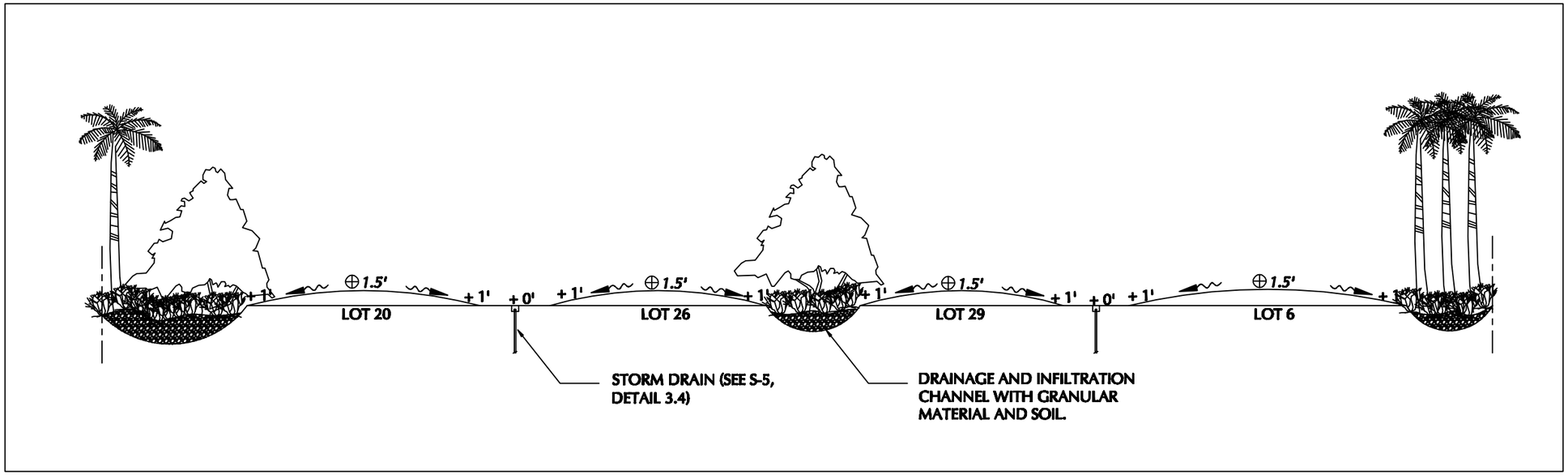
+	POST-CONSTRUCTION SPOT ELEVATION
⊕	CENTER OF PARCEL
	POST- CONSTRUCTION FLOW DIRECTION
	STORM DRAIN

DRAINAGE
MASTER
PLAN

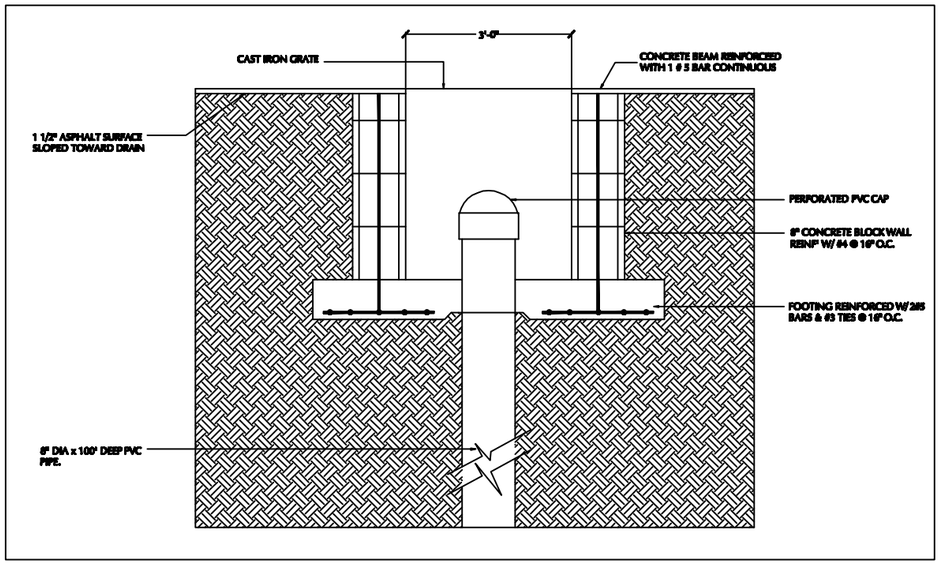
BLOCK 15 B
PARCEL 87

DETAILS

S-4



S A1-A1 SECTION A'-A"
SCALE: 1" - 50'



S 3.4 STORM DRAIN
SCALE: 1/4" - 1'-0"

DETAILS
SCALE: 1" - 50'

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KEY

+	POST-CONSTRUCTION SPOT ELEVATION
⊕	CENTER OF PARCEL
— - —	PROPERTY LINE
◄~~~	POST- CONSTRUCTION FLOW DIRECTION

DRAINAGE MASTER PLAN

BLOCK 15 B
PARCEL 87

DETAILS

S-5

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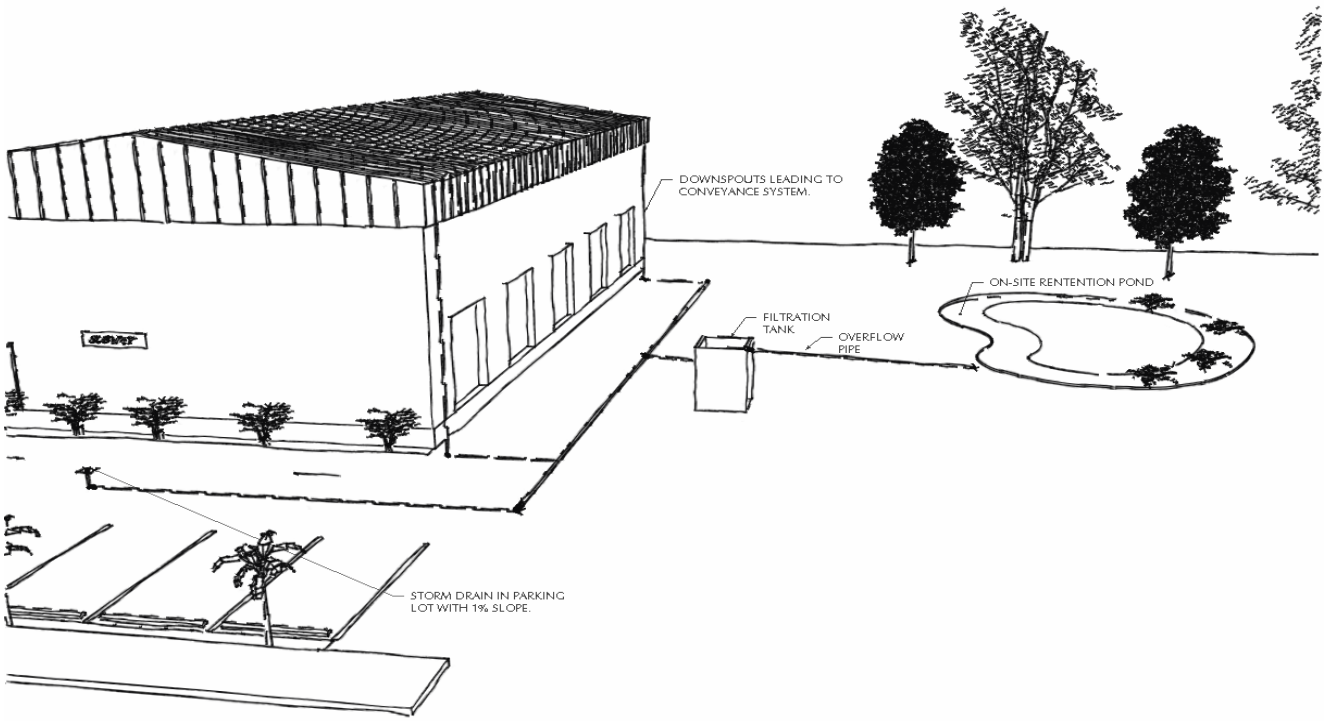
Appendix C: Alternative Drainage Tools

Appendix C recommends alternatives to the traditional deep well used for drainage on the island. The use of these drainage methods is strongly encouraged for all developments.

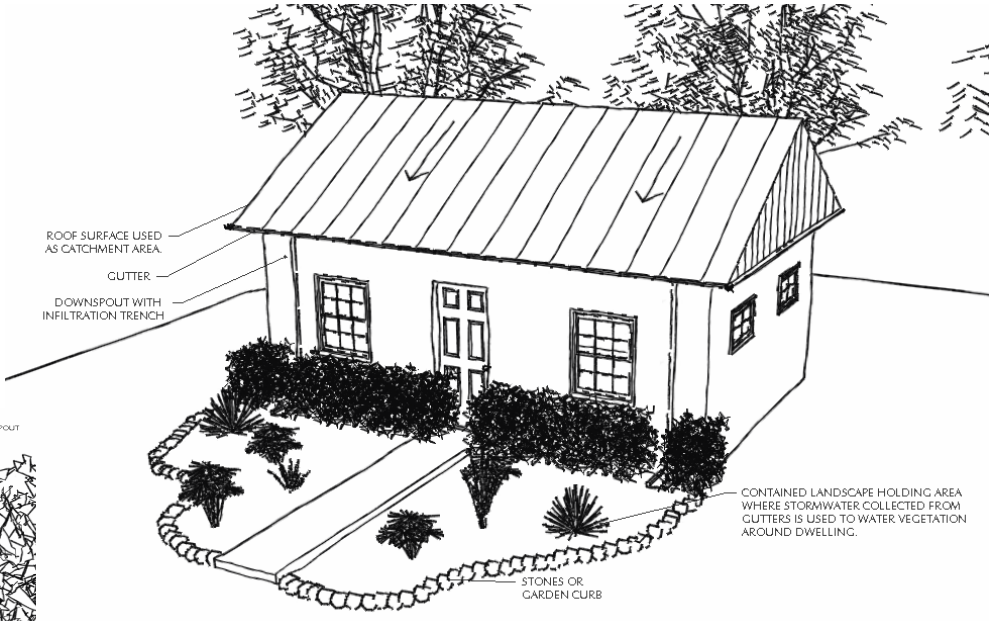
- On-site retention areas with landscaping or low-impact uses
- Concentrated roof drainage and infiltration trenches
- Paving and decking alternative materials
- Water harvesting & cisterns
- Subterranean drainage facilities
- Dual chamber wells

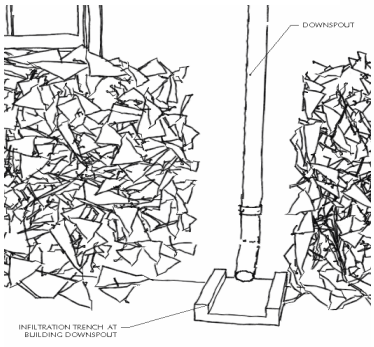
On-site retention areas with landscaping or low-impact uses



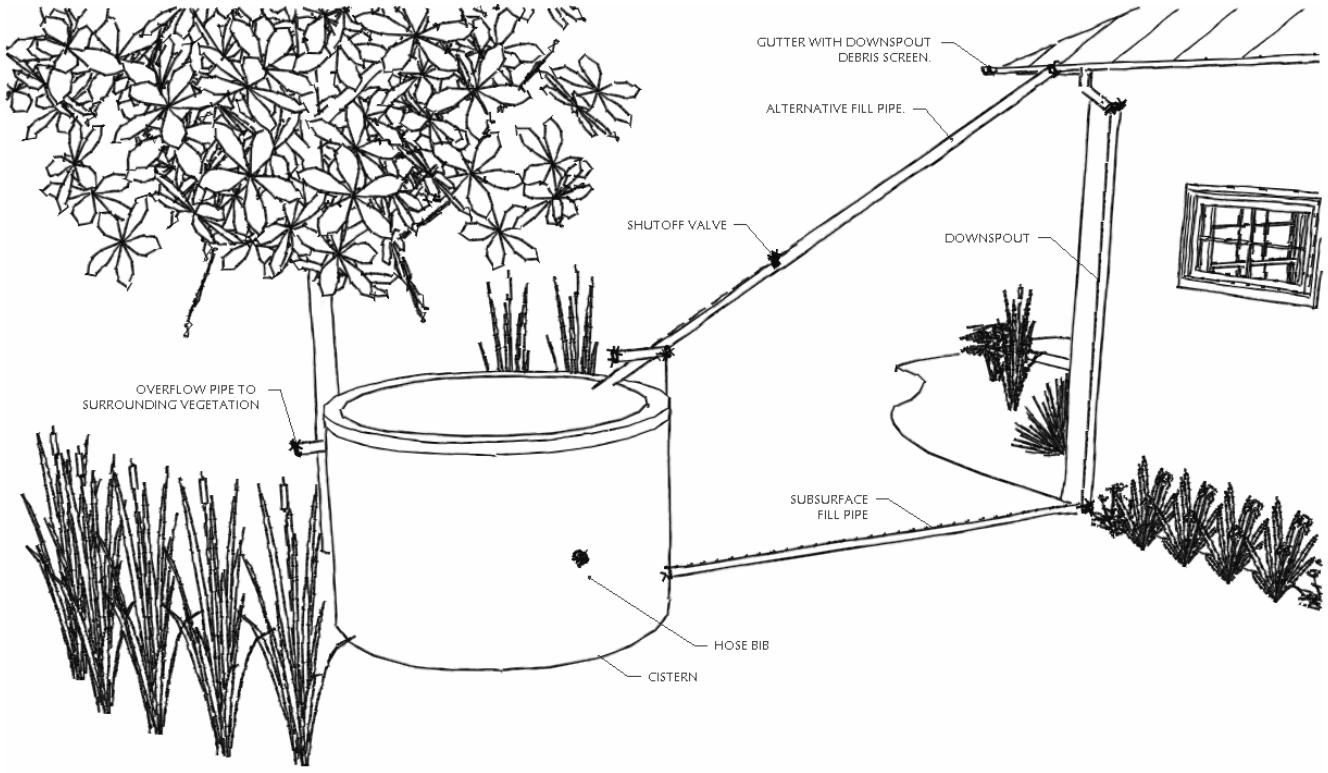
Paving and Decking Alternative Materials

Concentrated Roof Drainage & Infiltration Trenches

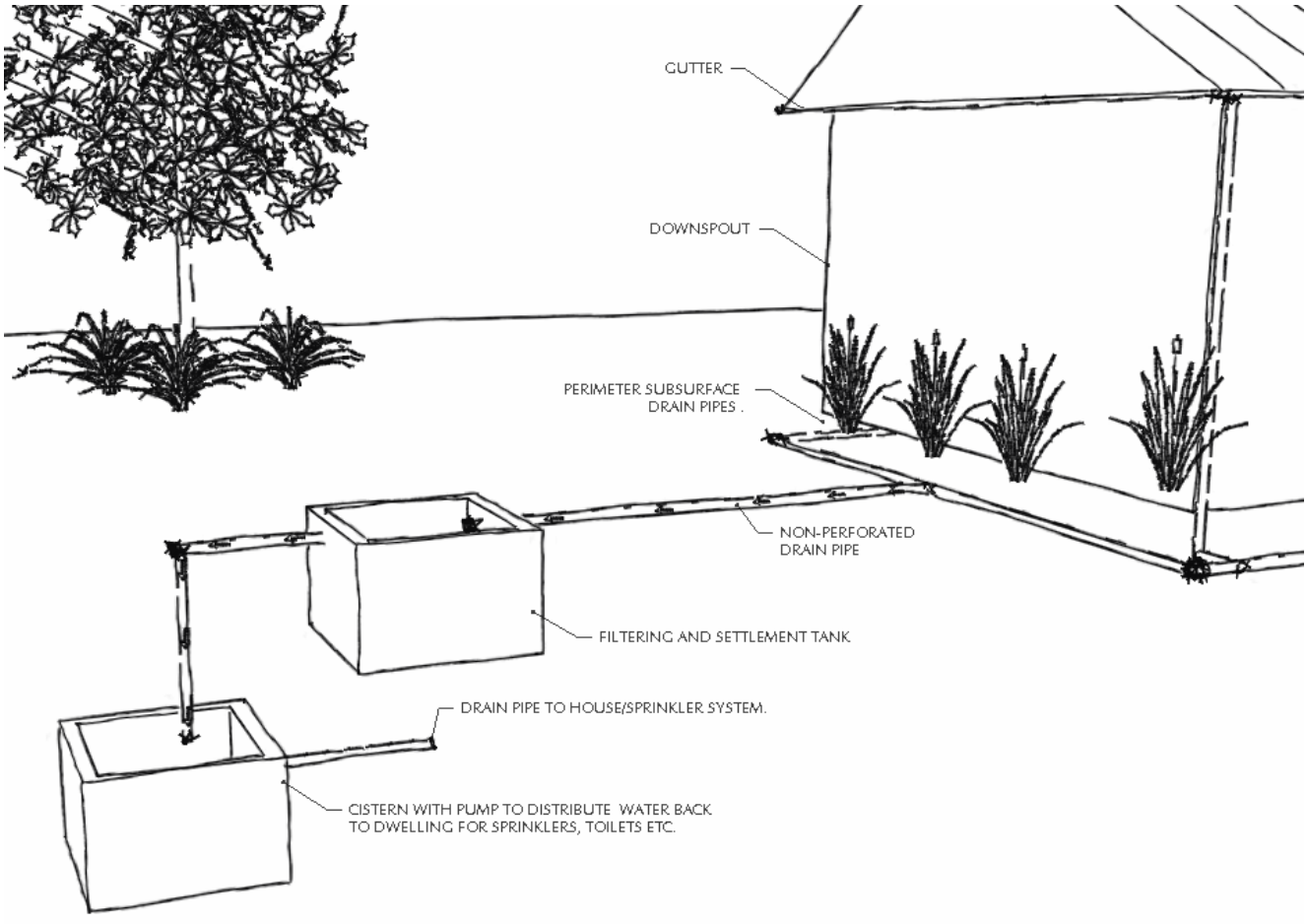




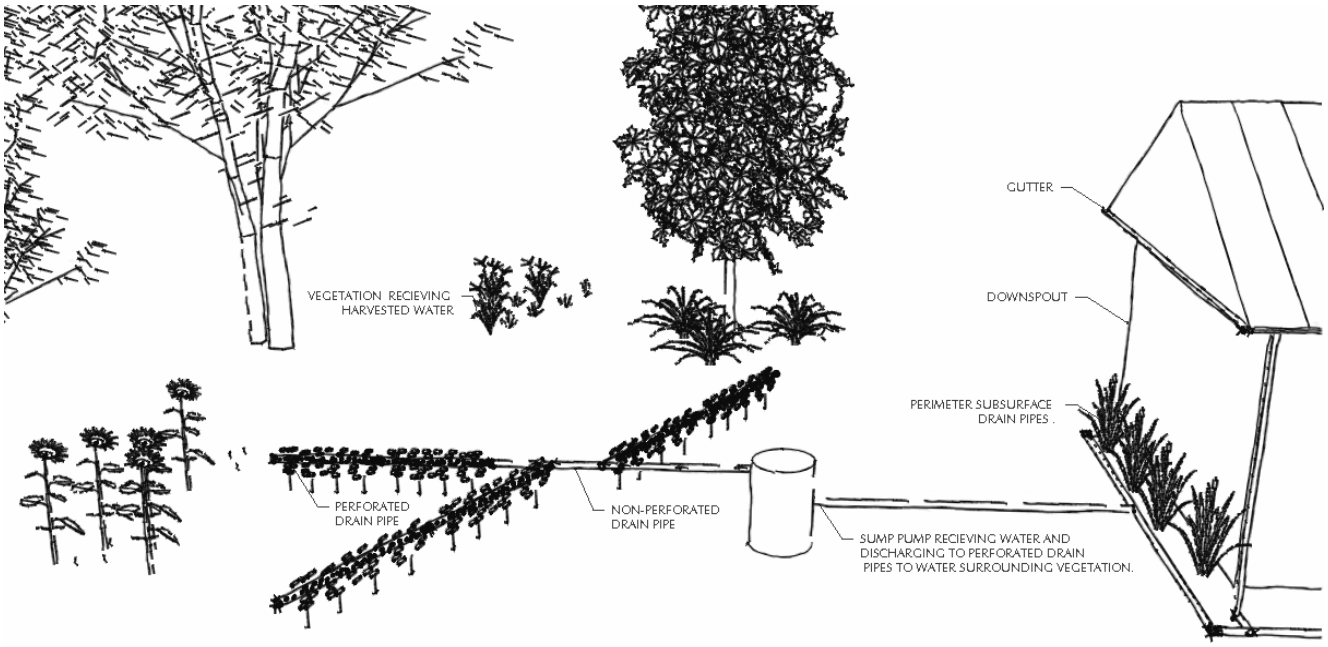
Water Harvesting & Cisterns

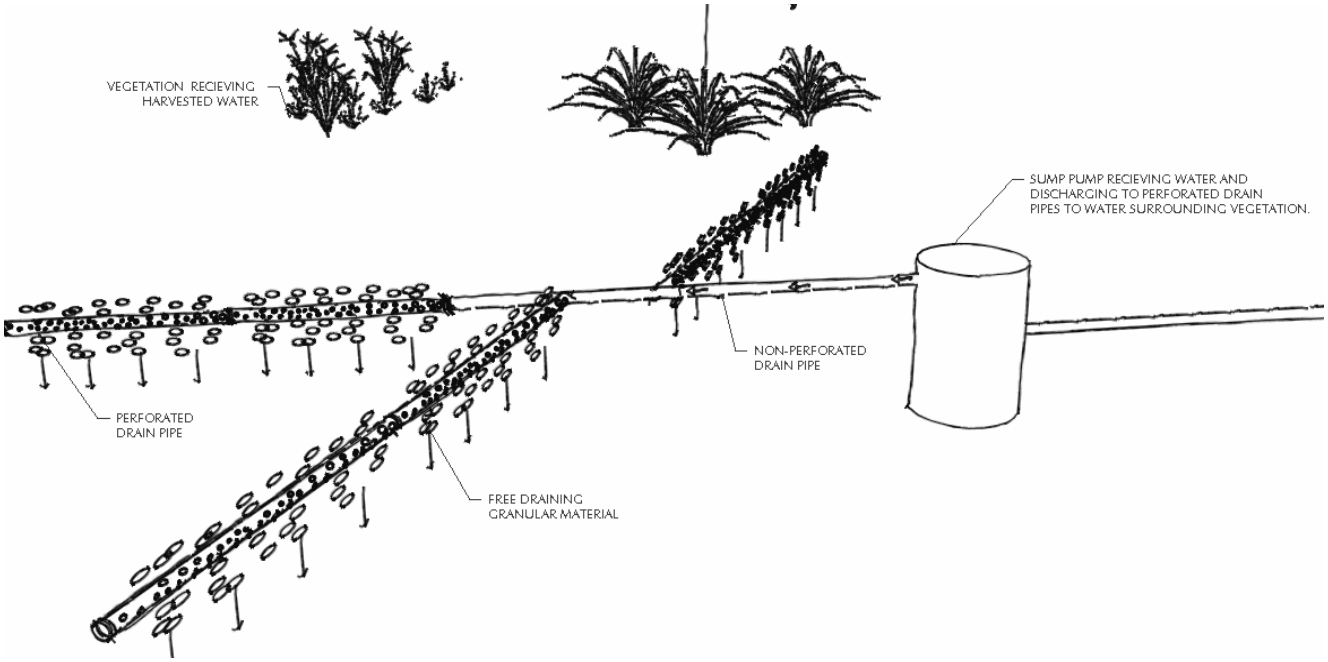


Dual Chamber Well



Subterranean Drainage Facilities





Appendix D: Outside Resources

1. SMRC - The Stormwater Manager's Resource Center
http://www.stormwatercenter.net/

2. International Stormwater Best Management Practices (BMP) Database
http://www.bmpdatabase.org/

3. Stormwater Authority
http://www.stormwaterauthority.org/about_us/news_clips.aspx

4. Stormwater The Journal for Surface Water Quality Professionals
http://www.stormh2o.com/sw.html

5. Water Harvesting Guidance Manual
http://dot.ci.tucson.az.us/stormwater/education/waterharvest.cfm