UC MERCED CAMPUS WIDE PROTOTYPE UPDATE

LEED v2.2/v3.0

SUSTAINABLE SITES 6.1: QUANTITY AND 6.2: QUALITY

JUNE 2012

Revised October 9, 2012

Prepared for:

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Attachments

Introduction

The purpose of this report is to summarize our analysis to determine if LEED Sustainable Sites (SS) Credit 6.1 and Credit 6.2 for versions 2.2 and 3.0 at the University of California, Merced campus can be met. Our previous campus-wide analysis was done in 2006 and used LEED 2.0 standards. We analyzed the pre-development condition, when the site was a greenfield against the post-development. The post- development condition includes existing buildings and parking lots, up through the Recreation and Wellness Building North, which was just completed in August of 2012 and future buildings that will constructed or are in construction currently. Attachment 3 is a current campus map of buildings which are included in this analysis .

The approximate location of the campus is just east of Lake Road and it extends as far east as the hairpin bend in the Fairfield Canal. The southern edge extends past Lower Pond and just north of Bellevue Road.

The area of development consists of three watershed areas based on the existing topography, which is shown in Attachment 1. The overall LEED boundary encompasses approximately 109.4 acres and includes four bodies of water; North Pond, Fairfield Canal, Little Lake and Lower Pond. North Pond and Fairfield Canal are the bodies of water in Watershed 1 and Little Lake and Lower Pond are the bodies of water in Watershed 2. The sections below analyze the existing and proposed conditions for these two watersheds. The LEED SS credit requirements are as follows:

LEED SS 6.1: Quantity Control

The intent is to prevent the erosion of natural stream beds by increased run-off velocities and volumes while allowing storm water to infiltrate the ground - helping to maintain the natural aquifer recharge cycle. Because the existing UC Merced campus was a golf course, the project shall comply with Case 1.

Case 1: Existing Imperviousness is 50% or less. Option 1 states that *the post development discharge rate and quantity must be equal to or less than the pre development values*.

LEED SS 6.2: Quality Control

Implement a storm water management plan that reduces impervious cover, promotes infiltration and captures and treats the storm water runoff from 90% of the average annual rainfall using best management practices (BMPs).

Existing Conditions

The pre-development condition is almost entirely landscape, comprised of approximately 96% pervious area and 4% impervious area. The site was previously used for a golf course and had a small parking lot and facility building which resided in Watershed 1. Pathways meandered through the campus and contribute to the impervious area. There is approximately 50 ft of elevation difference across the north and south edges of the site.

Watershed 1: North Pond

The North Pond watershed is approximately 31 acres and is bounded by Le Grand Canal to the North and Fairfield Canal to the South. Fairfield Canal is a man-made canal which serves the irrigation needs in the area. Storm water in this watershed drains to North Pond via hard pipe from buildings and parking lots. North Pond operates differently depending on the water level at Fairfield Canal, which is monitored by sensors. When the water level in Fairfield Canal is low, storm water is pumped from North Pond into Fairfield Canal. When the water level in the canal is high, water is retained in North Pond and any overflow is conveyed via gravity into Little Lake.

Watershed 2: Little Lake/Lower Pond

Watershed 2 boundary sits south of the intersection of Fairfield Canal and Rancher's Road, east of Lake Road and north of the north edge of Bellevue Road.

Watershed 2A includes the area which drains into Little Lake. The boundary of Watershed 2A is approximately 43.2 acres and extends south to Scholars Lane and to the eastern edge of Little Lake. The watershed drains in the southeasterly and southerly direction towards Little Lake where water outflows through an existing 12 inch outlet to Lower Pond.

Watershed 2B includes the area which drains into Lower Pond. The boundary is approximately 31.6 acres which lies south of Little Lake. The existing topography drains to Lower Pond from west to east and from north to south between Little Lake and Lower Pond.

Development Conditions

To conduct the storm water analysis, it was necessary to analyze all available construction grading and utility plans. The proposed condition was analyzed by project and watershed areas in order to obtain an understanding of drainage patterns, direction of pipe flow, and storm water outfalls. Geotechnical reports were also reviewed to analyze the soil characteristics of the site; however no percolation data was provided in these reports.

A percolation test was performed on May 2, 2012 in order to understand the infiltration rate of the soil. The percolation test was performed at two different locations on the south edge of Little Lake and at two locations on the southeast edge of Lower Pond. The resultant percolation rate was found to be about 2 inches per hour in three of the four locations. Refer to Attachment 2 for percolation test results.

Watershed 1: North Pond

Watershed 1 contains Library Lot 2, Library Lot (A), Kolligian Library, Classroom and Office Building, Student Services Building, Carol Tomlinson- Keasey Quad, Le Grand Lot (C&E), North Bowl Parking Lot Science and Engineering building, Social Science and Management Building, TES Tank and Central

Plant, Telecom Building, Campus Police and Facilities Services (A) and (B). Based on the construction drawings, all buildings and parking lots within this area, with the exception of the Library Lot (A), are hard-piped to North Pond. The general direction of drainage is from north to south, west to east. Storm water is pumped to Fairfield Canal when the canal water level is low. If the canal water level is high, the water is retained and large events overflow via gravity into Little Lake. The area is approximately 44% impervious and 56% pervious. A majority of the pervious area consists of manicured lawn for campus gathering spaces.

Watershed 2A: Little Lake

Watershed 2A contains, Joseph Gallo Recreation Center, Recreation Center North, Sierra Terraces, Valley Terraces, Terrace Center, Visitors Center, Dining & Dining Expansion, Housing 3, Housing 4 & ECEC. This watershed drains in the south-easterly and southerly direction via hard-pipe to Little Lake where water outflows through an existing 12 inch outlet to Lower Pond. From Lower Pond, the storm water infiltrates into the existing soil or overflows to Cottonwood Creek. The watershed consists of 30.6 % impervious and 69.4% pervious areas. Parking lots are a combination of gravel and asphalt and the landscaping generally consists of manicured lawn. The Valley Terraces building consists of pedestrian bridges which cross over bio swales that collects the surface runoff and is then hard-piped into Little Lake.

Watershed 2B: Lower Pond

The development within this watershed includes Lake Lot, Lot F, G & H and undisturbed land. The existing topography drains to Lower Pond from west to east and from north to south between Little Lake and Lower Pond. The percentages of impervious and pervious areas are 17.7% and 82.3% respectively. The pervious areas consist primarily of gravel which is used in Lot F and undisturbed soil. Parking Lot F is unique as it also acts as small retention basins. The drive isles are paved, but the parking stalls are a 12 inch gravel section, with a silt fabric below the rock and perforated pipe to prevent the stalls from overflowing. These large gravel stalls capture all the rain water in this area and recharges the ground water. The added perforated pipe will carry any additional water to a discharge point into a bio swell at Parking Lot H which flows into Lower Pond.

Analysis & Conclusions

The values for Q (flow rate) in Tables 1 and 2 were calculated using a time of concentration of 10 minutes for Watershed 1 and 15 minutes for Watershed 2A and 26, NOAA Atlas rainfall intensities for 1-year and 2-year storm events for the area, and a weighted c-value based on the proportion of impervious/pervious areas within each watershed.

Table 1: Pre-development flow rates calculated for 1-year and 2-year storm events

Watershed	Q (cfs) 1yr	Q (cfs) 2yr
1: North Pond	7.14	8.68

2A: Little Lake	8.81	10.72
2B: Lower Pond	**8**.08	9.83

Table 2: Development flow rates calculated for 1-year and 2-year storm events

Watershed	Q (cfs) 1yr	Q (cfs) 2yr
1: North Pond	11.59	14.13
2A: Little Lake	12.70	15.44
2B: Lower Pond	9.19	11.18

The values for V (volume) in Tables 3 and 4 were calculated using NOAA Atlas rainfall depths for 1-year, 24 hour and 2-year, 24 hour storm events for the area, and a weighted c-value based on the proportion of impervious/pervious areas within each watershed.

Table 3: Pre-development volumes calculated for 1-year, 24 hour and 2-year, 24 hour storm events

Watershed	V (cf) 1yr, 24hr	V (cf) 2yr, 24hr
1: North Pond	51,565	62,290
2A: Little Lake	63,640	76,877
2B: Lower Pond	58,410	70,560

Table 4: Development volumes calculated for 1-year, 24 hour and 2-year, 24 hour storm events

Watershed	V (cf) 1yr, 24hr	V (cf) 2yr, 24hr
1: North Pond	83,764	101,357
2A: Little Lake	92,034	111,177
2B: Lower Pond	84,472	102,042

LEED SS 6.1: Quantity

Based on 1-year and 2-year storm events, peak flow rates (Q) and the volume of runoff (V) for the development as noted above, have increased for all watersheds (See Tables 1-4 above). Both Watershed 1: North Pond and Watershed 2: Little Lake/Lower Pond has a retention pond that is sized adequately to reduce the post-development rate and quantity. Therefore, the campus as a whole meets LEED SS Credit 6.1 version 2.2 and 3.0 requirements.

Watershed 1: North Pond

Based on LEED version 2.2 and 3.0, Watershed 1: North Pond meets the LEED SS 6.1 requirements. The runoff volumes were calculated using values from the NOAA Atlas Precipitation Frequency Estimates. The equation: V=CAR/12 was used, where V is the captured volume, C is the runoff coefficient, A is the Watershed Area and R is the rainfall depth. The 2-year, 24-hour storm water volume calculated from Watershed 1 is 2.32 ac-ft. The capacity of North Pond is 2.79 ac-ft. Since storm water is generally released into Fairfield Canal, the North Pond runoff is reused for irrigation. Thus, the development of Watershed 1 does not impact natural waterways downstream.

Watershed 2: Little Lake/Lower Pond

All projects within the Watershed 2 boundary are hard-piped to either Little Lake or Lower Pond. A large increase in development also increased the imperviousness within this boundary and contributes to the additional storm water runoff in the proposed condition. Runoff is primarily collected in Little Lake which has an approximate permanent volume of 12.9 ac-ft and 5.2 ac-ft of additional capacity available for storm water runoff. Percolation testing with a double-ring infiltrometer was observed at 2 in/hr. Storm water beyond the available 5.2 ac-ft capacity will flow into Lower Pond.

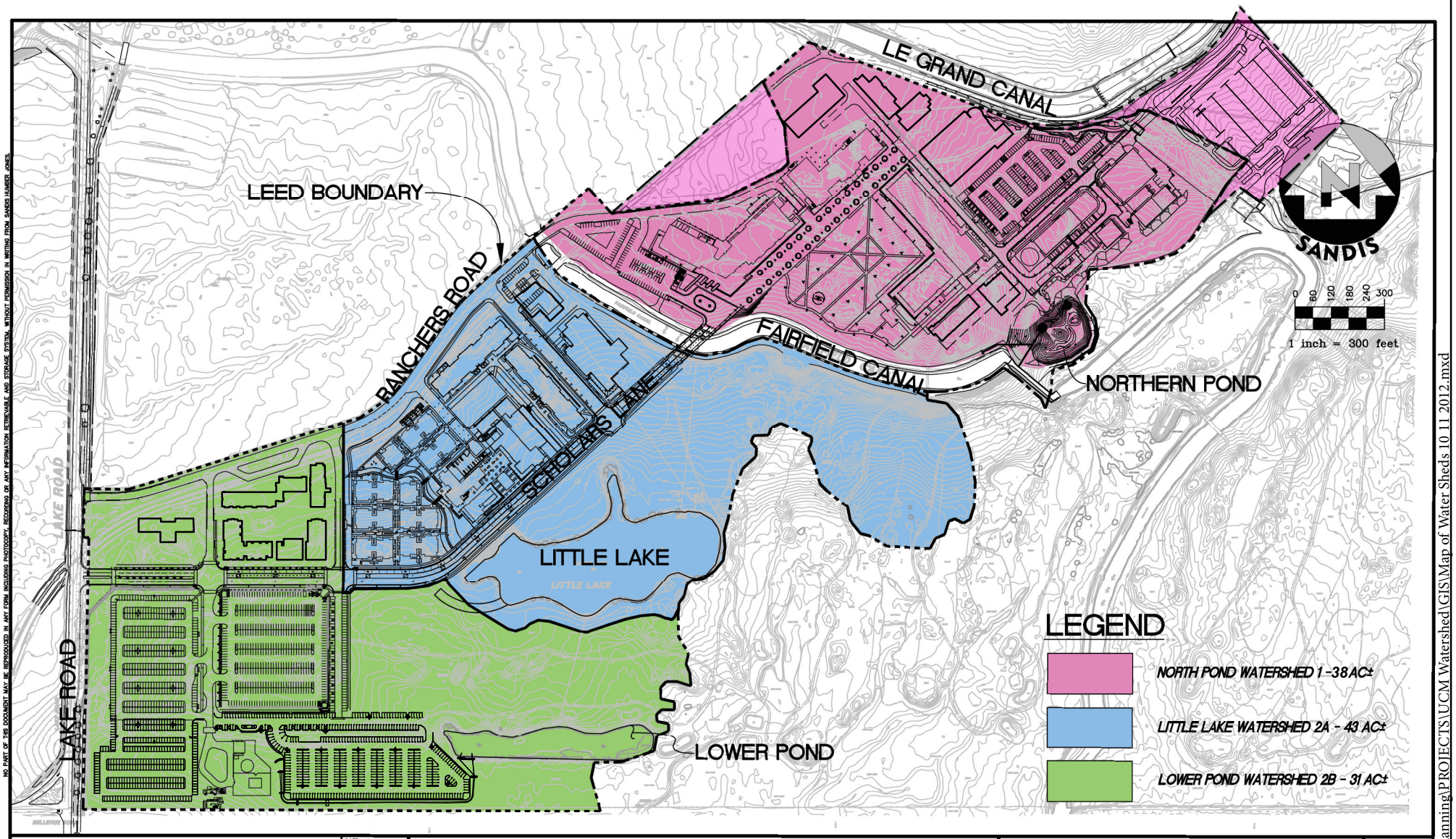
Lower Pond is a detention pond with a capacity of 1.1 ac-ft and the runoff will percolate at a rate of 2in/hr into the existing soils based on a double-ring infiltrometer test. A safety factor of 2 was used for the double-ring infiltrometer percolation testing that was performed. Therefore, the percolation rate used in all locations in this analysis is 1 in/hr.

The methodology used to validate the pond sizing is based on collecting average monthly precipitation data, rainfall data for a 1-year, 24-hour and 2-year, 24-hour storm event and local retention pond sizing methods. Based on the NOAA Atlas 14 Precipitation Frequency Estimates, the 1-year, 24-hour and 2-year, 24 hour storm depths are 1.25 in and 1.51 in, respectively. The equation: V=CAR/12 was used, where V is the captured volume, C is the runoff coefficient, A is the Watershed Area and R is the rainfall depth. For the volume draining into Little Lake, the 2- year, 24-hour event was calculated because the rainfall depth is greater and implies that the 1- year, 24-hour event requirement will be met. The volume expected to drain into Little Lake for a 2-year, 24-hour event is 2.55 ac-ft based on the following variables: C=0.52, A=39 ac, R=1.51 in.

An analysis was studied for the scenario where there are two successive 2-year, 24-hour storm events which occur within a span of 10-days from each other. Based on local standards, 10 days is a required draw down time for percolation into the existing soil. Given local precipitation data, there would be more than 10 days between storm events, providing an opportunity for runoff to percolate into the soil at Little Lake, therefore decreasing the excess runoff that drains into Lower Pond. In conclusion, the capacity of Little Lake/Lower Pond is adequately sized to accommodate a 2-year, 24-hour event in the post-development condition and does not exceed the pre-development runoff.

LEED SS 6.2: Quality

As previously described, the campus storm water runoff is retained into one of three ponds situated across the site. Because the ponds retain all of the runoff, the retention ponds act as sediment basins for treatment. Thus, LEED SS Credit 6.2 is met.



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MOUNTAIN VIEW ROSEVILLE OAKLAND

DATE: 05-09-2012
SCALE: 1"=300'
DRAWN BY: GL
APPROVED BY: SMU
DRAWING NO.: 609004

UNIVERSITY OF CALIFORNIA
MERCED, CALIFORNIA

Storm Water Analysis

SHEET 1 OF 1 SHEETS

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Attachment 1

ATTACHMENT 2: PERCOLATION TEST RESULTS

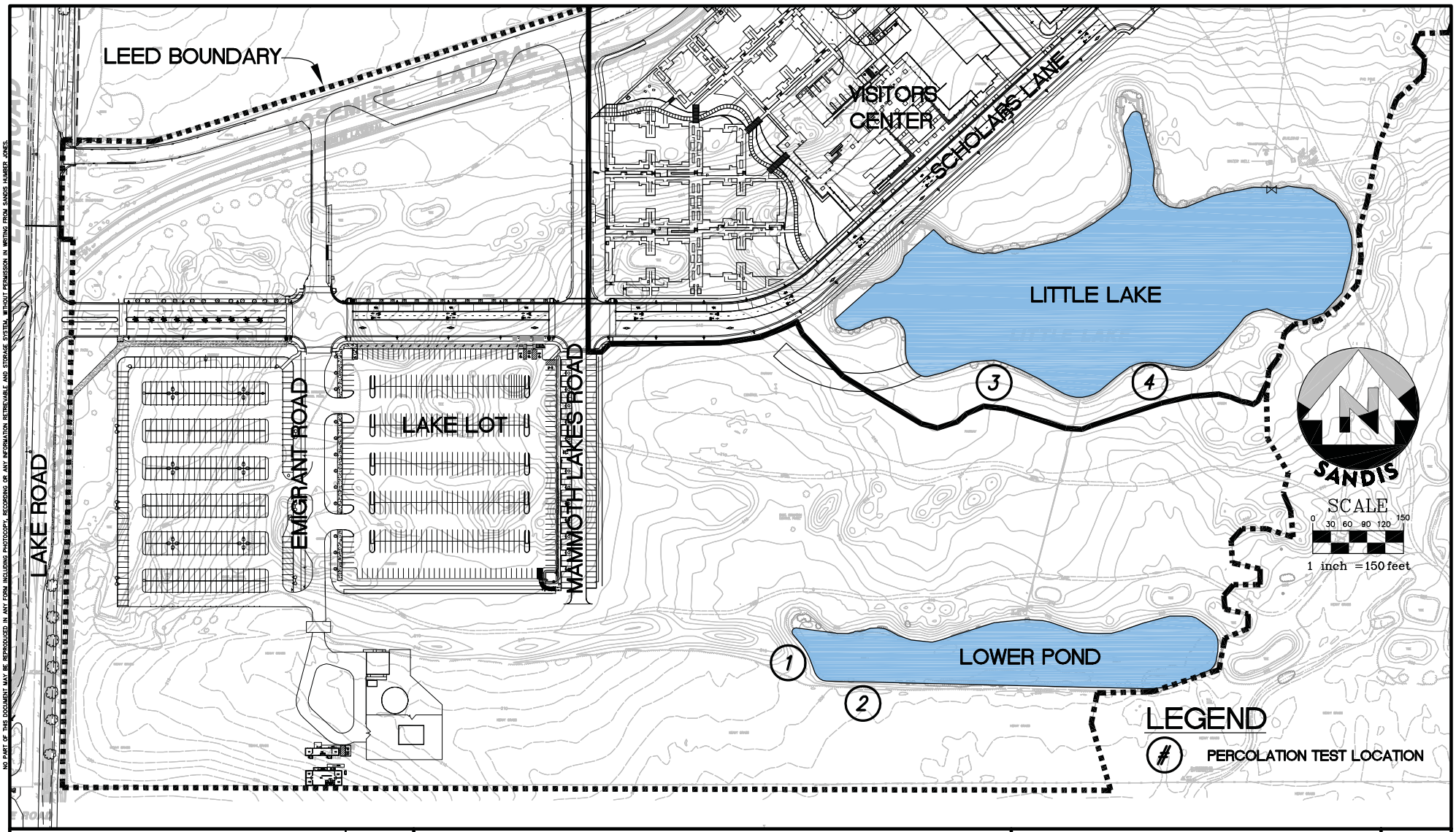
Percolation tests were performed at University of California Merced on 5/2/12. A Percolation Ring from Turf-Tek was used to test the infiltration at a depth of approximately 4" from finished grade. The soil was saturated for approximately 15 minutes before the test was performed.

Test Pit 1:
Soils here were found to be inorganic clays with moderate plasticity. The percolation rate was measured to be 0.0 inches an hour after 15 minutes. After the 15 minute test, the ring was removed and pit was completely filled with water. Two hours later, the pit was verified to have no percolation.

Test Pit 2:
Soils here were found to be organic silts and clays of low to moderate plasticity and appeared to be fully saturated. A 6" layer of composting organics and 3"-4" of soil was removed before the test was performed. A percolation rate of 2.0 inches an hour was measured.

Test Pit 3:
Test pit 3 was found to have soils of gravel-sand-silt mixture. The percolation test showed 2.0 inches per hour percolation rate.

Test Pit 4:
Test pit 3 was found to have soils of gravel-sand-silt mixture. The percolation test also showed 2.0 inches per hour percolation rate.



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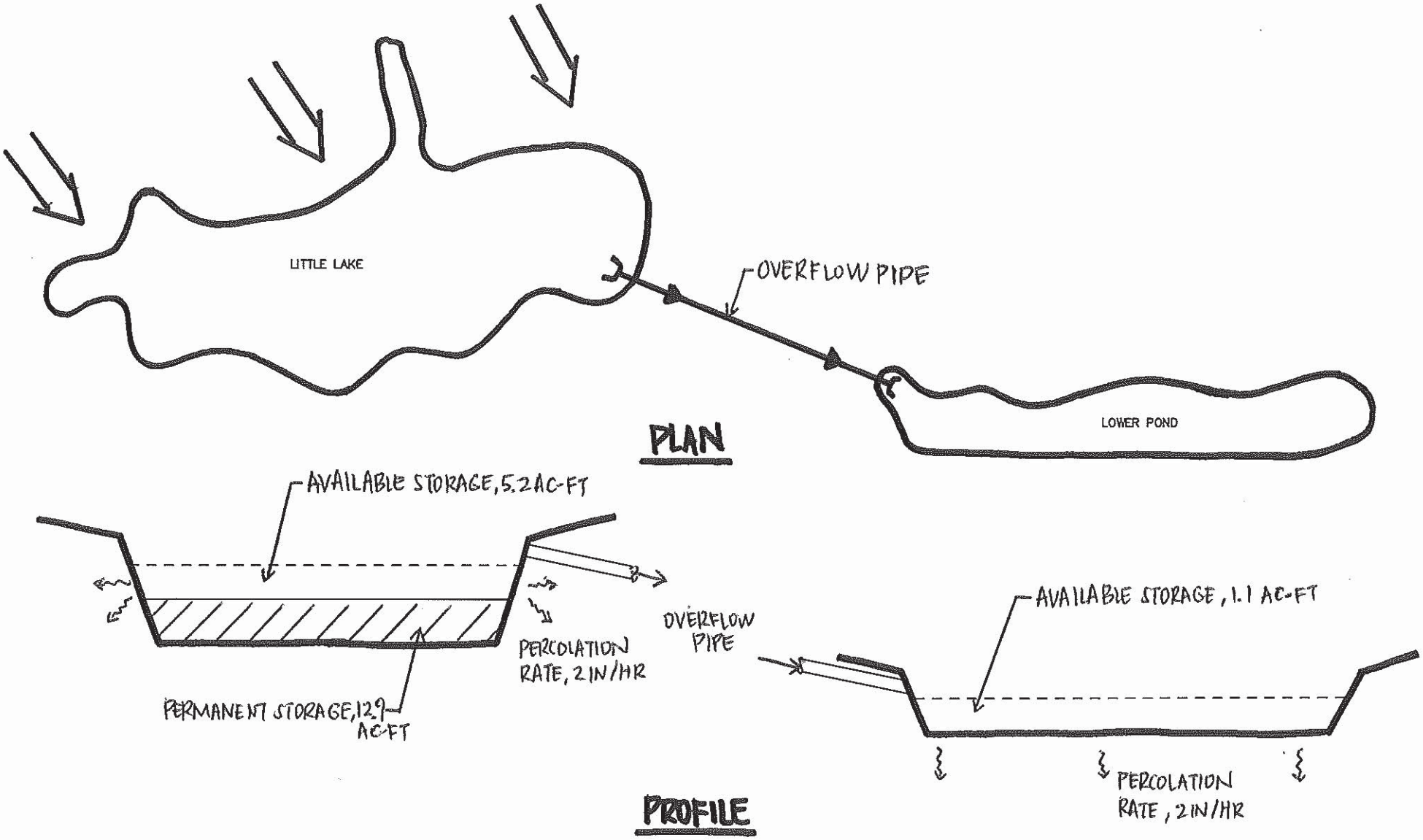
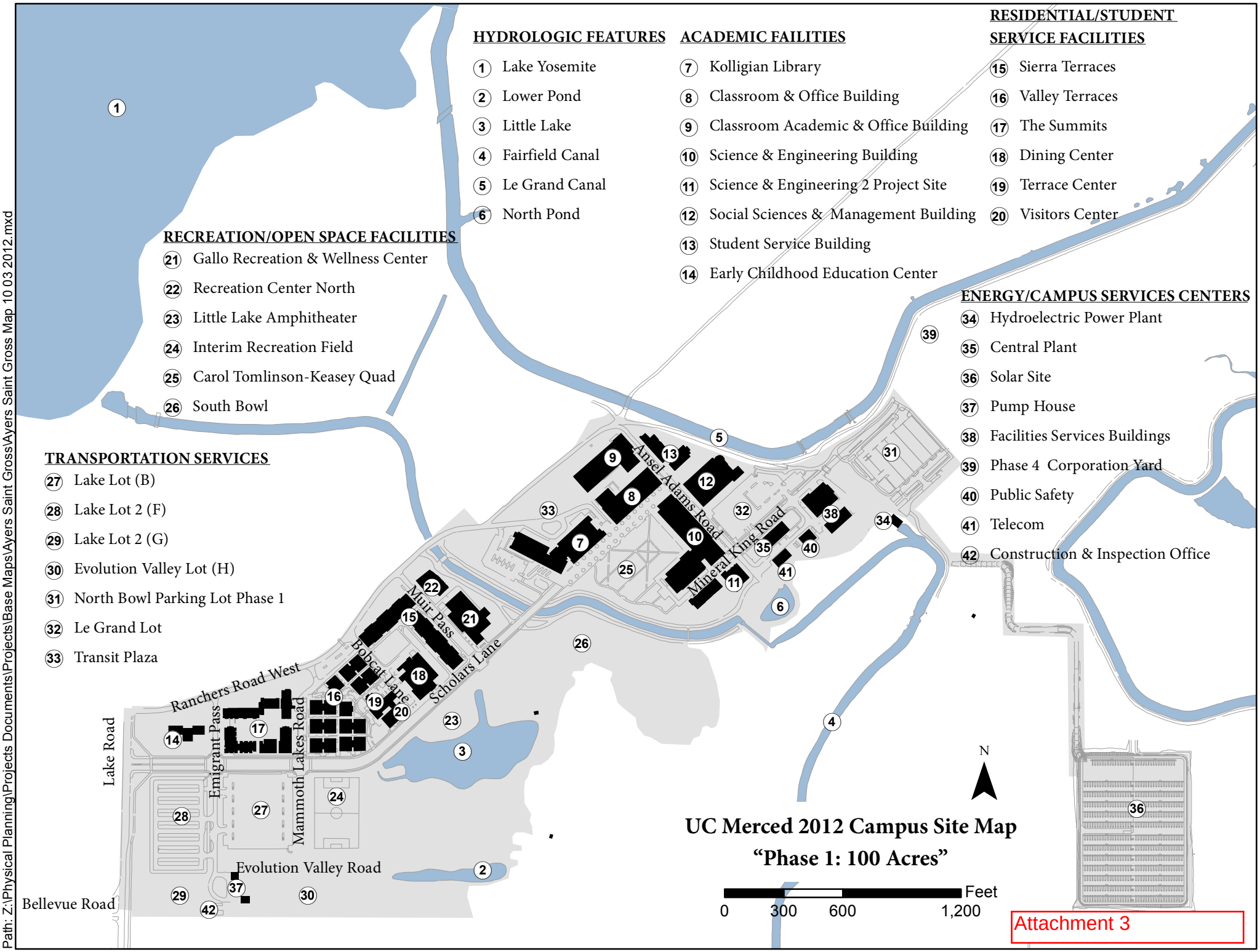
UNIVERSITY OF CALIFORNIA
MERCED, CALIFORNIA

PERCOLATION TEST LOCATIONS

SHEET 1 OF 1 SHEETS

ATTACHMENT 3: DIAGRAM OF WATERSHED 2A LITTLE LAKE/LOWER POND




HYDROLOGIC FEATURES
1 Lake Yosemite
2 Lower Pond
3 Little Lake
4 Fairfield Canal
5 Le Grand Canal
6 North Pond
ACADEMIC FAILITIES
7 Kolligian Library
8 Classroom & Office Building
9 Classroom Academic & Office Building
10 Science & Engineering Building
11 Science & Engineering 2 Project Site
12 Social Sciences & Management Building
13 Student Service Building
14 Early Childhood Education Center
RESIDENTIAL/STUDENT SERVICE FACILITIES
15 Sierra Terraces
16 Valley Terraces
17 The Summits
18 Dining Center
19 Terrace Center
20 Visitors Center
RECREATION/OPEN SPACE FACILITIES
21 Gallo Recreation & Wellness Center
22 Recreation Center North
23 Little Lake Amphitheater
24 Interim Recreation Field
25 Carol Tomlinson-Keasey Quad
26 South Bowl
TRANSPORTATION SERVICES
27 Lake Lot (B)
28 Lake Lot 2 (F)
29 Lake Lot 2 (G)
30 Evolution Valley Lot (H)
31 North Bowl Parking Lot Phase 1
32 Le Grand Lot
33 Transit Plaza
ENERGY/CAMPUS SERVICES CENTERS
34 Hydroelectric Power Plant
35 Central Plant
36 Solar Site
37 Pump House
38 Facilities Services Buildings
39 Phase 4 Corporation Yard
40 Public Safety
41 Telecom
42 Construction & Inspection Office
Ansel Adams Road
Mineral King Road
Muir Pass
Bobcat Lane
Scholars Lane
Ranchers Road West
Emigrant Pass
Mammoth Lakes Road
Lake Road
Evolution Valley Road
Bellevue Road
N
UC Merced 2012 Campus Site Map
"Phase 1: 100 Acres"
0 300 600 1,200 Feet
Attachment 3
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