CITY AND BOROUGH OF JUNEAU
ALASKA'S CAPITAL CITY
COMMUNITY DEVELOPMENT

DEVELOPMENT PERMIT APPLICATION

NOTE: Development Permit Application forms must accompany all other Community Development Department land use applications. This form and all documents associated with it are public record once submitted.

To be completed by Applicant

PROPERTY LOCATION

Physical Address: Gastineau Avenue

Legal Description(s) (Subdivision, Survey, Block, Tract, Lot): Pacific Coast Addition Block 2, Lots 12, 13, 14

Parcel Number(s): 1C070H020120

This property located in the downtown historic district

This property located in a mapped hazard area, if so, which Moderate

LANDOWNER/ LESSEE

Property Owner: Douglas J. Trucano

Contact Person: Doug

Mailing Address: 3560 N. Douglas Hwy Juneau AK. 99801

Phone Number(s): 907-586-2444

E-mail Address: Trucano@AlaskaN.com

LANDOWNER/ LESSEE CONSENT Required for Planning Permits, not needed on Building/ Engineering Permits

I am (we are) the owner(s)or lessee(s) of the property subject to this application and I (we) consent as follows:

A. This application for a land use or activity review for development on my (our) property is made with my complete understanding and permission.

B. I(we) grant permission for officials and employees of the City and Borough of Juneau to inspect my property as needed for purposes of this application.

X Douglas Trucano — Landowner/Lessee Signature — Date: 4/19/2023

X _____ — Landowner/Lessee Signature — Date: _____

NOTICE: The City and Borough of Juneau staff may need access to the subject property during regular business hours and will attempt to contact the landowner in addition to the formal consent given above. Further, members of the Planning Commission may visit the property before the scheduled public hearing date.

APPLICANT If the same as OWNER, write "SAME"

Applicant: Gastineau Lodge Apartments LLC

Contact Person: Steven Soenksen

Mailing Address: PO Box 35854 Juneau AK. 99803

Phone Number(s): 907-209-0709

E-mail Address: ssoenk@yahoo.com

X _____ — Applicant's Signature — Date of Application: 4-17-2023

---DEPARTMENT USE ONLY BELOW THIS LINE---

Intake Initials	
JLS	
Case Number	Date Received
USE23-008	5-1-23

INCOMPLETE APPLICATIONS WILL NOT BE ACCEPTED

For assistance filling out this form, contact the Permit Center at 586-0770.

CITY AND BOROUGH OF JUNEAU
ALASKA'S CAPITAL CITY
COMMUNITY DEVELOPMENT

ALLOWABLE/CONDITIONAL USE PERMIT APPLICATION

See reverse side for more information regarding the permitting process and the materials required for a complete application.
NOTE: Must be accompanied by a DEVELOPMENT PERMIT APPLICATION form.

To be completed by Applicant

PROJECT SUMMARY
New Construction - 72 UNIT APARTMENT BUILDING - Major Development - Moderate Hazard Zone

TYPE OF ALLOWABLE OR CONDITIONAL USE PERMIT REQUESTED
Accessory Apartment – Accessory Apartment Application (AAP)
Use Listed in 49.25.300 – Table of Permissible Uses (USE)
Table of Permissible Uses Category: _____

IS THIS A MODIFICATION or EXTENSION OF AN EXISTING APPROVAL? YES – Case # _____ (NO)

UTILITIES PROPOSED **WATER:** (Public) On Site **SEWER:** (Public) On Site

SITE AND BUILDING SPECIFICS
Total Area of Lot 14,995 square feet Total Area of Existing Structure(s) Ø square feet
Total Area of Proposed Structure(s) 40,000 square feet

EXTERNAL LIGHTING
Existing to remain (No) Yes – Provide fixture information, cutoff sheets, and location of lighting fixtures
Proposed (No) Yes – Provide fixture information, cutoff sheets, and location of lighting fixtures

ALL REQUIRED DOCUMENTS ATTACHED

Narrative including:
- Current use of land or building(s)
- Description of project, project site, circulation, traffic etc.
- Proposed use of land or building(s)
- How the proposed use complies with the Comprehensive Plan

If this is a modification or extension include:
- Notice of Decision and case number
- Justification for the modification or extension
- Application submitted at least 30 days before expiration date

Plans including:
- Site plan
- Floor plan(s)
- Elevation view of existing and proposed buildings
- Proposed vegetative cover
- Existing and proposed parking areas and proposed traffic circulation
- Existing physical features of the site (e.g.: drainage, habitat, and hazard areas)

----------DEPARTMENT USE ONLY BELOW THIS LINE----------

ALLOWABLE/CONDITIONAL USE FEES

	Fees	Check No.	Receipt	Date
Application Fees	$2,000.00	(CUP-Major $1,600, CUP-Hazard $400)		
Admin. of Guarantee	$			
Adjustment	$ -			
Pub. Not. Sign Fee	$ 50.00			
Pub. Not. Sign Deposit	$ 100.00			
Total Fee	$2,150.00			

This form and all documents associated with it are public record once submitted.

INCOMPLETE APPLICATIONS WILL NOT BE ACCEPTED

For assistance filling out this form, contact the Permit Center at 586-0770.

Case Number	Date Received
USE23-008	5-1-23

Community Development Department May 01,2023

City and Borough of Juneau

155S Seward St.

Juneau, Alaska 99801

Re: Conditional Use Permit Application, (Major Development)

Conditional Use Permit Application, (Moderate Hazard Zone development)

Hillside Development Endorsement permit, (Slopes exceeding 18%)

Case Number: PAC2022 0024

Applicant: Steven Soenksen, Manager

Owner: Douglas Joe Trucano, Property

Address: Gastineau Avenue & Bulger Way (Pacific Coast Addition Block 2, Lots 12, 13, and 14)

Parcel Code Number: 1C070H020120

Site Size: 14,995 square feet (Lots 12, 13, and 14 combined)

Zoning: MU (Mixed Use)

Greetings:

Per the PAC listed above, we are applying for the above referenced permits for this site. This application is consistent with the PAC meeting notes and 49.15.493.

Project Narrative

No current buildings exist on this site. As you may know, Gastineau Lodge Apartments, LLC is developing this parcel into new Multi-family, multi-story apartment building. This application is the second step in the permitting process. Project site is in the Downtown Juneau area.

The building use will be developed for 72 units (or more) of Workforce housing at 80 to 120% Annual median income. We would like to build a continuation of the pedestrian staircase in Bulger Way, a 4' CBJ easement to access utilities and construct new stairs to connect with South Franklin Street. A 6" storm and sanitary sewer lines are in this area. We will access CBJ water from the uphill side of the lot. There are three-2" water supply valves currently in the right of way.

We will have pedestrian and vehicle access and circulation from Gastineau Avenue on the uphill side. The site will be developed to have 10 units of parking on site. The Comprehensive Plan encourages multi-family apartment construction in the downtown core area.

Enclosed please find:

- Site Plan
- Floor Plans
- Elevation Views
- Vegetative Cover (Site Plan)
- Parking Areas (Site Plan)
- Traffic Circulation (Site Plan)
- Pre-Application Conference Report
- Site Specific Engineering Study (Baxandall Engineers)
- Hillside Development/Hazard Analysis
- Engineering Geologic Report,(PND Engineers)

We look forward to your review. Please feel free to contact me if you have additional questions.

Sincerely,

Steven Soenksen, Manager

Gastineau Lodge Apartments, LLC

9072090709

ssoenk@gmail.com

CITY AND BOROUGH OF JUNEAU
ALASKA'S CAPITAL CITY
COMMUNITY DEVELOPMENT

(907) 586-0715
CDD_Admin@juneau.org
www.juneau.org/CDD
155 S. Seward Street • Juneau, AK 99801

Gastineau Lodge Apartments

Case Number: PAC2022 0024

Applicant: Steven Soenksen

Property Owner: Douglas Joe Trucano

Property Address: Gastineau Avenue & Bulger Way (Pacific Coast Addition Block 2, Lots 12, 13, and 14)

Parcel Code Number: 1C070H020120

Site Size: 14,995 square feet (Lots 12, 13, and 14 combined)

Zoning: MU (Mixed Use)

Existing Land Use: Vacant

Conference Date: 5/18/2022

Report Issued: 5/26/2022

DISCLAIMER: Pre-application conferences are conducted for purposes of providing applicants with a preliminary review of a project and timeline. Pre-application conferences are not based on a complete application, and are not a guarantee of final project approval.

List of Attendees

Note: Copies of the Pre-Application Conference Report will be emailed, instead of mailed, to participants who have provided their email address below.

Name	Title	Email address
Steven Soenksen	Applicant	ssoenk@yahoo.com
James Bib	Architect, Northwind Architects	james@northwindarch.com
Scott Ciambor	Planning Manager	Scott.Ciambor@juneau.org
Jennifer Shields	Planner II	Jennifer.Shields@juneau.org
David Peterson	Planner II	David.Peterson@juneau.org
Dan Jager	CCFR Fire Marshall	Dan.Jager@juneau.org
Charlie Ford	Building Code Official	Charlie.Ford@juneau.org
Ken Hoganson	General Engineering	Ken.Hoganson@juneau.org
Edward Quinto	Permit Specialist	Edward.Quinto@juneau.org

Conference Summary

Questions/issues/agreements identified at the conference that weren't identified in the attached reports.
The following is a list of issues, comments and proposed actions, and requested technical submittal items that were discussed at the pre-application conference.

Project Overview

The project was previously presented for PAC2018-0007. The applicant gave an updated Powerpoint presentation on the development of a 72-unit, 6-story apartment building for workforce housing. The site is located in a mapped Moderate Hazard zone, and would be accessed from Gastineau Avenue via decking to the building. The point of access has not yet been determined.

Planning Division

1. **Zoning** – The property is zoned MU (Mixed Use). Per 49.25.300(c)(4), a **Conditional Use Permit** is required for Major Developments containing more than 12 dwelling units. The standards listed below apply for properties within this Zoning District.
2. **Subdivision** – Per 49.15.403, **Subdivision Application** would be required for consolidation of the three lots.
3. **Setbacks** – none
4. **Height** – none
5. **Access** – Submitted Concept Plan shows private improvements proposed within the CBJ right-of-way (ROW). Vacation of the ROW, or an Encroachment Permit, would be required prior to any development approvals. In addition, the property includes the following recorded easements:
   - Lot 13: Road Easement from the northeasterly property line to the back of curb and gutter constructed as part of the Gastineau Avenue Reconstruction Project ##01-200 as shown on drawing (Book 0581, Pages 723-725).
   - Lot 14: Road and Retaining Wall Easement from the northeasterly property line to the base of retaining wall, and to the back of curb and gutter constructed as part of the Gastineau Avenue Reconstruction Project ##01-200 as shown on drawing (Book 0581, Pages 726-727).
6. **Parking & Circulation**– Effective May 25, 2022, Ordinance 2022-04 will place the property within a "No Parking Required Area", thereby eliminating parking requirements for the development (see attached). Applications submitted prior to this date must meet existing parking requirements.
7. **Lot Coverage** – none
8. **Vegetative Coverage** – none
9. **Lighting** – Lighting must be provided and directed downward at door entries and stairs.
10. **Noise** – No comments at this time, though comments may arise during public comment process for a Conditional Use Permit.
11. **Flood** – N/A
12. **Hazard/Mass Wasting/Avalanche/Hillside Endorsement** – Landslide and Avalanche Hazard Map Amendments AME11-05 and AME-13-03 both reclassified the property from the Severe Hazard zone to the Moderate Hazard zone. Per 49.70.300(a)(3), a **Conditional Use Permit** is required for construction in a Moderate Hazard Zone. Also, using USGS contour data, the slope of the development area is ~ 45%. Per 49.70.200, future development of these areas would require a **Hillside Development Endorsement**

Permit for excavation of any slope in excess of 18%. The permit will be reviewed by the Planning Commission, as the project does not meet the exceptions outlined in 49.70.210(b).

13. **Wetlands** – N/A
14. **Habitat** – Check with the U.S. Fish and Wildlife on the presence of eagle nests in the area. The presence of eagle nests may impact construction scheduling. No anadromous waterbodies are on the subject parcel, or within 50 feet.
15. **Plat or Covenant Restrictions** – N/A
16. **Traffic** – N/A
17. **Nonconforming situations** – N/A

Building Division

18. **Building** – Fire and Sound separation will be required between units, based on code requirements at time of application for building permit.
19. **Outstanding Permits** - None

General Engineering/Public Works

20. **Engineering – Grading:** Slopes and retaining structures shall be shown on the Grading Plan. The heights and slope ratios shall be quantified.
    a. Easements: Site plan (plat) shall include all existing (and proposed) easements for drainage, utility lines, plumbing lines, access, snow storage, trash (dumpster) storage, or any other shared use that requires crossing the property line
21. **Drainage** – Drainage must be directed to pre-approved drainage ways and cannot be directed at neighbors or otherwise cause a nuisance. Drainage shall be shown in the Grading Plan with arrows. Any drainage structure(s) shall be identified and sizes called out.
22. **Utilities** – (water, power, sewer, etc.) Water service shall be provided. A CBJ ROW Permit and Utility Permit will be required. The plans shall include a Utility Plan that shows location of buried sewer and water utilities including valve, unions, cleanouts, and system components. Sizes and materials shall be called out. Power by others.
    a. **CBJ right-of-way (ROW) permit** - Once the construction plan for the utilities is approved, CBJ will create the ROW permit. The permit will cover the tapping of the water main and road restoration within the right-of-way (if required). Inspection fees, refundable bond amount, and conditions will be determined after review of the proposed construction plan. The extension of the utilities within the property will require further permitting and fee assessments. This process is done separately from the subdivision and typically in conjunction with the building permit application. Utility as-builts shall be submitted to GE prior to return of Bond and closure of permits.
    b. **Water Utility permit** – For the water/fire line to be installed to the new structure: The line sizing is by the engineer. The meter is required to be installed prior to any branches in the plumbing line. The meter location and sizing shall be shown on the mechanical plans. The meter installation and conduit installation is the responsibility of the applicant. A water assessment will need to be paid and will be determined after sizing of meter and domestic line are identified.
    c. **Sewer Utility permit** – For the sewer line to be installed to the new structure, the line sizing is

determined by the engineer. The mechanical plans shall include a drainage fixture unit (DFU) count. The sewer assessment and inspection fees are to be paid and will be determined after review of the DFU's and the configuration of the underground sewer line.

Fire Marshal

1. **Fire Items/Access** – Fire Marshal Jager had questions about Fire and EMS access as the lots do not currently connect to the ROW. Fire Marshal Jager was concerned about potential hazards and/or a potential blockage of Gastineau Ave during construction. The idea of "beefing up" the parking deck was discussed, to allow for the weight of emergency vehicles.

Other Applicable Agency Review

2. N/A

List of required applications

Based upon the information submitted for pre-application review, the following list of applications must be submitted in order for the project to receive a thorough and speedy review.

√1. Development Permit Application

√2. Subdivision Application (Lot Consolidation)

3. Conditional Use Permit Application (Major Development)

4. Conditional Use Permit Application (Moderate Hazard Zone development)

5. Hillside Development Endorsement Permit (slopes exceeding 18%)

Additional Submittal Requirements

Submittal of additional information, given the specifics of the development proposal and site, are listed below. These items will be required in order for the application to be determined Counter Complete.

1. A copy of this pre-application conference report.
2. Site specific study by a civil engineer experienced in landslide and avalanche analysis.
3. Engineering Geologic Report for hillside development.

Fee Estimates

The preliminary plan review fees listed below can be found in the CBJ code section 49.85.

Based upon the project plan submitted for pre-application review, staff has attempted to provide an accurate estimate for the permits and permit fees which will be triggered by your proposal.

1. Development Permit Application – N/A
2. Subdivision Application (Lot Consolidation): $185.00
3. Conditional Use Permit Application (Major Development): $1,600.00 (over 60 residential dwelling units)
4. Conditional Use Permit Application (Moderate Hazard Zone development): $400.00
5. Hillside Development Endorsement Permit: The fee to the developer is the gross hourly rate of $60.00 for professional review of the application and for inspection.

For informational handouts with submittal requirements for development applications, please visit our website at www.juneau.org/cdd.

Submit your Completed Application

You must submit your application(s) in person with payment made to:

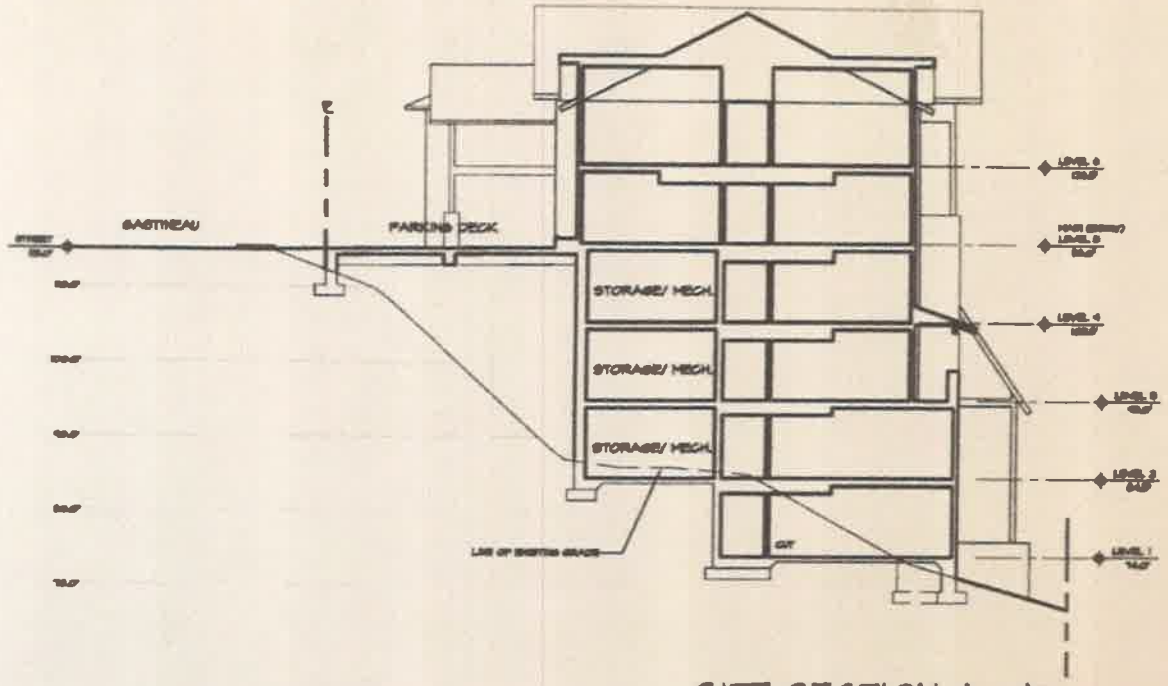
City & Borough of Juneau, Permit Center
230 South Franklin Street
Fourth Floor Marine View Center
Juneau, AK 99801

Phone: (907) 586-0715
Web: www.juneau.org/cdd

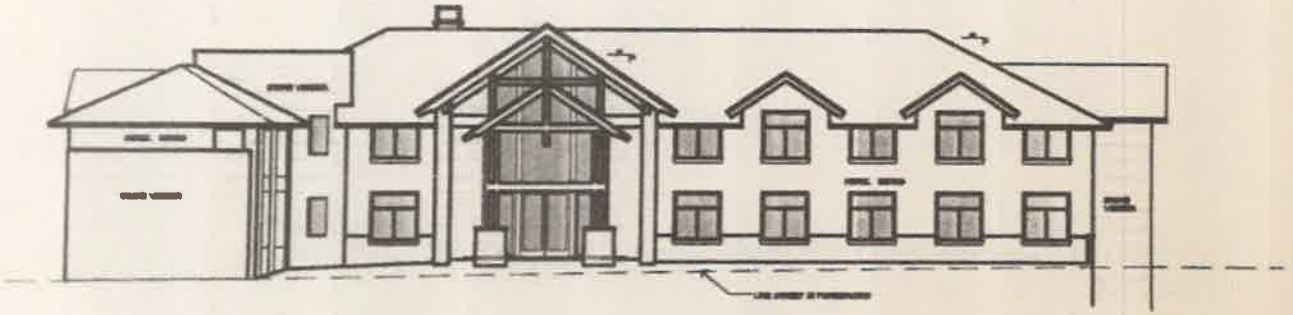
Attachments:

- 49.15.330 – Conditional Use Permit
- 49.15.403 – Lot Consolidations
- 49.70.200 – Hillside Development
- 49.70.300 – Landslide and Avalanche Areas
- Parking Ord. 2022-04(b) and Map – effective May 25, 2022
- Development Permit Application
- Conditional Use Permit Application
- Subdivision Application

Gastineau Lodge Apartments



SITE SECTION A -A



NORTHEAST (FRONT) ELEVATION

EXTERIOR ELEVATION/ SECTION
SC: 1/16" = 1'-0"

GASTINEAU LODGE APARTMENTS

11.2.17

TOM KING

11

Gastineau Lodge Apartments, LLC

Tony Walker, Archt. & Assoc., LLC

PROJECT & SHEET INFORMATION

UNIT COUNTS & SIZES*

UNIT	~OA	~SF
A=41	12 x 20	240
A-T= 1	12 x 26	227
A-L=2	17 x 20	277
B=11	12 x 26	312
B-L= 2	12 x 26	294
B-T= 1	18 x 26	389
B-WL1= 2	18 x 26	387
B-WL2= 1	18 x 26	371
C= 2	18 x 23	432
D= 1	18 x 26	478
HC=8	14 x 25	343
UNITS=72		

SYMBOLS

- TREE (TBD)
- TREE LOCATION (ABOVE OR BELOW, FOR REFERENCE)
- EXTERIOR LIGHT FIXTURE
- POT PLANTER

*NOTE: "OA" INDICATES OVERALL DIMENSIONS. THERE'S NO DISTINCTION FOR ODD-SHAPED AREAS. "SF" (SQUARE FOOT) IS AN APPROXIMATION OF THE AREA WITHIN THE SPACE.

ABBREVIATIONS

ALT	ALTERNATE
BLDG	BUILDING
CONC	CONCRETE
CORR	CORRIDOR
ENCL	ENCLOSURE
ELEV	ELEVATOR
EL	ELEVATION
E	EXISTING
FT	FOOT/FEET
FP	FIREPLACE
FFE	FINISH FLOOR ELEVATION
FRT	FREIGHT
FDN	FOUNDATION
GARB	GARBAGE
HC	HANDICAP
JAN	JANITOR
NIC	NOT IN CONTRACT
O/H	OVERHEAD
PLTR	PLANTER
PP	POWER POLE
PSNGR	PASSENGER
PVC	POLY VINYL CHLORIDE
RECEP	RECEPTION(IST)
RET	RETAINING
ROW	RIGHT OF WAY
STRL	STRUCTURAL
STOR	STORAGE
TLT	TOILET
TBD	TO BE DETERMINED
U/G	UNDERGROUND
VESTIB	VESTIBULE
VER	VERIFY
WWW	BUSINESS/COMPUTER

UNIT DESCRIPTIONS

A	STUDIO
A-T	STUDIO, T-SHAPE
A-L	STUDIO, L-SHAPE (DISCOUNTING HALL ENTRY)
B	LONG STUDIO
B-L	LONG STUDIO, L-SHAPE
B-T	LONG STUDIO, T-SHAPE
B-WL1	LONG STUDIO, WIDE, L-SHAPE-1
B-WL2	LONG STUDIO, WIDE, L-SHAPE-2
C	LARGE
D	EXTRA LARGE

150.04' S30°13'31"E
(FRONT YARD SETBACK: 0'–0")

(E) RET. WALL @ EASMT.

(E) PP

(E) STORM SEWER 6"

(E) SANITARY SEWER 6"

(E)13LF 4"(VER) PVC UNDERDRAIN

100.00' N61°08'29"E
(SIDE YARD SETBACK: 0'–0")

LEVEL 1 FFE: 74.0

See Level 4 for additional grading & drainage data

FDN WALL STEPS UP HILL

DRAINAGE CORRIDOR

BLDG RET. WALL (ABOVE)

FDN/SITE DRAIN

BLDG/RET. WALL

ACCESS/EXIT TO BULGER WAY ON LEVEL 2 (ABOVE)

BULGER WAY

STAIR

ELEV MECH

PASGR & FRT ELEV

COFFEE DISP.

WASHERS (STACKED)

STRL COLUMN (DIFF. SPACING THAN ABOVE)

SODA DISP.

TREAT DISP.

DET. DISP.

TABLE

FD

TABLE

SEATS

LAUNDRY

SEATS

DRYERS (STACKED)

WIN.

CORR.

AIR SUPPLY

AIR SUPPLY

STAIR

STUDIO A

STUDIO B

STUDIO B

STUDIO HC

STUDIO HC

STUDIO B

CORR.

STUDIO B

STUDIO B–WL1

STUDIO B–L

BALCONY

COVERED STOOP

PLAY YARD

(E) CONTOUR LINE @ FLOOR LEVEL (REF ONLY)

DECORATIVE WALL FEATURE

SIDEWALK

BALCONY ABOVE

150.04' S30°13'31"E
(REAR YARD SETBACK: 0'–0")

ACCESS/EXIT @ BULGER WAY

FDN/SITE DRAIN

FDN/SITE/ROOF DRAIN

FDN/SITE DRAIN

SITE ACCESS RET. BLOCK WALL & FENCING

100.00' N61°08'29"E
(SIDE YARD SETBACK: 0'–0")

TIE-IN CONTOUR INTO EXISTING (TYP)

Spot EL 86.5

Spot EL 84.5

Spot EL 82.5

Spot EL 80.5

Spot EL 78.5

Spot EL 72.0

Spot EL 73.5

Spot EL 73.5

84 83 82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50

100 (+40) 95 (+35) 90 (+30) 85 (+25) 80 (+20) 75 (+15) 70 (+10) 65 (+5)

SCALE: FEET

16 12 8 0 16 32

NORTH

LEVEL 1 DIAGRAM

Scale: 3/32" = 1'-0"

Gastineau Lodge Apartments, LLC
Tony Walker, Archt. & Assoc., LLC

LEVEL 2 FFE: 84.5

FDN WALL STEPS UP HILL

DRAINAGE CORRIDOR

SITE/FDN/ROOF DRAINS (TYP)

BLDG/RET. WALL

CONC. RET. WALL & FENCING

Spot EL 95.5

Spot EL 88.5

LANDSCAPE WALL-BENCH

Spot EL 84.5

ACCESS/EXIT @ BULGER WAY

Spot EL 82.5

CANOPY ABOVE

PLTR

PATIO (COVERED)

ELEV MECH

VESTIB.

PSNGR ELEV

FLEXIBLE STORAGE/ OTHER

MECHANICAL

STAIR

PASGR & FRT ELEV

STRL COLUMN

AISLE

COMMON MEETING ROOM

AISLE

SEATS

BLDG/ RET. WALL

(SEATING PATTERN SUGGESTION ONLY)

CORR.

AIR SUPPLY

AIR SUPPLY

CORR.

BULGER WAY

STAIR

UNIT B–WL1

UNIT A

UNIT B

UNIT B

UNIT HC

UNIT HC

UNIT B–T

STOR./ JAN

UNIT B

UNIT B

BALCONY

BALCONY

BALCONY

(E) CONTOUR LINE @ FLOOR LEVEL (REF ONLY)

DECORATIVE WALL FEATURE

NORTH

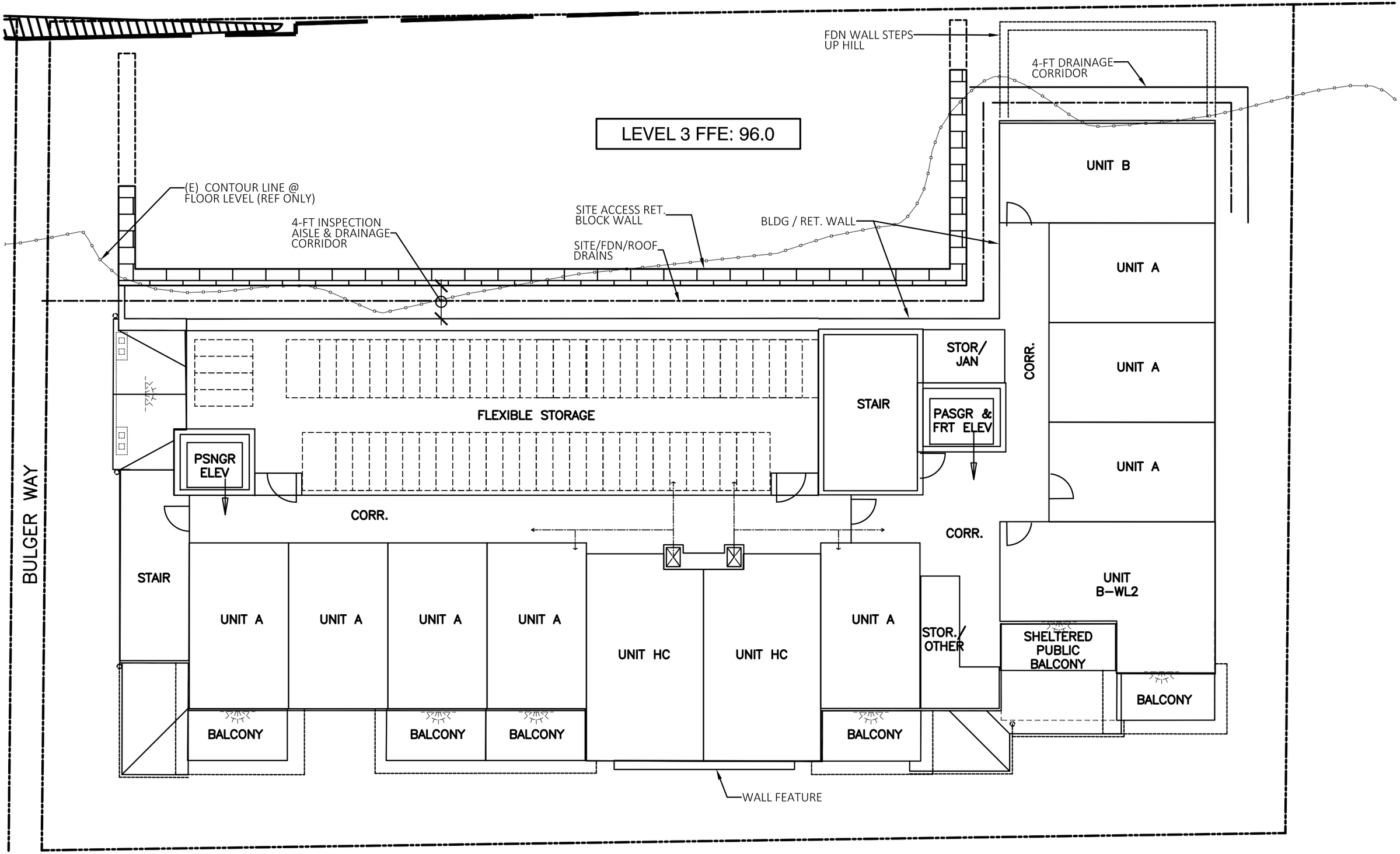
SCALE: FEET

16 12 8 0 16 32

LEVEL 2 DIAGRAM

Scale: 3/32" = 1'-0"

Gastineau Lodge Apartments, LLC
Tony Walker, Archt. & Assoc., LLC



NORTH

SCALE: FEET

16 12 8 0 16 32

LEVEL 3 DIAGRAM

Scale: 3/32" = 1'-0"

Gastineau Lodge Apartments, LLC
Tony Walker, Archt. & Assoc., LLC

ABANDON 3 (E) WATER LINES & COMBINE INTO ONE 4" WATER

(E)2" WATER

UNDETERMINED DESIGN AREA

EL. 115 (High Pt)

EL. 110

EL. 114

EL. 100

EL. 105

(E)2" WATER

ACCESS DECK EXTENDS INTO R.O.W.

CONC. RET. WALL

(DECK ABOVE)

Low Pt

EL. 110

LEVEL 4 FFE: 105.5

See Level 1 for additional grading & drainage data

ACCESS AREA (102' x 31')

DRAINAGE CORRIDOR

CONNECT SITE & FDN. DRAINS

4-FT INSPECTION AISLE & DRAINAGE CORRIDOR

(E) CONTOUR LINE @ FLOOR LEVEL (REF ONLY)

SITE ACCESS RET. BLOCK WALL

SITE/FDN/ROOF DRAINS

UNIT B

UNIT A

UNIT A

UNIT A

UNIT A

CORR.

(FLOOR ABOVE)

FLEXIBLE STORAGE

STOR/ JAN

STAIR

PASGR & FRT ELEV

STOR/ OTHER

PSNGR ELEV

CORR.

CORR.

STAIR

UNIT A

UNIT A

UNIT A

UNIT A

UNIT HC

UNIT HC

UNIT A

UNIT A–T

UNIT C

SHELTERED BALCONY BELOW

TIE-IN ROOF DRAINS TO UNDEGROUND DRAIN SYSTEM (TYP)

BULGER WAY

NORTH

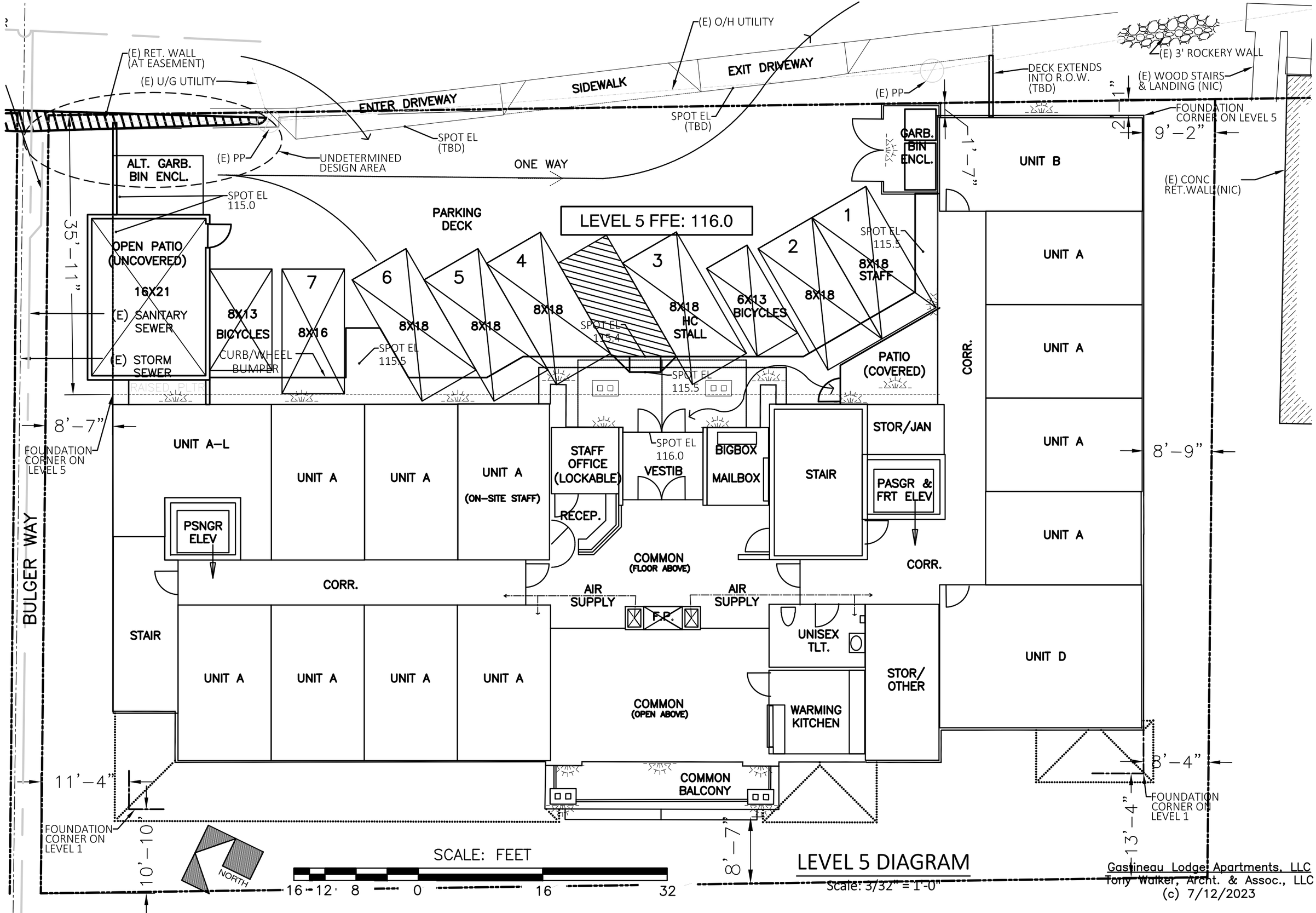
SCALE: FEET

16 12 8 0 16 32

LEVEL 4 DIAGRAM

Scale: 3/32" = 1'-0"

Gastineau Lodge Apartments, LLC
Tony Walker, Archt. & Assoc., LLC



LEVEL 5 DIAGRAM

Scale: 3/32" = 1'-0"

LEVEL 6 FFE: 126.5

BULGER WAY

UNIT A–L

UNIT A

UNIT A

UNIT A

PSNGR ELEV

CORR.

COMMON ROOM 2

WWW ACCESS

STAIR

STOR/JAN

PASGR & FRT ELEV

CORR.

UNIT B

UNIT A

UNIT A

UNIT A

UNIT A

90'–6"

STAIR

AIR SUPPLY

F.P.

AIR SUPPLY

RAILING

RAILING

UNIT A

UNIT A

UNIT A

UNIT A

OPEN TO BELOW

FITNESS/YOGA

UNIT C

ROOF ABOVE & TIE-IN GUTTERS TO DOWNSPOUTS TO U/G DRAINS (TYP)

ROOF @ WALL FEATURE

ROOF BELOW (TYP)

132'–3"

NORTH

SCALE: FEET

16 12 8 0 16 32

LEVEL 6 DIAGRAM

Scale: 3/32" = 1'-0"

Gastineau Lodge Apartments, LLC
Tony Walker, Archt. & Assoc., LLC

P | N | D
ENGINEERS, INC.

November 28, 2021 PND 212040

Mr. Steven Soenksen
Verde Infrastructure Partners
P.O. Box 35854
Juneau, Alaska 99803-5854

Re: Gastineau Lodge Apartments
Draft Geotechnical Report

Dear Mr. Soenksen:

This letter report presents the results of a geotechnical field investigation, performed by others, and design recommendations developed by PND Engineers, Inc. (PND) in support of the proposed Gastineau Lodge Apartments development in Juneau, Alaska. The report has been prepared by PND and describes geotechnical data gathered during the field investigation, laboratory results from testing performed on selected retained soil samples, geotechnical design recommendations and construction considerations.

PND performed the work in general accordance with the proposal *Bulger Way Apartments – Geotechnical Investigation Fee Proposal (Revised)*, dated January 21, 2021. Notable deviations from the proposal include that the investigation was performed by others.

Project Background and Description

Description

The project site is located on Gastineau Avenue at its intersection with Bulger Way (a narrow stairwell corridor) in downtown Juneau, Alaska. The site consists of three individual lots with no street address. The legal address is listed as Pacific Coast Addition, Block 2, Lots 12, 13 and 14. We understand that the client intends to construct one or more multi-unit residential structures with associated parking.

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Figure 1: Project Vicinity and Site Map

Existing Site Conditions

The site is currently undeveloped, although structures were once located at the site and some foundation elements remain. There is an access road from Gastineau Avenue to a relatively flat bench approximately midway downhill

on the property. Above and below this intermediate bench are vegetated slopes ranging in steepness from approximately 1.5:1 (horizontal:vertical) to 2:1. The intermediate bench is approximately 20 feet lower than Gastineau Avenue, and approximately 30 feet above the downhill property line. The slope continues downhill beyond the property line to structures located on South Franklin Street, approximately 60 feet below the intermediate bench. Topographic descriptions are based on survey information provided by others.

Regional and Local Geology, and Geologic Hazards

General geologic information for the local Juneau area is thoroughly discussed by Miller (1972), Gehrels (2000), and McClelland (1992). The following geologic summary has been developed on these referenced documents.

Overburden at the site can be generally described as colluvium, debris flow or mass wasting material originating from the Mt. Roberts hillside, on the opposite side of Gastineau Avenue immediately to the northeast of the project site. This overburden can consist of soil, rock, and organic matter, originally situated on the hillside. Trees and boulder-sized debris are not uncommon. Visually, soil samples retained during this investigation agree with historical surface mapping information.

Bedrock in the immediate vicinity of the investigation site includes various volcanic and sedimentary units that have undergone varying degrees of metamorphism. The site borders a region where the bedrock increases in metamorphic grade from little to no metamorphism on Douglas Island to increasingly higher metamorphic grades to the northeast of Juneau. The primary rock types mapped on the slopes of the immediate vicinity include metavolcanic and metasedimentary rocks that range in metamorphic grade from slate to phyllite to greenschist. In addition, commonly found intruding the metamorphic rocks are igneous mafic dikes. Both ductile and brittle forms of structural deformation have been locally imposed on the bedrock.

The currently-adopted City and Borough of Juneau (CBJ) landslide and avalanche hazard maps places the project site in a "Severe" hazard zone. Reportedly, a site-specific hazard assessment has been conducted (by others) and the site has been downgraded to a "Moderate" hazard zone. PND has not confirmed this, however. It should be noted that revised hazard maps are being considered by CBJ, but are not yet adopted. These revised maps also place the project site in a "Severe" hazard zone with regard to mass wasting. The project site appears to be in a "Low" risk hazard zone with regard to avalanches per the revised maps. No site-specific hazard assessment has been performed as part of this investigation.

Regional Seismicity and Seismic Hazards

The regional seismicity of the Juneau area is primarily defined by four known major faults: the Queen Charlotte-Fairweather Fault, Chatham Strait Fault, Denali Fault, and the Transition Fault. These four known faults surrounding Juneau all contribute to the seismic hazard of the project site. Wesson et al., (2007) found that these four faults would yield maximum moment magnitude (M_w) earthquakes of 7.8 to 8.2 for return intervals of 2% in 50 years. These ranges are consistent with the larger historic earthquakes that have previously been documented or recorded in the Juneau area (Brockman et al., 1988). Earthquakes of M_w 5.0 or less are common to Southeast Alaska, although they present low hazard to the project site.

The primary potential seismic-induced hazards for Juneau and the surrounding region include strong ground shaking, slope failure, liquefaction and landsliding. Both the seismic setting and glacially-scoured over-steepened terrain of the region contribute to the potential for both land-based and submarine landslides caused by earthquake-induced ground shaking or other triggering events, and are most likely to occur in saturated sediments and in unstable rock debris on steep slopes.

Additionally, large damaging ocean waves (tsunamis) generated either directly from local land displacement or due to earthquake-induced landslides have the potential to inflict damage to the region. Offshore tsunami generation and propagation in the vicinity of Juneau, however, is considered to be low due to the strike-slip nature of nearby faults; strike-slip faulting characteristically propagates horizontal land displacement motion,

rather than the vertical displacement that is typically responsible for generating tsunami events (Combellick and Long, 1983):

Regional Climate

The Juneau region experiences temperate rainforest/maritime climate conditions typical to Southeast Alaska. The average monthly temperatures recorded in Juneau range from 25°F to 56°F. Daily extreme temperatures have been recorded from (-)22°F to 90°F. Average annual precipitation is 62 inches.

Field Investigation

Geotechnical Exploration

The geotechnical investigation was performed by others and was not observed by PND. Videos, photographs, soil samples, and a hand-sketch test pit map were provided to PND after the investigation for use in developing this report. The investigation summary described herein is based on information provided to PND, and PND cannot attest to the accuracy of the information provided.

The geotechnical field investigation was performed in July 2021. Four test pits were excavated during this investigation. The test pit locations were selected prior to the investigation and distributed across the site with consideration given to equipment access. The test pits were reportedly excavated to refusal on bedrock using a Deere 135G track-mounted excavator. Soil samples were collected near the bottom of each excavation. The samples were placed in plastic containers. Photographic and video documentation of the investigation was performed.

All soil samples were provided to PND in sealed and unsealed plastic containers. The samples were delivered to PDC Engineers' laboratory in Juneau for testing.

Historical Explorations

PND conducted a geotechnical drilling investigation in Gastineau Avenue in 1999. Several boreholes were located immediately adjacent to the project site. The investigation showed overburden consisting generally of silty sand with gravel. Groundwater was noted at depths of 15 to 22 feet below ground surface (bgs). Bedrock was encountered at a depth of 40 feet bgs in one location. It was not encountered in other borings which extended to depths of 51 feet bgs.

Investigation Results

A test pit summary is provided in Table 1. Figure 2 shows a test pit map, provided by others.

Table 1: Test Pit Summary

Test Hole Designation	Collar Elevation (ft)*	Depth to Bedrock (ft bgs)	Termination Depth (ft bgs)
Test Hole 1	90	7	7
Test Hole 2	86	1	1
Test Hole 3	75	7	7
Test Hole 4	69	8	10

*Elevation estimated from topographic information provided by others, datum unknown.

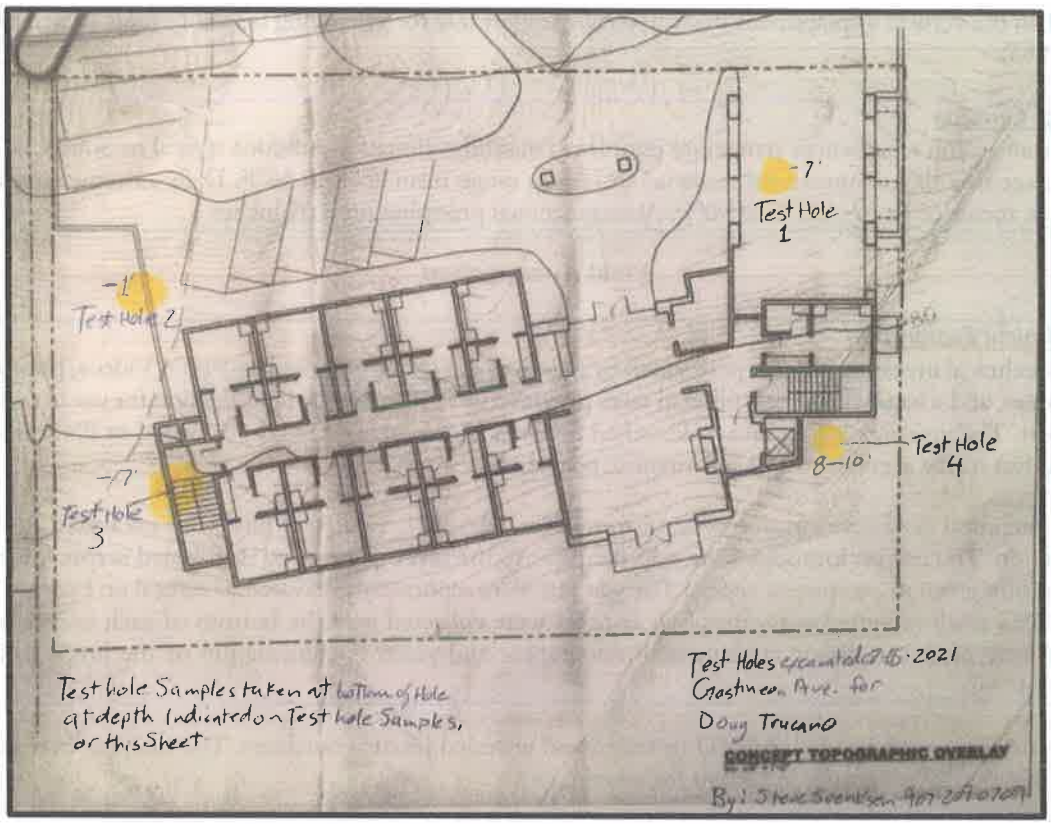


Figure 2: Test Pit Map with Site Plan and Topographic Overlay

Soil Lithology and Composition

Overburden at the project site generally consists of brown silty sand with gravel. Cobbles are noted in provided photographs.

Figure 3: Excavator and in-situ silty sand with gravel

Bedrock

Bedrock was reportedly encountered in all test pits, at depths ranging from 1 foot to 8 feet bgs. At Test Hole 4 the excavator was able to dig several feet into bedrock. The bedrock was described as "shaley" indicating a laminated or foliated structure that readily breaks along discontinuities.

Groundwater

Groundwater was not observed during the investigation. The 1999 PND geotechnical information in Gastineau Avenue encountered groundwater between 15 and 22 feet bgs. Groundwater at the project site may fluctuate seasonally or may travel along the overburden/bedrock interface.

Laboratory Testing

Selected soil samples were subjected to laboratory tests to evaluate soil index properties. All testing was performed at PDC Engineers' Juneau laboratory. Soil index tests included determination of grain size distribution and moisture content. All individual laboratory test results can be found in Appendix C.

Geotechnical Analysis and Design Recommendations

Summary

The existing site geometry and in-situ soils are generally not favorable for supporting typical building foundation loads. Global stability analyses yield unsatisfactory factors of safety in the static seismic conditions. The existing overburden at the site is also not suitable for foundation material due to excessive fines content, although it may be re-purposed as fill at depths greater than the published frost depth in Juneau (32 inches). If the in-situ material is used for slope construction, it should not be placed steeper than 2:1, assuming there are no external loads other than seismic. Building foundations or retaining structures should be founded on the shallow bedrock encountered at the site. Alternatively, the in-situ material could be replaced with structural fill as necessary to achieve satisfactory factors of safety for global stability. Deep foundations are not recommended, as they are not expected to be an economical solution.

Soil Design Parameters

Table 2 presents the generalized soil design properties for the project site. Values for future Structural Fill are estimated based on experience with this material. Values for the in-situ material are based on conservative estimates within typical ranges for the material encountered per sources such as Das (2007) and Coduto (1999). Global stability limit equilibrium analyses were also used to back-calculate parameters for the in-situ material, given the lack of known failures and stability observed during the test pit investigation.

Table 2: Generalized Soil Design Properties

Soil Type	Buoyant Unit Weight (pcf) [1]	Effective Friction Angle, ϕ (degrees)	Effective Cohesion, c (psf)	Elastic Modulus, E (ksf)
Structural Fill (Future)	73	42	0	3,500
Silty Sand with Gravel	63	38	0	400

[1] Buoyant unit weight is based on a unit weight of displaced water of 62.4 pcf.

Structural Fill, as described in Table 2, is inclusive of all imported material as defined in subsequent sections of this report.

Seismic Design Parameters

Structures in Juneau shall be designed to resist seismic loads in accordance with the appropriate design codes. Ground motions associated with the Maximum Considered Earthquake (MCE) have a probability of exceedance of 2% in a 50-year timeframe, which correlates to an average return period of 2,475 years. This seismic event is mandated by the International Building Code (IBC) and ASCE 7 for buildings, building-related structures and certain non-building facilities.

Site class was determined based on the soil conditions from this investigation and those at the nearest borehole from an historical investigation. Risk category was determined based on planned use of the proposed improvements (apartment buildings). Moment magnitude was obtained from the United States Geological Survey (USGS) online Unified Hazard Tool. All other parameters were obtained from the Applied Technology Council (ATC) Hazards by Location online utility, with the 2012 IBC as the reference code. All seismic parameters are given in Table 3.

Table 3: Seismic Design Parameters

Seismic Event (Return Period, Probability of Exceedance):	MCE (2,475 years, 2% in 50 years)
Site Class:	C
Risk Category:	II
Peak Ground Acceleration (PGA):	0.207g
S_s (0.2 sec period acceleration):	0.528g
S_1 (1.0 sec period acceleration):	0.356g
F_{PGA}:	1.193
F_a:	1.189
F_v:	1.444
S_{DS}:	0.418g
S_{D1}:	0.342g
Site-Adjusted Peak Ground Acceleration (PGA_M)	0.247g
Moment Magnitude (M_w):	7.9

Fault Rupture

The nearest significant fault (the Denali Fault) is located approximately 21 miles from the project site. Based on the absence of mapped faults across the proposed project area, the risk of fault displacement resulting in ground rupture is low.

Liquefaction

Liquefaction occurs when excess pore water pressure develops in saturated soils, typically as a result of vibrations or ground shaking such as earthquakes, which results in a loss of shear strength in the soil. Detrimental effects of liquefaction include ground settlement due to densification of the liquefiable soils, and slope instability, lateral spreading, and reduced bearing capacity due to loss of shear strength. Typically, liquefiable soils are very loose to medium-dense, clean to moderately silty sands, and some silts below the water table. Other soils may experience liquefaction depending on factors such as the duration of ground shaking. Gravels and soil with a high fines content (greater than approximately 35%) which exhibits clay-like behavior (Plasticity Index $\geq$ 7) are unlikely to liquefy (Boulanger and Idriss, 2006). Soils below a certain depth, often estimated at a maximum of 50 feet, may not liquefy due to high confining pressures (Day, 2002). This depth is based on site-specific conditions and engineering judgement, and should not be assumed for all cases.

A liquefaction analysis is beyond the scope of this investigation and the field data collected is insufficient to conduct such an analysis. The absence of observed groundwater during this investigation suggests that liquefaction may not be a real concern at the site. However, groundwater may have significant influence on certain analyses, including liquefaction, lateral spreading and global stability.

Foundations and Retaining Structures

Design of shallow foundations must consider the bearing capacity of the underlying soil as well as the potential for settlement and the effects of seasonal frost action. In general, foundation design should be consistent with the current edition of the IBC with any local amendments or requirements.

The following subsections will discuss allowable bearing pressure determinations with respect to bearing capacity, elastic settlement, and long-term settlement for perimeter strip footings. The existing in-situ silty sand is unlikely to be able to adequately support typical foundation loads in a sloped geometry. Excavation and replacement with structural fill, or constructing foundations directly on bedrock, is necessary to support building loads.

Bearing Capacity and Elastic Settlement

At present, shallow foundations and retaining structures are recommended to bear on bedrock. The 2012 version of the IBC permits a presumptive allowable bearing pressure of 4,000 pounds per square foot for sedimentary and foliated rock. This value assumes that the foundation will bear evenly on a flat rock surface. Elastic, or immediate, settlement is not expected to have a controlling influence for foundations bearing on rock.

The allowable bearing pressure for foundations bearing on structural fill over bedrock may be calculated using the values in Table 2. Alternatively, a presumptive allowable bearing capacity of 3,000 pounds per square foot may be used per the 2012 version of the IBC. Consideration must be given to proximity to nearby slopes. If slopes are within the foundation zone of influence, the bearing capacity will be reduced. Many geotechnical texts provide guidance on determining bearing capacity for foundations near slopes, which is reliant on slope angle, distance from slope and other factors currently unknown. As design progresses the allowable bearing pressure should be re-calculated based on site geometry.

Allowable bearing pressure is typically calculated by applying a factor of safety of 3 to the computed ultimate bearing pressure. The allowable value may be increased by 33% when considering short-term transient loads, such as wind and seismic forces.

Primary Consolidation and Secondary Compression Settlement

Long-term settlement occurs when soil consolidates over time due to an induced load, such as building foundation loads. Two types of long-term settlement are typically considered: primary consolidation and secondary compression. Both are typically attributed to compressible soils such as saturated silts and clays. No compressible soils were encountered during the investigation and therefore long-term settlement is not expected to be an issue for this project.

Lateral Load Resistance

Lateral loads on footings will be resisted by passive earth pressures developed against the footing block and frictional resistance against the base of the footing. A passive resistance (equivalent fluid pressure) of 250 pcf, which includes a factor of safety of 2, is recommended for structural fill. A coefficient of friction of 0.5 is recommended to be used for resistance of footings to lateral sliding, assuming concrete footings are cast directly against sand and crushed gravel (structural fill). Precast footings should use a coefficient of friction of 0.30. Footings cast direction on clean, sound bedrock may use a coefficient of 0.7. The passive resistance and sliding coefficient are permitted to be used together with no reduction.

Uplift Resistance

Uplift loads may manifest in some foundation elements due to overturning moments that occur as a result of wind and seismic forces. For sump structures at the project site extending below the groundwater elevation, uplift may also result from buoyancy effects of groundwater on the structure. Uplift loads may be resisted by the weight of the footing and soil within the limits of a truncated pyramid above the top of the footing. The shape of the truncated pyramid will vary with material type and density. For the material expected at this project site, the pyramid is defined by a 30-degree angle from vertical extending upward from the top of the footing.

Retaining Walls

All retaining walls must be designed to resist lateral pressures including lateral earth pressures, surcharge or surface loads, hydrostatic pressures, and seismic forces. We recommend the use of clean, angular, free-draining coarse grained soil to prevent the buildup of hydrostatic forces. Any retaining walls should be designed following the current edition of the IBC including any location amendments.

The magnitude of lateral earth pressure is a function of the type and density of the soil behind the wall and the allowable movement of the structure with respect to the backfill. For walls allowed to deflect laterally or rotate an amount equal to about 0.001 times the height of the wall, an active earth pressure condition under static

loading would prevail. If movement is restricted, the lateral earth pressure should be designed for an at-rest condition.

Use of the soil strength parameters for imported Structural Fill, provided in Table 2, is recommended for any retaining wall design provided that Structural Fill is used during construction. These parameters allow for the computation of lateral earth pressure "K" coefficient for the design soil-structure state of either active (K_A), at-rest (K_0), or passive (K_P) conditions. Additionally, the lateral earth pressure should consider the angle of the soil behind and in front of the retaining wall, any surcharge, distributed, or point loads, and wall-to-soil interface friction. Engineering judgment should be exercised as to which state the wall is in when calculating driving and resisting forces from the soil for external stability. Consideration should also be given to any compaction-induced lateral earth pressure. For walls retaining level backfill, an equivalent fluid pressure of 25 pcf may be used for the active condition; an equivalent fluid pressure of 45 pcf may be used for the at-rest condition.

Seismic forces will also impart short-term transient loads on retaining structures. There are several methods for estimating the earthquake load, P_E, on retaining walls such as the following proposed by Seed and Whitman (1970):

$$P_E = \frac{3}{8} K_H (H)^2 \gamma$$

where: P_E = earthquake load, in pounds force per foot of wall
K_H = horizontal seismic coefficient, typically the site-adjusted PGA
H = height of the retaining wall
γ = effective unit weight of retained soil

This method recommends that the earthquake load be applied at a height of 0.6H above the base of the wall.

The external stability of sliding and overturning should have minimum factors of safety of 1.5 and 2.0, respectively, under static conditions. The allowable bearing capacity should consider eccentric loads on the footing and should have a minimum factor of safety of 3 under static conditions. Factors of safety may be reduced under certain short-term transient loading conditions such as seismic forces.

Global Stability

A global stability analysis was performed based on the existing site geometry, the soil lithology encountered in this investigation, and historical borehole logs from the 1999 PND investigation on Gastineau Avenue. The software program Slide2, by Rocscience, was used to conduct the stability analyses. Two site typical sections analyzed: Section A (based on Test Holes 2 and 3) and Section B (based on Test Holes 1 and 4). The sections are depicted in Figure 4.

The analyses considered two load cases: static (long-term) and pseudo-static/seismic (short-term with seismic accelerations). The pseudo-static analysis was further examined in two scenarios, one with the in-situ silty sand remaining and one assuming that the silty sand had been replaced with structural fill. These two pseudo-static scenarios were analyzed to determine if foundations bearing on structural fill was viable or if foundations must bear on bedrock. Geometry beyond the property lines was modeled, but the analysis boundaries were truncated at the property lines. Slopes above and below the project site may need to be considered in the overall analysis as design progresses.

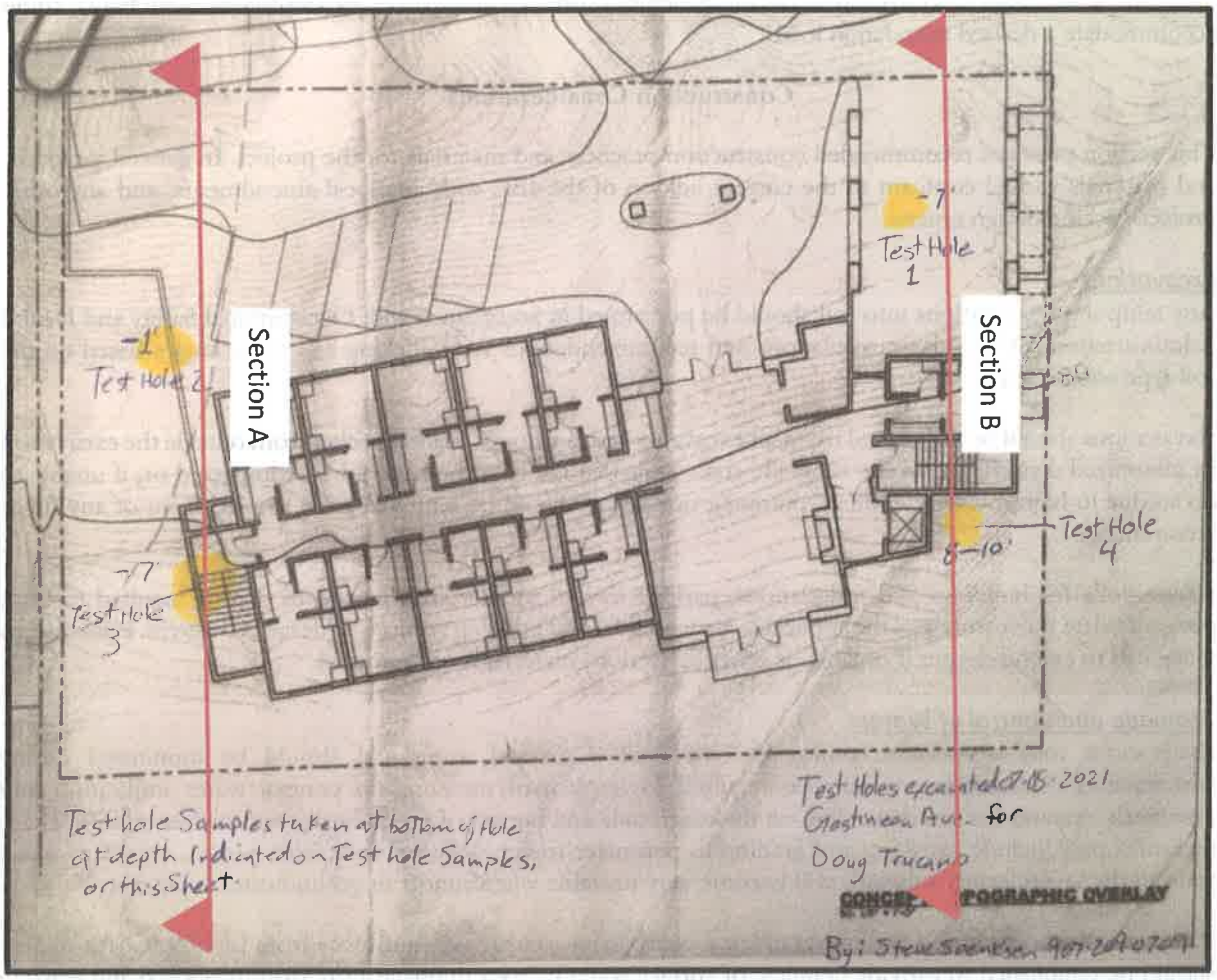


Figure 4: Site Map and Sections

The static long-term load case models the existing soil in terms of effective stress (drained state). The pseudo-static (seismic) load case subjects the soil to short-term seismic loads. The seismic loads are applied in terms of horizontal seismic coefficients, typically PGA as a percentage of gravity. Geotechnical texts (Day, 2002) and design codes (AASHTO, 2017; NCHRP, 2008) suggest a design horizontal seismic coefficient equal to one half of the site-adjusted peak ground acceleration (PGA_M), provided in Table 3, for earthen slopes that are considered non-rigid or yielding (i.e., allowed to move). Implementation of this reduced seismic coefficient assumes that some deformation, on the order of inches, is allowed to occur during the design seismic event which is anticipated to be acceptable for this project. Therefore, a horizontal seismic acceleration of 0.13g was used for all seismic analyses.

The static analysis with in-situ soil produced failure surfaces with unsatisfactory factors of safety (less than 1.5) although all surfaces were generally minor "unraveling" type failures (for practical purposes, this in-situ soil is likely stable without external building loads at slopes not exceeding 2:1). An arbitrary distributed load of 500 pounds per square foot was then applied to the existing bench, which resulted in failure surfaces below the applied load with unsatisfactory factors of safety. It is therefore unlikely that the sloped in-situ soils could support typical foundation loads with adequate factors of safety in either the static or pseudo-static scenario.

The stability analysis with structural fill replacing the in-situ soil yielded more favorable results considering the aforementioned distributed load under both static and pseudo-static situations. An iterative analysis would be

necessary to establish what slope or retaining structure geometry, and excavation/replacement fill limits, could accommodate a desired foundation load.

Construction Considerations

This section provides recommended construction practices and materials for the project. In general, practices and materials should conform to the current edition of the IBC with any local amendments, and any other project-specific design criteria.

Excavation

Any temporary excavations into soil should be performed in accordance with Occupational Safety and Health Administration (OSHA) laws, regulations and recommendations for trenching and slope angles based on the soil type encountered.

Excavations should be performed using an excavator with a smooth-bladed bucket from outside the excavation to minimized disturbance of the subgrade soils. Soils that are disturbed should be compacted or, if unable to do so due to high moisture content, pumping or rutting, should be removed prior to placement of any fill as recommended.

Excavations for buildings and foundations, parking lots, at utilities shall extend to depths required to both accommodate the feature and the applicable structural fill and bedding sections as described herein. Excavations may need to extend deeper if organic or other deleterious material is encountered.

Drainage and Control of Water

Excavations may experience seepage due to shallow ground water and should be monitored during construction. The contractor may be required to implement measures to control water infiltration and effectively dewater the site depending on the magnitude and impact of groundwater and surface runoff. These measures may include installing and grading to perimeter trenches, sump wells with pumps, etc. Excavation walls in the in-situ sandy subgrade will become very unstable when runoff or groundwater is present.

Parking areas should have a positive gradient toward drainage structures and away from buildings. Site grading should be established to provide drainage of surface water or roof drainage away from proposed and existing buildings and toward suitable drainage structures.

The ground immediately adjacent to any building foundation or retaining wall should slope away (minimum 3% for gravel surfacing, 2% for pavement surfacing) for a minimum distance of 10 ft measuring perpendicular to the face of the wall. Grading should be designed to prevent ponding of surface water except where retention ponds, or similar devices, are intended. Freely-draining soils should be used as backfill around foundations and retaining structures.

Perimeter foundation drains should be installed at or below the same elevation as the bottom of the exterior footings. Foundation drains should daylight into drainage ditches or connect to an underground storm drain system. Discharging storm water directly onto downhill slopes is not recommended as it may cause erosion.

Construction Materials and Compaction

This section will provide general recommendations for the use of imported aggregate fill to be used during construction. All aggregate fill should be angular, clean, sound, durable, and free of any frozen clumps, ice or any deleterious material prior to placement and follow all project specifications. Fill should be a well-graded mixture of non-frost susceptible (NFS) sand and gravel. All fill material should be protected from freezing during construction. No frozen soil should be used as fill, nor should any fill be placed over frozen soil. Any frozen soil should be removed, replaced, or thawed prior to fill placement.

Moisture control of materials should be implemented when stockpiling and placing fill material. Such measured may include tarping during wet weather Additional moistening or drying of fill material may be required in order to obtain the optimum moisture content for maximum compaction.

No hauling or grading equipment should be used in lieu of appropriate compaction equipment. Any loosening of fill material by hauling or other equipment should be repaired by re-compacting as needed. The number of passes required to meet the compaction requirement will depend on the size of the compaction equipment used.

Base Course

Base course material should have a maximum particle size of 1 inch and less than 6% passing the No. 200 sieve size. Base course shall be placed in lifts not exceeding 8 inches in loose thickness and shall be compacted to 95% of the maximum density as determined by a control strip test, such as Alaska Test Method (ATM) 309 Relative Standard Density of Soils by the Control Strip Method.

Structural Fill

Structural fill material should have a maximum particle size of 6 inches and less than 6% passing the No. 200 sieve size. Structural fill shall be placed in lifts not exceeding 12 inches in loose thickness. Compaction of structural fill shall be achieved by performing a minimum level of effort consisting of six complete passes with a 15-ton vibratory steel drum roller. In areas of any structural fill that are too small to accommodate a roller, compaction shall be accomplished by a minimum level of effort of six complete passes with a vibratory plate compactor with a minimum rated centrifugal force of 15,000 lbs.

Structural Foundations, Parking Lot, and Utility Recommendations

Structural Foundations and Slabs

All footings and slabs should be constructed over, at a minimum, a 6-inch thick lift of base course or clean, sound bedrock. When constructing footings, the base course and structural fill should extend a minimum of 1 ft beyond the footing perimeter. Exterior footings should be buried a minimum of 32 inches for protection against frost action.

Parking Lots

Paved surfaces for light vehicle traffic should be constructed as follows, at a minimum: 2 inches of asphalt concrete pavement; 4 inches of base course; 26 inches of structural fill. The intent is to create a minimum 32-inch thick structural section in general accordance with CBJ Standard Details. A thicker section may be warranted if subgrade conditions vary from those described herein. If heavy vehicle loading is anticipated, a specific pavement design should be performed.

Buried Utilities

Buried utilities, including storm sewer, sanitary sewer and water conduits and utility structures, should bear on a minimum 6-inch thick lift of base course or comparable material that will not damage the utility component. The utility should be bedded on all sides with appropriate bedding material per CBJ Standard Details. Any remaining open excavation for utilities with the building/road/parking lot footprint should be backfilled with structural fill to the appropriate grade. Utilities outside the building footprint or any travel way may be backfilled with approved, inorganic granular excavated material. Reused excavated material should be compacted in a manner identical to that of structural fill. Sub-excavation and backfill with structural fill should be performed if poor subgrade conditions are encountered.

Sanitary sewer lines shall have a minimum cover of 4 feet; water lines shall have a minimum cover of 5 feet. Lines shall be insulated if the specified minimum cover cannot be achieved. Utility crossings shall be addressed in accordance with CBJ Standard Details.

Limitations and Closure

The information submitted in this report is based on data from a field and lab geotechnical investigation conducted for this project and other sources discussed in this report. Effort was made to obtain information that is representative of the actual conditions at the site. However, actual subsurface conditions will vary and additional information may be discovered. If conditions significantly different from those indicated in this report are encountered by subsequent investigations or during construction, such conditions should be reviewed by PND.

This report was prepared by PND Engineers, Inc., for use on this project only, and may not be used in any manner that would constitute a detriment to PND. PND is not responsible for conclusions, opinions, or recommendations made by others based on data presented in this report.

Included in Appendix C of the previous report is a copy of the Geoprofessional Business Association (GBA) publication "Important Information about Your Geotechnical-Engineering Report." The publication is included in this report to help the Owner, Contractor, and others who read this document understand the limitations described above and the additional limitations contained in the publication and made a part of this report. This document should be read carefully. If in the opinion of Contractors bidding this project, sufficient information has not been made available to satisfactorily bid the project then the Contractor should perform additional geotechnical investigations as necessary to satisfy themselves as to site conditions.

Sean Sjostedt, P.E.
Senior Geotechnical Engineer
November 28, 2021

Dick Somerville, P.E.
Principal
November 28, 2021

Attachments: Appendix A – Site Map with Test Pit Locations
Appendix B – Laboratory Test Results
Appendix C – GBA Publication: *Important Information about Your Geotechnical Engineering Report*

References

ASTM D2216. "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass."

ASTM D2487. "Classification of Soils for Engineering Purposes (Unified Soil Classification System)."

ASTM D6913. "Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis."

Boulanger, Ross W. and Idriss, I.M. (2006). "Liquefaction Susceptibility Criteria for Silts and Clays." Journal of Geotechnical and Geoenvironmental Engineering.

Brockman, S.R., Espinosa, A.F., and Michael, J.A. (1988). Catalog of Intensities and Magnitudes for Earthquakes in Alaska and the Aleutian Islands – 1786 – 1981. United States Geological Survey, Survey Bulletin 1840.

City and Borough of Juneau Engineering Department Standard Details, 4th Edition (2011).

Coduto, Donald P. (1999). Geotechnical Engineering Principles and Practices. Prentice-Hall, Inc. Upper Saddle River, New Jersey.

Combellick, R.A. and Long, W.E., (1983), "Geologic hazards in southeastern Alaska: an overview", Alaska Division of Geological & Geophysical Surveys Report of Investigation 83-17, 17 p.

Das, B.M. (2007). Principles of Foundation Engineering, 6th edition. Cengage Learning, Stamford, CT 06902.

Day, Robert W (2002). Geotechnical Earthquake Engineering Handbook. McGraw-Hill. New York, New York.

Gehrels, G.E. (2000). Reconnaissance geology and U-Pb geochronology of the western flank of the Coast Mountains between Juneau and Skagway, southeastern Alaska, in Stowell, H.H., and McClelland, W.C., eds., Tectonics of the Coast Mountains, Southeastern Alaska and British Columbia: Boulder, Colorado, Geological Society of America Special Paper 343., pp. 213-233.

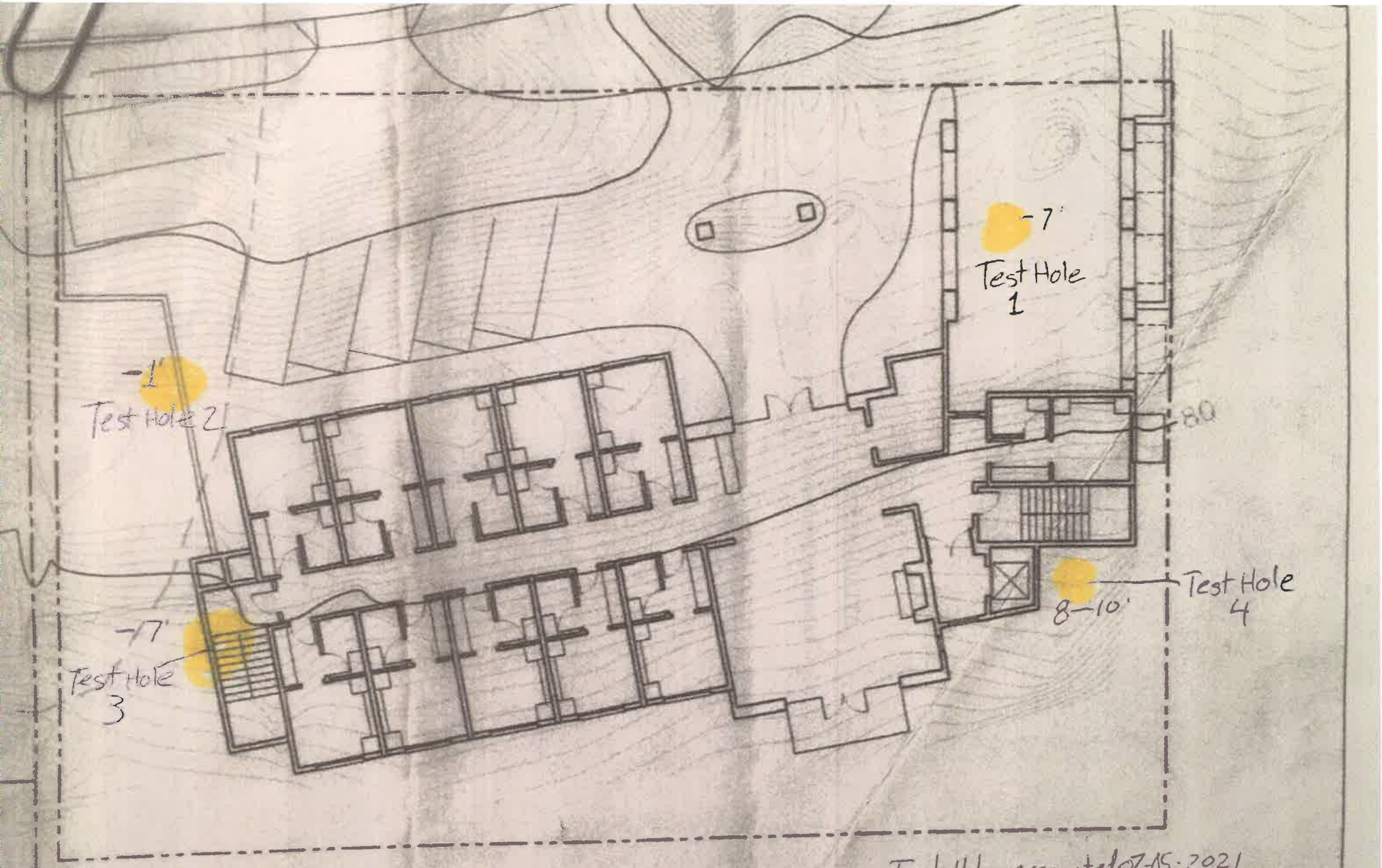
McClelland, W.C., and Gehrels, G.E. (1992). Upper Jurassic-Lower Cretaceous Basinal Strata Along the Cordilleran Margin: Implications For the Accretionary History of the Alexander-Wrangellia-Peninsular Terrane, Tectonics, Vol. 11, No.4, p. 823-835.

Miller Robert D. (1972). *Surficial Geology of the Juneau Urban Area and Vicinity, Alaska with Emphasis on Earthquake and Other Geologic Hazards.* United States Geological Survey Open-File Report, 100p.

Seed, H.B. and Whitman, R.V. (1970). *Design of Earth Retaining Structures for Dynamic Loads.* ASCE Specialty Conference, Lateral Stresses in the Ground and Design of Earth Retaining Structures. Cornell University, Ithaca, NY., 103-147.

ATTACHMENT A

Site Map with Test Pit Locations



Test hole Samples taken at bottom of Hole at depth Indicated on Test hole Samples, or this Sheet.

Test Holes excavated 07-05-2021 Grastineau Ave. for Doug Trucano

CONCEPT TOPOGRAPHIC OVERLAY

By: Steve Soenksen 907-209-0709

ATTACHMENT B

Laboratory Test Results

PDC ENGINEERS
PLAN • DESIGN • CONSTRUCT

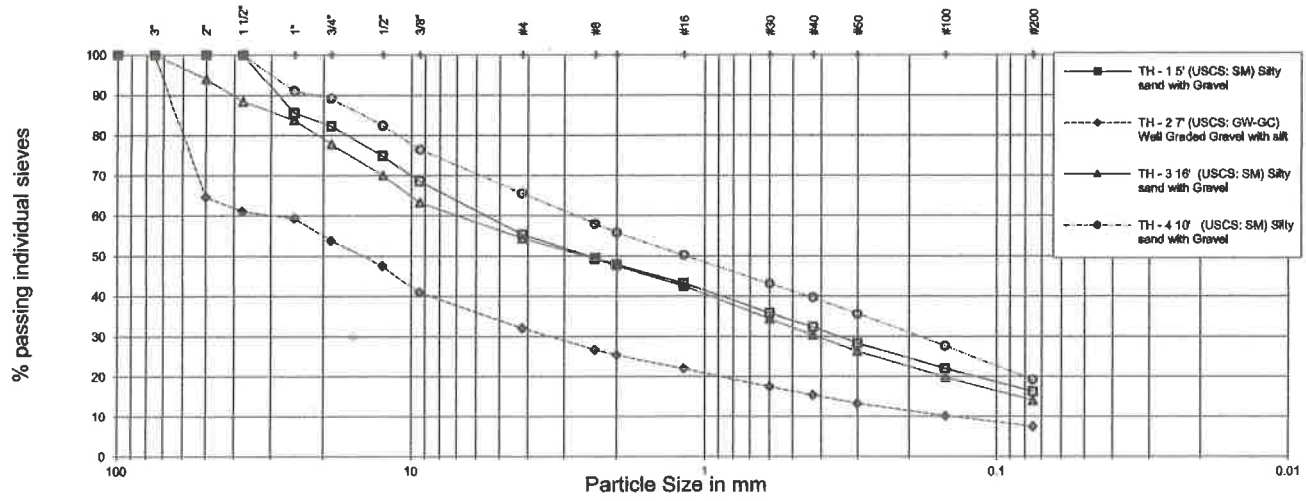
9109 MENDENHALL MALL ROAD, SUITE 4, JUNEAU, ALASKA 99801

Sieve Analysis AASHTO T 27 / T 11

Client	PND Engineers	Project #	21MT0.19JM
Project	Bulger Apartments	Received Date	7/14/2021
Location Sta/Offset	Juneau, Alaska	Reported Date	7/19/2021
Material/Source	Test Pits	Tested by/date	SRA 7/15/21
Sampled by/date	S. Soenksen/ 7-7-21		

Moisture	18.4%		9.9%		21.1%		17.3%	
SIEVE SIZE	Percent passing	Required specs	Percent passing	Required specs	Percent passing	Required specs	Percent passing	Required specs
	TH - 1 5' (USCS: SM) Silty sand with Gravel		**TH - 2 7' (USCS: GW-GC) Well Graded Gravel with silt**		**TH - 3 16' (USCS: SM) Silty sand with Gravel**		**TH - 4 10' (USCS: SM) Silty sand with Gravel**	
4 "								
3 "			100		100			
2 "			65		94			
1 1/2 "	100		61		88		100	
1 "	86		59		84		91	
3/4 "	82		54		78		89	
1/2 "	75		48		70		82	
3/8 "	69		41		63		76	
No 4	55		32		54		66	
No 8	49		27		49		58	
No 10	48		25		48		56	
No 16	43		22		42		50	
No 30	36		17		34		43	
No 40	32		15		30		40	
No 50	28		13		26		36	
No 100	22		10		20		28	
No 200	16.3		7.4		14.0		19.1	

Grain Size Distribution



Cobbles and Gravel	Sand	Silt and Clay

ATTACHMENT C

GBA Publication – *Important Information about Your Geotechnical Engineering Report*

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be,* and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

BAXANDALL ASSOCIATES
CIVIL AND ENVIRONMENTAL ENGINEERING

1107 NORTH ELEVATION STREET
HANCOCK, MICHIGAN 49930
TELEPHONE (906) 483-2372
fwbaxand@mtu.edu

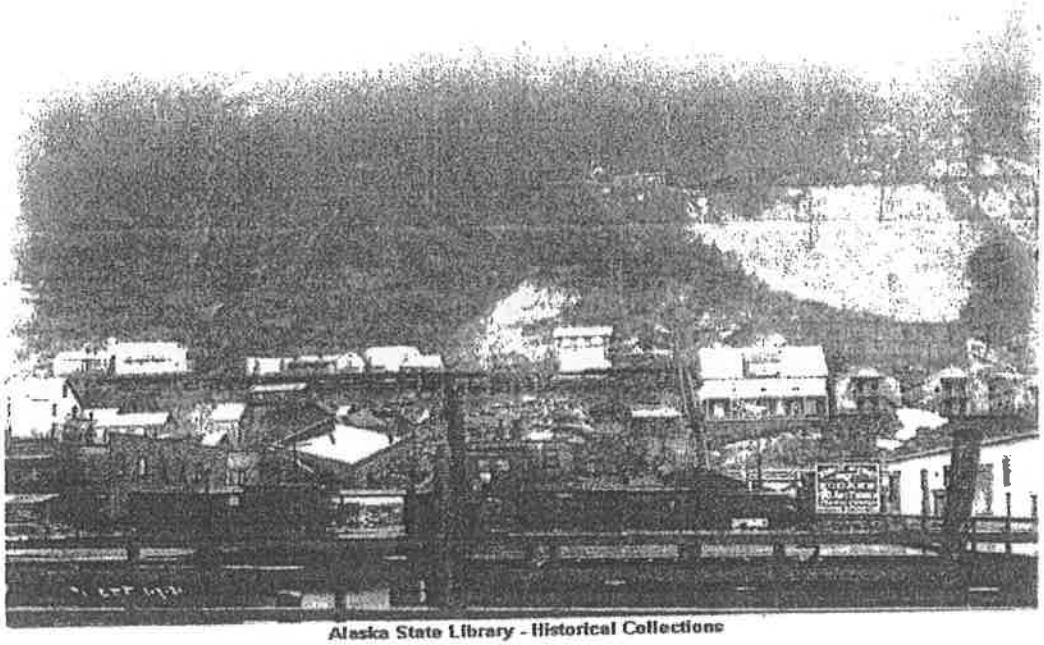
3 August 2012

Eric Feldt
Department Planning and Community Development
City & Borough of Juneau
155 South Seward Street
Juneau, Alaska 99801

Dear Mr. Feldt:

We have been asked to do a further review of the potential hazard classification for Lot 3, Block 2, Pacific Coast Addition to the City of Juneau, the property being located at 307 South Franklin Street. The review also includes Lots 12, 13, & 14 of Block 2 which abut on Gastineau Avenue.

The hazard potential for Lots 3, 12, 13, & 14 of Block 2 of the Pacific Coast Addition has changed from that as shown in the Geophysical Hazards Investigation for the City & Borough of Juneau that was done in 1972.



Alaska State Library - Historical Collections

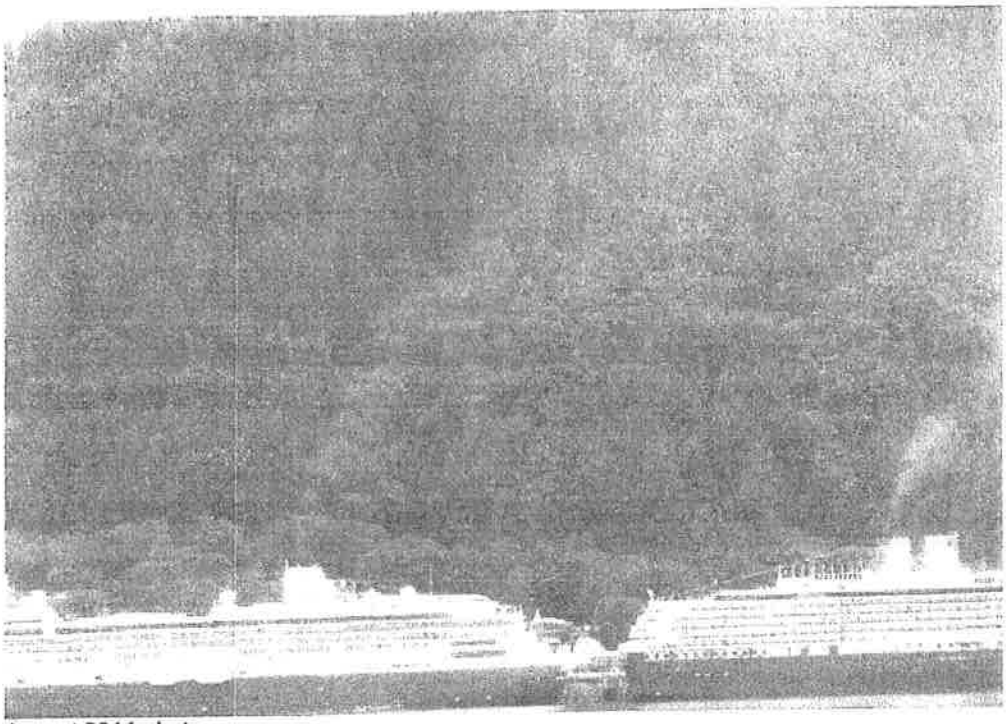
The above picture is of the slide that occurred on January 7, 1920. The top of the slide is at approximately 250 ft. of elevation, which is the top level of the old beach deposits. The slide

resulted in removal of most of the soil and overburden from that area. The minor slide that occurred on November 14, 2009 followed the same path as the water flow that is shown on the left side of the of the slide path. As stated in the 1972 study regarding this event, "It was apparently triggered by rapid addition of water to an already saturated soil mass due to overflow of the A.J. water flume on January 1, 1920."

The interesting thing is that Gastineau Avenue was on a trestle in that area at that time. This explains why there were no deposits along the base of the old stone wall that was present prior to the reconstruction of Gastineau Avenue in 2004. The other interesting thing is that when they constructed the tunnel that ran through Mt. Roberts to the Gold Creek basin, they dumped the rock removed from the tunnel construction on the slope below the tram tracks. This has stabilized the slope and explains why there have been no debris flows occurring in that area.

Alaska State Library - Historical Collections

What is interesting is the re-growth of the timber on the slopes of Mt. Roberts as shown in the above picture. As best as can be determined, this picture was taken in the winter of 1918. The picture below is from 2011 and the entire slope has been re-forested. It leads one to believe that the age of much of the present tree cover is younger than what was believed.



August 2011 photo

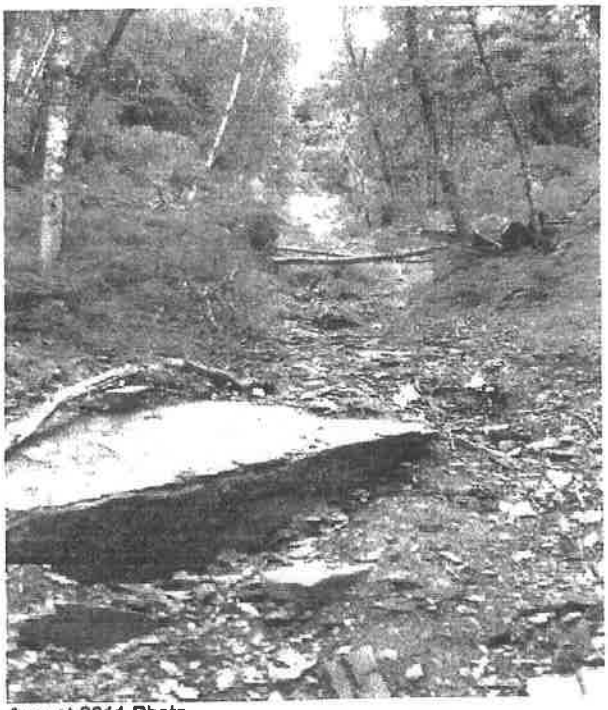
Picture below is the existing AJ Mining Company building foundation. This foundation is evident in pictures that go back to 1917. The structure has served as both a slope stabilizer as well as a debris flow barrier. It has protected lots 12 & 3 of Block 2 since it was constructed.

August 2011 photo

This photo shows the starting point for the minor slide that occurred on November 14, 2009. It is interesting as to how quickly the slope has re-vegetated.

August 2011 Photo

Lower end of the slide showing a small debris deposit that could possibly move further down the slope during another major rain storm. The volume of debris present is less than 50 cubic yards. The existing rock deflection wall adjacent to the Housing First building would deflect the minor flow away from the building. The existing concrete traffic barrier along the downhill side of Gastineau would keep this flow from continuing down the slope.



August 2011 Photo

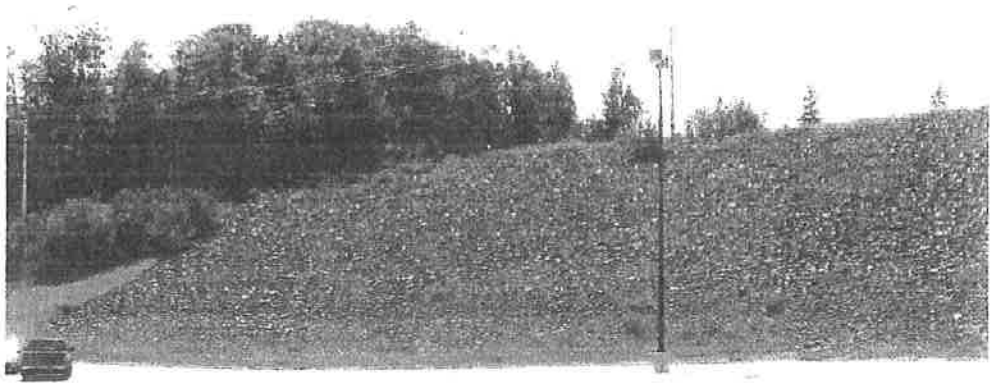
Juneau Empire Photo

The vehicles parked on the uphill side of Gastineau Avenue basically stopped the flow and most likely caused the sideward movement of the debris flow that impacted the side of the Housing First building. The flow velocity was slowed enough to allow the vehicles to keep the debris flow from reaching the concrete traffic barrier wall on the downhill side of the street. Past inspection of the various small slide paths along Gastineau Avenue showed that it takes from 80 to 100 years for sufficient material to build up in the "V" notches to pose a threat of debris flow that would impact the street. The flow that occurred in 2009 was 89 years after the 1920 event. The cubic yardage of this debris flow is what we observed in our study of this path that was done in the late 1980's.

There are several factors we have observed that determined the request to remove the Lots 12, 13, & 14 of Block 2, Pacific Coast Addition from the severe hazard zone. As Lot 3 of Block is directly downhill from Lot 12, it would be included due to its location.

The first consideration is that the major landslide that occurred on January 7, 1920 removed the majority of the marine and beach deposits subject to sliding from the area above the subject properties. This slide was attributed to a major overflow the A J flume which no longer exists. The volume of the debris material remaining, should a future slide occur, would be stopped by the concrete traffic barrier along the downhill side of Gastineau Avenue.

The placement of the tunnel excavation material, which is composed of angular rock, has played a major role in stabilizing the slope below the tram. Placement of rock debris of this size on slopes of this degree is used as a standard method for steep slope stabilization.



This picture shows a typical use of fractured rock that provides slope protection from landslides. The picture is of a local slope here in Houghton that is of the same rock size and slope angle as that below the tunnel entrance above Gastineau Avenue.

Attached is a copy of CBJ's hazard area map, B0-6 Hazard, showing the subject properties location and requested boundary adjustment for the severe hazard zone as these properties should be considered as being within the moderate hazard zone. We request that the hazard map for this area be adjusted from severe hazard to moderate hazard placing Lots 3, 12, 13, & 14 of Block 2, Pacific Coast Addition into the moderate hazard zone.

Should you have any questions regarding our request, please let us know.

Sincerely;

Bill Baxandall

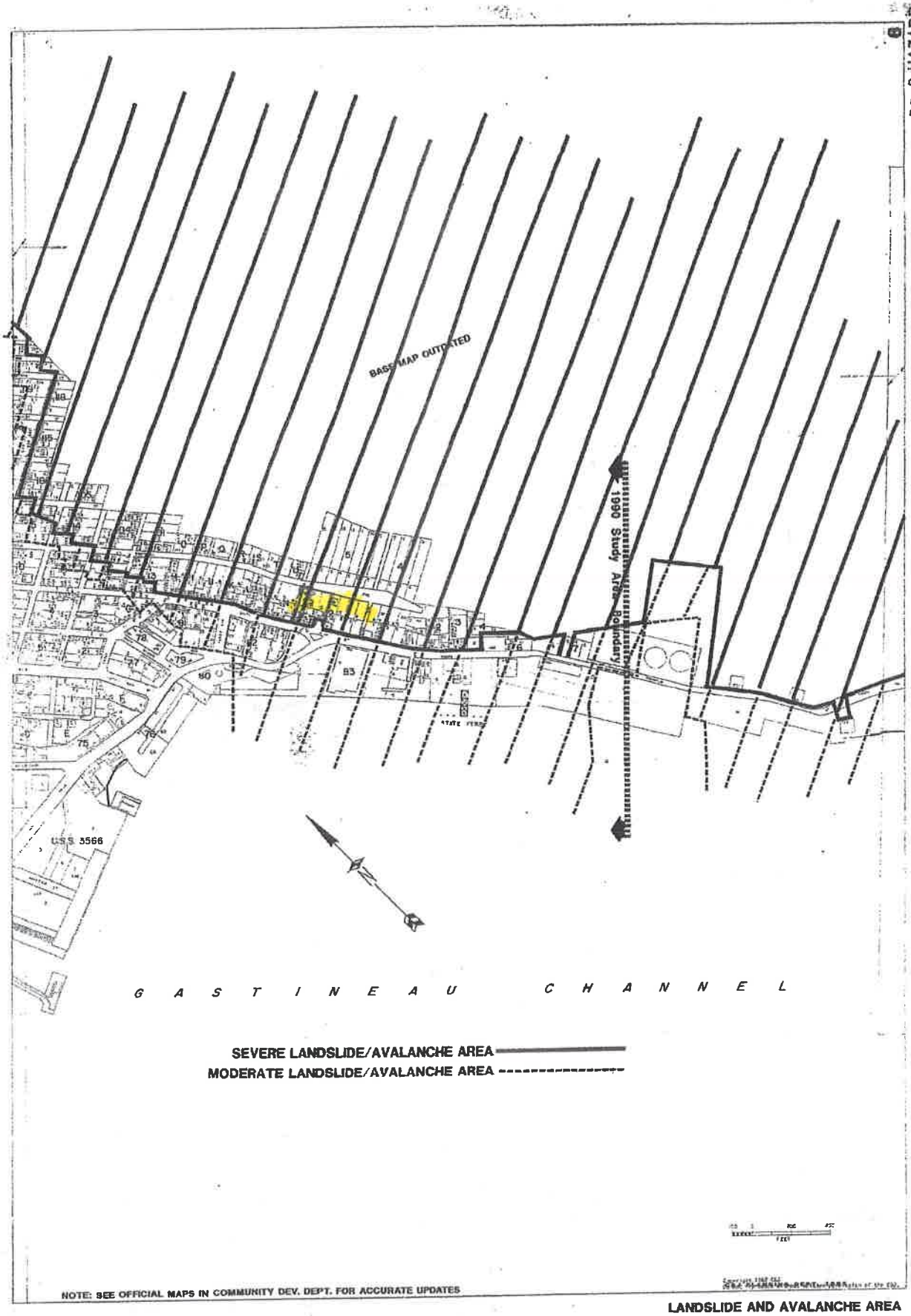
F.W."Bill" Baxandall, P.E.
Principal

Attachment

Cc: Doug Trucano, Trucano Construction
Rich Conneen, Architect

STATE OF ALASKA
49TH
F.W. BAXANDALL
No. CE 5035
REGISTERED PROFESSIONAL ENGINEER

8/13/2012



LANDSLIDE AND AVALANCHE AREA

PAGE 7, LOTS 3, 12, 13 & 14 HAZARD STUDY, 8/03/2012

SHEET 1 OF 7

DOUGLAS N. SWANSTON
CONSULTING ENGINEERING GEOLOGIST
10121 SILVER STREET
JUNEAU, ALASKA 99801

December 13, 1989

Bax:

The lot we inspected immediately above the small "pocket park" along Gastineau Avenue and northwest of the proposed tram right-of-way is situated directly at the mouth of a known debris flow gulley identified in the 1972 Geophysical Hazards Investigation for the City and Borough of Juneau.

At the present time, this gulley is clear of significant quantities of debris and is partially stabilized by a substantial cover of 50+ year-old alder. While the supply of debris for a large-scale debris flow from this gulley is limited, the steep gradient of the gulley, the presence of a small mass of debris stored along the north bank, and the presence of rock cliffs at its head indicate a potential for damage to unprotected structures on the property.

I estimate a maximum flow velocity of about 6.24 m/s (20.5 ft/s) obtainable in this gulley using the generalized Poiseuille equation for flow and field assumptions as follows:

$$V=\frac{\delta \sin\theta H^2}{3\tau}$$

where: V= velocity in m/s (ft/s)
δ= assumed unit weight of 20 KN/m^3 (127 lbs/ft^3)
θ=channel gradient estimated at 34°
H=flow height estimated from apparent trim-line of most recent flow occurrence at 1.8 m (6.0 ft)
τ=apparent dynamic viscosity estimated at 2 kPa.s or 2x10 poise (41.7 lbs/ft^2)

At the densities and viscosities which normally occur in such flow masses (conservative estimates based on personal knowledge and data from debris flow analyses in British Columbia), impact loads on any structure in the flow path was estimated using the Momentum Equation of fluid dynamics where:

$$P=\rho V^2 \sin\alpha$$

where: P= impact force in Pascals (lbs/ft^2)
ρ=estimate bulk density of the flow mass at 2000 kg/m^3 (124.9 lbs/ft^3)
α=angle of movement against the structure assumed at 90°
V=flow velocity at 6.24 m/s (20.5 ft/s)

Thus, the impact force on any channel structure perpendicular to the flow would be about 77.9 kPa (1628.5 lbs/ft^2) or about 8 metric tones-force/m^2(0.8 british tons-force/ft^2). To this should be added the triangular hydrostatic pressure of piled-up debris flow material behind the structure. Point forces produced by impacts from logs and boulders could be 2 to 3 times higher. As you can see, inclined deflection walls can significantly reduce impact loads, but care needs to be taken to avoid damage to adjacent properties.

I hope these comments will be of some assistance to you. If you have any additional questions, give me a call.

Sincerely,

Doug Swanston

CERTIFIED
OREGON
Douglas N. Swanston
2276
ENGINEERING GEOLOGIST