Revised 10 March 2023 Job No. 22135

Envision I, LLC
Attention: Sibley Simon
189 Walnut Ave
Santa Cruz, 95060
Sibley@envisionhousing.us
831-419-4091

Subject: Geologic feasibility of proposed development
Proposed housing
900 High Street
Santa Cruz, CA 95060
County of Santa Cruz APN 001-022-40

REFERENCES

"Preliminary Geotechnical Investigation For Proposed Townhome Development – 900 High Street – APN 001-0232-40 – Santa Cruz, California", dated 9 March 2023, by Dees & Associates, Inc.

"Phase I Karst And Slope Stability Hazards Investigation - Peace United Church - Envision Housing, Proposed Housing Development, 900 High Street - Santa Cruz, California", dated 2 July 2018, by Zinn Geology.

"Peace Village – 900 High Street – Santa Cruz, CA 95060 – Utility Plan", Sheet C3.1, dated 15 August 2022, by C2G/Civil Consultants Group, Inc.

"Peace Village – 900 High Street – Santa Cruz, CA 95060", Sheets AP3.01, AP3.02, AP3.03, AP4.01, dated 21 November 2022, by Workbench.

Dear Sibley,

This letter presents our opinion of the geological feasibility of the current proposed development on the subject property. We are partially relying upon the body of work completed by the author (Erik Zinn) under the auspices of Zinn Geology in 2018. That work culminated in a geology report titled "PHASE I KARST AND SLOPE STABILITY HAZARDS INVESTIGATION" dated 2 July 2018 by Zinn Geology (Job #2018011-G-SC). Zinn Geology also completed some supplemental geological work in February 2022 to assist Dees and Associates with their quantitative slope stability analysis of the slope that lies behind the southernmost portion of the development.

OVERVIEW

It is our understanding that scope of the development has changed from the scope laid out in 2018. The City of Santa Cruz has made the following request regarding our 2018 geologic investigation and report:

"The geology report references the 2018 project design and not the current project design. Please provide a revised report or addendum letter that references the current project and provides needed changes to the analysis or recommendations" (excerpt from City comments given to us by Workbench).

Zinn Geology encountered evidence of karst geology underlying the property and the proposed development area (current and past) during their prior investigation in 2018 (Zinn Geology, 2018) and supplemental geologic investigation in 2022 (Zinn Geology, 2022). Substantive evidence and findings was presented in their 2018 report describing the hazards and risks related to the underlying karst geology at the site, along with recommendations that flowed from those findings.

The widely spaced gridded small-diameter boring program pursued in 2018 by the Project Geotechnical Engineer of Record, Becky Dees of Dees and Associates, encountered marble bedrock at depth below the site, mantled by an inconsistently thick blanket of marble rubble, some soft soil and marine terrace deposits (see attached plates excerpted from the Zinn Geology 2018 report). This is consistent with the University of California at Santa Cruz (UCSC) campus geology that abuts the property to north, the exposure of marble in an old quarry to the east and the marble bedrock that is documented to underlie the City of Santa Cruz Bay Street Reservoir site.

Subsequent field work completed by Zinn Geology in 2022 to assist Dees and Associates with the geological portion of the slope stability analysis also encountered marble bedrock at depth, albeit with much more soil on top of the marble bedrock. It was clear from the borings drilled at the top of the slope in 2022 that the marble bedrock surface encountered in 2018 projects northward under the hill, which fits the geological model for this area. This is because the surface is likely an uplifted wave cut platform carved several hundred thousand years ago during a major sea level high stand.

The number of borings drilled in 2022 at the top of the slope were adequate for intended scope of work – determining the stability of the slope, but were too far apart to determine the karst hazard potential for the area covered.

The following recommendations were issued in the 2018 Zinn Geology report:

1. The project geotechnical engineer should analyze the blanket of denser soils that overlie the marble bedrock in the area centered on boring B2, flagged as a doline of concern (shaded orange polygons on Plate 1), taking our prescribed maximum doline width into account. The geotechnical engineer should determine if the density and thickness of this surficial "blanket" is sufficient to buffer any structures from damage caused by the potential stoping or settlement of the relatively softer soils below.

Mitigation of this condition should be proposed if warranted. Mitigation schemes could potentially include proper foundation design, ground improvement under the foundation, or subsurface changes made to the soft soil zones.

2. Because of the high degree of variability of soil conditions over short intervals encountered throughout the study area, we recommend that all structures for the lower parking lot area be designed to span zones of subsidence or soil collapse of a prescriptive minimum of thirty feet. We recognize that this may be economically prohibitive for residential construction. The minimum prescriptive subsidence zone value can be potentially reduced by drilling on a denser grid under the proposed structures in order to reduce the uncertainty of the marble surface between the current spacing of the borings.

We recommend a gridded drilling program be pursued for the upper meadow quadplex development prior to any foundation design being pursued. The drilling grid should be laid out to allow for borings to be completed under the proposed residential footprint. One or more borings should be advanced near the steep quarry wall that lies to the east of the site in order to characterize the thickness and character of the marine terrace deposits that overlie the marble bedrock. All borings advanced on the upper meadow site should be drilled to refusal on the underlying marble bedrock.

3. We recommend that all of the storm water generated for this project be disposed in the City of Santa Cruz storm drains. Attenuating the storm flows by detaining the water in impervious structures is geologically acceptable, as long as the water is NOT allowed to infiltrate the soil.

4. Landscape watering for the project should NOT saturate the subgrade in an unnatural fashion. The natural distribution and application rate of rainfall should be emulated for landscaping irrigation, in order to avoid saturating the subgrade and triggering a doline collapse.

5. Seismic shaking values for any structures designed on the property should at least adhere to the minimum prescriptive design values outlined in the 2016 California Building Code. The seismic shaking values should be developed by the Project Geotechnical Engineer of Record as part of their soils report for the design of proposed structures.

6. Any soft soil zones exposed in the foundation footings or soil changes encountered during excavation should be investigated in the field at the time of construction by the project geotechnical engineer and the project geologist.

7. We recommend that Zinn Geology be retained to inspect all cuts made during grading for the project in order to identify unanticipated potential karst hazards.

8. We recommend that our firm be provided the opportunity for a review of the final design and specifications in order that our recommendations may be properly interpreted and implemented in the design and specification. If our firm is not accorded

the privilege of making the recommended review we can assume no responsibility for misinterpretation of our recommendations.

The above recommendations were issued for a preliminary geology investigation which was intended to assess whether the proposed development was geologically feasible. Although the footprint of the project has changed since our initial work, our original recommendations still apply to current proposed development scheme.

The main change to the 2018 development scheme is the added branch of residential buildings stepping up the slope from the parking lot to the upper terrace, in lieu of the scattered units across the upper terrace proposed in 2018. The geology hasn't changed since then, and our supplemental 2022 work confirmed that marble bedrock also underlies the slope above the parking lot and the upper terrace.

It is important to note that the currently proposed project is geologically feasible in our opinion. The risks related to geological hazards to the current habitable structure footprint (seismic shaking, doline reactivation, differential settlement) can all be mitigated through adequate geotechnical engineering and structural engineering design and construction and ground improvement. At this point in the project, there is clearly further geological work to be completed once a building footprint has been settled upon, but the development itself is geologically feasible because the risks can be mitigated.

It is also important to note that it is unnecessary and ill advised to begin a more exhaustive drilling program to refine the risk related to potential karst hazards until the building footprints have been solidified and settled upon. This is because the karst hazard risk assessment is very site specific and relies upon an expensive battery of tightly gridded small-diameter borings drilled down to the intact marble bedrock surface. Development of this nature in karst typically is done in stages or phases to allow the feasibility work to be completed and then refine the findings and recommendations to design levels in later phases of the project.

AMENDED FINDINGS & RECOMMENDATIONS

1. The original findings and recommendations from the 2018 Zinn Geology report are still valid for the current development footprint.

2. Once the development footprint has finally been settled upon, the Project Geologist of Record should develop a design-level karst drilling program in conjunction with Project Geotechnical Engineer of Record for the portion of the habitable structure footprint where the risk related to karst hazards has not been adequately quantified for final design.

3. Because of the high degree of variability of soil conditions over short intervals encountered throughout the study area, we currently recommend that all structures for the lower parking lot area be designed to span zones of subsidence or soil collapse of a

prescriptive minimum of thirty feet. We recognize that this may be economically prohibitive for residential construction. If the developer and design team want to reduce the minimum prescriptive subsidence zone value, then drilling on a denser grid should be completed under the proposed structures to reduce the uncertainty of the marble surface geometry and the density of the doline fill between the current spacing of the borings.

4. The project geotechnical engineer should analyze the blanket of denser soils that overlie the marble bedrock in the area centered on boring B2, flagged as a doline of concern (shaded orange polygons on Plate 1), taking our prescribed maximum doline width into account. The geotechnical engineer should determine if the density and thickness of this surficial "blanket" is sufficient to buffer any structures from damage caused by the potential stoping or settlement of the relatively softer soils below. Mitigation of this condition should be proposed if warranted. Mitigation schemes could potentially include proper foundation design, ground improvement under the foundation, or subsurface changes made to the soft soil zones.

5. One or more borings should be advanced near the steep quarry wall that lies to the east of the site to characterize the thickness and character of the marine terrace deposits that overlie the marble bedrock. All borings advanced on the upper terrace site should be drilled to refusal on the underlying intact marble bedrock.

6. We recommend that all the storm water generated for this project be disposed in the City of Santa Cruz storm drains. Attenuating the storm flows by detaining the water in impervious structures is geologically acceptable, as provided the water is NOT allowed to infiltrate the soil.

7. Landscape watering for the project should NOT saturate the subgrade in an unnatural fashion. The natural distribution and application rate of rainfall should be emulated for landscaping irrigation, to avoid saturating the subgrade and triggering a doline collapse.

8. Seismic shaking values for any structures designed on the property should at least adhere to the minimum prescriptive design values outlined in the 2022 California Building Code. The seismic shaking values should be developed by the Project Geotechnical Engineer of Record as part of their soils report for the design of proposed structures.

9. Any soft soil zones exposed in the foundation footings or soil changes encountered during excavation should be investigated in the field at the time of construction by the project geotechnical engineer and the project geologist.

10. We recommend that Pacific Crest Engineering be retained to inspect all cuts made during grading for the project to identify unanticipated potential karst hazards.

11. We recommend that our firm be provided the opportunity for a review of the final design and specifications in order that our recommendations may be properly interpreted and implemented in the design and specification. If our firm is not accorded the privilege of making the recommended review we can assume no responsibility for misinterpretation of our recommendations.

This concludes our letter. Please do not hesitate to contact us if you have any questions or concerns about this letter.

Sincerely,

PACIFIC CREST ENGINEERING INC.

Erik N. Zinn
Principal Geologist
P.G. #6854, C.E.G. #2139

Attachments: References
Plates 1 and 2 excerpted from 2018 Zinn Geology report (back of letter)
Plate 1 – Map Showing Upper Terrace Borings For Slope Stability

ZINN GEOLOGY
3331 Glen Arbor
Santa Cruz, CA 95062
Tel: 831.334.4833
ezinn@gmail.com

GEOLOGIC SITE MAP

Peace United Church - Envison Housing
900 High Street
Santa Cruz, California

Date: 2 July 2018	Revised:
Job #2018011-G-SC	
Scale: 1"=10'	**Plate 1**
Drawn by: ENZ/enz	

CERTIFIED ENGINEERING GEOLOGIST
ERIK N. ZINN
No. 2139
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
ERIK N. ZINN
No. 6854
STATE OF CALIFORNIA

284' - 11"

A'

A

B'

B

Qmt/mar

UPPER MEADOW

40' - 0"

70' - 0"

72' - 0"

15' - 6"

170' - 6"

TYP

QUARRY SLOPE

QUARRY SETBACK

60' - 0"

recommended geologic setback from top of steep slope/steep quarry wall

top of steep quarry wall/top of steep slope

LOWER LOT

B1	332	10'	322
B2	329	24'	305'
B3	329	9'	320
B4	329	9'	320
B5	332	6'	326
B6	332	6'	326
B7	332	7'	325
B8	331	10.5'	320.5
B9	332	7'	325
B10	330	12	318

325 320 315 310

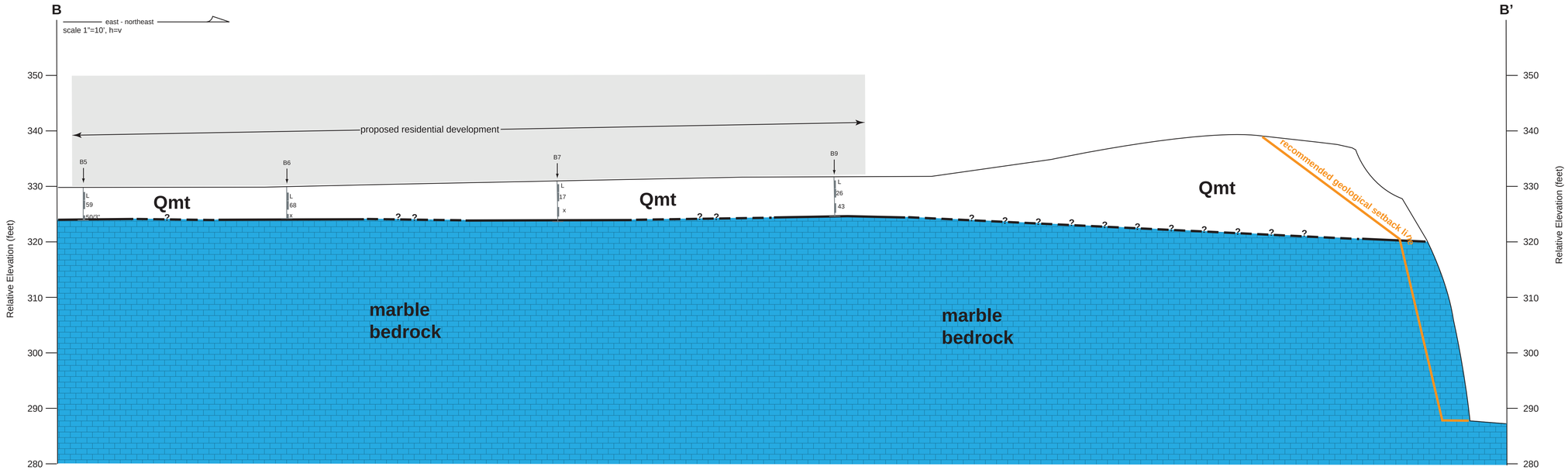
EXPLANATION

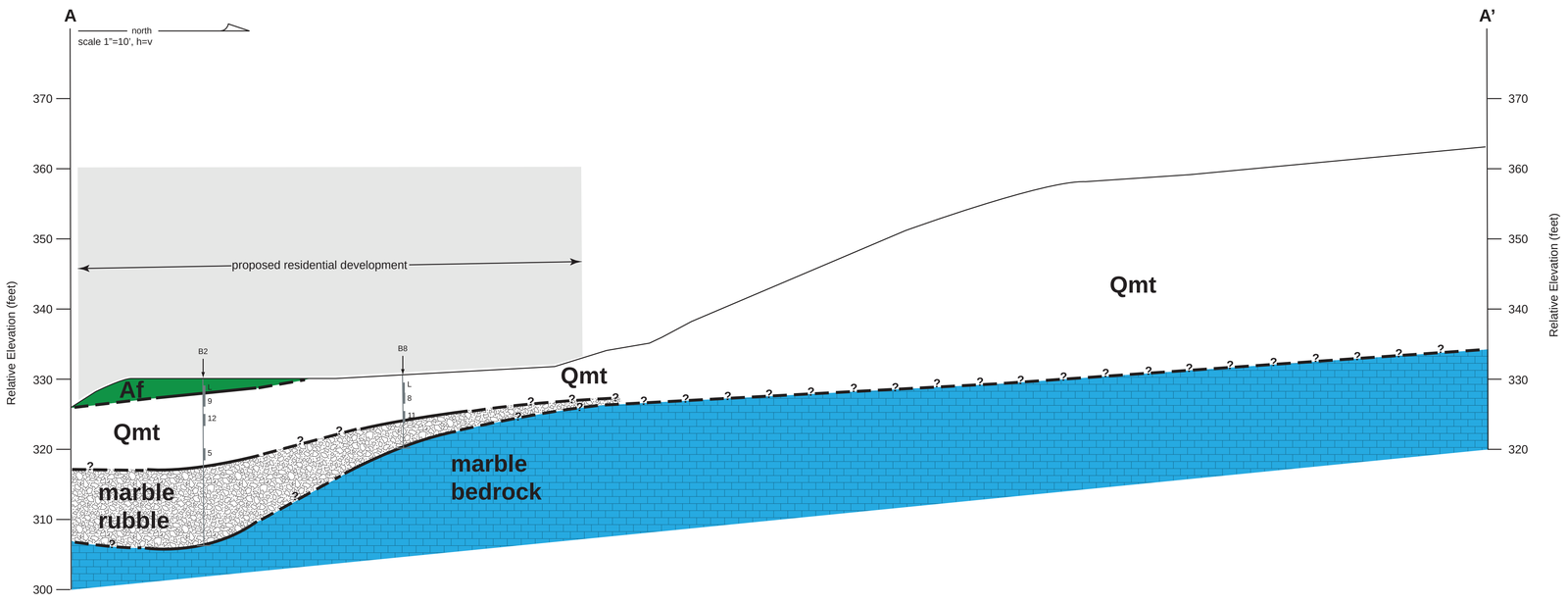
- **B10** — 330 / 12 / 318 — Small-diameter borings advanced for this project; the elevation of the boring, the depth below the ground surface at which intact marble bedrock was encountered and the elevation at which intact marble bedrock was encountered is beside the boring symbol.
- Intact marble bedrock surface elevation contours; five-foot contour interval; hachures point downslope within closed depressions in bedrock.
- Dolines containing relatively soft soil that pose a risk to the proposed development due to settlement or collapse
- **B** — **B'** — Line of geologic cross section; see Plate 2 for cross sections
- **Qmt/mar** — Marine terrace deposits underlain by marble bedrock

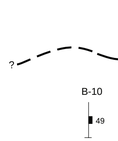
N W E S

0 5 10 20 Feet

BASE MAP: Excerpted from a digital copy of A00 titled "*Envision Housing - Peace United Church-Site Plan*", by David Baker Architects, dated 12 April 2018, intended publication scale: 1"=100'.







SYMBOLS

Interpreted contact between earth material units; queried where uncertain

Exploratory boring advanced by Dees & Associates; Small filled rectangles indicate where samples were taken; integers next to rectangles are blow counts for that sample, normalized to a Terzaghi sampler.

EARTH MATERIALS

Af Artificial fill

Qmt Marine terrace deposits

Marble rubble Marble rubble - angular gravel to boulder sized fragments of marble that have collapsed into doline

Marble Intact marble bedrock

NOTES

1. Marble rubble are shown only on cross section.

2. The configuration of the marble surface portrayed on our geologic profile does not exactly match the marble surface portrayed on Geologic Site Map (Plate 1). The marble surface contour map was used as a general guideline for the profile constructions. The karst geometry is conservatively interpreted on the profile; hence, the marble surface shown on the profile varies slightly from the configuration portrayed on Plate 1.

3. Final location and foundation depth of proposed buildings has not been decided upon as of the publication of this report. Buildings shown on this cross are schematic and are intended only to aid the reader in understanding where the building might approximately lie upon the existing ground surface with respect to the underlying geologic structure.

CERTIFIED ENGINEERING GEOLOGIST
ERIK N. ZINN
No. 2139
STATE OF CALIFORNIA

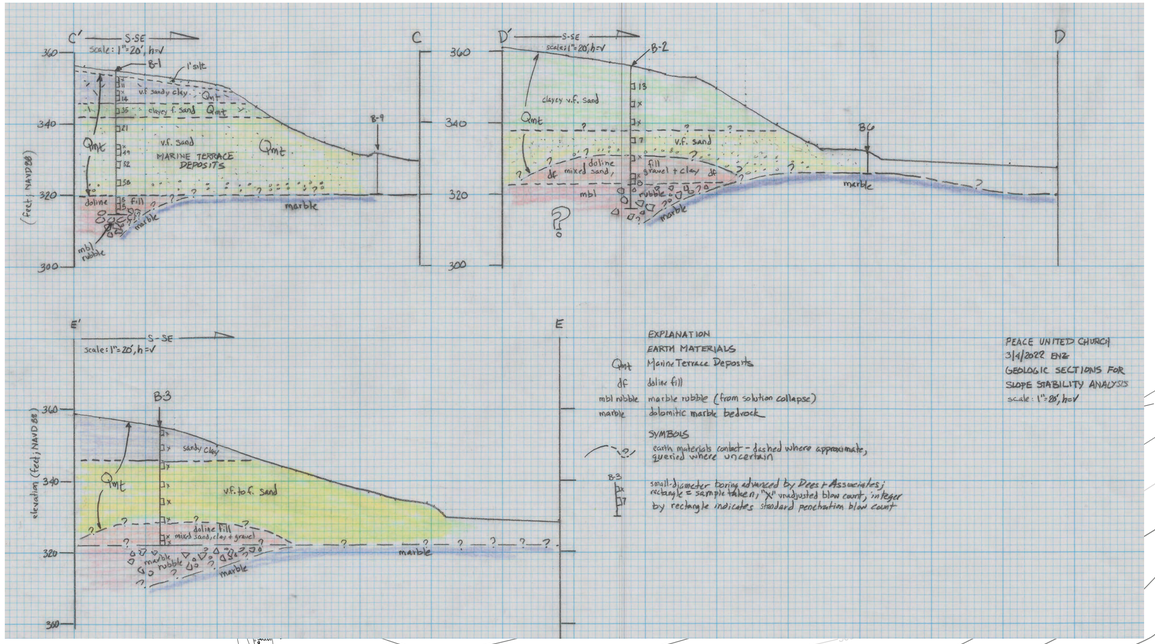
PROFESSIONAL GEOLOGIST
ERIK N. ZINN
No. 6854
STATE OF CALIFORNIA

ZINN GEOLOGY
2211 30th Avenue
Santa Cruz, CA 95062
Tel. 831.334.4833
enzinn@gmail.com

GEOLOGIC CROSS SECTIONS

Peace United Church - Envison Housing
900 High Street
Santa Cruz, California

Date: 2 July 2018	Revised:
Job #2018011-G-SC	
Scale: 1"=10', h=v	**Plate 1**
Drawn by: ENZ/enz	



CERTIFIED ENGINEERING GEOLOGIST
ERIK N. ZINN
No. 2139
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
ERIK N. ZINN
No. 6854
STATE OF CALIFORNIA

ZINN GEOLOGY
2221 40th Avenue
Santa Cruz, CA 95062
Tel. 831.334.4833
enzinn@gmail.com

MAP SHOWING UPPER TERRACE BORINGS FOR SLOPE STABILITY

Peace United Church - Envison Housing
900 High Street
Santa Cruz, California

Date: 6 March 2022 Revised: 7 March 2023
Job #2018011-G-SC
Scale: 1"=20'
Drawn by: ENZ/enz

Plate 1