CROSBY HOUSE

STRUCTURAL OBSERVATION & ASSESSMENT

SARGENT
Sargent Engineers, Inc.
320 Ronlee Lane NW
Olympia, WA 98502
Tel 360-867-9284

For: City of Tumwater

Observation Dates:
Feb. 9th, 2021 & July 7th, 2021

INTRODUCTION

STRUCTURE DESCRIPTION

The Crosby House was built by Nathaniel Crosby III circa 1860 and is located at 702 Deschutes Way, Tumwater, WA. The house is currently owned by the City of Tumwater and is listed on the Tumwater Register of Historic Places. In 2007, foundation repairs were made to the structure, including the installation of a perimeter strip footing and CMU stem wall.

SCOPE OF WORK

The Crosby House is exhibiting signs of settlement in the form of cracking and distress to the interior finishes of the house. Sargent Engineers Inc. has been contracted to perform a structural assessment of the house in order to determine if structure movement is on-going.

A site visit to the house to observe the visible structural framing systems and areas exhibiting signs of movement was conducted on February 9th, 2021. We performed an initial elevation survey of the structure using a liquid level, which gives relative elevations of the features surveyed. A follow-up site visit was performed on July 7th, 2021 to repeat the elevation survey and determine if the framing systems had moved since the initial survey.

OBSERVATIONS

During the initial site visit, we visually observed the first and second floors, perimeter foundation, crawl space, and attic space looking for anything which could be contributing to the cracking and distress to the interior finishes. We then used a manometer water level to take relative elevation measurements throughout the first and second floors.

During the follow-up site visit, we again observed the perimeter foundation and crawl space then repeated the relative elevation measurements looking for any additional settlement.

INITIAL SITE VISIT

VISUAL OBSERVATION:

The first and second floors living spaces show signs of settlement which include cracks in the wall and ceiling finishes, sloped floors, sagging doorways, and areas of springy floors.

The second-floor attic space which is accessed through a hatch in the store room revealed evidence of a previous fire near the chimney. This chimney had been repaired and while doing so a section of one of the roof joists had been cut out. The section of joist remaining below the chimney is now supported by a vertical 2x4 placed between the roof joist and floor joist. The portion of cut roof joist above the chimney is being supported by a 4” wide strip of plywood which spans to the adjacent joists on either side.

The exterior of the perimeter foundation was visually observed; however, no obvious signs of differential settlement, such as significant cracks, were observed.

The crawl space was entered through the access hatch at the northeast corner of the house. There is a plastic vapor barrier covering the ground, no insulation between the floor joists, and insulation wrapped duct work running throughout. The perimeter foundation consists of a CMU stem wall supported by a continuous concrete footing, that was not visible for inspection, constructed in 2007. Scattered throughout the crawl space are several intermediate support points that consist of timber posts attached to 11''x11''x8'' precast concrete blocks that support beams of varying span lengths that act to support the floor joists. These concrete blocks and timber posts are assumed to be part of the 2007 repairs. Additions were made to this building over time and as a result the location and spacing of the interior support blocks is rather inconsistent throughout the crawl space.

The grout pad on top of the CMU stem wall is missing sporadic sections with a few areas where the reinforcing is exposed. There were no obvious signs of differential settlement in the perimeter foundation or CMU stem wall.

Several of the intermediate support blocks are buried to the point that the bottom of the untreated timber post is several inches below ground. Along the western most perimeter wall below the kitchen, the excavation that was done when the perimeter foundation was installed left a few interior post footings nearly undercut (see photo to right).

The original floor joists are in generally poor condition. There are many that are very soft and crumble when touched. These joists are also peppered with small pin holes which may be an indication of insect infestation. The ends of the joists were notched up to 1.5 inches when the perimeter foundation was replaced.

As we progressed through the crawl space from the northeast corner to the west side the ground became looser and looser. There is an abandoned well located in the northwest corner under the kitchen. A significant amount of rodent activity is present throughout the crawl space. Rodent activity includes excrement, chew holes in the insulation of the duct work, dead rodents, and live rodents running about.

RELATIVE ELEVATION MEASUEMENTS:

The manometer water level works on the principle that water will equalize to the same level across a connected conduit, whether in the natural environment or a tube. The manometer applies this principle to measure elevation differentials across horizontal surfaces. The manometer base unit was placed on the front porch concrete slab for the first-floor measurements. The entire first floor was surveyed by taking multiple measurements around the perimeter and interior spaces of each room. The highest point was found near the midpoint of the north wall in the sitting room. This point was labeled as 0.0" causing all remaining points to read as a negative value. The lowest point was found in the southwest corner with a relative elevation of -7.9" (see Appendix). The manometer base was then moved to the second floor and placed near the top of the stairs. The second floor was surveyed in a similar fashion as the first floor. The highest point of the second floor was found at the midpoint of the north wall directly across from the stairs. The lowest point was found in the southeast corner of bedroom 3 with a relative elevation of -4.7".

FOLLOW-UP SITE VISIT

VISUAL OBSERVATION:

The exterior of the perimeter foundation was visually observed again but still no obvious signs of differential settlement were observed.

The follow-up observation of the crawl space found no noticeable changes to the structure. The floor joists are still peppered with holes and in generally poor condition (see photo to right). The bottom 1/3 of multiple floor joists have severe deterioration such that you can squeeze and crush the wood with your hand. This is most noticeable along the south wall below the stairs. It's evident that a pest specialist had been in the crawl space since the initial visit with the presence of rodent traps and vent screen repairs.

RELATIVE ELEVATION MEASUEMENTS:

The relative elevation measurements for the entire first and second floors were repeated. Great care was taken to utilize the same locations for all monometer measurements in order to get the most accurate comparison between the two visit's measurements. The highest point was found at the same location as on the initial visit and found to be 0.1" lower than previously measured. The lowest point was found in the southwest corner just as before with a relative elevation of -8.1" (see Appendix).

COMPARING DATA FROM THE TWO VISITS

RELATIVE ELEVATION MEASUEMENTS:

The front porch of the Crosby House is a concrete slab on grade and this is the location we chose for the monometer base unit. All measurement comparisons are based off the assumption that this porch slab did not settle during the 5 months between visits. If this slab settled even 0.10", it would have a big impact on our findings.

After comparing the relative elevation measurements from the first visit to the second, it appears that there is significant active settlement occurring (see Appendix). The first floor has areas that settled as much as 0.20" with most areas settling an average of 0.11".

The location of the base unit for measuring the second floor (at the top of the stairs) is likely to have settled at least 0.10", looking at the amount of settlement directly below it on the first floor. This makes comparing the measurements of the second floor unlikely to give us an accurate picture of where the movement is occurring.

CONCLUSION AND RECOMMENDATIONS

The fact that we were able to measure up to 0.2" of new settlement over a five-month time period indicates that some significant movement is actively occurring. The house is significantly out of plane with up to 8" of difference from the highest point to the lowest on the first floor. Approximately two inches of that difference is presumably as-built as the kitchen was originally a porch that had a sloped floor which was likely never corrected prior to it being enclosed and converted to living space. Another contribution to the unlevel floors likely occurred prior to the construction of the new perimeter foundation in 2007. Any of the slope in the floor would have been locked into place with this new foundation. This could explain why there are no significant cracks in the exterior CMU stem walls. The 2007 foundation plans called for 24"x24"x7.5" footings at the intermediate support points scattered throughout the crawl space. The currently in place 11"x11"x8" precast concrete blocks are likely inadequate and can possibly be settling. The 0.2" of new settlement we measured is likely the result of multiple factors. In order of likelihood of being a significant contributor of the settlement, these factors include:

- Damaged/decayed wood crushing
- Interior support posts settling
- Perimeter foundation settling
- Seasonal swelling and shrinkage

Any attempt to make this house level would likely cause more damage and issues then it would solve. On that same note, allowing it to continue to settle at this rate is even worse for the structure. The highest priority for repair recommendations is to stop the insect activity as much as possible within the framing of the house and have a more in-depth inspection of the wood members of the house. After that is complete, we recommend the house be monitored every 6 months, including ongoing elevation measurements, until a plan to strengthen the compromised floor framing and foundations is implemented. The next set of elevation measurements should include a mapping of all interior posts and beams and special care taken to get measurements directly above supporting element. This will allow for a better understanding of what elements are causing the most movement.

Respectfully,
Sargent Engineers, Inc.

Chet Kocan, PE
Project Engineer

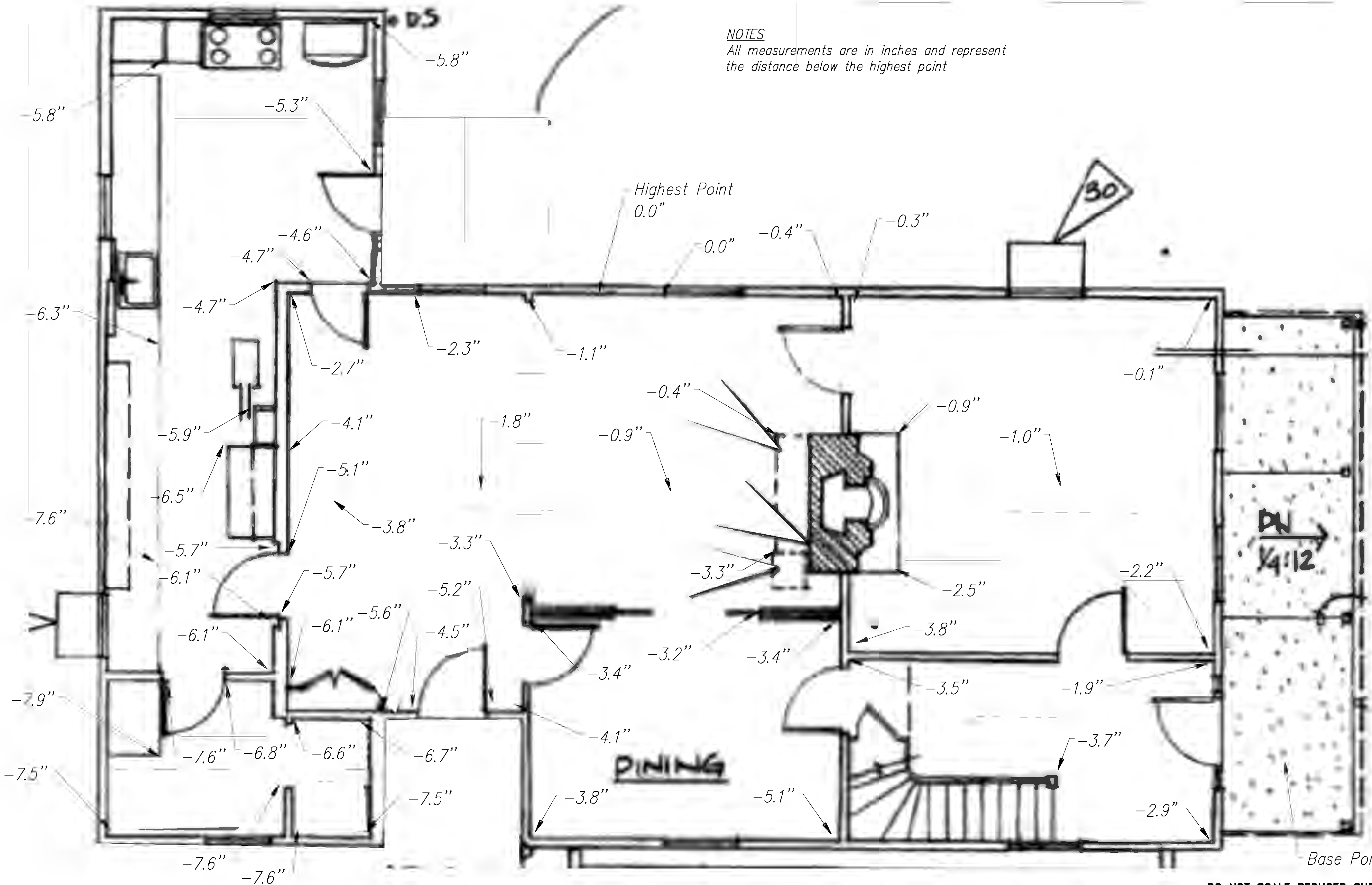
8/27/2021

CBK
B:\19Files\A19101.03 Crosby House Assessment\Crosby House Assessment Report-Final.docx

APPENDIX

RELATIVE CHANGES IN ELEVATION LAYOUTS

NOTES
All measurements are in inches and represent the distance below the highest point



DO NOT SCALE REDUCED SHEETS

PLAN CHECK	DATE				
DESIGNED BY: R.W. Larsen					
CHECKED BY: C.B. Kocan					
PRJ DRAFTER: R.W. Larsen					
DETAILED BY:					
DETAILED BY:					
ISSUED:	7/30/2021	DATE	NO.	REVISION	BY

FEDERAL AID PROJECT NO.
C.R.P. NO.

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CITY OF TUMWATER

FIRST FLOOR INITIAL VISIT

CROSBY HOUSE ASSESSMENT

THURSTON COUNTY, WA

S1.0

S1.5

A19101.03

NOTES
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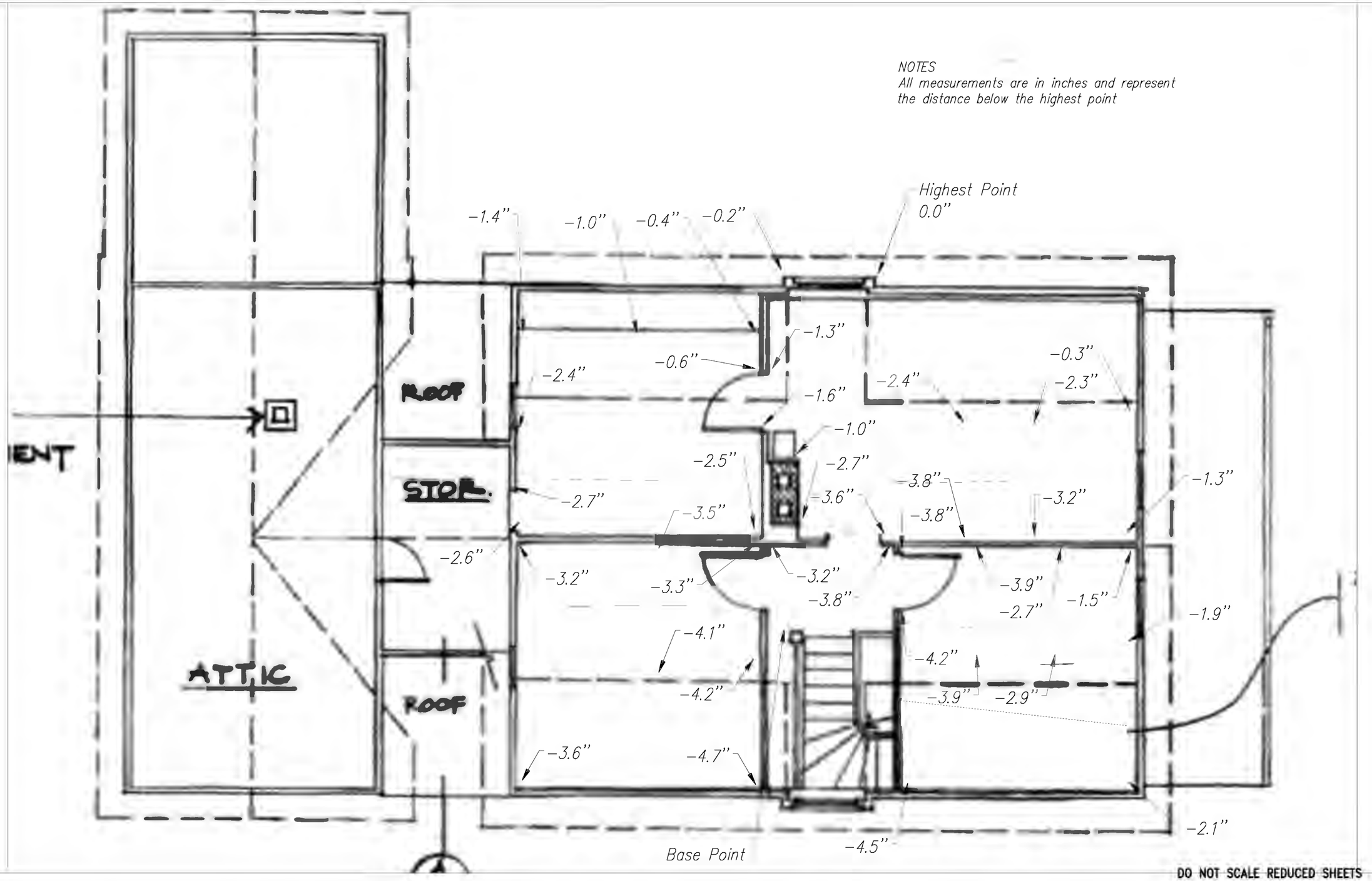

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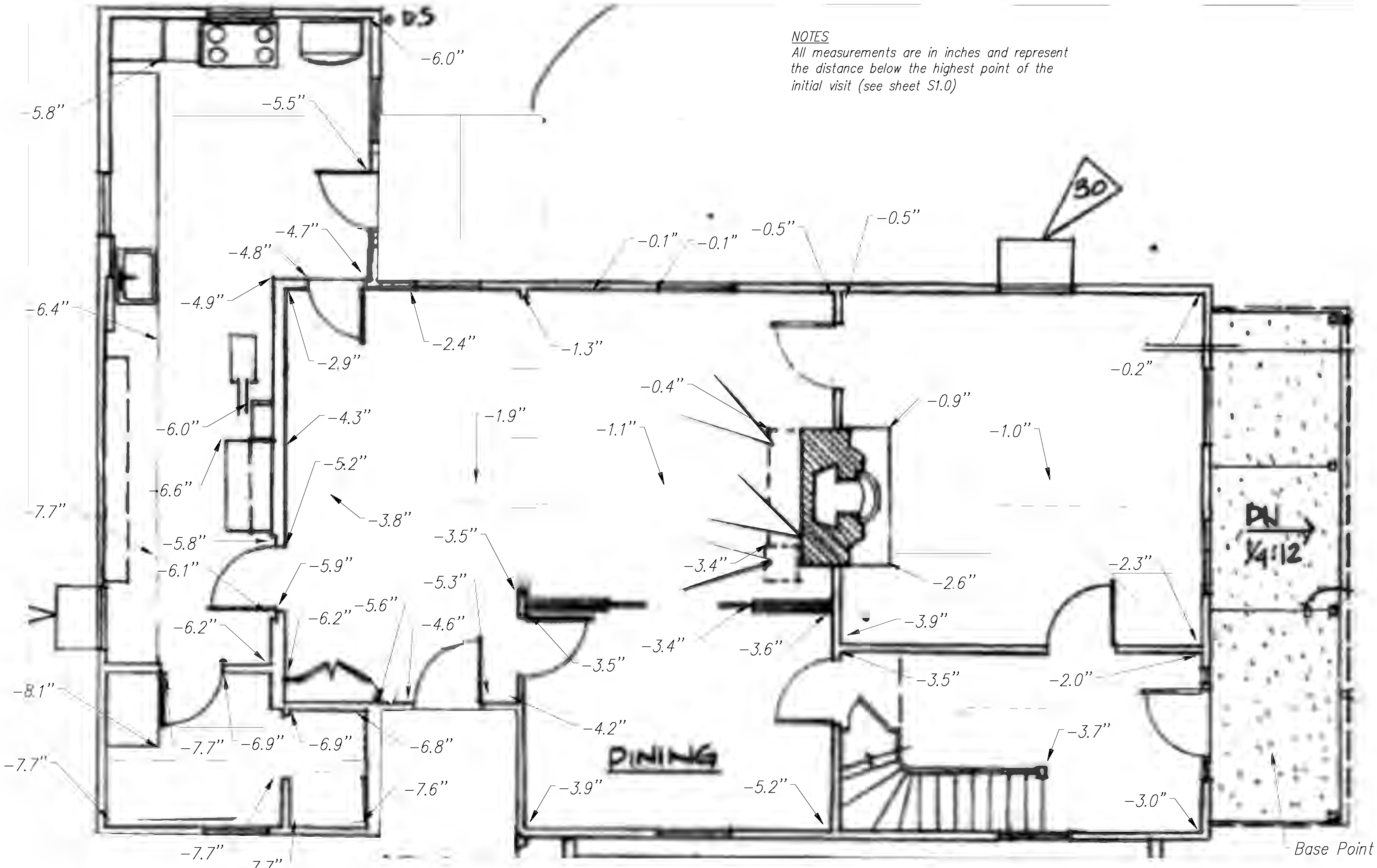
SECOND FLOOR INITIAL VISIT

CROSBY HOUSE ASSESSMENT

THURSTON COUNTY, WA

S1.1
S1.5
A19101.03



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CITY OF TUMWATER

FIRST FLOOR FOLLOW UP VISIT

CROSBY HOUSE ASSESSMENT

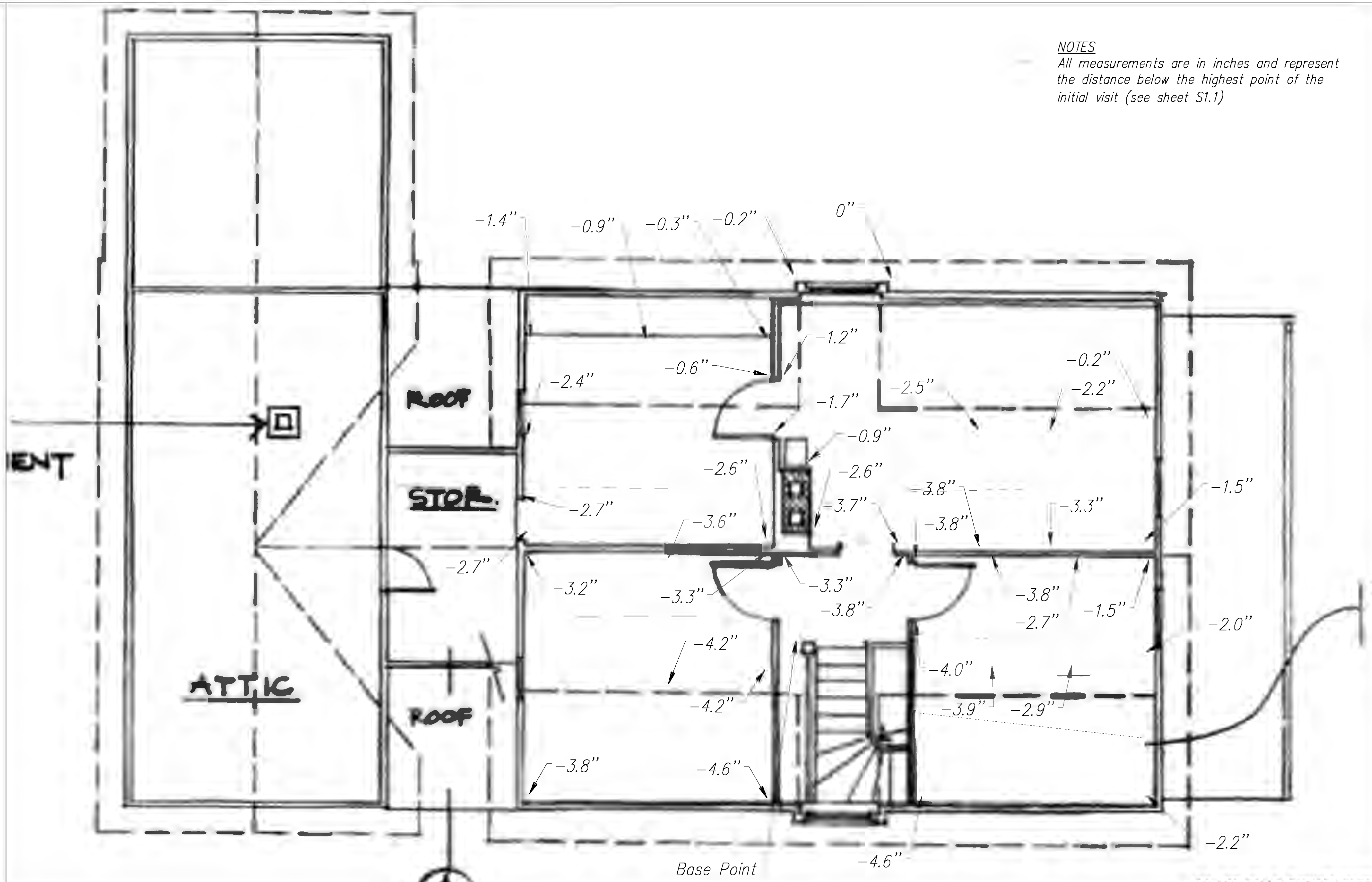
THURSTON COUNTY, WA

S1.2

S1.5

A19101.03

NOTES
All measurements are in inches and represent the distance below the highest point of the initial visit (see sheet S1.1)



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SECOND FLOOR FOLLOW UP VISIT

CROSBY HOUSE ASSESSMENT

THURSTON COUNTY, WA

S1.3

S1.5

A19101.03

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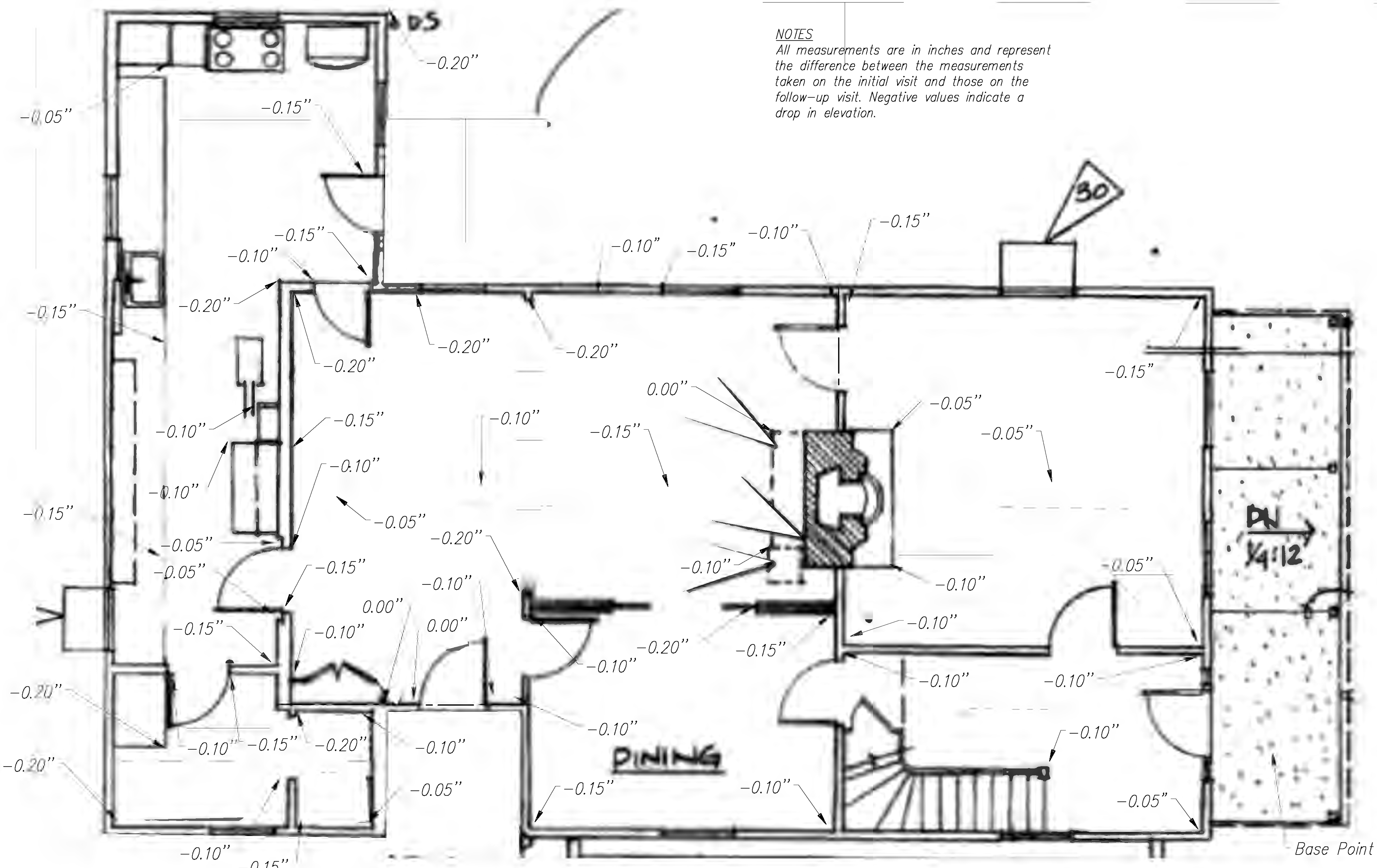

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CITY OF TUMWATER

FIRST FLOOR COMPARISON

CROSBY HOUSE ASSESSMENT

THURSTON COUNTY, WA

S1.4

S1.5

A19101.03

NOTES

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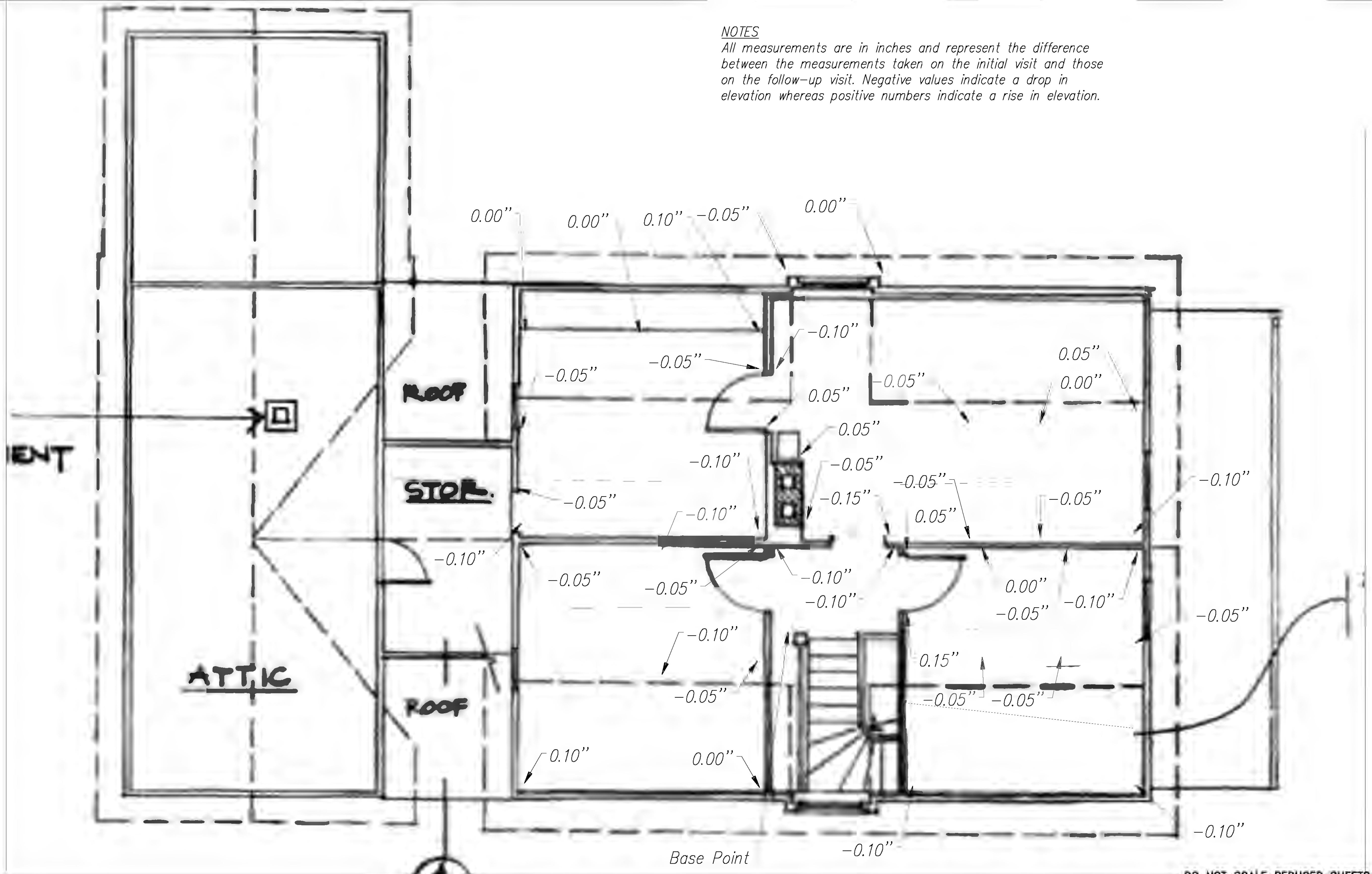

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CITY OF TUMWATER

SECOND FLOOR COMPARISON

CROSBY HOUSE ASSESSMENT

THURSTON COUNTY, WA

S1.5

S1.5

A19101.03