September 26, 2022

To	City of Ukiah		
Copy to	GHD Files		
From	GHD	**Tel**	+1 415 283 4970
Subject	City of Ukiah FEMA Map Revision Review	**Project no.**	12589077

WORKING DRAFT MEMORANDUM

1. Review Summary

This memorandum summarizes GHD's preliminary review of the Mendocino County Map Revision (Orrs, Gibson, Doolin and Zone AE) Updates, prepared by FEMA Region 9 presented to the City of Ukiah (the City) on August 16, 2022. This review included the preliminary Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) dated April 29, 2022, and the hydraulic analysis model and data provided by the FEMA's STARR II contractor team on August 2, 2022.

The preliminary FIRM shows changes on the floodplain extent in the City. In general, the preliminary FIRM shows additional floodplain areas especially for Zone A and Zone AE. For example, in FIRM panel 06045C1514, a significant portion of urban area between Orrs Creek and Gibson Creek are remap as floodplain Zone AE, as shown in Figures 1 and 2. The changes are partly due to a different hydraulic analysis approach in this floodplain area. The hydraulic analysis for the effective FIRM was based on one dimensional (1-D) creek modeling. The new hydraulic analysis for the preliminary FIRM included a limited two dimensional (2-D) floodplain modeling to provide additional resolution to the floodplain routing and flow exchange between Orrs Creek and Gibson Creek. These updates of floodplain extents in the preliminary FIRM may trigger new flood insurance requirements in the area.

GHD completed a preliminary review of the hydraulic analysis, and identified a number of areas where additional clarification is needed to better understanding the accuracy and precision of the analysis. The project team recommends the City to contact FEMA and its STARR II contractor team, to discuss the review comments and seek additional information to validate the remapping findings and to identify next steps to plan, to manage, and to communicate floodplain mapping changes to the community.

The following section summarized the technical review comments on the preliminary FIS, FIRM, and hydraulic analysis.

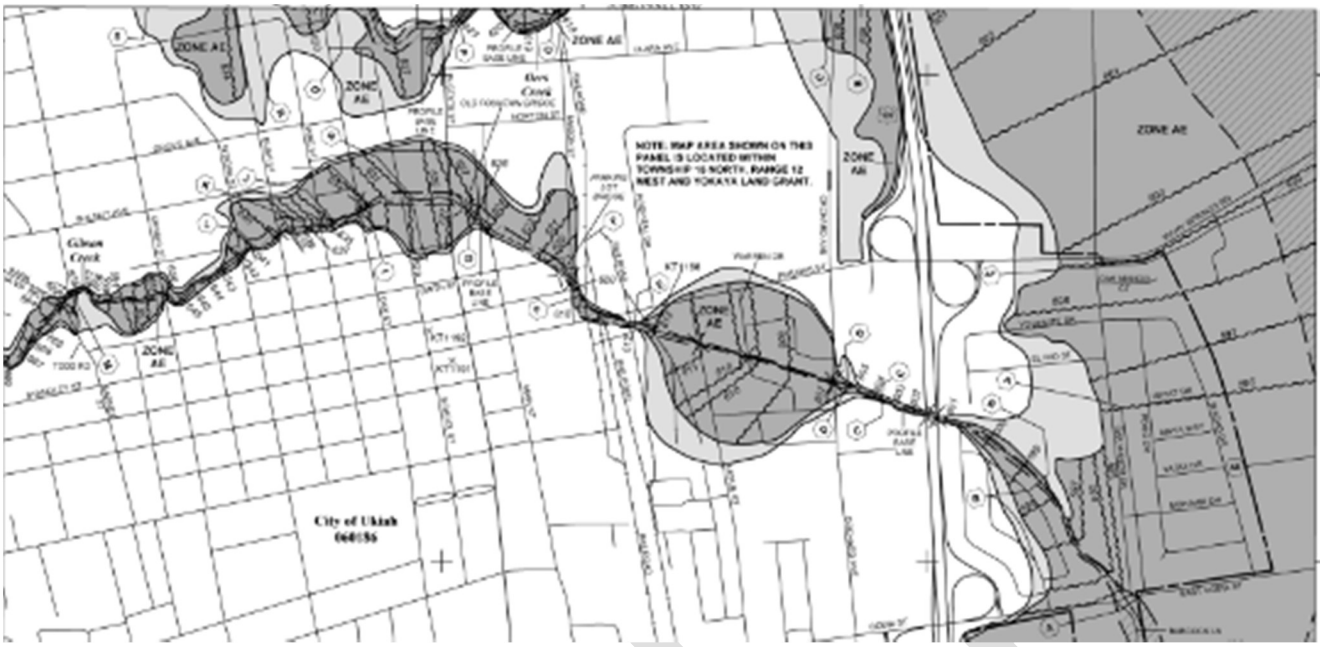

Figure 1. Effective FIRM Panel 06045C1514F (June 2, 2011)

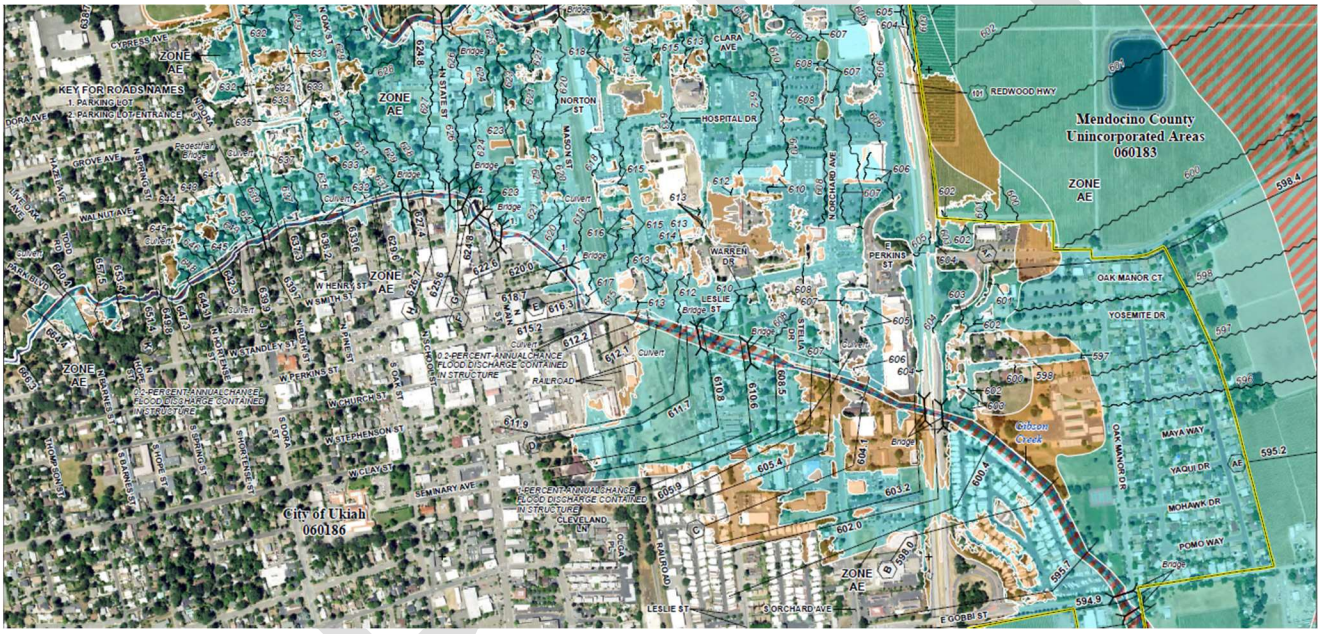

Figure 2. Preliminary FIRM Panel 06045C1514G (April 29, 2022)

2. Review Comments

2.1 Flood Insurance Study Comments

There are a number of information missing from the preliminary FIS reviewed. The review team would like to discuss the study with the FEMA's STARR II contractor team for additional information.

2.2 Flood Insurance Rate Map Comments

As a standard of practice, a workmap should be provided that shows the effective floodplain and floodway and the revised and included in the Hydraulic Report. An example is provided below.

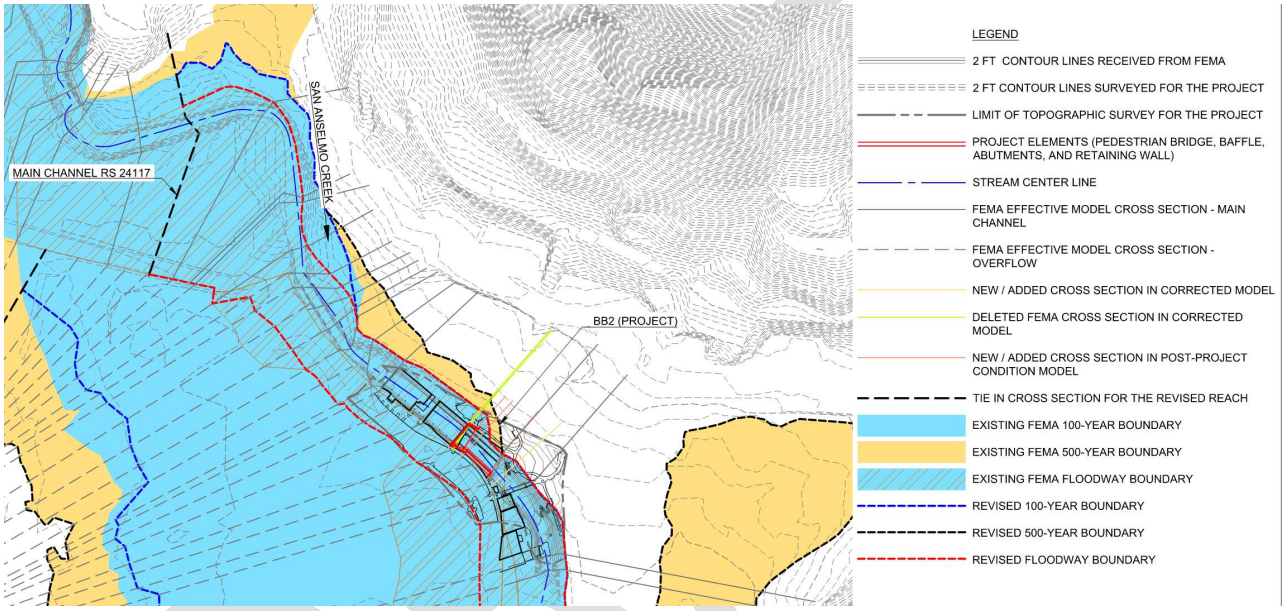

Figure 3. Workmap Example

The workmap is an important tool for the review team to identify areas of changes in floodplain and floodway boundary. The review team would like to request this additional information from the FEMA's STARR II contractor team for review.

2.3 Hydraulic Analysis Comments

Orrs, Gibson, and Doolin Creek are represented by three separate 1-D HEC-RAS hydraulic models. The below section summarizes the comments based on a review of the three models. In addition, Orrs Creek and Gibson Creek share a floodplain with intermingled flow. A separate 2-D model was developed to analyze the prominent flow paths. Comments on the 2-D model are included below as well.

Orrs, Gibson, and Doolin Creek Model Comments

1. Provide additional information on how the models are calibrated or verified for its accuracy.
2. The model domains for Orrs, Gibson, and Doolin Creeks extend to the confluence with the Russian River. The portion of the creeks between Hwy. 101 and the Russian River is within the Russian River floodplain and it seems that the Russian River would have a hydraulic impact on all three Creek profiles in this area. However, a normal depth downstream boundary condition was used for Orrs, Gibson, and Doolin Creek, so it is not clear if consideration was given for the effect of the Russian River on the creek profiles. We would recommend that a coincident peak analysis be completed to justify the normal depth boundary condition.

3. The models were run with a subcritical flow regime, however, there are several places where the model defaulted to critical depth because a subcritical solution could not be found. The channel may have areas with supercritical flow that are not accurately captured by running with a subcritical flow regime. While we understand that model runs in subcritical flow regime usually yield a more conservative water surface elevation estimate, we would recommend that the models be run in mixed flow and a comparison be made with subcritical flow.

4. Cross-sections were extracted from 10-ft grid LiDAR and only in limited instances updated with survey data. 10-ft grid LIDAR may not be sufficient to capture the channel geometries and may impact channel capacity. We recommend that any surveyed cross-sections be compared to 10-ft grid cross-sections and the cross sections used in the effective FIS, to show the difference in a figure as part of the Hydraulic Report. This will provide an understanding of the limitations of the 10-ft grid.

5. Based on the hydraulic profile for the Doolin Creek, it appears that many of the bridges and culverts along the channel are constrictions and control the upstream hydraulic profile as shown in Figure 4. All these structures are overtopped during the 100-yr flow, so the elevation of the bridge deck/roadway and the structure opening may have significant impacts on the hydraulic profile upstream of the structure. Per the Hydraulic Report, these structures were all surveyed, but we wanted to highlight this observation in case there is any uncertainty in the geometry of the structures.

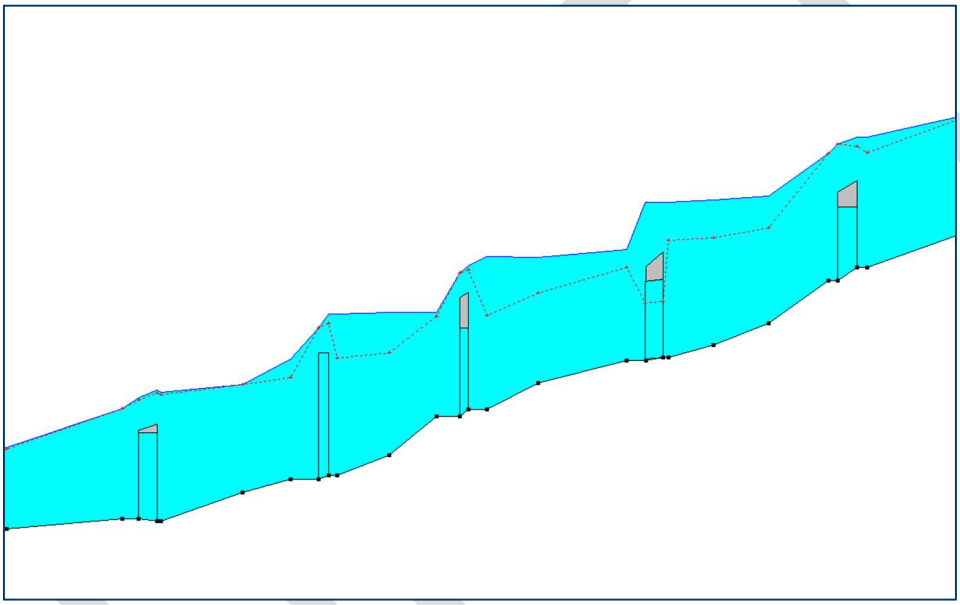

Figure 4. Hydraulic profile (100-yr) of section of Doolin Creek showing bridges/culverts controlling HGL

6. The Orrs Creek 1-D HEC-RAS model has two cross-sections with contraction and expansion coefficients set at 0.6 and 0.8 respectively. The accompanying report does not include a justification for these values.

7. The Hydraulic Report describes the efforts used to determine the floodplain flow mingling between Orrs Creek and Gibson Creek. In an effort to evaluate the intermingling between these two creeks, a separate HEC-RAS 2-D model was created of the floodplain between the creeks. Figure 5 shows the model domain. The following comments apply to the analysis of this process:

    a. This hydraulic analysis did not include an update to the watershed hydrology. The 2-D model rebalanced flow between Orrs Creek, Gibson Creek, and the floodplain between the two creeks. Table 1 shows the flow comparison between effective FIS and preliminary FIS. While Orrs Creek has slight increase in flow, Gibson Creek has over 200 cfs flow reduction.

Table 1. 100 Year Flow Between Effective and Preliminary FIS		
Stream	**Effective FIS**	**Preliminary FIS**
Gibson Creek	954 cfs	725 cfs
Orrs Creek	2,940 cfs	2,985 cfs
Doolin Creek	2,160 cfs	2,160 cfs

b. The 2-D model uses normal depth boundary conditions at the downstream extents. The normal depth assumption may be artificially lowering the hydraulic grade line through the model area. It would be a more appropriate to use the Russian River 100-year water surface elevations (WSE) depending on the outcome of a coincident peak analysis.

c. The 2-D model only includes the right overbank area of Orrs Creek and left overbank of Gibson Creek. The creek channels are not included in the model area. The input peak flow to the 2-D model area is derived from the 1-D model domain. This appears to be an iterative process where the intermingling of floodplain flow would impact the WSE in each creek which would impact the flows leaving or entering the creeks.

d. Overall the development of two separate HEC-RAS models induces complexity and a large number of assumptions that could be avoided if Orrs Creek and Gibson Creek were modeled with one large 2-D model.

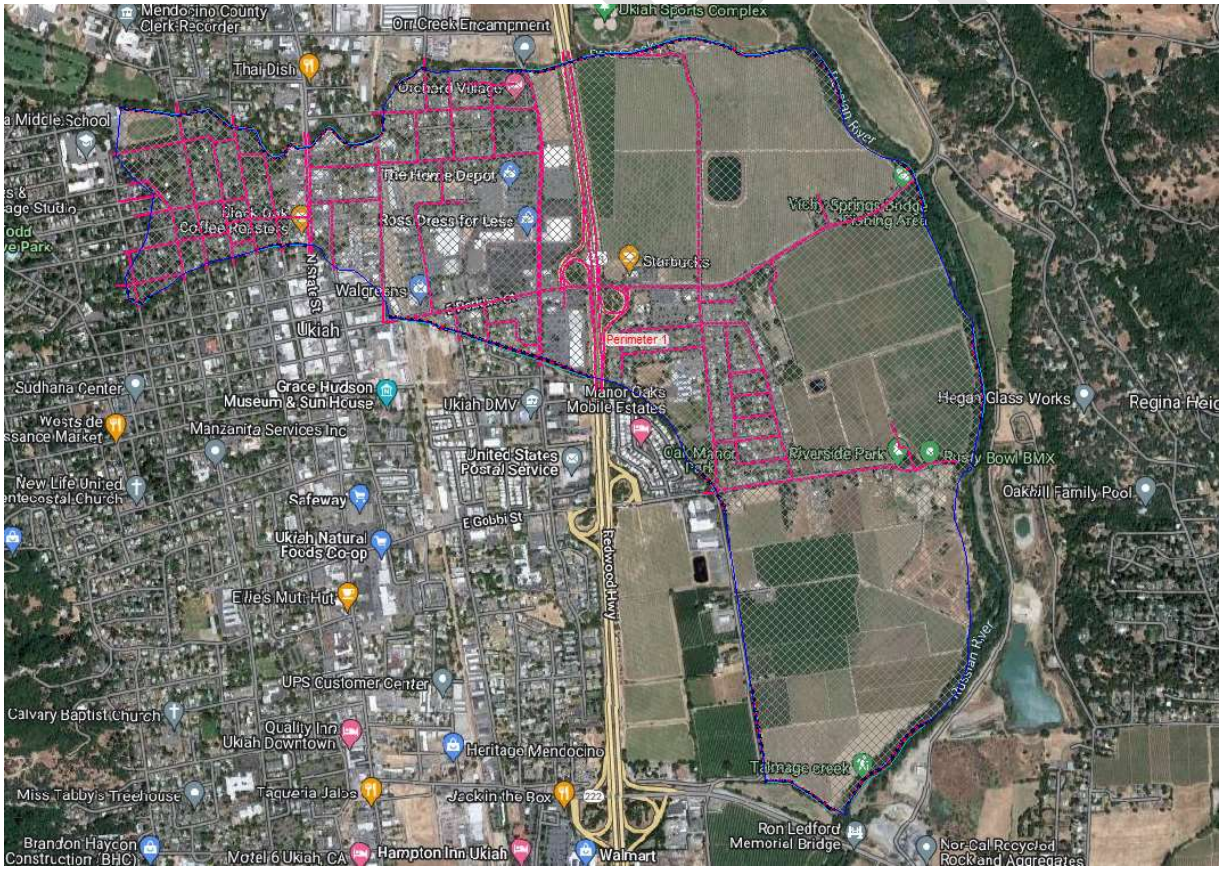

Figure 5. 2-D model domain for the Orrs Creek/Gibson Creek intermingled floodplain flow