Tasks 1 and 2 – Existing Conditions Analysis Memorandum & Coastal Groundwater Mapping and Graphics

Larry Walker Associates (LWA) will conduct a detailed analysis of the existing conditions beginning with data from the sources below:

- Department of Drinking Water (DDW), water quality reports
- Department of Water Resources (DWR), CASGEM water levels
- DWR, Well Completion Reports
- United States Geological Survey, Stream Gauges
- DWR, Dry Well Reporting System Data
- California Geologic Survey, Geologic maps
- Federal and state agencies, climate data, including evapotranspiration and rainfall
- Local agencies, water and wastewater infrastructure
- County Land Use Surveys

Data will first be used to identify the appropriate Study Area for the coastal groundwater study. The initial area evaluated should extend to the watershed boundaries for all streams that discharge to the Pacific Ocean on the Mendocino County coastline. The groundwater study area should include the marine terrace and streamside alluvial aquifers that are present at the coast and the bedrock groundwater aquifers that are tributary to them. Study Area boundaries will be hydrologic (watershed) and hydrogeologic in nature and will be accurately mapped future use. LWA will analyze data collected from within the study area and provide a narrative description of the hydrogeologic framework. The description will include:

- Geometry and structural controls of the alluvial and marine terrace deposits
- Delineation of alluvial/terrace aquifers and bedrock
- Evaluation of aquifer properties (e.g., saturated thickness)
- groundwater elevation
- groundwater storage
- water quality
- impacts of sea level rise on groundwater levels and stream flows
- potential for water quality degradation due to saltwater intrusion

The assessment of available data and existing conditions analyses will include the evaluation of data gaps and provision of recommendations for methods to fill those gaps. LWA's evaluation of these existing conditions, data gaps, and analytical approaches will be summarized in a Technical Memorandum that includes relevant groundwater maps and graphics.

- Data compiled for the Technical Memorandum will be stored in a GLA-Data database management system (DMS). GLA-Data uses a relational database (SQL Server) backend for storing tabular data and a representative state transfer (REST) server for storing spatial data.

LWA will use the information and data compiled, analyzed, and developed as described above to prepare maps and graphics that represent regional hydrology, topography, terrace and streamside alluvial aquifers, groundwater conditions, and other factors related to the Study Area. These maps and graphics will be related to the existing condition analyses and will be incorporated into the technical memorandum. All maps will be prepared using modern geographic information systems (GIS) software and data management techniques to provide usable, reproducible, and easily updated resources.

- LWA maps and graphics must clearly define the Coastal Zone using hydrology and hydrogeology and account for water district and local purveyor boundaries, land use, water sources, water use,

topography, and surface water features as well as supporting a basic hydrogeologic conceptual framework, to develop as-needed hydraulic models, and to support proof of water testing. Maps and graphics developed as part of this task will include:

- Historical and current land use
- Surface water watersheds and water bodies
- Water supply sources
- Water supply well locations and density
- Precipitation variation in space and time
- Climate monitoring station locations
- Potable water conveyance systems
- Wastewater collection systems
- Geologic and geomorphic maps
- Terrace and streamside aquifer locations and boundaries
- Localized aquifer parameters
- Sea level rise and saltwater intrusion potential

The Technical Memorandum produced will include a relevant narrative description and discussion of existing conditions along with maps and graphics. All maps and graphics generated will be included in the final report and may be used in additional tasks.

Task 1 & 2 Deliverables:

- Draft and final existing condition documentation Technical Memorandum including relevant groundwater maps and graphics submitted electronically in Microsoft Word and pdf formats.
- GLA-Data DMS with a user-friendly, web-based interface that presents available spatial and time series data associated with the project.

Task 3 – Hydraulic Model Development

LWA will develop several analytical models to support land use planning and well permitting decisions.

Watershed Model

LWA will engage with County staff to evaluate potential watershed-wide surface water model tools that could be developed to assess hydrologic conditions in all of the watersheds and streams that discharge to the Pacific Ocean along the Mendocino County coast. Potential platforms for a hydrology model include the United States Geological Society (USGS) Basin Characterization Model (BCM), effectively a simplified grid-based model framework that iteratively computes a water balance given a spatial extent and climate inputs. Additional platforms that will be considered include the United States Environmental Protection Agency (EPA) Better Assessment Science Integrating Point and Non-point Sources (BASINS) (currently in iteration 4.5) that utilizes national scale resources including the National Hydrography Dataset (NHD), National Land Cover Dataset (NLCD), and other datasets to efficiently represent surface water hydrology and translate these representations into other models such as the Watershed Characterization System (WCS), Soil and Water Assessment Tool (SWAT), and others. Both model platforms are likely to allow for the simulation of surface water conditions for areas contributing to the coastal zone in existing conditions and in future land use and climate change scenarios. The watershed model will be used to evaluate if and where the watershed is supporting the local coastal aquifer with more basin-wide recharge. These results will then be included in the more localized approaches.

Saturated Thickness Model

This Excel-based model will serve as the primary tool to assist County staff in determining whether a well proposed to supply a new development will be able to produce water during long dry seasons and multi-

year droughts. It will contain fields for entering selected information from the well completion report and the pumping test report. This information will be combined with values from look-up tables indicating the amount of water-level decline expected under intense and prolonged dry conditions. LWA will develop the look-up table values from available water-level hydrographs and structure the tables to facilitate the frequent addition of new data as they become available from recommended monitoring programs. The model will indicate the remaining saturated aquifer thickness above the bottom of the well screen at the end of the dry condition, and LWA will recommend a minimum thickness for County staff to apply.

Recharge Model

LWA will apply a one-dimensional rainfall-runoff-recharge model to various combinations of land cover, precipitation, soil type and slope to generate maps of annual recharge in normal, dry and critically dry years. For evaluating specific wells, County staff can determine the amount of recharge available to a well as a weighted average of the 1-D recharge rates in the area surrounding the well. To support land use planning, LWA will translate the recharge map into maximum densities of wells that can be supported by local recharge, with different densities for different well uses (residential, commercial, agricultural).

Climate Change Model

LWA will review available climate models and data sets for their applicability to the study area. The selected future time series of precipitation and evapotranspiration (ET) will be substituted into the recharge model to estimate recharge under future conditions. As with the existing conditions analysis, the resulting recharge maps can be used to evaluate individual wells and to recommend maximum development densities. The recharge model operates at a daily time step, which allows the effects of a shift to larger but less frequent storm events to be estimated, in addition to changes in average annual or drought period rainfall and ET.

Sea Level Rise Model

LWA will apply conservative assumptions about sea-level rise, regarding the inland water-table profile, to determine whether well depth and saturated thickness criteria developed for existing conditions will need to be modified for future conditions. The conceptual model for saltwater penetration up creek and river channels is that the slope of the channel approaching the ocean can be used to estimate the inland advance of saltwater for every increment of sea level rise. LWA will create maps showing where existing or future wells would be impacted.

Additional Modeling

As an option, LWA can work with County staff to identify, design, and implement additional phases of model or other analytical tool development to facilitate additional future planning.

Task 3 Deliverables:

- Draft and final model approach memorandum presenting selected modeling techniques and tools prior to model construction.
- Electronic Microsoft Word and .pdf drafts and final model technical memorandum with complete documentation of the modeling and associated analytical methodologies.

Task 4 – Land and Water Use Forecasts

LWA will work closely with County and other local municipal staff to bridge knowledge gaps in the Coastal Element and develop appropriate land and water use forecasting methodologies that are informed by their institutional knowledge. Utilizing information collected from County, local municipal, and other agency staff, LWA will develop and apply a quantitative land use forecasting framework that identifies parcels which will likely undergo land use change to permanent households, transient households (motels, hotels, vacation home rentals, campgrounds, and recreational vehicle parks), employment, retail activities, and major recreational sites. LWA will then evaluate the anticipated water demand associated with these potential land use changes for comparison to the available water supply from the models already developed.

Task 4 Deliverables:

- Electronic Microsoft Word and .pdf drafts and final technical memorandum presenting land use forecasts throughout the Study Area.

Task 5 – Proof of Water Testing Guidelines and Procedures

In this task, LWA will use the information developed in the preceding tasks and work with County staff to develop comprehensive guidelines for proof of water adequacy testing throughout the coastal groundwater zone. This task will also include review of historical proof of water testing procedures in Mendocino County and in other counties with similar programs.

The Saturated Thickness Modeling tool and the maps from all four hydraulic modeling analyses will be included in these procedures to provide the basis for evaluating the adequacy of water supply to a well under exceptionally dry conditions. In addition, and subject to participation, pumping tests will be requested as they are designed to confirm that a well is physically capable of producing the maximum day demand for the proposed domestic, vacation, commercial, or other development without reduced well performance or significantly impacting neighboring wells. The test should include concurrent water-level measurements at nearby wells, if those well owners opt to participate. If included, pumping test procedures will be clearly defined in the guidelines, including criteria to identify who is authorized to perform the tests and specific data collection and reporting requirements.

- Data collected during pumping tests would benefit ongoing updates and refinements to the Saturated Thickness Modeling tool for evaluating supply adequacy under dry conditions. Using the Saturated Thickness Modeling tool in combination with pumping tests could remove the requirement for dry season well testing, thus streamlining and simplifying the proof of water requirements for property owners and other planning permit applicants.

The pumping test guidelines will include tiered well yield requirements tied to water demand estimates that include all potable, non-potable, and fire flows while the proof of water guidelines will include procedures for testing and minimum yield and storage requirements for springs. The yields and required storage capacity for springs will be the same as those for wells and the testing procedures will primarily focus on demonstrating that the spring has been developed to capture and convey water.

Task 5 Deliverables:

- Electronic Microsoft Word and pdf format Drafts and final guideline document with the procedures, methodologies, and requirements for demonstrating adequate water from any well and/or spring proposed as water supply sources in the Study Area.

Task 6 – Problem/Issues Identification

Using the findings from hydraulic model development combined with land use forecasts LWA will identify locations of water supply shortage susceptibility within the study area, based on a range of future climate and development scenarios. This task also will examine problematic data gaps and provide recommendations to fill them. A series of vulnerability maps and descriptions of potential water supply capacity issues will be incorporated into a Technical Memorandum on Mitigation Measure Development and Recommendations associated with other tasks.

Task 6 Deliverables:

Deliverables for this task will be included in Task 7 and 8.

Tasks 7 & 8 – Development & Analysis of Alternatives, and Mitigation Measure Development & Recommendations

Across the study area, LWA will use the model tools developed and apply statistical methods that incorporate current conditions to identify the number of parcels prone to declining water levels under dry conditions. A

status quo scenario for the most vulnerable portions of the study area will involve running the models while incorporating development projections no mitigation in place. Alternative scenarios will center on mitigating the impacts of increasing density on groundwater resources through a variety of approaches, including more stringent water conservation policies, increasing surface water distribution capacity through public water system establishment or expansion, and strategic zoning restrictions. The specific alternatives for analysis will be developed in close consultation with the County and other municipal and local agency staff. The effectiveness of each mitigation measure will be evaluated by reviewing existing and estimated future conditions to assess potential water availability improvement associated with management alternatives.
Finally, a preliminary cost-benefit analysis will be conducted to rank the mitigation alternatives explored. This analysis will provide guidance to the County as to which alternatives will be most effective if implemented.

Task 7 & 8 Deliverables:
Electronic Microsoft Word and pdf format Drafts and final technical memorandum presenting potential problems and development issues, land use alternatives and associated analysis, and mitigation measures identified for each of the land use alternatives

Task 9 – Recommendations
While working on Tasks 1 through 8, LWA will develop recommendations focused on assisting the County and providing data and tools to conduct an ongoing planning process. Recommendations developed will include:

- Additional work that the County should consider bolstering land use
- Entitlement decision-making processes such as:
    - continued data collection for supplementing the proof of water testing procedures and criteria for wells, springs, and small water systems
- Reduced future demands including:
    - limitations on development density
    - localized conservation requirements
    - increased scrutiny on new water demand associated with lot splits
- Address data gaps identified during the study including:
    - additional location
    - capacity
    - use type
    - water quality
    - water level data from existing wells

Task 9 Deliverables:
Deliverables will be included in Task 10

Task 10 – Draft and Final Reports
LWA will prepare a comprehensive Final Report incorporating and documenting all preceding tasks. The Final Report will be a stand-alone document that includes all components of the project from the existing conditions documentation, mapping, and graphics, through recommendations. All interim work products will be incorporated and summarized in the text of the Final Report in sufficient detail to provide planning guidance to the County. LWA in conjunction with Mendocino County will host a stakeholder meeting to present and discuss study findings and incorporate any feedback into the final report. Complete copies of the interim work product will be appended to the Final Report to provide a comprehensive stand-alone document.

Task 10 Deliverables:

- Administrative draft Final Report in both pdf and Microsoft Word formats for County staff review
- Draft Final Report incorporating County comments from the administrative draft for stakeholder comment
- Final Report in pdf and Word formats incorporating stakeholder and County comments

Task 11 – Ongoing Meetings and Project Management

LWA will maintain routine communications with County personnel, including monthly progress meetings and reporting, maintenance of the overall project budget and schedule, including percent completion of tasks and monthly budget balance. Monthly progress meetings will be held virtually at a mutually agreed time and will include those team members with relevant contributions dependent on the work in progress or upcoming at the time of the meeting. Monthly progress reports will accompany invoices, including budget and project status details to allow the County to track progress by task. Progress reports will also present expected upcoming activities for all active tasks. In addition to these routine project meetings, LWA will also attend a meeting to present study findings and recommendations to the County Planning Commission and a separate meeting and presentation for the Board of Supervisors.

Task 11 Deliverables:

- Monthly progress reports
- Virtual Monthly Progress meetings
- Agenda and minutes for monthly meetings
- Schedule updates as needed
- In person presentation to County Planning Commission of the study summary, including findings and recommendations
- In person presentation to County Board of Supervisors of the study summary, including findings and recommendations