



WOOD RODGERS

TECHNICAL MEMORANDUM

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FROM: Michael C. Nowlan, P.E. *MCN*

DATE: April 3, 2008 – Revised June 23, 2009

SUBJECT: City of Colusa – Levee Overview

INTRODUCTION

There are many areas within the United States and California that are protected by levees from frequent flooding, and to some limited degree infrequent flooding. The City of Colusa (City) is no exception. With the country living in a “post-Katrina” flood management environment, population centers in close proximity to rivers with levees are being closely evaluated. Situated in the middle of the northern central valley, the Sacramento River abuts the City along its northern and eastern borders, creating a desirable river environment during the summer, but also a potential flood risk for the existing and future citizens of the City during periods of heavier precipitation. Many agencies and regulations, representing federal, state and local interests are involved in dealing with the regulatory oversight, maintenance activities, and future improvements of these levees. With the decision-making for future land use resting with the City, the City is also intimately involved in such “flood protection” issues. At the onset of the implementation of its new General Plan (2007), the City should be as well informed as possible of the various physical and regulatory constraints it faces as a governing body because levees and people are both present within its jurisdiction.

BACKGROUND

Wood Rodgers Inc. was hired by Ponticello Enterprises as part of the consultant team to serve the City’s engineering and planning needs relative to drainage and flooding. As part of this effort, it was clear that the assessment of the threat of flooding to the City must consider the levees that provide some degree of protection by “containing” flows within the adjacent Sacramento River channel and, in doing so, also raising the water levels interior to the levees. Prior to the levees being constructed, the Sacramento River spread out considerably more than it does today, conveying flow at a lower and slower level and flooding more area more frequently. It is unknown how much difference there is in maximum flood elevation given there are now dams and reservoirs upstream, attenuating flow within the river watersheds now contained by levees. The safety of the City’s citizens relative to potential upstream dam failures has already been addressed as part of the General Plan. In recapturing the historic floodplain, the flow within the levees is generally higher than land immediately outside of the levees, creating some level of risk to these lands.

The levees currently protecting the City of Colusa have yet to suffer catastrophic failure, but in the past they have had deficiencies identified and addressed related to erosion and structural degradation. There have been many recent presentations on the Sacramento River's influence on levees over time, and prominent experts agree that the Sacramento River channel is degrading due to upstream dams and reservoirs that are trapping sediment, and creating scour and incision of the channel. Over the long term, these conditions will not help the integrity of the levees, although with incision may come a slight lowering of the contained water surface elevations, the undercutting of the waterside toe (foundation) of the levee can also occur. These deficiencies are addressed in more detail in the sections relating to local jurisdictions.

REGULATORY OVERVIEW

Federal

The Federal Government oversees the administration of flood insurance through the National Flood Insurance Program (NFIP), administered by cooperative agreement between communities (cities and counties) and the Federal Emergency Management Agency (FEMA). FEMA agrees to provide mapping and flood insurance studies and supportive assistance for communities, when funding is available, to identify flooding hazards and to provide access to affordable flood insurance for citizens living within communities participating in the NFIP. Communities, as the building authority, agree to maintain control of changes to the floodplain within their jurisdictions by requiring studies and submittals for proposed development to mitigate negative impacts to flooding hazards where third-party properties are being impacted. Preventing injury or loss of life due to flooding is the priority for any city.

For many decades there have been areas where levees were assumed to protect lands behind them, where FEMA grandfathered the integrity of levees if they were constructed by its sister-agency the U.S. Army Corps of Engineers (Corps). Recently, the integrity of these levees has come into public question, particularly with the failure of levee systems designed by the Corps, such as in New Orleans during Hurricane Katrina, and with closer scrutiny of underseepage potentials.

Just prior to Hurricane Katrina, FEMA began addressing the issue of how much protection levee systems could be relied upon to provide, and released a Procedural Memorandum #34 (FEMA34, attached), which requires levees to be re-evaluated before the structural integrity can be relied upon to help protect properties from damage. In order for such levees to be considered certified and mapped as such under the NFIP, they must be proven to provide protection in accordance with the latest standards, with all necessary structural testing and analysis to support such claims. FEMA 34 clearly lays out a procedure for communities to establish if the levees are certifiable. If the levees cannot be certified, it provides the opportunity for FEMA to return and re-map areas with flood hazards where none were previously thought to exist. While there is no specific FEMA timeline for re-mapping flood hazards where levees should be treated as failed/removed, the procedural memorandum clearly defines this as imminent if communities cannot prove the levees protecting them are certified. FEMA's focus will first fall on urbanized areas where there

are large populations and significant inhabited properties potentially at risk. FEMA may not have a timeline for when it will reach Colusa, mostly because the effort is so great and federal funding is cyclical, but Colusa can be assured that its region will be evaluated some time in the future, particularly if the state takes an accelerated pro-active role with bond measure efforts (discussed below).

Corps Standards

Currently, the standards for evaluating the structural integrity of levees are established by the Corps. The process for establishing if a levee is certifiable is very involved. The interior (core) of the levee and subsurface (foundation) conditions must be tested, by boring into the levee at specific intervals and examining/testing/classifying the material within the levee. The levee must be measured to determine its structural cross-section dimensions as well as the physical conditions and geometric cross sections of the river on one side, and the elevations of the landside toe outward for some distance. All the physical conditions affecting the levee's ability to withstand flooding stresses are quantified, such as determining the expected flow and erosive conditions within the river, reviewing the vegetative conditions on the levee slopes (waterside and landside) and levee crown, identifying/documenting the inspection, operation and maintenance practices of a responsible overseeing entity, seismic conditions, underseepage and through seepage potential to boil and mobilize structural material out of the core of the levee, etc. Every aspect of potential failure must be examined and accounted for. Currently, the Corps takes all this information and performs a risk and uncertainty analysis to assert how much confidence can be placed in the levee to withstand adverse conditions. Formerly, levees were evaluated with design storm conditions and physical freeboard was added to account for uncertainty. FEMA has yet to officially accept the risk and uncertainty methodology, but both the Corps and FEMA are working together to come to a mutual decision on how best to consider a levee certified in the near future.

It must be made clear that FEMA does not certify levees. The Corps can certify a levee and submit the technical documentation to FEMA, whereby FEMA will accredit the levee as certified on its mapping. Qualified and licensed civil engineers can also certify levees on behalf of their clients (public or private) and submit the certification to FEMA for accreditation. If levees cannot be certified and accredited, lands immediately adjacent to these levees will be placed into the 100-year floodplain, as modeling and mapping is funded and completed, potentially affecting much of the City of Colusa and surrounding areas.

State

Currently the Central Valley Flood Protection Board (formerly the State Reclamation Board) has oversight of levees in the Central Valley. Its role is to oversee any proposed projects that will change the structural integrity or physical properties/dimensions of the levees under the state's jurisdiction, in an attempt to ensure that the existing levee integrity is not compromised. This authority was granted to the State Reclamation Board after the California agreed to operate and maintain the levees constructed by the Corps under its projects system. Not all levees are under

the jurisdiction of the state. There are many privately-owned levees that may protect agricultural lands that do not fall under its jurisdiction. However, the current State Reclamation Board oversight includes the levees protecting Colusa along the Sacramento River.

In order to work on any levee under the State Reclamation Board's oversight, an encroachment permit must be obtained, defining the work to be done as well as the impacts of such work to the environment, to flood risk assessments, and increased risk to any affected properties.

STATE LEGISLATIVE OVERVIEW

Recent Senate and Assembly Bills – SB5, SB17, AB5, AB70, AB156, and AB162

There have been many changes/additions to the legislative backdrop for levee-related issues. Several recent bills have been passed by the State Legislature by both the State Senate and Assembly designed to improve flood protection/management.

Senate Bill 5 (Mike Machado), Senate Bill 17 (Florez), Assembly Bill 5 (Lois Wolk), Assembly Bill 70 (Jones), Assembly Bill 156 (John Laird), and Assembly Bill 162 (Lois Wolk), were all signed by Governor Schwarzenegger on October 10, 2007, and require various performance issues to be met with target dates. Areas behind levees with greater than three feet of potential inundation are scheduled to be identified by December 31, 2008, by the Department of Water Resources (DWR). By September 2010, all property owners threatened by floodwaters contained by levees are scheduled to be notified as such, and every year thereafter, until levee certification is achieved. There are numerous reporting requirements and executive restructuring requirements and coordination between the local and state levels to ensure thorough identification of existing problems, notification, and steps to improvements.

One significant threshold defined in SB 5 is under the definition of urban and urbanizing communities. The requirements for 200-year flood protection (by 2025 or sooner) is for urban communities with current populations in excess of 10,000 people, or urbanizing communities projected to exceed 10,000 people in 10 years. Areas with projected populations of less than 10,000 people in 10 years do not currently fall under the SB 5 legislation and may not have to perform at the same level as more populated areas. The recently adopted General Plan by the City essentially projects that a growth rate of 6.45% is planned, which will create a population of greater than 10,000 within the next 10 years. This is a difficult issue because lower growth rates, suggested by the General Plan as "more likely," could perhaps keep the Colusa area just under the threshold of 10,000 people in 10 years. For purposes of this memorandum, our assumption is that the City will urbanize and be treated as an urbanizing community. It is not known how the state will treat areas with projected populations and adjust the eligibility in the future, if these areas do not reach 10,000 people in 10 years, but given that Colusa will reach 10,000 people with a "less than planned" growth rate, the state may categorize Colusa as an urbanizing community. The state could also recognize that its own classification/designation could influence growth rates, given that development interests may seek out communities with plans that do not have the requirements of meeting 200-year standards. Given that the growing City is a populated area

close to a major levee and river, the state may also recognize this and designate Colusa as an urbanizing area with the same standards as other populated areas along the Sacramento River, to prevent over-attraction of development interests to areas with lesser requirements.

State Bond Measures – Study Contracts (Mapping and Geotechnical Exploration)

As most people in California are aware, two major bond measures were passed by the electorate in 2007, Propositions 1E and 84. Both these measures were broadly targeting either flood control and levee issues, or water supply and water quality/safety issues, with a focus on river systems and public safety. While this memorandum could address the purpose of these bonds in greater detail, it is not the intent of this memorandum to explain the basis of these efforts, but simply to point out that part of the implementation of these bonds and future bonding will bring studies identifying flood risk, and could potentially bring funding/assistance for reconstruction and/or future certification of the existing levees.

Current efforts underway using these bond funds include obtaining detailed topographic mapping of the entire Sacramento River valley, detailed hydrologic and hydraulic analyses of major river systems and areas protected by levees, and geotechnical exploration of levees and their foundations. Wood Rodgers is one of several contractors hired over the next five years by DWR to identify flood hazards behind levees in the Central Valley, with our area focusing on the lower Sacramento River watershed, and to prepare FEMA-level mapping on behalf of DWR. Currently, the City area is covered under the upper Sacramento River watershed area, which is being completed through a team headed by CH2M Hill. Under this effort, it is very likely that the City will be evaluated and re-mapped within the next five years, perhaps without further levee exploration.

LOCAL ISSUES

There are two localized maintenance efforts underway affecting the Sacramento River levees. DWR) has a Maintenance Area (#1) operation out of its Sutter yard office between Yuba City and Colusa, along Highway 20, which oversees inspection and maintenance upstream of the Bridge Street/River Road crossing over the Sacramento River within the City. Wood Rodgers has performed a record search and retrieved operation & maintenance manual information, as well as geotechnical studies of borings within the levees.

We have also met with the Sacramento River West Side Levee District (SRWSLD) and obtained its most recent project documentation regarding the Moon Bend levee rehabilitation. It is also our understanding that the SRWSLD has provided its setback levee recommendations to the City for consideration in requiring development to provide adequate setbacks from levees to allow future flood fighting and reconstruction (if necessary). Once development is allowed to come within the recommended setbacks, it makes future work on the levee much more problematic and costly.

Overview of Existing Conditions

Wood Rodgers has researched and gathered previously published geotechnical exploration data for the levees along the Sacramento River affecting the City. It was not part of our scope of services to perform preliminary underseepage calculations/evaluations, or even to evaluate if the boring data is deep enough for current standards, but to summarize and report the conclusions of others. Currently, the Corps has a document titled, "Standard Operating Procedure Engineering Design Guidance 2003 (SOP-EDG03)," which provides recommendations for spacing, depth, and number of borings at each location (three per cross section). Preliminary review of the previous documented work indicates that explorations within the SRWSLD area may be adequate to proceed with an underseepage analysis, using the data already gathered. The conclusions of such an analysis are not yet known.

The data available for Maintenance Area 1 (DWR) is less complete with six borings performed in 1992 (documented in the February 1993 report titled, "Basis of Design - Geotechnical Evaluation of Levees for Sacramento River Flood Control System Evaluation - Upper Sacramento Area - Phase V") along the reach from the City to the Glenn County line, located primarily where boils had been documented. To quote the report on page 6, "Borings 2F92-7 and -8 indicate the levee materials consist of loose sand while the foundation soils are composed of variable deposits of clay, silt and clayey sand or sandy clay." The report also indicates that at the time there were two sites identified as having seepage problems, one of which was approximately 1,600 feet in length and located "in the town of Colusa between 5th and 9th Streets." Further upstream (approximately 11 miles), the seepage issues were significant enough to close Highway 45 by Caltrans in 1983. Much of the levee on both sides of the river has experienced seepage issues creating minor flooding well away from the river as well as indications of hydraulic connectivity through wells becoming artesian during high-water events as far as two miles away. Underseepage was not a major concern in the 1990's when much of these studies were conducted.

The August 1997 design memorandum (follow up to the 1993 efforts) sought to implement only two sites for rehabilitation/reconstruction because they were the only projects that were economically feasible.

The introductory section of the 1997 document states, "Studies indicate that sections of the levees are susceptible to seepage, subsidence, instability, and partial collapse and do not provide the design levels of flood protection. Potential problems are primarily the result of sandy soils, fat clays, and organic material within the levee embankment and foundation. Reconstruction work of about 12.4 miles is required to meet project design requirements at an estimated cost of \$10.6 million. About 5,000 people reside landward of the levees that need reconstruction. Damageable property in those areas is estimated at more than \$140 million.

Under current guidelines, the Federal interest in levee reconstruction is limited to work in areas that are economically justified on an incremental basis. The benefit-cost ratio is equal to or

greater than one at only two sites: Site D and Site E. Under this criteria, 3.7 miles of levee are recommended for reconstruction at a first cost of \$6.46 million.”

From this previous analysis, which did not evaluate underseepage, the integrity of the levees protecting the City should be considered suspect and Wood Rodgers recommends conducting further evaluations to ensure that any substandard levee conditions are at least identified and the appropriate steps taken to ensure the future safety of the community.

Construction of cutoff walls occurred in the 2004/2005 timeframe along portions of the west bank levee under the jurisdiction of the SRWSLD downstream of Bridge Street, however, these improvements were designed in the 1990's using older methods of analysis. While the underseepage issue was beginning to take shape in the early 2000's it did not become a significant design concern until the publication of the "Recommendations for Seepage Design Criteria, Evaluation and Design Practices" in July 2003 by the CESPCK Levee Task Force. With funding and design for the SRWSLD levee improvements essentially complete, there was no effort to retroactively evaluate the design from the 1990's to see if it met the latest criteria, since there is no evidence of a published report to that effect. It is important to note that new evaluations may show that the levee improvements already in place are sufficient for current criteria, perhaps even meeting the 200-year criteria established through legislation. However, until such evaluations are completed, the default position will likely be that the levees cannot be considered certified.

SUMMARY CONCLUSIONS

The Flood Insurance Rate Maps from FEMA will be revised in the future through the efforts of the State of California for the Colusa area, or by FEMA directly based on funding and mapping priorities. Without further investigation, the levees protecting the City will be considered "not certified" forcing significant revision to the FEMA maps depicting flooding for the City. Further geotechnical investigations are necessary to identify any potential structural levee deficiencies and to begin positioning for future levee rehabilitation funding to protect the City's citizens. Estimated costs for conducting geotechnical investigations, mathematical modeling, and problem identification activities for the levees directly adjacent to the City's Sphere of Influence is approximately \$1-2 million. All future levee work along the Sacramento River should be coordinated through the appropriate local, state, and federal agencies and be designed and certified consistent with current standards and practices. Current cost estimates for rehabilitating levees to correct structural underseepage is approximately \$5-10 million per mile of levee. With approximately 4 miles of levee directly adjacent to the City, such improvements may range from \$20-40 million. So far during the year of 2009 levee rehabilitation costs are bidding significantly lower than previous years, likely due to economic downturns in general. At the time that levees might be repaired for Colusa, the costs are assumed to return to pre-2009 levels for estimating purposes.