ATTENTION: CONFIDENTIAL

DO NOT DISTRIBUTE.

SUBJECT TO ATTORNEY/CLIENT PRIVILEGE

M E M O R A N D U M

TO: Christopher J. Neary

FROM: Richard Ingram, Sarah Yardley

SUBJECT: City of Willits Wastewater Treatment Capacity & Brooktrails Community Services District Capacity Share
B&R File No. 3478.00

DATE: July 20, 2010

At your request, we have conducted a focused review of the plans and specifications for improvements to the City of Willits wastewater treatment plant (WWTP). Plans for the new facilities, designed by SHN Engineering and dated December 2009, are titled City of Willits WWTP Stages 2 & 3. The contract documents include four addenda. We also reviewed the draft NPDES permit, Order No. R1-2010-0017, and subsequent letter from Lisa Bernard, Regional Board Sanitary Engineering Associate, dated May 25, 2010, that lists the revisions to the draft permit made pursuant to negotiations with the City (May 25 letter). We also reviewed portions of the Preliminary Engineering Report: Wastewater Treatment Facilities Upgrade (SHN Engineering, 2004) related to projection of future flows and to UV disinfection.

The extent of the review was limited by the agreed-upon time and budget constraints. While a concerted effort was made to examine the contract documents thoroughly, some details may have been missed. We do believe that, although a few details may be missing, our overall assessment is reflective of the contract documents.

The review was directed towards elucidating the following issues:

1. Evaluation of the unit capacities of the new facilities and explanation of Biolac process
2. Estimation of portion of recently purchased parcels which is planned for use in wastewater treatment, storage and disposal.
3. Review of draft NPDES permit
4. Focused assessment of risk of change orders
5. Evaluation of the overall capacity of the new facilities
6. Determining Brooktrails share of capacity of the Willits WWTP

These subjects are addressed below.

1. EVALUATION OF THE UNIT CAPACITIES OF THE NEW FACILITIES

The project Plans state that the new facilities are designed to treat a peak flowrate of 7 million gallons per day (MGD). The new treatment facilities will consist of secondary aeration basins and clarifiers and an ultraviolet light (UV) disinfection facility. These facilities are linked by an RAS (return activated sludge) pump station, piping, and flow control boxes. The capacity of the units has been evaluated on the basis of (1) adequacy of the biological and physical processes and (2) sufficiency of hydraulic structures to accommodate peak flows. Units are discussed in order below:

Secondary Aeration Basins

The secondary aeration basins are designed to create an environment that will support the aerobic microorganisms that break down organic matter in the wastewater. These basins have been designed using an extended air activated sludge process with alternating bands of aerobic and anoxic water within the basin, facilitating removal of not only organic matter but also the nitrogen compounds ammonia and nitrate. Willits must reduce the nitrogen load in its discharge to Outlet Creek in order to comply with its NPDES permit.

Biolac process

The aeration basins will use equipment sold by Parkson Corporation and patented as the Biolac process. Biolac equipment includes air diffusers that are suspended from headers in the aeration basin so that they swing freely, improving mixing. The headers are supplied with air in slowly moving bands, creating alternating aerobic and anoxic zones within the basin, which promote nitrogen removal. Parkson has been producing Biolac equipment for approximately 30 years, and there are approximately 40 installations in California.

Brelje & Race has experience with Biolac from our work for the Town of Windsor WWTP. In the mid-1990's, Windsor's aerated pond facility was experiencing difficulty meeting its NPDES permit requirements, and the Town wanted to upgrade the secondary units to a reliable activated sludge process that would reduce nitrogen concentrations as well as removing organic matter. During design, we evaluated four different process equipment options and determined that the Biolac would be the most cost-effective approach. The first Biolac basin at the Windsor WWTP was constructed in 1996, and a second in 2001. We have been able to observe the operations, performance and maintenance of the Biolac basins since 1996. Our assessment is that the process produces effluent that reliably meets permit requirements. Nitrogen removal is typically approximately 85%. Operation is straightforward, and electrical consumption lower than for the previous aerated ponds. The one maintenance challenge has been a tendency for strings and hair that slip through the influent screens to wrap around the diffuser membranes. Diffusers must be pulled out of the water occasionally for cleaning. However, this issue has not seemed to impact the quality of the effluent. It is our opinion that the Biolac process is a proven, cost-effective and robust approach to extended aeration activated sludge treatment of municipal wastewaters.

Capacity of Aeration Basins

Aeration basins must be designed to provide adequate detention time and air supply for microorganisms to break down the organic matter. The two basins will have a combined capacity of 2.44 million gallons (MG). Based on the Biolac basin sizing procedure, the Average Dry Weather Flow (ADWF) capacity of the basins is estimated at 1.22 million gallons per day (MGD). The blowers are designed to provide air to the basins, to supply in the range of approximately 15,000 to 72,500 pounds per day (ppd) of oxygen. This aeration capacity is commensurate with standard design practice.

Secondary Clarifier Capacity

The secondary clarifiers are intended to provide a quiescent zone for separation of the activated sludge solids from treated wastewater. Standard design parameters for clarifiers for extended aeration systems indicate an overflow rate of 200-400 gpd/SF (gallons per day per square foot of clarifier water surface) at average flows and 600-800 gpd/SF at peak flows (2-hour peak period, Metcalf & Eddy, *Wastewater Engineering*). Clarifiers for Biolac systems are often designed for a peak flow overflow rate of 1,000 gpd/SF (Steve Young, Parkson Corp., personal communication, July 1, 2010). The two clarifiers will have a combined surface area of 7,693 SF, so that they will accommodate an average flow of approximately 2.3 MGD. At the design peak flow of 7 MGD, the overflow rate will be 910 gpd/SF[1]. The peak overflow rate is therefore somewhat higher than

[1] The Plant Design Criteria (Plans, Sheet G-8) list a maximum clarifier overflow rate of 1,099 GPD/SF. We calculated the overflow rate by dividing 7,000,000 gallons per day by 7,693 SF, resulting in 910 gpd/SF, a more conservative value.

standard practice, but lower than what Parkson has found sufficient for Biolac plants. It should be noted that the standard cited in Metcalf & Eddy is for a two-hour peaking period. Our impression is that the Willits WWTP is intended to operate at the Peak Flowrate for a week or longer at a time. In this case, the overflow rate may not provide adequate settling time during periods of sustained peak wet weather flows.

Return Activated Sludge Pump Station Capacity

The RAS pump station will pump settled solids from the bottom of the secondary clarifiers back to the aeration basins. Standard practice in design of RAS pump stations for extended aeration systems is to provide pumps capable of pumping from 50% to 150% of the average treatment flowrate (Metcalf & Eddy). The two duty RAS pumps shown in the Willits WWTP design are each capable of pumping from 0.5 to 1.8 MGD. The RAS pumping capacity is therefore more than sufficient to provide 150% of the design average flowrate of 1.81 MGD. At the peak flows of 7.0 MGD, the maximum combined RAS flow of 3.6 MGD will provide 51% of the wastewater flow rate. While this ratio meets the standard design criteria, our experience has been that settling can be poor during periods of high rainfall, and we are not certain that the RAS pump rate will be adequate during peak flow periods.

Capacity of the Ultraviolet Light Disinfection Facility

Disinfection with UV light is measured as the delivered dose, measured in uW-sec/cm^2 (micro-watt seconds per square centimeter). The UV system at the Willits WWTP will consist of a single channel with five duty modules and one redundant module. Room in the channel is reserved for a "future" seventh module. Each module will have 40 lamps. The Project Plans, Sheet G-8, list a design dose of 50,000 uW-sec/cm^2. Determination of the delivered dose of a particular UV system is complex, as it depends upon the number of active lamps, output of UV light per lamp, the flowrate and transmittance of the wastewater, and the system configuration. Different manufacturers of UV systems have developed proprietary formulas for the dose delivered by their systems. These formulas are not generally available. Brelje & Race designed a UV disinfection system for the Town of Windsor WWTP that used lamps and modules made by the same manufacturer as the system designed for the Willits facility. We have a copy of the dosage calculation spreadsheet for Windsor, which we modified to evaluate the capacity of the Willits UV facility. The modified formula is of limited applicability, because the Windsor formula is based in part findings from full scale bioassay tests that were performed after construction of the system. Using the Windsor calculation, we estimate that, at flows of 7 MGD, the Willets UV system will deliver a dose of approximately 60,000 uW-sec/cm^2 (assumed 90% lamp age and 55% UV transmittance).

The basis for selection of a design dose of 50,000 uW-sec/cm^2 for the Willits system is not clear. The May 25 letter states that the permit reflects "disinfection requirements at the new ultraviolet (UV) disinfection system consistent with enhanced secondary[2] requirements…" We have been unable to locate regulatory or standard design requirements for the UV dose for disinfection of enhanced secondary effluent. We contacted Lisa Bernard, the Regional Board Sanitary Engineering Associate who prepared the Willits permit, and asked her what the basis was for the 50,000 uW-sec/cm^2 dose. She was unable to provide a citation and referred us to a contact at SHN. Rather than contact SHN, we called a senior engineer at Infilco Degremont, the UV manufacturer, to discuss selection of UV dose. The Infilco Degremont engineer told us that Infilco Degremont typically uses a dose of 40,000 uW-sec/cm^2 to produce an effluent with 23 MPN/100 mL of Fecal Coliform, and they had proposed a system sized to deliver that dose. However, during the value-engineering review, Kennedy Jencks recommended that the dose be increased to 50,000 uW-sec/cm^2.

The Preliminary Engineering Report (SHN, 2004) used an assumed UV dose of 80,000 uW-sec/cm^2, stating that "Systems designed to achieve coliform inactivation levels required for agricultural reuse employ a

[2] The permit (page G-2) defines enhanced secondary level treatment as the ability to achieve 10 mg/L as a monthly average for BOD_5 (Five Day Biochemical Oxygen Demand) and TSS (Total Suspended Solids).

delivered dosage of 80 uW-sec/cm^2." The report discussed the uncertainties associated with UV disinfection of secondary effluent, citing the possibility that suspended particles could shade bacteria from the UV light, and suggested that it might be necessary to install a filter upstream of the UV system if the UV system were not able to meet the disinfection requirements. Filtration, often required for reuse effluents, decreases the particle size and number of solids and produces a more consistent effluent quality, resulting in decreased UV dose demand and more reliable disinfection performance. The report mentioned that onsite pilot testing prior to design could be used to determine the actual design requirements. We do not know whether pilot testing was performed. Since the secondary treatment process will be changed, pilot tests may not have been performed in the knowledge that tests using the existing effluent may not have produced applicable results.

While it appears that the UV system will deliver the design dose, there is a discrepancy between the coliform removal rate required by the permit and that in the specifications. The permit requires a maximum average monthly Total Coliform Organism count of 23 MPN/100 mL. The Specifications call for the UV system to produce an effluent with Fecal Coliform of 23 MPN/100ml (Addendum No.1, Specification Sheet 44 44 73 - 2). Since Fecal Coliform is a subgroup of Total Coliform, a UV system that reduces Fecal Coliform to 23 MPN/100mL not reduce Total Coliform to the same level. We do not have knowledge of the comparative UV inactivation rate between Fecal and Total Coliform. The increase in design dose from 40,000 to 50,000 uW-sec/cm^2 may have been intended to provide the required Total Coliform inactivation.

The Specifications refer to the National Water Research Institute's (NWRI) "Guidelines for UV Disinfection." No such publication exists. The reference is likely intended to be to the NWRI publication "Ultraviolet Disinfection: Guidelines for Drinking Water and Water Reuse." This publication includes validation testing protocols that CDPH relies upon for validation of UV disinfection systems for tertiary-treated wastewater. The NWRI publication provide no guidance regarding UV disinfection systems for secondary effluent.

The draft permit (Condition E.1.g., May 25 letter) requires that the Discharger submit to the Executive Officer "a copy of a letter from the UV supplier showing written acceptance of the UV system capacity based upon the National Water Research Institute validation testing from the CDPH supplied for the Willits WWTF"[sic]. The Specifications (page 44 44 73 – 3) require that the "Basis for evaluating the dose delivered by the UV system shall be the supplier's bioassay as determined by third party system validation testing completed in accordance with the NWRI standards."

The UV system appears to be sized to provide the design dose. However, the inconsistent references and requirements for the UV system are troubling. It is not clear whether a full scale bio-assay will be performed after completion of the units. If the system does not meet the Total Coliform inactivation requirement, the supplier's warranty for Fecal Coliform removal may free the supplier of responsibility to increase the system capacity.

Hydraulic Capacity of the New Facilities

In addition to the evaluation of the treatment capacity described above, we verified the capacity of the new units to convey the design peak flow of 7 MGD. Our analysis consisted of tabulating weirs, piping, controls boxes, inlets, etc., along the water's course starting at the UV disinfection facility and working upstream to the headworks. Dimensions and elevations were based on the Willits WWTP Stages 2 & 3 Plans. Headloss factors for each feature were then used to calculate hydraulic grades through the facility.

Our calculations predicted slightly higher water elevations at the aeration basins, clarifiers, and UV channel than indicated in the project plans. Differences were small, in the order of an inch or two. It appears that the units are adequate to convey the design flow of seven MGD at the water surface elevations that we calculated.

The unit capacities discussed above are summarized in the table below.

Table 1: Summary of Capacities of the Willits WWTP Stages 2 & 3 Treatment Units

Treatment Unit	Average Dry Weather Flow Capacity, MGD	Peak Flow Capacity, MGD	Comment
Aeration Basins	1.22	7	
Secondary Clarifiers	Not a limitation	7	The clarifier sizing is somewhat smaller than standard practice, but larger than what Parkson has found sufficient for Biolac facilities.
RAS Pump Station	Not a limitation	7	We are uncertain whether the peak pump rate will be adequate during peak flow events.
UV Disinfection Facility	Not a limitation	7	We do not have the information to know whether the design dose will be adequate for the secondary effluent produced by the new aeration basins and clarifiers.

MGD - million gallons per day

2. ESTIMATION OF PORTION OF RECENTLY PURCHASED PARCELS WHICH ARE PLANNED FOR USE IN WASTEWATER TREATMENT, STORAGE AND DISPOSAL

Brelje & Race searched the Mendocino County property records on-line using "Real Quest," for parcels belonging to the City of Willits. The attached map shows the parcels adjoining the existing WWTP that have been purchased by the City since 1996, outlined in red. The combined area of the identified parcels is approximately 330 acres. The areas that are shown on the City of Willits WWTP Stages 2 & 3 plans as being used for wastewater facilities are hatched with diagonal lines on the map. The total area of the indicated wastewater facilities on the parcels purchased since 1996 is approximately 120 acres, which represents approximately 36% of the total areas of these parcels. There may be other wastewater-associated uses, such as irrigation, on those parcels which are not included in the City of Willits WWTP Stages 2 & 3 plans.

3. REVIEW OF DRAFT NPDES PERMIT

Brelje & Race reviewed the draft NPDES permit, including revisions made pursuant to negotiations with the City (May 25 letter). Our findings were conveyed to the District via email to C. Neary and M. Chapman on June 7, 2010. As stated in that email, the items in the initial draft that we had been concerned about were addressed in the revisions. We did not see errors or items that were inconsistent with applicable regulations. It should be noted that the Regional Board continues to add increasingly stringent requirements to all permits, and Willits can expect increased operational costs associated with increases in monitoring requirements.

4. FOCUSED ASSESSMENT OF RISK OF CHANGE ORDERS

Change Orders during project construction have the potential to increase the overall project costs. We were asked to review the plans and specifications for ambiguities, inconsistencies, and missing information that could provide the basis for a Contractor requesting Change Orders. It was agreed that a review that focused on one or two portions of the plans should provide a reasonable indication of the overall vulnerability to Change Orders. Plans and specifications for the RAS pump station and for earthwork were selected for review, as being representative of major aspects of the project. We did not perform a comprehensive review of the Plans and Specifications.

RAS Pump Station Plan Review

The review of the RAS (return activated sludge) pump station focused on whether the bid documents were complete and consistent. The review did not include an evaluation of the quality of the design or of the equipment being specified.

Areas reviewed included excavation, subexcavation, formwork and rebar, concrete, mechanical equipment, piping and valves, coatings, variable frequency drives, instrumentation, electrical, controls and construction sequencing. All pertinent drawings and Specification sections were reviewed.

The Plans and Specifications were generally complete and consistent. Reference to the RAS MCC (motor control center) are inconsistent. The Plans refer to MCC-4, but the Specifications in several places refer to MCC-3. We see no likely cost increase or Change Order associated with this inconsistency.

Risk of Change Orders from Earthwork Portion of the Project

In general, earthwork can be subject to change orders if the plans indicate an amount of cubic yards that proves incorrect or fail to indicate the full scope of the work. Earthwork is not quantified as a bid item for the City of Willits WWTP Stages 2 & 3 project. Earthwork is included under a lump sum that includes all Civil Work. The Specifications state that the General Civil work bid item includes but isn't limited to "earthwork such as clearing and grubbing, stripping and stockpiling, demolition, mass excavation, compacted fills, and fine grading to construct features such as aeration basin berms, enhancement wetland berms, road and other fill prisms, and flooding and wetland mitigation areas…"

The standard of civil engineering practice is to perform complete calculations for earthwork, so that contractors are bidding on the same quantity of work. It is the engineer's responsibility to translate the recommendations of the geotechnical report explicitly unto the plans, to provide clear visual instructions for construction. Plans should depict the earthwork requirements – the extent of excavation, subexcavation, type of fill and percent compaction for each unit in the project.

The plans do not provide earthwork measurements, but depict elevations and contours that the Contractor could use in producing his estimate of earthwork. An Appendix is provided with the engineer's estimate of earthwork quantities, but the Contractor is cautioned not to rely on the engineer's estimate in preparing his bid. The specifications state that the estimated earthwork volumes are not adjusted for influences such as shrinkage or losses, to reflect gravel road surfaces or base, structure excavations, work around plant paving areas or sliver fill (Addendum 3).

Addendum 3 states,

> "Upon award, and completion of initial surveying lay-out by Contractor, estimated quantities will be reviewed, and areas of additional borrow, or grade adjustments will be agreed to arrive at a balanced cut and fill.
>
> 1. In the event that estimated final earthwork excavation quantities are inadequate for the fills as anticipated, additional locations on the project site will be identified in the areas of the Enhancement Wetlands on the east side of Outlet Creek and the wetland mitigation areas west of Outlet Creek, from which to generate the compensating fill quantities. No additional compensation shall be made for additional materials borrowed from identified areas within the project limits…."

This text in the Addendum appears to increase the scope of the unquantified lump sum earthwork. The phrase "will be agreed" implicitly acknowledges that there may be disagreement over quantities and/or grade adjustments.

The Addendum also includes Alternate Bid Items to establish unit costs in event the earthwork is so imbalanced as to require import or export of materials. The Alternate Bid Items allow for the authorization, if required, of disposal of excess materials if there is an overage and for import of additional materials if there is a shortage. Addendum 3 also adds language clarifying that the Bidder should base his lump sum price on the "total cut and fill volumes on the greater amount of materials handled; that is final quantities required to fill to the designed contours." [sic]

Compaction requirements are a critical aspect of earthwork design. We found no compaction requirements in the Specifications. The geotechnical report, which provides recommendations for compaction, is provided as an Appendix in the form of a CD in the back of the Contract Documents. The recommendations in the geotechnical report are consistent with common practice for this sort of construction. However, the Contract Documents are defined as only printed or hard copies of the items listed in the Agreement. The Agreement Form lists the Specifications as part of the Contract Documents, but it is ambiguous whether the recommendations in the geotechnical report would be considered project requirements. Several locations in the Specifications require that grade be sloped away from building "as specified in the geotechnical report," but we found no reference to compaction requirements. We did not find a clarification to this ambiguity in our review of the four Project Addenda. It appears that during the bid period, no contractor brought up the question of compaction requirements.

We looked through the plans for section views that show subgrade preparation. We were able to find compaction requirements, for aggregate base only, in only two locations, on Sheets C-3 and C-6 of the Plans. We found structural subgrade preparation and compaction depicted only for the clarifier base (S-3-3) and the headwall between the aeration basins (S-1-1). We were unable to find drawings that depict subexcavation, compaction and other earthwork requirements for foundations for roadways, wetlands dikes, buildings or other structures. Sections show only surface grades. The structural and mechanical sections for buildings show either no surrounding earth or undisturbed earth up to and beneath the structures.

The earthwork for the project is particularly difficult and risky because of the high groundwater and the tight construction schedule. It seems that the intent of the lump sum approach to the bid is to leave no room for a change order based on underestimation of earthwork quantities or unforeseen field conditions. The designer has passed the responsibility for earthwork calculations off to the Contractor, saying in effect that the payment is fixed as a lump sum, whatever the quantity. However, the ambiguities created by the absence of adequate earthwork sections, coupled with the lack of clear requirements for compaction, seem to us to create a risk of change order disputes.

The ultimate amount of change order billings depend not only upon the contract documents but also on the particular contractor and the construction administrator, and on the relationship between these entities. Plans that are not explicit do not necessarily lead to large change orders, if the contractor and administrator are able to communicate well and are both interested in completing the project in a fair and cost-effective way.

5. EVALUATION OF THE OVERALL CAPACITY OF THE NEW FACILITIES

The new WWTP has been designed to treat a Peak Weekly Flow (PWF) of 7 MGD through the secondary treatment units. Our review of the unit process facilities (Section 1) did not find any significant issues with the PWF capacity. Design Conditions listed on the Plans for the new WWTP show a ratio of 1.18 MGD ADWF to 6.70 MGD PWF. Based on the ratio of ADWF to PWF, the ADWF associated with a PWF of 7 MGD would be 1.23 MGD. This ADWF capacity is consistent with the estimated ADWF capacity of the Biolac aeration basins of 1.22 MGD, presented above.

Table 2: Capacity of New City of Willits Wastewater Treatment Facilities

Peak Weekly Flow	7.0 million gallons per day
Average Dry Weather Flow	1.22 million gallons per day

6. DETERMINING BROOKTRAILS SHARE OF CAPACITY OF THE WILLITS WWTP

Brooktrails' agreement with the City of Willits for sewage services is based on Average Dry Weather Flow (ADWF). The agreement defines ADWF as the average daily flow during the five-month period from May 1 through September 30. Any determination of Brooktrails share of treatment capacity should therefore be in terms of ADWF, as defined in the agreement.

We have been told (Neary, PC, 6/17/10) that Brooktrails paid 37.69% of the costs of up-grades and expansions to the Willits WWTP in the late 1980's and that the City is asking Brooktrails to pay 37.69% of the costs of the current project. Brooktrails' 37.69% share of the plant's 1.22 MGD ADWF capacity would be 0.46 MGD.

We recommend that Brooktrails require the City to guarantee Brooktrails 0.46 MGD of ADWF capacity in exchange for Brooktrails agreeing to pay 37.69% of the costs of the current project.

The agreement, by expressing Brooktrails' capacity as ADWF, leaves determination of SFR (Single Family Residence) capacities to Brooktrails and the City, independent of one another. As long as Brooktrails is assured of its 0.46 MGD ADWF share, it need not concern itself with how the City allocates its SFRs.

Brooktrails can derive its SFR (Single Family Residence) capacity in the Willits WWTP by dividing its total ADWF capacity (0.46 MGD) by one SFR ADWF. To estimate the SFR ADWF, the Brooktrails ADWF into the Willits sewer system would be divided by the number of connected SFRs. We have been told (Chapman, 6/17/10, PC) that the current Brooktrails ADWF is approximately 0.3 MGD, with 1428 connected SFRs. The current Brooktrails SFR ADWF can be calculated by dividing 0.3 MGD by 1428 SFRs, to be approximately 210 gpd. Dividing the 0.46 MGD total ADWF allocated to Brooktrails by the SFR ADWF of 210 gpd indicates that Brooktrails' share would be equivalent to 2190 SFRs, at current sewage generation rates. This would be an increase of 762 SFRs over the current 1428 SFRs. It is important to keep in mind, however, the unit flow from Brooktrails residences may change over time, causing minor changes in Brooktrails SFR capacity.

IMPORTANT POINTS REGARDING CAPACITY

1. The agreement with the City is based on percentage of ADWF, not SFRs.
2. Brooktrails SFR unit flow (ADWF) will change over time.
3. Every five years, Brooktrails should reevaluate its unit flow (SFR ADWF) and the SFR equivalents of its share of the Willits WWTP capacity.