AECOM
300 Lakeside Dr.
Suite 400
Oakland, CA 94612
www.aecom.com

510-894-3600 tel
510-874-3268 fax

June 19, 2017

Nevada Irrigation District
1036 W. Main Street
Grass Valley, CA 95945

Attention: Mr. Doug Roderick, P.E.

Subject: Centennial Reservoir Project
White Paper on Project Delivery Alternatives

Dear Mr. Roderick:

We are very pleased to submit this White Paper on Project Delivery Alternatives for the Centennial Reservoir Project located near Grass Valley, California.

In accordance with the scope of work authorized under Task Order 9, this White Paper was prepared to inform Nevada Irrigation District (NID) of the various delivery alternatives that may apply to the Centennial Reservoir Project that includes the following elements:

- Excavation of the dam foundation,
- Dam construction,
- Bridge construction,
- Relocation of roads and recreation facilities, and
- Construction of a pump station and pipelines.

This White Paper discusses project delivery methods used in the heavy civil construction industry, focusing on Design-Bid-Build and Design-Build, the methods most applicable to the reservoir project. AECOM presented the project delivery alternatives to NID on March 7, 2017. This White Paper follows up on that presentation.

Thank you for the continued opportunity to assist the NID on this very important project. We are available to discuss any questions or comments you may have on this White Paper. Please contact me at (510) 874-3012 if you would like to schedule a time to meet.

Sincerely,
AECOM Technical Services, Inc.

M.P. Forrest, P.E., G.E.
Project Manager

Enclosure:
Centennial Reservoir Project, White Paper on Project Delivery Alternatives

Cc: Noel Wong, Ted Feldsher (AECOM)

AECOM

Centennial Reservoir Project
Project Delivery Alternatives

1. PURPOSE AND SCOPE

The Nevada Irrigation District (NID) is proposing to construct a new reservoir on the Bear River in California, known as the Centennial Reservoir Project (CRP). Because of the magnitude and importance of this new project, the NID has decided to identify and compare potential project delivery methods, to evaluate the benefits and limitations of each method, and to assess which method(s) may be most appropriate for use on the CRP. Selection and implementation of the most appropriate project delivery method(s) for the various elements of the CRP will help NID achieve optimal value for the project.

Traditionally, most heavy civil public infrastructure projects have been delivered using the Design-Bid-Build (DBB) project delivery method. However, in recent years, project owners have sought out ways to save time and optimize capital spending on large, complex projects. This has led to an increase in the number of projects delivered with alternative methods, particularly in the transportation sector. Alternative methods have also been used in the water sector, although less commonly. One of the most common alternative project delivery methods has been Design-Build (DB). Other methods include Construction Management at Risk (CMAR), Progressive Design-Build (PDB), and Public-Private Partnership (PPP). The following sections of this white paper describe each of these methods in more detail, including schedule and risk allocation considerations and potential applicability to the CRP. The two methods judged most likely to be applicable to the CRP are DBB and DB, and a comparison is presented describing some potential benefits and potential limitations of each method.

2. PROJECT DESCRIPTION OVERVIEW

The proposed Centennial Reservoir Project, currently in review with engineering and planning studies, includes a roller-compacted concrete dam retaining new water storage reservoir. Besides the dam and its appurtenant facilities, the proposed project includes a new three-span, 1,200-foot-long box girder bridge across the reservoir upstream of the dam, relocated roads and recreational facilities, and a new pump station and associated water transmission pipelines.

The proposed site for the new dam and reservoir is located on the Bear River between the existing Rollins and Combie reservoirs, both of which are also owned and operated by NID. The project area is located in both Nevada County (on the north side of the river) and Placer County (on the south side of the river). The proposed new reservoir will extend from the upstream end of Combie Reservoir to a point several miles downstream of Rollins Reservoir. The NID has identified a 110,000 acre-foot storage capacity objective for the project, corresponding to a maximum normal reservoir water surface of approximately El. 1,855 feet at the proposed dam site. Creating a reservoir at this elevation would require a new dam height of approximately 275 feet above the Bear River.

Previous studies concluded that a roller-compacted concrete (RCC) dam would be the preferred dam type for the selected site (AECOM, 2017a). Constructing the dam would involve the following main steps in approximately the indicated sequence:

1. Construction of river diversion works
2. Excavating 600,000 cubic yards to prepare a suitable dam foundation
3. Grouting the foundation to reduce the risk of excessive leakage
4. Developing a rock quarry and producing RCC aggregate
5. Importing about 130,000 tons of cement and fly ash for the RCC mix
6. Mixing and placing about 800,000 cubic yards of RCC

Preliminary estimates suggest that constructing the proposed dam could cost about $260 million and take about 2½ years to complete (AECOM, 2017b).

3. PROJECT DELIVERY METHODS

A typical objective for large infrastructure projects is to minimize risk at the lowest practicable cost. Selection of the project delivery method is one important tool owners can use to help achieve this objective. The five project delivery methods addressed in this white paper are compared in Figure 1 below, which illustrates some of the key characteristics of each method. For example, higher levels of collaboration can usually be achieved with Progressive Design-Build (PDB) than with other methods. Similarly, higher levels of schedule control can usually be expected with the Design-Build (DB) or Public-Private Partnership (P3) delivery methods. Cost control can be expected to be similarly high with both the Design-Bid-Build (DBB) and Design-Build (DB) delivery methods. Each of the methods is described in more detail below. A greater emphasis is placed on DBB and DB in the following descriptions, as these methods are judged most likely to be applicable to the CRP.

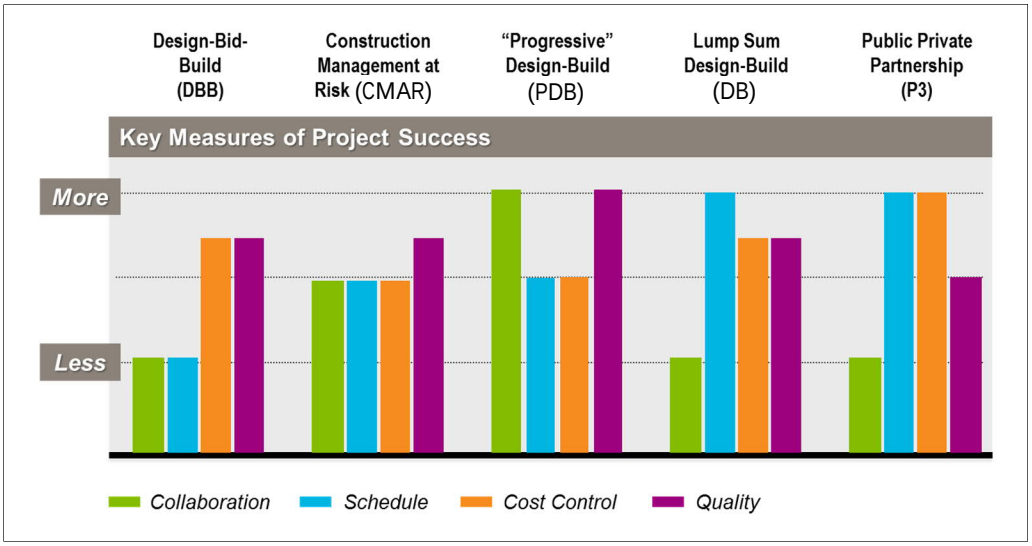

Figure 1. Comparison of Project Delivery Methods

3.1 Design-Bid-Build Delivery Method (DBB)

DBB is the most common project delivery method for public works projects in California. This method provides for competitive procurement of construction, while providing the owner with the most input

into the design before signing a contract. The owner provides complete and permitted design documents for the work. In general, the contract is awarded to the contractor that submits the lowest responsive and responsible bid. Of the delivery methods discussed, DBB allows the least opportunity for the designer and contractor to collaborate before bidding and contracting. With DBB, the owner has to respond with change orders for both unforeseen conditions and deficiencies in the design documents. The potential for and number of change orders can be minimized and mitigated by performing comprehensive site investigations, developing robust design details, drafting clear definitions of risk allocation, and establishing a strong partnering relationship between the owner, contractor and designer. Early contractor involvement during the design phase can also help to minimize risks.

In the DBB project delivery method, the designer is usually the engineer of record (EOR) and the contractor is a separate entity. Both the designer and the contractor are contracted directly with the owner. The owner sometimes retains a construction manager (which could also be the designer) to administer the contract. The owner (or his representative) coordinates with the regulatory permitting agencies such as the Division of Safety of Dams (DSOD). Figure 2 illustrates a typical DBB project organization.

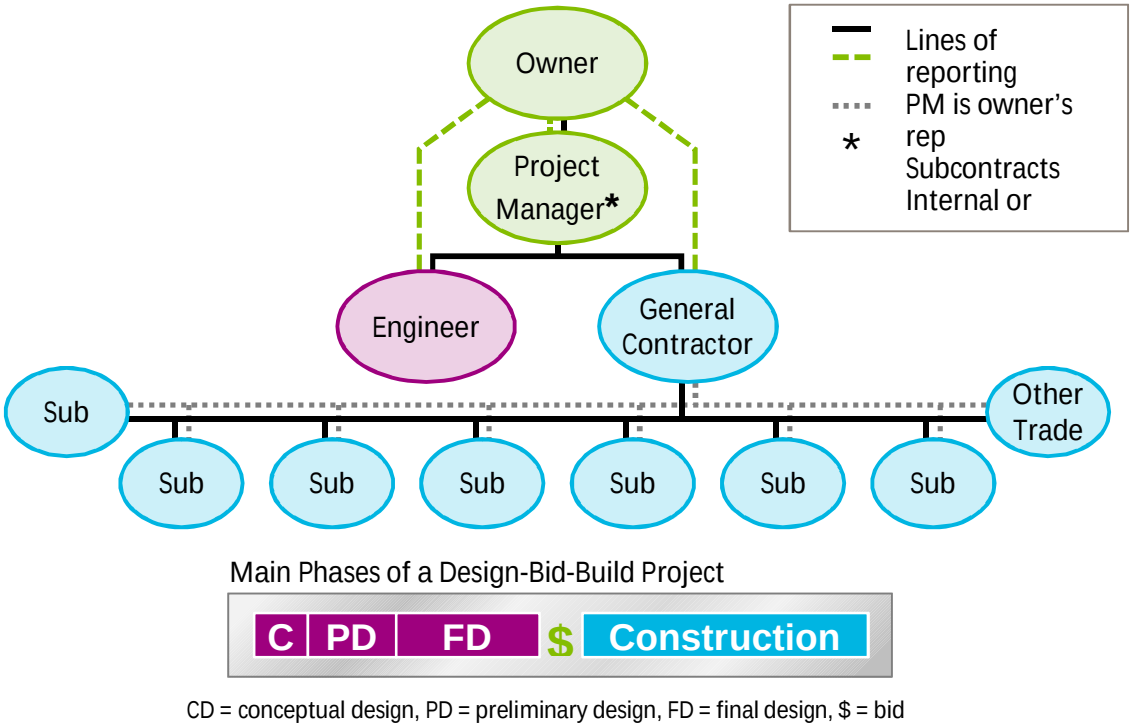

Figure 2. Typical Design-Bid-Build (DBB) Project Organization

3.2 Design-Build Delivery Method (DB)

In the DB project delivery method, the DB entity normally contracts directly with the owner, and takes responsibility for both engineering and construction of the project. As part of the DB entity, the designer is usually subcontracted directly by the contractor, and serves as the EOR. The owner

separately retains an engineer who is normally responsible for developing the DB procurement criteria and RFP, as well as performance specifications, technical specifications, and the basis of design (sometimes to a 30% level of design completion), and would assist the owner in reviewing the DB entity's design and construction work. The DB contractor's EOR is responsible for producing a design acceptable to regulatory agencies and meeting other established criteria, and for making sure it gets properly implemented during construction. Figure 3 illustrates a typical DB project organization.

The overall project delivery schedule is generally the overriding reason owners consider using the design-build contract delivery method. By combining design and construction under one contract, the work can be executed concurrently, which normally saves time in the overall delivery schedule. The actual construction duration is usually relatively similar in either case, but concurrent design and reduced procurement times can reduce the overall schedule (see Figure 4).

In the DB project delivery method, the owner is responsible for establishing the scope, project definition, design criteria, performance measurements, and existing conditions of the site including initial geotechnical investigations to characterize subsurface conditions. The DB entity usually has the responsibility for additional project specific geotechnical or subsurface investigations beyond what the owner provides. As the EOR, the responsibility for plan accuracy, conformance with established standards and constructability rests with the DB entity.

With the DB delivery method, one key question regarding risk allocation is how much the owner is willing for the DB entity to assume the design responsibility. If the owner is willing to minimize the amount of prescriptive detail in the design, focusing instead on guidelines and performance criteria, the DB entity will have maximum flexibility in addressing the project objectives and will also assume the maximum amount of design risk. If the owner is willing to give up ultimate control over the final design, this project delivery method can be an effective risk management strategy.

Selection of a DB entity typically involves a two-step approach focused on best value rather than lowest price or lowest bid. The first step consists of a qualification process based on proposer experience and project understanding, and the result usually consists of a short list of the top proposers. The second step involves the development and submittal of price proposals from the short-listed proposers. The proposal with the highest final score (typically based on a combination of the technical score and total bid price) is then normally awarded the contract.

A typical RFP package for a DB project would include the following some or all of the following elements:

- Preliminary design
- Proposal general requirements
- Technical contents and evaluation criteria
- Scope of work/project description
- Revisions to standard specifications
- Special provisions
- Risk/responsibility allocations
- Project specific reference materials
- Typical bid proposal documents

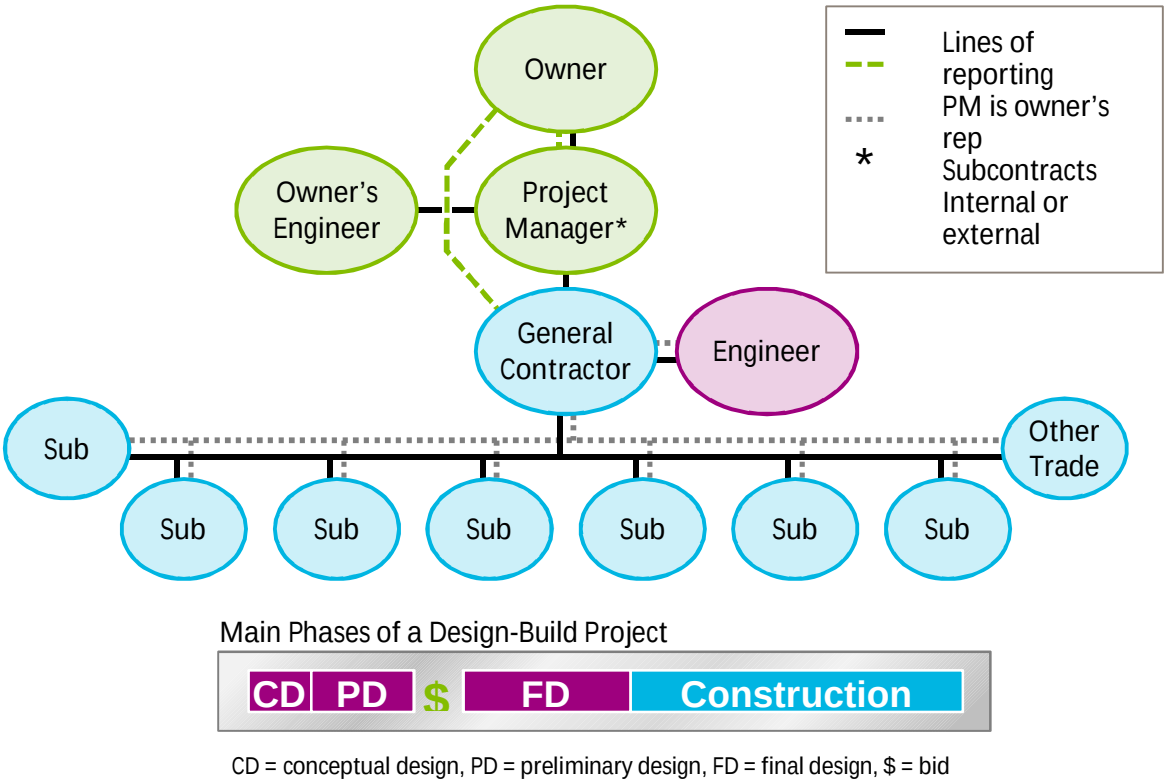

Figure 3. Typical Design-Build Project Organization

3.3 Construction Management at Risk Delivery Method (CMAR)

With the Construction Management at Risk (CMAR) delivery method, the owner selects the contractor early during design. The selection is usually based on qualifications and some element of preconstruction fee and construction markup. The owner then has the benefit of that contractor's input during design for construction pricing, optimizing construction elements, and open-book pricing for construction. The contractor bids all trade work open-book with the owner to develop a stipulated sum for construction. The contractor does not have an obligation to ensure that the preliminary pricing is accurate, because the final contract sum is dependent on the trade bids. The owner does have the option to terminate the CMAR before establishing the stipulated sum if the pricing or scope of services is not acceptable to the owner. In that event, the owner would then bid the design documents in the open market the same as the DBB delivery method. With CMAR, the owner retains responsibility for unforeseen conditions and for design deficiencies discovered during construction. The CMAR project delivery method is not considered suitable by NID for the CRP and so was dropped from further evaluation.

3.4 Progressive Design-Build Delivery Method (PDB)

Progressive Design-Build (PDB) is a hybrid between the DB and CMAR project delivery methods. In this version, the owner selects the DB entity based only on qualifications, not on price. Construction pricing is then developed as the design progresses. Like DB, this method can save time in the overall schedule

by overlapping the design and construction phases. The PDB project delivery method is not considered suitable by NID for the CRP and so was dropped from further evaluation.

3.5 Public Private Partnership Delivery Method (P3)

With the Public Private Partnership (P3) delivery method, the owner normally contracts with a single entity for design, construction, financing, and operation, and maintenance. The contracting structure is complex and best suited for public projects with revenue streams that can pay for the cost of the P3. For that reason, the P3 delivery method is not considered suitable by NID for the CRP and so was dropped from further evaluation.

4. COMPARISON OF DBB AND DB DELIVERY METHODS

For the reasons described above, DBB and DB are judged to be the two project delivery methods most likely to be applicable to the Centennial Reservoir Project. Table 1 below presents a summary of some potential benefits and limitations for each of these two delivery methods.

Table 1. Comparison of Potential Benefits and Limitations – DBB and DB

Design-Bid-Build	Design-Build
Potential Benefits	Potential Benefits
Maximum control of design outcome via prescriptive nature of procurement documents	Earlier price identification than DBB
Strong, well-proven, contractual basis and marketplace acceptance	More opportunity for innovative design details and construction solutions
Can provide opportunity for innovative construction solutions (design is prescribed)	Overall schedule reduction possible by concurrent design and construction
Regulatory approval process remains under owner's control	Integrated team for design and construction leads to fewer conflicts and disputes
Design responsibility maintained by EOR throughout project	Design risk transferred to DB entity
	Single point of responsibility for delivery process
	Reduced risk management costs
	Fewer change orders and claims
Potential Limitations	Potential Limitations
More limited integration of design and construction	Owner relinquishes control of design
Quality of constructor may be limited in selection (pre-qualification of bidders would mitigate this)	RFP process may require monetary stipends to proposing DB teams
Design and operational risks remain with the owner	"Best value" selection process can be somewhat subjective
Typical process requires selection of lowest bidder rather than best value	Comparison of alternate proposals may be difficult
	Regulatory uncertainty may limit potential for design and construction innovations
	Preliminary design and geotechnical conditions must be well-defined; relatively little time exists for improvements

In the DBB delivery method, the owner typically bears the entire responsibility and risk for design-related issues. All responsibility for design decisions and conformance to standards rests with the owner and engineer of record. In design-build, several of these responsibilities or risk shift to the DB entity. With the DB method, the owner is still usually responsible for unforeseen conditions. However, responsibility for deficiencies in the design documents shifts to the DB entity. Because design risks are transferred to the DB entity, the total DB fee plus contingency may exceed the low-bid price under DBB contract delivery. The DB contract delivery method usually works best where performance expectations can be clearly defined and uncertainties are relatively low and manageable.

Figure 4 presents a conceptual comparison of DBB and DB project delivery schedules. The shorter overall project duration for DB in this case is mainly due to the overlap between the final design and construction activities. The DB design period may also be shorter than under DBB, because the design drawings and specifications do not need to be as detailed. The following section presents a discussion of the applicability of DBB and DB to the various components of the CRP.

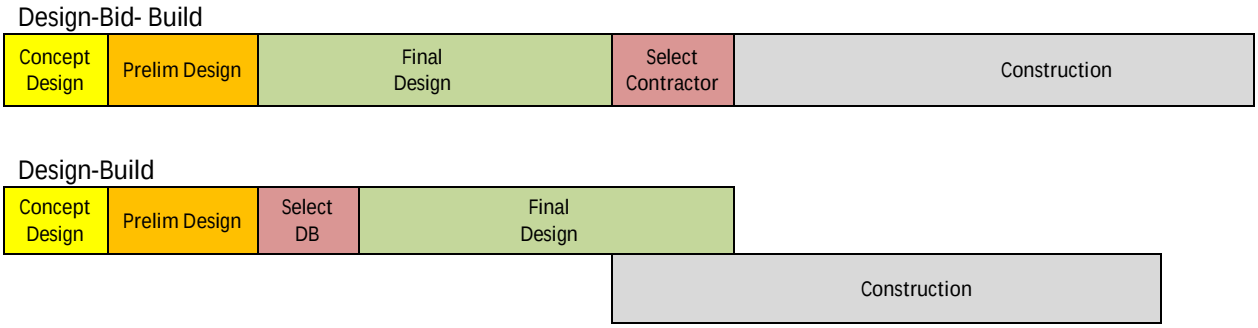

Figure 4. Conceptual Comparison of DBB and DB Project Delivery Schedules

5. APPLICABILITY OF DB AND DBB TO CRP PROJECT COMPONENTS

As previously described, the proposed CRP consists of a number of distinct major project components. Some of these project components are relatively independent and thus could be separated for bidding and construction purposes into separate smaller contracts. Other components have critical schedule and/or technical dependencies and therefore are better kept together for contracting purposes. Similarly, some project components are likely more suitable for procuring with the traditional DBB delivery method and others could potentially be suitable for DB.

The following sections discuss the applicability of the DBB and DB delivery methods for the following main project components: (1) foundation excavation, (2) dam construction, (3) bridge construction, (4) relocation of roads and recreational facilities, and (5) construction of a pump station and pipelines.

5.1 Foundation Excavation

General. Traditionally, foundation excavation and dam construction are usually packaged together into a single construction contract with unit price bid items. This approach eliminates the need for the owner to coordinate between separate contractors. A combined package may also be more cost effective since the site would be under the control of a single contractor and additional mobilizations would not be required. Although the full extent of excavation is not known until construction, the design documents can normally address this effectively. Obtaining a sufficient amount of geotechnical investigation data during the design phase is particularly important for projects that include substantial foundation excavation components.

Schedule. Foundation excavation is clearly on the critical path schedule for the project. Foundation excavation is somewhat weather dependent, and is most efficiently performed during the dry months of the year. If the foundation excavation were to be performed under a separate contract ahead of dam construction, final design of the dam could proceed in parallel with the foundation excavation work, potentially gaining some overall design schedule efficiency. However, even with a separate contract, the foundation excavation will still be on the overall critical path to project completion.

In that scenario, the bid documents for dam construction contract could be finalized at some point after the overburden and weathered rock have been removed and the final foundation contours have been identified. Waiting until that point to bid and award the construction of the dam may introduce a delay in the overall completion schedule, because with a single contract dam construction could start immediately following completion of the excavation and foundation preparation. If the dam construction was undertaken using the DB delivery method, there would still be a delay following foundation excavation to allow for procurement of the DB contractor (see Figure 5).

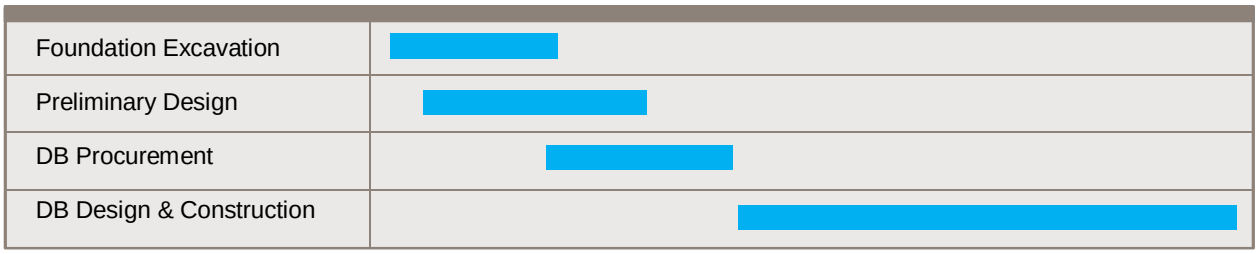

Figure 5. Design-Build with Foundation Excavation Separated from Dam Construction

Risks. Although combining the foundation excavation with dam construction under a single contract is common, this approach does entail certain risks. Perhaps most notably, the foundation excavation phase of the project contains the greatest risk of encountering unforeseen subsurface conditions. Even with a comprehensive geotechnical investigation program, uncertainties will remain for projects that are built on large, complex sites like the CRP. This represents a risk of increased costs and schedule overruns. Under a single construction contract, unexpected delays in foundation excavation would most likely impact the critical path schedule of subsequent dam construction activities. Appropriate contractual provisions and bid items can help mitigate this risk, but would not eliminate it entirely.

If the foundation excavation was carried out under a separate contract, the excavation would be fully advanced to reach the specified foundation objective prior to issuing a notice to proceed for the subsequent dam construction contract. The second contract would include foundation surface treatment; construction of the RCC dam, spillway and outlet works; foundation grouting; and installation of instrumentation, gates and valves. After completion of the excavation under the first contract, the foundation surface would be topographically and geologically mapped and the dam design and construction quantities would be updated to reflect the final surface contours. The topographic map and updated dam design would be provided to bidders for the subsequent dam construction contract to complete the project. This two-phased contracting approach would eliminate the risk of delays and unknowns in the foundation excavation impacting the dam construction contract critical path. However, it would introduce a separate delay due to the time required to update the design and procure the dam construction contractor.

Weather represents a risk factor for both foundation excavation and dam construction. If the foundation excavation is left open for a significant period of time prior to dam construction, the chance of weather-related deterioration increases, particularly if left over a winter season. For the dam construction, adverse weather can occur both in summer (excess heat) and winter (excessive precipitation and/or cold temperatures). Coordination between the foundation excavation and dam construction efforts will be needed to minimize the potential impacts of adverse weather on each activity. With separate construction contracts, achieving optimal coordination and scheduling may be more difficult and the total construction duration is likely to be longer.

Design-Bid-Build. If the foundation excavation is procured separately from dam construction to minimize the risk of delays, the work lends itself best to a low-bid DBB delivery method. Since the foundation excavation design will be based primarily on performance and rock quality criteria, there will be little or no latitude for design innovation or efficiency, and little if any reason to consider a DB delivery method. The bid documents will likely require the contractor to excavate to certain elevations and/or to meet specific rock quality criteria (e.g., degree of rock weathering), which will be established based on the geotechnical investigations. The majority of the work would be bid as unit price items to mitigate the uncertainties in the actual quantities required. Example bid items include excavation and hauling to disposal sites or to stockpiles for use as backfill. Once the excavation is complete and the foundation is fully revealed, the final topography of the excavated surface will need to be incorporated into the dam design. Once the updated design is approved by DSOD, the process of separately bidding the dam construction portion of the work can be carried out.

Design-Build. If foundation excavation and dam construction were to be procured together in a single DB package, the risk of encountering unknown conditions during excavation would still be present. As with DBB procurement, this risk can be mitigated by performing a thorough investigation program ahead of time and by including appropriate risk-sharing provisions in the contract. Fully shifting the subsurface conditions risk to a DB contractor is not generally considered a viable approach, because the DB contractor would be forced to price that risk and include it as a contingency sum in its contract bid, significantly increasing the overall cost of the project.

5.2 Dam Construction

General. As described above, separating the dam construction work into a second contract could have some advantages in terms of risk mitigation, but is judged unlikely to decrease the overall project cost or schedule duration.

Schedule. For separate DBB foundation excavation and dam construction contracts, bid and award for dam construction would occur after completion of the foundation excavation. The dam design would require prior DSOD approval (the foundation design lines would be based on the geotechnical investigation).

For DB procurement of the overall dam construction, the foundation excavation could potentially be completed months ahead of a DBB schedule. The bid advertisement could be issued after excavation is complete and DSOD agrees with the basis of design and foundation. Dam design would begin while the contractor is mobilizing and performing other preparatory work and construction work (see Figure 6).

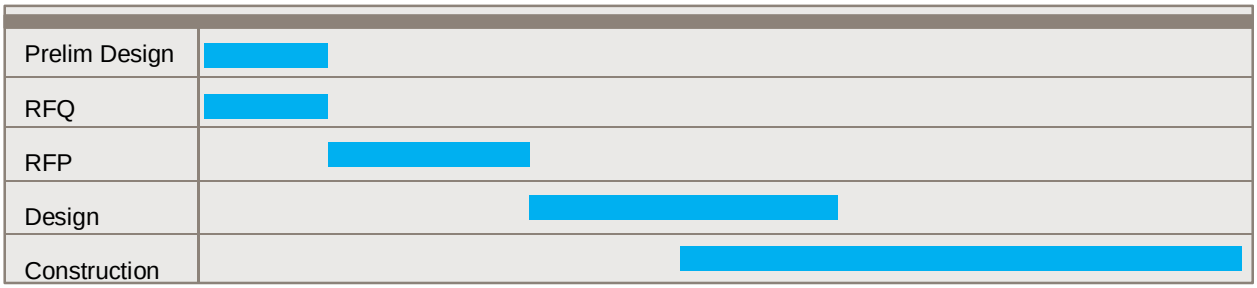

Figure 6. Design-Build for Dam Construction

Risks. If foundation excavation and dam construction are issued as separate contracts, and the dam construction bids are delayed until after the foundation excavation work is complete, the overall dam construction schedule could be extended. If the work extended over a winter season, the excavation could be subject to some additional deterioration during the delay, necessitating additional cleanup and preparation efforts.

Under DB procurement, the DB entity could be made responsible for obtaining final permits from DSOD and environmental agencies. However, if any permitting agency requires the DB entity to redesign and/or incur schedule delays and additional costs, the owner may still be exposed to some risk. Under DBB procurement, the owner would be subject to risks of design errors, omissions, or ambiguities. With DB procurement, the risk of design issues would almost completely reside with the DB entity.

Design-Bid-Build. In a DBB contract for dam construction only, the project would be advertised for bidding after the foundation design was completed and accepted. The topographic map of the completed foundation excavation would be provided to the dam construction bidders. The contractor would mobilize and begin construction following award of the contract.

Design-Build. With a two-step procurement approach (Section 3.2), a shortlist of DB contractors would first be established. Bid documents would be issued once the foundation excavation is complete and approved by DSOD. The design phase would proceed and the contractor could start work, "fast tracking" certain elements of construction (including equipment, materials, and plant mobilization) at its own risk before completion of the design. The design phase and construction phase would overlap, thus saving overall time in construction (see Figure 4). This is widely recognized as the greatest benefit of DB.

The DB entity would be required to allow NID and DSOD reasonable time for design review and permitting. The DB entity would be responsible for incorporating any normal, foreseeable comments/changes from DSOD into its design at no cost to NID. NID would bear the risk of unforeseeable comments/changes.

The DB engineer would be the EOR; hence, any review by NID or its engineer would be only for general conformance with the RFP criteria documents. Such a review is not an extensive review of details and calculations.

The EOR and contractor would collaborate on certain elements of the dam construction to balance material costs versus labor costs with the lowest cost result. Further, the DB entity would design the project to take advantage of its unique processes that make it competitive. However, as mentioned in Table 1, there would be a limitation on design innovation for the dam due to DSOD jurisdictional involvement. There would also be little time to improve concept design in a DB process.

5.3 Bridge Construction

General. This element is planned to be independent of the foundation excavation and dam construction. A preceding bridge construction contract would eliminate the risk of bridge construction interfering with foundation excavation and dam construction.

Schedule. As mentioned above, current plans call for the bridge to be completed before foundation excavation and dam construction begins. If DB procurement is used for bridge construction, schedule savings would result from overlapping design and construction, as discussed above for dam construction.

Risks. With DBB, NID would be exposed to the risk of change orders from ambiguous design. That would not be the case for DB.

Design-Bid-Build. Based on a discussion with NID's bridge consultant, most bridge construction projects are executed by DBB. However, certain contractors would be more competitive bidding one design of a bridge versus another bridge design. When NID proffers the design for bidding, it would experience a less competitive field from all contractors. Details to the design could limit contractor innovation.

Design-Build. The bridge may be suitable for DB. DB bridge contractors can design and build the most efficient bridge that their particular construction methods can achieve within the constraints of the RFP.

5.4 Relocation of Roads and Recreational Facilities and Construction of Pump Station and Pipelines

General. There a number of roads and recreational facilities to be relocated and a pump station and pipelines to be constructed as part of the CRP. At this time, the scope of work for these items is not fully defined, so the discussion in this section can only be generalized.

Schedule. Design and construction could be started and completed any time before the reservoir is filled.

Risks. This project is a good candidate for small contracts with local designers and contractors. With DBB and DB, there is a risk that these contractors may interfere with dam construction contractors using haul routes, quarries, etc. NID would need to coordinate this work closely with dam construction.

Design-Bid-Build. These projects can be performed using DBB or DB. With DBB, all the designs could be prepared and ready for bidding when NID is ready. Bidding could occur at any time, as long as construction is completed before the reservoir is filled.

Design-Build. NID has experience in issuing small DB contracts and has used DB for pump stations; DB can be used for the new pump station as well. Each of these projects individually or a few bundled are good candidates for DB to minimize design and construction costs and potentially overlap their schedules, reducing overall construction time.

6. CONCLUSIONS AND RECOMMENDATIONS

To select the most suitable project delivery method for the components of the CRP, the NID should consider the expectations, risk allocation, and potential schedule ramifications associated with each method. Both the DBB and DB methods appear to be appropriate for different components of the project. In general, the DB delivery method could reduce some elements of risk to NID, but the project cost may be higher as a result. Some schedule benefits may be achievable with DB, since the final design efforts can start earlier and run in parallel with construction. However, those benefits may be partially offset by the additional time necessary to authorize and implement a DB procurement process and to select a DB entity that offers a best value solution to NID.

Under DB procurement, the responsibility for engineering and construction would both fall under the same DB entity, simplifying the contract administration process for NID. However, a downside of the DB approach is that NID would relinquish control over the design. For the dam construction, final approval of the design will need to be obtained from the DSOD. The scope of design innovations that a DB entity could potentially bring forward is relatively limited. The DB entity would be responsible for items such as the final RCC mix design and details such as the facing elements and joint details. Relatively little if any benefit or cost savings to NID would be expected from having these types of elements designed by a DB entity.

The following CRP project components are judged to be appropriate for contract packaging: (1) excavation of the dam foundation, (2) dam construction, (3) bridge construction, (4) relocation of roads

and recreational facilities, and (5) construction of a pump station and pipelines. Any of these components that are pulled out into separate contract packages would still need to be coordinated with the other components to make sure they avoid interfering with each other. The contract packages would also have to comply with the same overall environmental review documents and mitigation requirements being developed for the project as a whole.

In our opinion, foundation excavation is a viable candidate for a separate stand-alone construction contract, using the DBB delivery method. This approach could help mitigate the risk of unforeseen conditions potentially impacting the dam construction schedule. However, this risk reduction would come at the expense of potentially lengthening the overall schedule for the project, because with a separate contract the dam construction would not be able to start immediately following the completion of excavation and foundation preparation.

If the dam construction is procured under a separate contract from foundation excavation, it could potentially be delivered with either DBB or DB. The DB approach could potentially save some time, but would still be constrained by the prior foundation excavation contract. The preliminary engineering would need to be advanced far enough by the owner's engineer so that the permitting risks faced by the DB entity are minimized. Any significant permitting challenge to the final design could delay the DB entity's work and increase costs.

The proposed new bridge construction, relocation of roads and recreational facilities, and construction of a pump station and pipelines are all candidates for either DBB or DB project delivery methods. Of these, the pump station and pipeline project components appear to be relatively well suited for the DB delivery method.

7. REFERENCES

AECOM, 2017a, Nevada Irrigation District, Centennial Reservoir Project, Conceptual Engineering Report, Draft, May 24.

AECOM, 2017b, Nevada Irrigation District, Centennial Reservoir Project, Roller Compacted Concrete Dam, Opinion of Probable Construction Cost, May 15.