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Schedule Impact Analysis Using CPM Schedules

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Abstract

Impacting events causing interruption and change occur regularly on construction projects, frequently resulting in disagreement over the true time and cost related to the impact. Recognizing the need to develop a systematic approach within the Virginia Department of Transportation for addressing events that impact the project schedule, the VDOT – Virginia Tech Partnership for Project Scheduling developed a preferred manner in which to address impacting events using Schedule Impact Analysis (SIA). SIA is defined through the following process herein: 1) Identify, assign responsibility, and classify schedule impacts on construction projects. 2) Recognize the documentation necessary for an impact once it has occurred such that adequate information is provided for analysis, quantification, and apportionment of impacts. 3) Analyze project documentation developed from an impacting event to determine entitlement to a contract time extension and responsibility for the delay or change. 4) Recognize various types of schedule impact analysis techniques and use the contemporaneous as-built method to quantify and apportion impacts on construction projects, and 5) Summarize and effectively communicate the results of the analysis to the appropriate parties.

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Introduction

Impacts that cause delay and change are a fact of life in the construction landscape. Far too often these impacts, and the failure to properly and completely address them in a timely fashion, lead to disputes that distract the project team from its purpose and are far more costly and time consuming than necessary.

Furthermore, with the increasing complexity of construction projects and the associated impacts resulting thereof, it is incumbent upon the construction professional to be equipped to recognize impacts and rightly respond to the impacts once they occur.

When an impact is experienced, the common result is a dispute over time, specifically the project completion date, and money – the financial implications of the impacting event. The increasing acceptance and required usage of the Critical Path Method (CPM) schedule provides a ready tool for considering the effect of the impact on the project schedule, yet many in the field are not experienced with, or as of yet are not convinced of the power and utility of the CPM schedule as a tool to solve the impact puzzle and determine a fair, equitable and justifiable resolution.

Whereas few enjoy dealing with the problems that occur on construction projects, many are tempted to delay addressing these issues as long as possible, frequently until the end of the project. Instead of dealing with impacts contemporaneously, as they occur, schedule impact issues tend to drag out, only becoming more costly and a greater drain on time and resources.

What is well known is that impacts will and do occur. What is not commonly known and agreed upon among construction professionals is the proper response when a time impact does occur. With these concerns in mind, and recognizing the need to develop a systematic approach within the Virginia Department of Transportation for addressing events that impact the project schedule, the VDOT – Virginia Tech Partnership for Project Scheduling developed this technical report to expose and train VDOT's employees and those it does business with in the methods of schedule impact analysis, specifically the Partnership's preferred manner in which to address impacting events. This technical report is designed to train readers to:

1. Identify, assign responsibility, and classify schedule impacts on construction projects.
2. Recognize the documentation necessary for an impact once it has occurred such that adequate information is provided for analysis, quantification, and apportionment of delays.
3. Analyze project documentation developed from an impacting event to determine entitlement to a contract time extension and responsibility for the delay or change.
4. Recognize various types of schedule impact analysis techniques and use the contemporaneous As-Built method to quantify and apportion impacts on construction projects.

5. Summarize and effectively communicate the results of the analysis to the appropriate parties.

Quantification of impact costs is outside the scope of this technical report. This technical report specifically addresses projects for which a detailed CPM schedule is ***both*** created ***and*** regularly updated. Therefore, this technical report is specifically created to address projects with a Category III, IV or V CPM schedule, in accordance with VDOT special provision. Following these guidelines will lead to a more expeditious and favorable outcome for any project impact, while resulting in a fair and equitable judgment for all parties involved.

All specification references come from the 2002 VDOT Road and Bridge Specifications, denoted by RBS. This technical report shall serve as a guide only, and is not to be interpreted to take the place or supersede any contract documents on VDOT projects.

Chapter 1 – Identification and Classification of Impacts on Construction Projects

The purpose of this chapter is to define schedule impact analysis and explain the benefits of its use for addressing impacts on construction projects. Furthermore, this section of the manual discusses the types of project impacts and their root causes, as well as providing a means to classify delay and change events to determine entitlement to a project time extension.

1.1 The Case for Schedule Impact Analysis

Schedule Impact Analysis (SIA) may be defined as the process of quantifying and apportioning the effect of change and/or delay on the project schedule. The scope of an impact analysis is to identify a discrete *impacting event*, which may be further defined as any event that results in an interruption of the work or produces change in any of its forms that affects the project schedule, and use the SIA processes described in this manual to:

- Identify the impact by type, cause and entitlement classification
- Recognize adequate documentation of the event
- Evaluate the impacts of the event using the contemporaneous As-Built CPM schedule method to determine any appropriate time extension, and
- Utilize the output from this method to summarize and report the findings.

The goal of this process is to produce a uniform method for analyzing impacts that addresses the impact at the time that it actually occurred (contemporaneously), without prejudice for any certain outcome in an effort to produce a fair and equitable resolution that is contractually supported. Such a methodology will result in far more expeditious resolution to the disputes that frequently arise on construction projects. Additionally, recent court cases support this method as the most legally justifiable means of quantifying and apportioning impacts [Wickwire et al 2003].

The further result of this process is the ability to clearly quantify and assign responsibility (apportion impact delay) for each and any of the impacting events on the project. This apportionment then provides a solid basis for the financial quantification discussion.

Wickwire et al [2003] state that schedule impact analysis is advantageous because it:

1. Is used with the CPM schedule to define the critical path and the logical relationships between activities, and can be used to clearly show precisely how a particular delay affects the project duration as a whole.
2. Is impartial and fair in its treatment of changes and delays, and is therefore beneficial in bringing two disputing parties to resolution.
3. Isolates and quantifies specific delays in a contemporaneous manner.
4. Handles multiple and concurrent delays on critical and non-critical paths.
5. Is able to evaluate the impact of delayed but unchanged work.
6. Provide suggestions for the optimum means of recovery, as well as lending information concerning delay prevention and mitigation.
7. Leads to accurate current estimates for project completion, making the CPM schedule a more useful tool.
8. Assists in proving the relationship between a specific delay and its related costs.
9. Supports or refutes delay claims.
10. Ensures that the project schedule remains up to date and encourages continual review of information shown on the schedule.

Conversely, the result of failure to use schedule impact analysis and address issues as they arise can be seen throughout the construction industry: longstanding issues that drag on throughout the project while growing in size, draining morale and deteriorating project relationships, avoided until the end of the project to be dealt with by upper management after the actual facts have been long forgotten. History shows that this method is far more likely to end up in litigation and result in higher costs. Failure to incorporate impacts into the schedule as the work progress renders the schedule useless as a management tool [U.S. Army Corps of Engineers 1979], and forces the prudent contractor into constructive acceleration to avoid breach of contract caused by late completion.

1.2 Types of Impacts

Prior to and as part of determining entitlement to time extension as a result of a schedule impact event, it is important to identify the type of impact and the root cause of that impact. The following section divides impacts into types of interruptions of work and types of changes.

1.2.1 Definition of Impact

As defined previously, impact events on construction projects include interruptions of work and changes, in each of their varying forms. Understanding the type of impact will later assist the analyst in classifying entitlement, and ultimately in quantifying and apportioning delays. To this point, impacts have been identified simply as ‘interruptions of work’ or ‘change’ for convenience. However, separate and very distinct impacts exist under the heading of ‘interruption of work’ and include delays, disruptions,

suspensions, and default/termination. True delays are only one segment of impacts that interrupt work. Therefore, whenever 'delay' is used in this technical report, it will be taken to mean only those impacts that fit the delay description as follows, while the word 'impacts' will be used to mean any event that may have an effect on the project schedule. Likewise, change also has various forms, and includes directive, constructive, and cardinal. Change can include a simple change in quantity, a full change in scope, or a change in site conditions (known as differing site conditions).

1.2.2 Change

All types of impacts involve some type of change from the conditions or understanding as represented in the Contract. Therefore, although mentioned separately, this form of impact is a part of all of the others. The occurrence of change on construction contracts is nearly a foregone conclusion. The main question remaining is how the contract governs change. Most contracts, including the Department's, include clauses granting the owner unilateral rights to make changes to the work that the contractor must comply with and complete. Furthermore, clauses allow the contractor to seek payment if justified for the cost of the changed work [Bartholomew 2002]. See VDOT RBS Sections 104.02 and 109.04.

Changes that occur fall into three main categories: directive, constructive and cardinal. Directive change is change that occurs under the direct order of the owner, such as the issuance of a change order that leads to a formal change in the contract. All change, however, is not directed by the owner. Constructive change occurs when the owner requires an action or prevents action by a contractor, stating that it is required or prohibited in the contract when it is, in fact, a change. In order to achieve a constructive change claim, the contractor must prove that change actually occurred, and that the owner actually directed (or prohibited) the contractor on certain actions [Bartholomew 2002]. Finally, a cardinal change is a change so broad and far-reaching, that it changes the scope of the entire contract. A cardinal change on a VDOT contract would not be legal, as it violates the Public Procurement Act.

Change that may act to impact the project schedule comes in many forms, the most prevalent of which is the formal work order. Work orders issued should all have a schedule impact analysis component to address the critical time required to perform the added work. As frequently as possible, time should be granted in a forward-scheduling basis – in other words, prior to the work actually being performed. This method ensures that the contractor will work as efficiently as possible to complete the work. Forward-pricing/scheduling will be discussed more in Section 3.2 of this document.

The other main source of change on VDOT Contracts is added quantities. On VDOT Contracts, RBS Section 108.09 allows an increase in contract time due to overrun quantities based on the total dollar value of the additional work divided by the Daily Dollar Value (DDV). DDV is calculated by dividing the original contract value by the total number of calendar days for performance. Care should be taken, however, as a recent Special Provision in many contracts acts to strike this clause and require a work order for any project overruns that impact completion. The main fault of the standard clause is that it does not in any way relate to whether the extra work is on the critical path, or ensure that the extra work

affects the total working time of the contract. Furthermore, even if the work is on the critical path, few activity's durations are accurately based on the average Daily Dollar Value of the contract (i.e., one day's work earns exactly the DDV). For example, items with high materials costs, such as asphalt pavement pay items, frequently overrun, yet are able to earn far more than the DDV for a normal day's work (meaning the contractor is granted more time than appropriate). Conversely, items with low materials costs can be very time consuming and labor intensive and yield less than the DDV for a days work, shortchanging the contractor. For this reason, as much as possible, overruns should be converted to work orders with an appropriate schedule impact analysis performed to determine a fair and equitable time extension.

An additional source of change is differing site conditions. Differing Site Conditions occur when the conditions found on the project are materially different from the conditions that could be reasonably anticipated from the Contract documents. This element of change will be covered more in Section 1.3.1 of the manual, and is governed on VDOT projects by RBS Section 104.03.

An important side note to the change discussion is the definition of who is authorized to make change. Change may only be made by an authorized agent. Care must be taken to clearly identify who is authorized to make changes to contracts. In the Department's current structure, the Chief Engineer has delegated change authority to the responsible charge position, which is normally the Area Construction Engineer. However, in most districts, final authority to authorize change that results in a revised fixed completion date lies no lower than the District Administrator.

1.2.3 Delay

A delay is an interruption of the work in which an activity or activities are wholly or in part prohibited from taking place for a discrete period of time, during which no part of the delayed activity or activities may take place as a direct result of the impacting event. Delays normally occur because of an act of omission on the part of the responsible party, rather than a specific direction to stop work. Once a delay occurs, no (or at least very little) progress is made on the affected activities until the delay is resolved.

Multiple VDOT specifications discuss the treatment of delays, and will be handled individually through the course of the document. The main sources of delay on construction projects include defective specifications, site availability problems, changes and differing site conditions, and the owner's failure to act administratively [Bartholomew 2002].

An example of a delay is the failure to provide timely approval of shop drawings, per the time limit defined in the project specifications. In this case, the owner fails to act in the timeframe specified, and as a result, the activities for which the shop drawing pertained (fabrication and installation) cannot start until the delay in the approval is concluded. The remainder of the work on the project can continue, assuming that the remaining work is not a direct successor of this shop drawing approval.

Another example of a delay is the breakdown of a key piece of the contractor's equipment, for example a crane on a structural steel operation. Similarly, the activity to set the structural steel is essentially stopped until the crane is repaired or replaced.

In light of the preceding examples, it is important to note that on ***any*** impact, there is an implied responsibility for both parties to mitigate the effect of the event to limit schedule impact [Bartholomew 2002]. VDOT specifications do not specifically include this statement, but Virginia Road and Bridge Specifications (RBS) Section 105.16, Submission and Disposition of Claims, does require early notice of claim events for the express purpose of attempting to mitigate or eliminate the impacts. In the previous example, successful mitigation might mean that the contractor's delay is zero, if the contractor is able to fully utilize its resources tightening bolts or performing some other critical work. Likewise, the owner's delay in the first example may also be zero if the contractor is able to work on some other piece of critical work while waiting for resolution. Note: the foregoing fact does not mean that the contractor's cost of delay will be zero, but that is out of the scope of this technical report.

1.2.4 Disruptions

Also called interference or hindrance, disruptions are events that affect the performance conditions reasonably anticipated by the specifications in such a manner as to reduce productivity, efficiency, and/or effectiveness of the project resources, making the work slower, more difficult, and/or more expensive. Disruptions exist in the midst of the ongoing work and encumber or add to the requirements of the planned work, normally altering the contractor's means and methods or forcing it to occur out of the planned sequence.

Disruptions often result from change. The contractor has the right to schedule its work according to the most efficient means; any interference with that schedule is a disruption. Disruptions can also proceed from delays if the work is unable to resume as planned after the delay.

In determining whether an actual disruption exists, the analyst must carefully review the contract documents to determine what conditions were represented at the time of the bid under which the contractor would be expected to work, and what specifically changed in those conditions.

Suppose a contract that calls for a pipe under a Railroad in which open cut is not allowed. If no special provision states otherwise, the contractor may assume the right to install the pipe with a traditional jack and bore method. If, upon submitting this plan for approval, the Railroad rejects this method and requires a slower hand-tunneling method to minimize potential impacts to the live track above, a disruption has occurred. In this case, the contractor is not delayed from starting the work, nor at any point is the contractor required to stop work, but the operation will in all likelihood require a longer duration due to the slower method. Costs will also likely increase.

In another example, a contractor is depending upon a particular access route provided by the owner to move some material for the work. The bid documents represent free and open access. However, upon prosecution of the activity, the contractor discovers that the owner has also granted some other third party this same access (say, a utility relocation), such that this third party presents an

obstruction slowing haul rates or perhaps resulting in reduced clearance and requiring the contractor to utilize smaller equipment. Again, the performance reasonably assumed by the contractor at the time of the bid is hindered, resulting in increased performance time and cost.

1.2.5 Suspension

Suspensions are complete stoppages of work, often all of the work, usually due to an owner directive to stop work. A delay can be considered the result of a suspension, though for the purposes of this manual the words will be kept separate to avoid confusion.

As in most contracts, VDOT as the owner has the right to suspend the work on the project per RBS Section 105.01, which states:

> *The Engineer has the authority to suspend the work wholly or in part if the contractor fails to correct conditions that are unsafe for workers or the general public or carry out the provisions of the Contract. The Engineer may also suspend work for such periods as he may deem necessary because of unsuitable weather in accordance with the requirements of Section 108.10, conditions considered unsuitable for prosecution of the work, or any other condition or reason deemed to be in the public interest.*

On VDOT contracts, the Contractor and Owner are governed by the following requirements of RBS Section 108.10, Suspensions of Work, in order to consider recovery of time and/or money as a result of the suspension:

- Proper notice, within seven days of notice to resume work
- Justification that cost and/or time required for the performance of the contract has increased as a result of the suspension
- The suspension was caused by conditions beyond the control of and not the fault of the Contractor and its parties
- The suspension was not caused by weather
- Performance would <u>not</u> have been delayed or suspended by another cause in the absence of the noted suspension.
- An adjustment is <u>not</u> provided for or excluded under other terms or conditions of the Contract.

An example of a suspension that would affect part of the work is in the case of a contractor conducting blasting operations adjacent to a railroad, using an approved blasting plan. Upon blasting in a location particularly close to the railroad tracks, the energy from the blast resulted in upheaval and kinking of the tracks. The Contractor's blasting operations were suspended until a revised blasting plan could be produced and approved by the Department and the Railroad. Because the suspension resulted from actions within the contractor's control, no time extension or compensation were considered as a result of this critical path activity suspension.

1.2.6 Termination

Termination is a permanent stoppage of work of all or a portion of the Contract, and the contract is terminated. Termination exists as a right only if specifically stated in the contract. Most contracts have specifications allowing the owner to terminate the contract, while some contracts allow the contractor to terminate the contract.

Termination is divided into two main categories: default termination and convenience termination. Default termination results from the default clause in contracts, which normally gives the owner the right to find the contract in default if the contractor does not meet the obligations of the contract. As will be discussed later, this clause is especially important to contractors which have experienced perceived delays, but have not yet been granted a time extension. Failure to meet the contract completion date can be reason for default, meaning that if no time extension is granted, the prudent contractor must take steps to accelerate to complete on time.

The second type of default is convenience default, which is a clause in the contract that allows the owner to terminate a contract for its convenience, based on the specific needs of the owner. Such termination must be carried out in good faith, or will likely be overturned if challenged.

VDOT RBS Section 108.14 covers Terminations of Contract, which allows the entire Contract or any portion thereof to be terminated. The Department's specification has a default termination clause in it, based on the definition of default from RBS Section 108.13. Reasons to default a contractor are given as follows:

- Failure to begin work within 10 days of Notice to Proceed
- Failure to perform work with sufficient resources to ensure prompt completion
- Unsuitable or negligent performance of the work or refusal to perform rework
- Discontinuance of prosecution of work
- Failure within a reasonable time period to resume work that had been discontinued
- Bankruptcy or insolvency
- Allowance of final judgment unsatisfied for a period of 10 days.

VDOT also has a limited convenience termination clause, which allows the Department to terminate the contract for convenience, but only in the following situations:

- National emergency
- Action by the State, U.S. Government, or court order
- Conditions beyond the control of the Department.

RBS Section 108.14(b) gives specific provisions for each party's duties once termination has been enacted.

The Department rarely defaults a contractor, and therefore even more rarely is there a default termination. Termination for convenience would be even more infrequent. Default termination might result in the case of a Contract that experiences multiple contractor delays due to errors and performance

issues towards the end of the project. If the Contractor were unwilling to perform the corrections necessary and removed resources from the site, that contractor may be found in default, and then have the remainder of the Contract terminated.

1.3 Causes of and Responsibility for Impacts

Once the type of schedule impact has been evaluated and an event has been clearly labeled as an actual impact, the root cause (or responsibility) of the schedule impact is the next key element prior to determining entitlement. For the purposes of this technical report, causes of impacts may be identified as Owner, Contractor, Third Party, or Force Majeure, though only a party privy to the contract may be found responsible for the impact. Ultimately, the question of which party is found responsible the impact is an issue of either *control* or *assignment*. The party that has control, or should have control – the ability and duty to act (either implied or explicitly assigned) – over the impact is normally given responsibility for the impact. In addition, the Contract assigns responsibility for certain impacts to each party involved in the contract. As a result, careful examination of the contract is necessary to fully determine the responsible part for each impact. This topic is further expounded upon in Section 1.4 of this manual.

1.3.1 Owner Responsible Impacts

Owner responsible impacts (ORI) are impacts that are directly attributable to actions or inactions of the owner, or are responsibilities or risks assigned to the owner, that impact the project schedule. Owner impacts in some way prohibit the contractor from completing the work in the manner planned. In determining Owner responsible impacts, the burden of proof that an impact has occurred lies with the contractor [Bartholomew 2002].

Owner impacts are many and varied in number. However, they can generally be categorized into the following key sources of owner-caused impacts: defective plans and specifications, site availability and access problems, changes (including differing site conditions), and the owner's failure to act administratively in the specified timeframes.

<u>Defective Plans & Specifications</u>

Defective plans and specifications are said to be the greatest source of Owner responsible impacts on construction projects [Bartholomew 2002]. The owner assumes full responsibility for the accuracy and absence of conflicts and confusion in the contract documents. Errors, omissions, conflicts or multiple interpretations will normally be decided upon in the contractor's favor and labeled as an owner impact. This implied warranty of the contract documents by the owner has its precedence in the Spearin Doctrine, originating from a 1918 landmark Supreme Court case ruling assigning owner responsibility for defects in the plans and specifications. In other words, the Contractor should be able to rely on following the contract documents produced by the owner to achieve the intended result.

The Department warrants its plans by stating that *"plans consisting of general drawings and showing such details as are necessary to give a comprehensive understanding of the work specified will*

be furnished by the Department." (RBS Section 105.02) A clear error that alters the original understanding of the work results in an Owner responsible impact.

Recognizing that discrepancies between individual contract documents is a distinct possibility, the Department unites the individual documents by stating that a requirement occurring in one is as binding as though occurring in all, while ranking the documents in order of interpretation (RBS Section 105.05). See Figure 1.1 for a visual representation of this hierarchy. Section 1.4 discusses contract interpretation more thoroughly, including the treatment of the various contract documents.

Frequently on VDOT projects, the contract documents that are found to have defects or errors are produced in part by third parties, such as consultant designers. Because the Contractor has no contractual relationship with the Consultant Designer, recovery will occur through the Owner as an Owner responsible impact. The Department may then pursue the Consultant Designer for the costs of the impacts that occur because of design errors, and can be successful. However, barring negligent, extremely costly, or numerous errors, the Department most often accepts the resulting costs of impact and does not further pursue reimbursement.

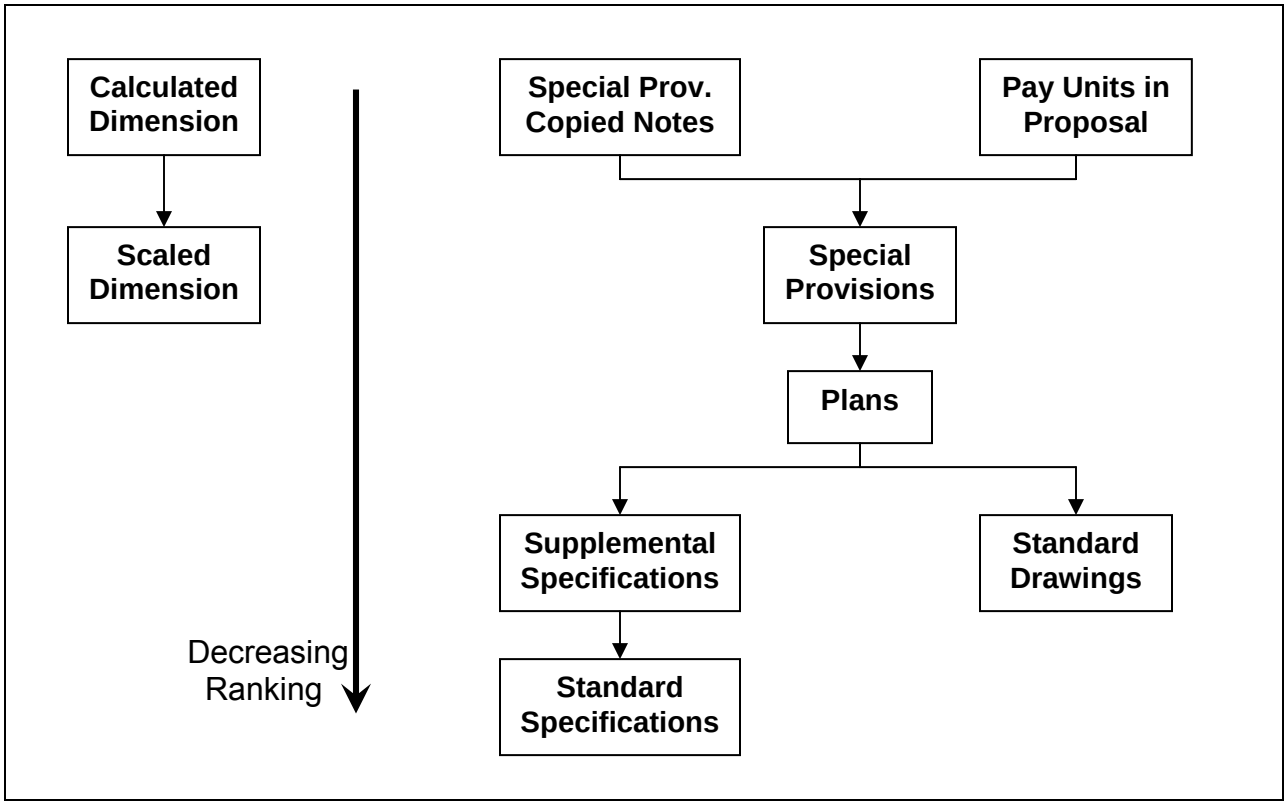


Figure 1.1 - Contract Document Hierarchy

Site Availability/Access Problems

The requirement for the owner to provide access to the work is implied on all construction contracts [Bartholomew 2002]. Any delay to providing this access to the entire site following the Notice to

Proceed (NTP) is an Owner responsible impact. Any part of the project that will be restricted following the NTP must be specifically stated in the Contract documents.

Restrictions to availability can take several forms. Some examples of common restrictions on availability included in contracts on VDOT projects are as follows:

- Specific portions of the project restricted for a portion of time while a third party, such as a utility, railroad, or separate contracted contractor performs work
- Time of day restrictions for work, such as restrictions on busy roadways around rush hour, or limiting the closure of roadways to night operations.
- Time of year restrictions, such as limitations to work in and around streams around periods of high water or spawning seasons.
- Holiday restrictions, as per RBS Section 105.09, which prohibits work on Sundays and specific holidays except by permission.

Some extreme contract language may even require the contractor to provide its own means of access. In any case, these items are (or should be) clearly specified in Department contracts. Any decision by the owner to restrict availability beyond the contract language is an owner impact. For example, in reference to the RBS Section 105.09 Holiday restrictions, the Department recently elected to expand the restriction of work in and around traffic from 12:00 PM the day before the holiday weekend to 12:00 PM the day after the holiday weekend. As such, any critical operations were delayed by a total of one day, which was an Owner responsible impact.

Change / Differing Site Conditions

Change and its various forms are also discussed in Section 1.2 of this document. Any true change to the original interpretation of the work to be done or the manner in which it may be prosecuted creates an Owner responsible impact. In fact, change must occur in some form for any Owner responsible impact. Changes result from many and varied sources such as field conditions varying from the plan estimation, new laws and regulations, value engineering proposals, the convenience or desire of the owner, or various other errors or conflicts that arise.

One key form of change is covered by the Differing Site Conditions (DSC) clause in contracts. This clause, which appears in many construction contracts and is covered by RBS Section 104.03 on VDOT projects is stated as follows:

> *During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site. . .and if it is determined that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding anticipated profits will be made.*

This language removes the risk from the contractor for any significant reasonably unforeseeable changes in site conditions. It is important to note that the VDOT specification also places the following requirements and limitations on DSC:

- Proper written notification must be provided 'promptly' after the DSC is discovered
- The Department must properly investigate the notification filed.
- Profits are not to be included in the compensation package
- The contract adjustment will not be allowed for any work not affected by the DSC

Differing Site Conditions are usually split into one of two categories depending on the issue. The first category involves a condition materially different from that indicated on the contract. To successfully assert this type of DSC, the contractor must prove that the contract documents indicated or represented the conditions present in a certain manner, and that the actual conditions are materially different from this representation.

A common example of this category of DSC is subsurface soil conditions. As it is extremely difficult for either the owner or the contractor to know exactly what lies beneath the surface, even when extensive soil boring logs are taken, the possibility of differing conditions is significant.

On VDOT contracts, the Department transfers this risk back to the contractor via RBS Section 102.04:

> *The submission of a bid will be considered conclusive evidence that the bidder has examined the site of the proposed work. . .and is satisfied as to the conditions to be encountered in performing the work. . .Any conclusions drawn by the Department concerning subsurface conditions are based solely on the data and are merely indications of what appear to be existing subsurface conditions. The Department does not warrant these conclusions to be correct. . .nor does the Department warrant the condition, amount, or nature of the material that may be encountered. . .The bidder shall make his own interpretation of the subsurface data. . .The submission of a bid will be considered conclusive evidence that the bidder is satisfied with regard to the subsurface conditions to be encountered in the work*.

It should be noted that due to the extremely broad and far reaching implications of a clause such as this, called an exculpatory clause, and because the contractor is not reasonably able to fully investigate every subsurface condition that might exist, care should be taken in applying it. The cost of such an investigation and the time limit in which to submit the bid are prohibitive in this case. Therefore, there may be some cases where this clause may not fully protect the Department from liability for a subsurface DSC, as this clause may be deemed to conflict with the DSC clause. In addition, the owner is expected to have 'superior knowledge' of the site because of its position as owner, especially as a government agency, and is in general held more accountable for discovering and making known subsurface conditions on the project.

An example of this category of DSC might be in the case of a contract that requires a certain CBR value (California Bearing Ratio) for the material used in its fills. The grading diagram shows the project to be balanced, and indicates a manner in which the cuts may be placed in the fills. No borrow material is set up on the project. All of the soil boring logs indicate the material in the sections to be excavated have a sufficient CBR value to be used in the fills. However, after work begins, all of the material that is excavated is unsuitable, and is found to have insufficient CBR values. The Contractor is forced to haul material in from outside the project limits to complete the fills, and waste all of the excavated material. The conditions on site have materially changed from what the contract documents indicated.

The second type of DSC relates to the physical conditions ordinarily encountered and generally recognized as inherent for a specific type of work. In this case, the DSC is not necessarily something represented or indicated in the contract, but rather a condition that is entirely unexpected for the type of work as could be reasonably be anticipated by the contract. In other words, a material might be properly identified, but exhibit characteristics completely unexpected for that type of material [Bartholomew 2002].

For instance, boring logs and simple observation indicate that the soil on a project consists of a clay material, which normally compacts readily. However, upon starting the grading operation, the Contractor discovers that the clay material will not compact. After trying all of the standard methods for achieving compaction (heavier rollers, different types of rollers, adding water, drying, blending with other soils, etc.), the material still will not achieve the required 95% compaction. Material is hauled in from off site to complete the fills. In this case, the conditions were not misrepresented, but they behaved quite differently than could be anticipated.

In both categories, a properly documented Differing Site Condition not otherwise transferred by the Contract documents is an Owner responsible impact.

Owner Failure to Act Administratively

The owner has certain specified timeframes to perform various reviews and other administrative functions or contractual acts required of the owner. Even in the case where a timeframe is not specifically identified, the owner is required to act in a ‘reasonable’ amount of time. Any failure to promptly act as needed is considered an Owner responsible impact. Examples of such a delay include: shop drawing and submittal review and approval, formal requests for information, contractor change requests, work order preparation and issuance, differing site condition investigation or any other communication of an owner decision.

VDOT specifications allow 30 days for the review of working drawings, or 45 days if a third party is involved in the review, as identified in RBS Section 105.02. Failure to meet this time limit may result in an extension of time. If the third party fails to act promptly and so delays approval past the noted deadline, VDOT is held responsible. In some cases the Department may be able to recover some of the damage costs from the third party, but usually this type of delay is a risk that remains with the owner.

As mentioned above, there are numerous other decisions and actions required by the owner that do not have specific timeframes attached to them. To address this problem, the Department issued

Construction Division Memorandum 2004-1, which specifies particular timeframes for responding to requests for information, confirmation of verbal instruction, requests for owner action, and contractor change requests. The timeframes set forth in this memorandum are now in most contracts, and are the basis for an Owner responsible impact if not met.

1.3.2 Contractor Responsible Impacts

Contractor action (or inaction) can also be the cause of impacts on construction projects. As was mentioned earlier, the burden of proof lies with the contractor to prove entitlement to an impact. Failure to successfully prove that a change occurred from the documents used to bid the project and the reasonable understanding indicated by those documents, or to identify an issue clearly in one of the categories above, results in a Contractor responsible impact (CRI). Like owner delays, contractor delays are either under the control of the contractor, or are a risk assigned to the contractor by the Contract.

Contract Assigned Risks

The Contract assigns numerous risks to the contractor that become the sole responsibility of the contractor if they occur. The contractor has little or no control over the occurrence of these events, but will be held responsible for planning and executing the work to complete in a timely fashion. These contractor's risks are many and varied, but examples that are found on VDOT projects include:

- Weather. No time extension will be granted for weather on VDOT projects. (RBS Section 108.09) RBS Section 105.01 does give the Engineer the authority to suspend work because of unsuitable weather; however, RBS Section 108.10 states that no contract modification will be issued for such a suspension.
- Maintenance of the project. The Contractor is required to maintain the roadways and project in general during construction, per RBS Section 104.04 and RBS Section 107.16. Impacts due to repair of excessive damages resulting from traffic, weather, vandalism or other causes is not cause for an extension of time.
- Permits or other contractor furnished certifications. The contractor is often required to obtain permits from a third party (such as a Railroad, an environmental agency, or a property owner borrow/disposal site) not associated with the owner, as noted in RBS Section 107.02. Delays by those parties in obtaining the permit or certification is not cause for a time extension.
- Differing Site Condition exculpatory clauses. As was mentioned in the DSC section, VDOT RBS Section 102.04 transfers the responsibility for certain subsurface uncertainties back on the contractor.
- Indemnification Clauses. These clauses, which typically protect State employees from lawsuit to some degree, relate more to financial impacts and therefore are not covered by this technical report.

The contract must be carefully reviewed to determine if the stated impact is covered by one of these risk transferring clauses.

Contractor Controlled Impacts

Many impacts experienced by contractors are a result of contractor controlled events, largely related to the contractor's responsibility to complete the work within the required timeframe and in accordance with the contract documents. Examples of contractor controlled impacts on VDOT projects are as follows:

- Failure to maintain proper resources to complete the project on time. The contractor is required to procure all manpower, equipment, materials and services to complete the job on time. RBS Section 108.13 states that the failure to meet this requirement is a cause for Default. Resource management would also include retaining and coordinating the work of subcontractors necessary to complete the work. Delay in mobilizing a subcontractor to the site is solely a contractor delay. This area also covers properly maintaining equipment, such that equipment breakdown is not a cause for time extension.
- Failure to meet necessary, planned production rates. If the Contractor has sufficient resources on site, but is unable to meet the planned production rates necessary to complete the project on time (absent owner disruptions or change in the original contract documents and requirements), the resulting schedule impact is the contractor's responsibility.
- Poor or errant planning. The contractor may have all the resources planned and produce work at the rate planned, but not meet the completion date due to insufficient or errant planning that did not capture the full scope of the work required by the contract documents. The Contractor is responsible for a detailed examination of the proposal, and per RBS Section 102.04 the submission of a bid is considered conclusive evidence that the bidder understands the conditions and requirements of the work. Failure to take into account the full scope of the contract documents is not cause for a time extension. RBS Section 108.09 states that *"no request for an extension of time will be considered that is based on any claim that the contract time limit as originally established was inadequate."*
- Re-work or quality issues. Per RBS Section 105.13, work that does not conform to the requirements of the Contract will be considered unacceptable work, which shall be remedied or removed immediately and replaced in an acceptable manner at the Contractor's expense. The schedule impact of any re-work is therefore the contractor's responsibility.
- Failure to carry out Contract provisions. Closely related to the issue above, any time spent correcting deviations from any of the Contract provisions, absent a change, is solely the Contractor's responsibility.

- Safety issues. RBS Section 105.01 grants the Engineer authority to suspend the work wholly or in part if the Contractor fails to correct conditions that are unsafe for workers or the general public. A safety threat caused by the Contractor's work will result in a Contractor impact. A possible exception to this statement is if the unsafe working condition is the result of a differing site condition, or if the work as originally indicated by the contract documents essentially requires unsafe working conditions in the act of carrying out the work (in which case the true impacting agent would be the change in the contract documents by the owner to remedy the situation).
- Failure to carry out orders by the Engineer. The authority of the Engineer is identified in RBS Section 105.01. The Engineer is further authorized, per RBS Section 104.02, to make, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. The specification then states that *"the Contractor agrees to perform the work as altered."* A refusal to comply with this or any order of the Engineer will constitute a Contractor impact <u>until such time as the Contractor complies</u>. As noted earlier, the carrying out of the order of the Engineer may certainly constitute an Owner impact and result in a time extension.

Other examples may be identified as well. In short, any example of the Contractor failing to fulfill a responsibility or obligation designated in the Contract is a Contractor Impact.

1.3.3 Third Party Impacts

A Third Party impact occurs when an entity or party not contract-connected causes an impact to the project schedule by impacting one or both of the parties, or the work itself. Though Third Party impacts can occur fairly frequently, the responsibility for the impact must fall to one of the two contracting parties. Contract clauses may exist which preclude one party or the other from collecting damages for certain Third Party risk events, but the other party will be excused from paying damages also. Some impacts will result in a contractor a time extension but no damages. This entitlement discussion is continued further in Section 1.4, but is important to mention here to explain the effect of a Third Party impact.

In VDOT contracts, RBS Section 105.07 recognizes utility companies as a Third Party, stating:

Except as otherwise specified herein, the Department will not be responsible for any claims for additional compensation from the Contractor resulting from delays, inconvenience, or damage sustained by him attributable to interference by utility appurtenances, or the operation of moving the same, other than a consideration of an extension of time.

In other words, the Contractor is excused from finishing the work by the original completion date, but is not able to recover damages. Similar language exists in RBS Section 105.08 relating to cooperation among contractors working adjacent to or even among one another. A 'save harmless' clause protects

the Department from damages, though critical interference may result in a time extension. Depending on the Contract language, other Third Parties may exist that can exert very real impacts to the project.

1.3.4 Force Majeure Impacts

The term 'Force Majeure' literally means "out of my control" [Bartholomew 2002]. Therefore, in the instance of a Contractor impact, the Owner may say that the impact is force majeure, or out of its control. However, the typical use of force majeure to describe events on a construction project relates to impacts that are out of the control of both parties. These events, often also called Acts of God, are completely outside of the control of the Contractor and have no relationship to poor planning, negligence, or lack of control. Thus, the force majeure clause, which allows the contractor to receive a time extension commensurate with the period of the event, transfers the risk of extreme and unexpected situations that prohibit the contractor from performing.

Common events that are specifically identified in many force majeure specifications include [Clough et al 2005]:

- Unusually severe weather, as compared to a history average for a given region
- Strikes and Labor Unrest
- Acts of God – hurricanes, tornadoes, flood, earthquakes or similar disasters
- Freight embargoes
- Acts of the Government
- Fire, epidemic, quarantine
- Acts of terrorism or of the public enemy

Other events that are sometimes included in these specifications include:

- Inability to obtain critical materials when proper procurement methods have been followed
- Project accidents
- Clauses that do not specifically enumerate or limit all events that might be considered for inclusion, but allow room for interpretation

The VDOT Specifications do not contain a specific Force Majeure clause. The term act of God is not found, nor are any items, such as those listed above, specifically enumerated that are considered outside of the Contractor's control and specifically justified for a time extension. One possible exception to this statement is that RBS Section 108.04, Critical Materials, allows a possible suspension and time extension if critical materials become scarce because of the needs of national defense or industrial conditions beyond the control of the Department or Contractor. In fact, VDOT specification language is the opposite of common Force Majeure language in terms of weather; RBS Section 108.09, Determination and Extension of Contract Time Limit, states weather and conditions resulting from weather will not be considered for a time extension.

The specifications do allow consideration for time extension for delays beyond the control of and without the fault or negligence of the Contractor (RBS Section 108.09). This language opens the door permitting the Engineer to consider, but not be required to enact, a time extension for events that are normally considered force majeure.

Further evidence of this permission granted lies in the Engineer's authorities in RBS Section 105.01 to suspend work due to conditions unsuitable for work. RBS Section 108.10 discusses the responses and results of a suspension, and allows the possibility for the contractor to submit a request for time (and even money) for suspensions – other than suspensions caused by weather. Finally, the Department may terminate a contract based on the following specific force majeure cases: national emergency, action by the State, US Government or court order, and conditions beyond the Department's control. Although this is not nearly the equivalent as an extension of time, it does permit an alternative beyond default of the contract for extreme events beyond the control of the contracting parties.

Extreme care should be taken in utilizing the aforementioned VDOT specifications to allow time extension for events that may be considered force majeure to ensure uniform application throughout the Department.

1.4 Classifying Impacts for Entitlement

With the impact identified by type and cause, it is appropriate to now classify the impact to determine whether there is entitlement to time extension or damages. To begin the entitlement discussion, the analyst must have a firm understanding and be equipped to interpret the contract documents. Once the contract documents are properly interpreted, a particular impact, or set of concurrent impacts, can be evaluated and classified for entitlement.

1.4.1 Understanding the Contract

The basic purpose of any contract is to define the risks, rights and responsibilities that the contracting parties will operate under in the process of carrying out some defined scope of work. As has been previously explained, an impact is a change to those conditions or scope of work, or an interruption in the reasonably anticipated intended prosecution of that work. Therefore, to correctly identify if a change has indeed occurred, the analyst must understand how the Contract on a particular project assigns these risks, rights and responsibilities. If one of the parties correctly exercises a right, then it is not liable for the impact that has occurred; conversely, if the party has failed to carry out a responsibility, or if a risk has been assigned to the party and the risk event occurs, then that party is liable.

Starting with the Owner, rights generally assigned by the Contract include:

- Make changes in the work
- Hold retainage on payment, and/or withhold payments for adequate reasons
- Award other contracts in connection with the work
- Carry out portions of the work in case of default or neglect

- Suspend or terminate the work under certain circumstances
- Inspect the work as it proceeds
- Direct the contractor to expedite work

With these rights, the Owner also has a general set of responsibilities, namely:

- Promptly paying the contractor for properly completed work
- Providing surveys that locate and describe the work
- Providing access to the work and sufficient right-of-way
- Securing necessary easements
- Make extra payments and grant extensions of time based on specific circumstances identified in the contract
- Refraining from directing means and methods, or unreasonably interfering with operations
- Adequacy of the design [Clough et all 2005]

Risks assumed by the Owner include:

- Accuracy of the plans and specifications
- Occurrence of specified risk events designated to the Owner
- Differing site conditions from those indicated in the contract documents
- Third party interference, except as specified

The Contractor also has rights defined by most construction contracts:

- Ability to rely on the contract documents to plan and base work operations on
- Pursue the work (in general) by the means and methods desired
- Timely receipt of payment for properly completed work
- Recourse in the case of Owner responsible impacts or other impacts as stated in the Contract
- No requirement to review the plans unless specifically stated

Likewise, the Contractor's defined responsibilities generally include:

- Adequate examination of the contract documents and field conditions prior to bidding
- Construct the project according to the plans and specifications, within the timeframe specified
- Staff the project with knowledgeable and responsible workers
- Prosecute the work in a continuous and time manner
- Conform to laws and ordinances
- Comply with environmental and safety regulations
- Provide for the safety of everyone on or around the construction project
- Warrant all materials and workmanship
- Preserve the work completed and maintain the site until its final acceptance
- Replacing defective or noncompliant work
- Call obvious plan discrepancies to the attention of the Owner

- Procure certain types of insurance [Clough et al 2005]

Standard risks faced by contractors include:

- Except for a relatively few specifically identified events, as well as Owner responsible impacts, the Contractor must complete on time despite adversities encountered on the project
- Escalation of prices for resources used to build the project (except as allowed for in escalation clauses)
- Requirement to install added quantities or deletion of quantities, or other directions by the Engineer that change the work.
- Items it has held the Owner harmless from

The above lists are examples of general rights, responsibilities and risks. VDOT RBS Section 100, General Provisions, details the majority of these items for work Department contracts. **Appendix A** contains a detailed list of many of the rights, responsibilities and risks assigned in this section of the standard specifications. It is noted that Special Provisions, Copied Notes, and other contract-specific documents will identify others on a given project, and must be carefully reviewed during any analysis. If the rights, responsibilities and risks assigned can be properly identified and applied to the impact event, then a correct position on entitlement usually follows.

1.4.2 Interpreting the Contract

Despite the implied ease in applying the rights, responsibilities and risks identified in the Contract, in practice this is the most challenging part of any impact analysis. Disagreements on the *interpretation* of the Contract language, and the associated assignment of the "3-R's" (rights, responsibilities and risks), are the main focus of most disputes. Therefore, the analyst must be thoroughly trained in contract interpretation, including the evaluation of unclear, imprecise or even conflicting contract documentation.

The primary objective in interpreting a given specification or document, or set thereof, is to determine the original intent of the contracting parties at the time of contract execution [Sweet 2000]. In other words, the intended meanings and associated assignments as understood when the parties entered into the contractual agreement must be identified. One means of discovering intended meaning is to examine **manifestations of intent**, which are documents or practices that reveal original intent. Five main manifestations of intent can be identified [Bartholomew 2002]:

1) <u>Express contract terms</u>. The most clear of all manifestations of intent is found in contract language that specifically addresses and event or operation, and expressly states how that item is to be interpreted.

2) <u>Course of Performance</u>. The treatment or interpretation of similar circumstances in the same contract, including the enforcement or failure to enforce specification language, is a major indicator for original intent. Even if historical record does not match the actual original intent, this

history can override and become the *de facto* intent. As a result, it is extremely important to carefully follow all specification requirements throughout the Contract. This manifestation is sometimes called the *practical interpretation rule*. The practical interpretation rule only applies to language with multiple interpretations, but this is normally easy to prove.

3) Course of Dealing. A third indication of intent is how to contracting parties have interpreted a given specification requirement in past contracts. In other words, if the particular issue has not arisen in the current contract, but has been dealt with previously, the outcome of the previous event may be taken as the understood intent on the current contract (unless a different intent can be clearly shown in the current Contract).

4) Separately Negotiated Terms. These terms specifically deviate from boilerplate or 'standard' language, and were drafted for that individual contract and strongly indicate an intent to apply that language.

5) Customs and Trade Practices. A fifth manifestation is the customs and trade practices of a particular industry. In the absence of specific language to the contrary, it may be presumed that the normal manner of performing work is implied.

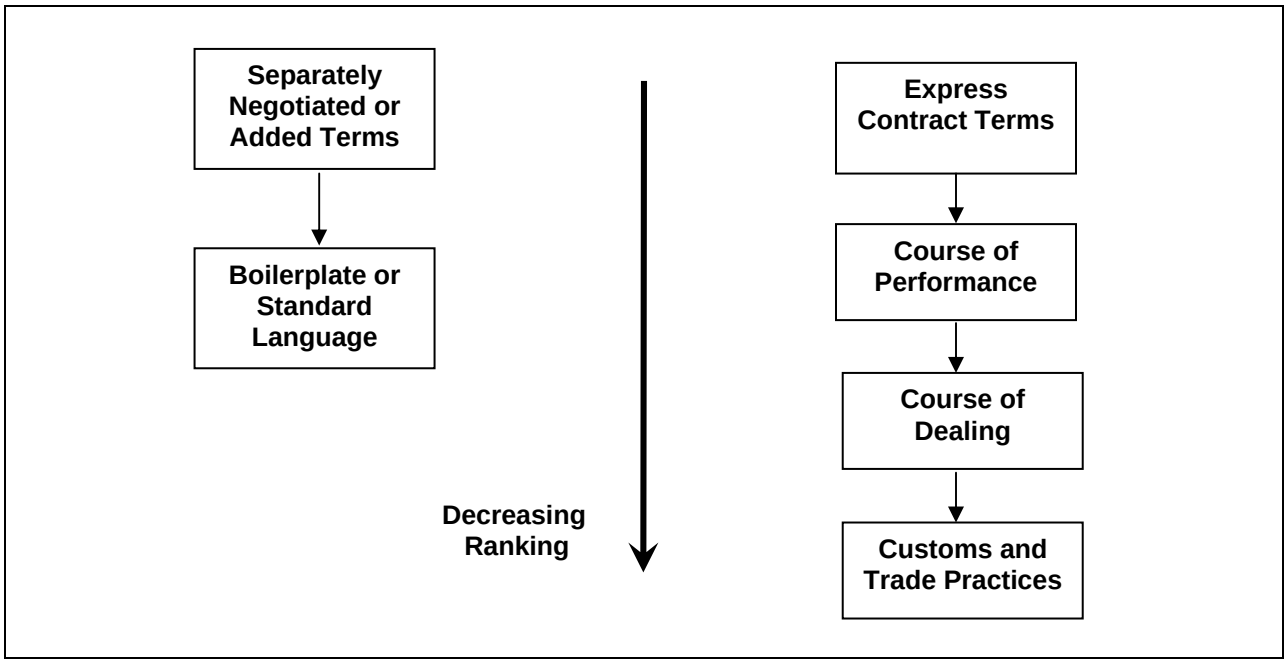


Figure 1.2 - Manifestation of Intent Hierarchy

When evaluating these manifestations of intent, a hierarchy of the five is generally considered, displayed in Figure 1.4 above.

In the hierarchy, manifestations other than express contract terms are called extrinsic evidences of intent, and are considered under the *parole evidence rule*. Parole evidence is forms of evidence

outside of the express terms, and is used when the express terms are unclear [Bartholomew 2002]. All other manifestations of intent beyond express terms are parole.

A second general rule for contract interpretation is that the contract documents must be taken as a whole, and not broken into isolated or unrelated parts, and then reconciled. No part of the contract many be arbitrarily ignored. In other words, if clarifying or supplementary language exists in the Contract, it must be taken into consideration. However, as mentioned above, failure to enforce specification language over time may void that particular language in future events.

Over the course of litigating many and varied types of disputes, courts have set precedence defining multiple other rules and guidelines for interpreting contracts [Sweet 2000]:

- The *plain meaning rule* limits the interpretation powers of judge and jury. If the specification is written in plain language, then it is not appropriate to look elsewhere for a modified interpretation. It is noted, however, that contract language is rarely sufficiently definitive to negate the need for extrinsic evidence.
- Facts and circumstances surrounding the time the Contract was formed play a role in the interpretation. For example, language written around 9/11 discussing terrorist acts would indicate a certain meaning from the writers.
- In the case of multiple interpretations, if one interpretation would lead to conditions so unfavorable that it becomes questionable if the Contractor would have bid under those conditions, the other interpretation is selected.
- The interpretation that results in a fair and reasonable result will likely be selected over the one that leads to unfair or unreasonable results.
- In the *doctrine of contra proferentem*, ambiguous language is ruled against the drafter of the specification. The party that creates the language is considered responsible for making the language clear.
- The *doctrine of patent ambiguity* states that if an obvious error or discrepancy exists that would be detected by a reasonable contractor and brought to the attention of the Owner, then disputes surrounding that error or omission will usually be decided in the favor of the Owner. Case history suggests that *patent ambiguity* will rule over *contra proferentem* [Sweet 2000]. Criteria for determining an 'obvious' error include the following:
    - Was the error noted and questioned by other bidders
    - Did professionals from the Owner's personnel discover the error
    - Were the contract documents clear and well laid out such that the error would be difficult to miss
    - Was the cost of actions to correct the defect large compared to the overall bid
    - Did the error occur in over the course of several items on the Contract

- Are there more than one prime contractor on the job
- Will the Contractor profit significantly from the error

If several of these questions are answered in the positive, then *patent ambiguity* may apply.

- If one clause discusses an item in only general terms, while another clause covers it specifically, the specific clause will be favored over the general clause.
- Specifications written more recently will be favored over older clauses, based on an assumption that intentions become more focused towards true intentions as time passes.
- Handwritten clauses will take precedence over typed out clauses.
- In the case where both parties make serious fundamental errors in assumptions, the performing party is normally relieved of responsibility.

The foregoing is a sample of case history results. Specific contract language will influence these guidelines significantly. Some guidelines may be less influential in the presence a contract document ranking system, such as was shown in Figure 1.1. Original intent is often difficult to define, but these principles will assist the analyst in interpreting the meaning of contract language and determining whether an impact event warrants entitlement consideration.

1.4.3 Determining Entitlement – the 2 x 2 Matrix

As one identifies the rights, responsibilities and risks laid out in the Contract, and interprets the meaning of the language in the Contract, a uniform and simple method for formally determining entitlement is beneficial. To that end, Dr. Mike Vorster, the senior Virginia Tech professor at the VDOT – Virginia Tech Partnership for Project Scheduling, has developed the 2 x 2 Matrix for analyzing impact events. Figure 1.3 displays Dr. Vorster's matrix. The matrix is a convenient means for comparing the baseline, as-bid conditions and assertions with the actual conditions and construction experienced on the project. Deviations from the 'Plan' point towards entitlement, and can be used as a method to quantify the impacts. The discussion in this manual will be limited to the entitlement question.

The convention for using the matrix is as follows:

<u>Step 1: The Contract</u> – Review the bid documents to determine the baseline conditions, assertions, representations, rights, responsibilities and risks laid out in the contract documents. This step should have been completed as part of understanding and interpreting the Contract, discussed previously.

<u>Step 2: The Baselines</u> – As a result of the Contract conditions noted in Step 1, the Contractor develops a plan, a baseline understanding of the Contract, for performing the work, including: 1) the planned scope of work (the what), 2) the planned means and methods for performing the work (the how), 3) the planned schedule for prosecuting the work (the when), and 4) the planned budget for completing the work (the

how much). Steps 1 and 2 represent the entire scope of the planned work prior to starting any construction.

Step 3: The Conditions – Once the Contractor begins work on the site, actual conditions are uncovered and experienced. The actual conditions are noted, especially as they relate to the Contract-implied conditions.

Step 4: The Records – This step documents the As-Built work: the actual scope of work, the actual means and methods utilized for construction, the As-Built dates of performing the work, and the actual costs incurred. These items detail and enumerate the actual prosecution of the work.

Step 5: Entitlement – Step 5 is the process in which entitlement on an impact event is determined. To assert entitlement, a change must have occurred between the baseline conditions, assertions, representations, rights, responsibilities and risks laid out in the contract documents, and those actually experienced during construction. If there is no identifiable ***change***, then there is no entitlement.

Step 6: Quantification – This step quantifies the time and cost impacts of an event. If there has been a change between the bid documents and the actual conditions, then the additional costs and delays to the part of the work affected by that change are due the Contractor. By comparing the planned scope, methods, schedule and budget with the actual experience, the difference is the quantified impact. The specific method for which to measure the time impact is discussed in detail in Chapter 3. The financial impact is beyond the scope of this manual.

Step 7: Cause and Effect – There must be a direct relationship between the change in the contract documents that justified the entitlement, and the change in the carrying out of the contract documents that resulted in a quantification of costs. In other words, the modification must actually result in delay and cost impact and be directly responsible for it.

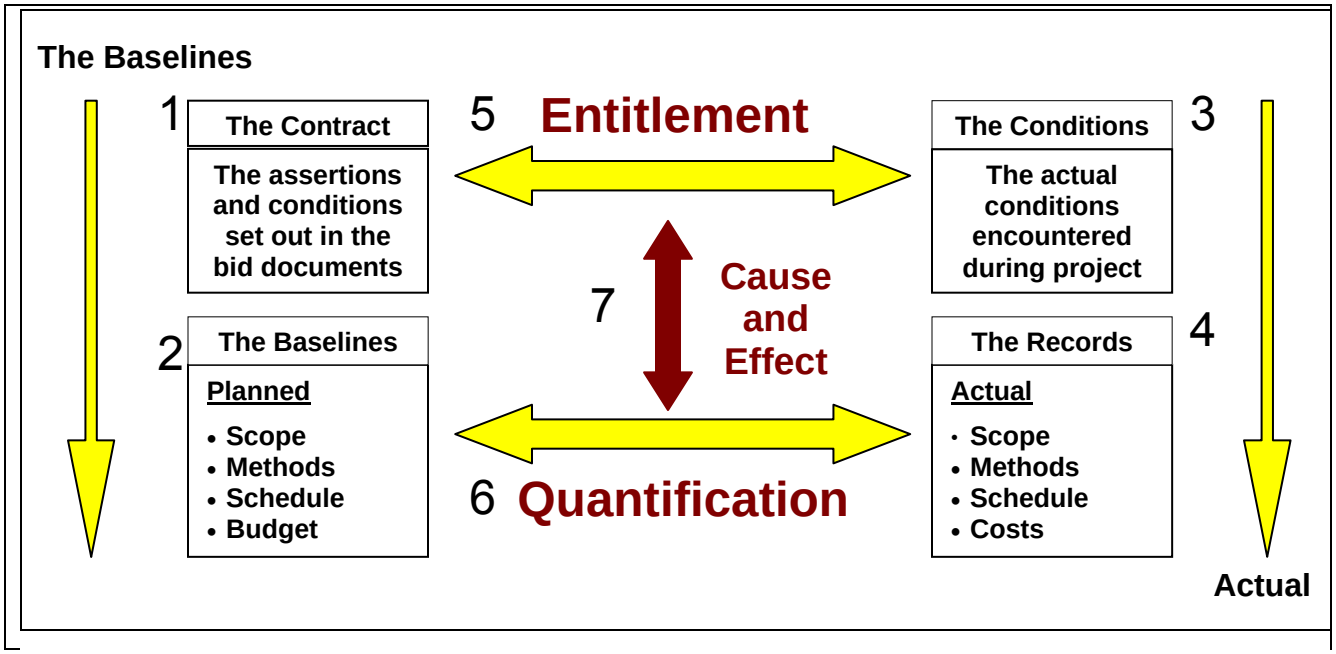


Figure 1.3 – Dr. Mike Vorster's 2 x 2 Matrix for Impact Analysis

1.4.4 Classifying Impacts

Once the analysis is performed to this point, classifying the impacts becomes a simple matter, based on whether there is entitlement for time and money. Impact entitlement is classified in two different ways: excusable or non-excusable, and compensable or non-compensable.

Excusable vs. Non-Excusable Impacts

Classifying an impact as excusable or non-excusable relates directly to the allowance of a time extension. An excusable impact is one that 'excuses' the Contractor from paying damages (liquidated damages) for late performance. In other words, an excusable delay is one in which a time extension is granted. The Contractor has successfully proven that there was an impact for which, at least in part, it was not found responsible. There was either a change from the original contract conditions, or an impact event for which the specifications allow the granting of a time extension. Examples of excusable delays which warrant at least a time extension include Owner responsible impacts, 'force majeure' type events, and other risk events specifically listed in the contract as resulting in a time extension should they occur.

Conversely, a non-excusable impact is one for which no time extension is due. Essentially, the Contractor was found to be responsible for the impact, and no relief is provided. Late performance will result in the Owner charging for damages. Contractor responsible impacts result in non-compensable delays.

Compensable vs. Non-Compensable Impacts

The delay is not fully classified until cost is classified as well. A compensable impact is an impact for which the Owner has been found responsible. The Owner will be responsible for all additional costs due to the late performance, including all direct and indirect costs. As a result, an individual Owner responsible impact is classified as an Excusable/Compensable delay, in which the Contractor receives a time extension and damages. Non-Excusable/Compensable delays do not truly exist, except in some cases of concurrent delays (see next section of this manual).

For an event to be considered a compensable impact, three conditions must exist at once: 1) as defined in Section 1.2, the impact is an Owner responsible impact, 2) the event results in an actual cost impact to the Contractor, 3) the Contract does not assign the risk to the Contractor, and 4) none of the Contractor's actions have resulted in the assumption of that risk [Wickwire et al 2003].

Non-Compensable impacts are impacts for which the Contractor is not granted any damages as a result of the impact (separate from excusability). The Contractor is either responsible or jointly responsible for an event, or a risk event has occurred that specifically states that no damages will be assessed. Excusable/Non-Compensable impacts are impacts in which time is granted, but no damages. This type of impact is the frequent result of a force majeure event, concurrent delay, or other risk event specifically noted. Frequently, Excusable/Non-Compensable impacts are simply called Excusable

impacts. Non-Excusable/Non-Compensable impacts cover Contractor responsible impacts, and result in no time extension or damages. Figure 1.4 summarizes the classifications of impacts.

One common clause in Contracts that Owners insert to protect themselves from compensable impacts is called a *no-damage-for-delay clause*. In theory, this clause protects an Owner from paying damages, even if the Owner is solely responsible for an impact that qualifies as a compensable impact as defined above. The result of such a clause is that the Contractor must include ***all*** costs for ***any*** potential impacts in its bid. Because this clause is an express statement of intent, it will usually be upheld, even on public projects. However, whereas this clause is forced upon a bidding contractor, and would place the Contractor at an essentially uncapped risk for loss based on the severity of the Owner responsible impact, some courts have ruled against this clause in various states. The main reasons cited that this clause is not enforced by the courts includes the following: 1) 'bad faith' on the behalf of the Owner, including fraud or misrepresentation, 2) impact caused by active Owner interference, 3) impact of such unreasonable length that it could be grounds for abandoning the Contract, 4) impact not contemplated by the contracting parties as a possible impact, and 5) gross negligence caused the impacts [Sweet 2000]. If the Contract is silent on damages for delays, then the Contractor must sue for breach of contract in order to collect any time extension or damages [Bartholomew 2002]. VDOT contracts do not contain a no-damages-for-delay clause, and specifically allow for the submission of damages due to qualifying events.

	Excusable	**Non-Excusable**
Compensable	**Time, Money**	**N/A**
Non-Compensable	**Time, No Money**	**No Time, No Money**

Figure 1.4 – Classifications of Impacts

1.4.5 Classifying Concurrent Impacts

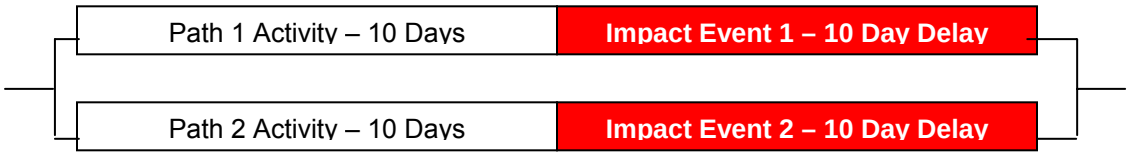
If the entitlement question can be answered, classifying individual impacts is a fairly simple procedure. However, the challenge grows significantly if there is a claim of concurrent impacts. Concurrent impacts exist when two or more impacts occur on parallel paths during the same period of analysis [Bartholomew 2002]. Concurrent impacts, or at least claims of concurrent impacts, are commonplace because: 1) the complex nature of construction often results in more than one party being responsible for, or contributing to the extent of, a particular impact, and 2) a party that is clearly responsible for an impact may seek to find a concurrent impact in an attempt to reduce or share the consequences of its own impact. This section of the manual will address proper classification of different types of impacts that occur concurrently with other impacts.

Determining Concurrency

When classifying concurrent impacts, the first step is to determine if the impacts under consideration are actually concurrent. For multiple impacts to be considered truly concurrent, they must all individually impact the project schedule, such that if any one impact were removed, the other (or others) would still impact the project schedule [Stumpf 2002]. Any impact that is not on a critical path of the project, or would not have impacted the schedule absent the other event, is not considered a concurrent impact. Non-critical impacts, regardless of whether they occur during the exact time period as an impact on the critical path, are not concurrent so long as the impact on the non-critical path does not exceed the float available (prior to the impact on the critical path – further discussed later in this section).

Examples of the possible concurrency scenarios discussed in the last paragraph are shown below in Figure 1.5. In Case 1, impacts of identical duration occur on two parallel critical paths. The impacts are considered fully concurrent over the entire duration. In Case 2, however, the impact to the top critical path is longer in duration than the event on the parallel critical path. In this case, the delay is concurrent for the duration of the shorter impact. The impact extending past this duration would be solely attributable to the responsible party of the longer impact. As a note, it does not matter if the impacts start on the same day or even overlap at all, so long as the impacts occur on parallel critical paths during the same period of analysis. This scenario is demonstrated in Case 3. Case 4 presents an example where Path 2 is not critical, and so, for classification purposes, no concurrency exists. Finally, Case 5 showcases an example where Path 2 was originally non-critical, but the impact exceeded its available float and results in concurrency.

Case 1: Concurrent Delays on Parallel Critical Paths



A 10-Day concurrent impact has occurred on this project.

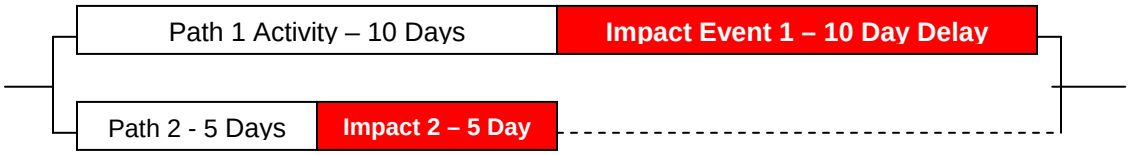
Case 2: Concurrent Delays of Different Durations

A 5-Day concurrent impact has occurred on the project, and a 5-Day impact is attributable solely to Impact #1.

Case 3: Non-Simultaneous Concurrent Delays

A 10-Day concurrent impact has occurred on the project during the period of analysis

Case 4: Non-Concurrent Delays



No concurrent impact exists because Path 2 is non-critical.

Case 5: Partially Concurrent Delays

A 5-Day concurrent impact has occurred on the project, and a 5-Day impact is attributable solely to Impact #1. The Path 2 impact is non-critical until its float is consumed

Figure 1.5 – Example Scenarios Involving Concurrent Impacts

Path 1 and Path 2 are parallel critical paths prior to any impacts in each case, except for Cases 4 and 5. It is noted that this methodology for determining concurrency also works for different *types* of impacts. For instance, a critical disruption could occur along a critical path parallel to a critical delay or suspension. In this case, which would most likely be closest to Case 3, the total disrupted time would be compared to the total delay or suspension time, with the shorter period being concurrent, and the difference belonging to the responsible party for the longer impact.

The burden of proof is on the claiming party asserting a concurrent delay. Proving concurrency, however, is somewhat easier than proving individual non-concurrent impacts because for full responsibility the claimant must prove that the other party is the sole cause of the delay [Wickwire et al 2003]. As mentioned previously, the nature of construction lends itself to multiple responsibilities.

Assigning Responsibility

Once concurrency has been determined, the second classification step is applying the cause of the impact (responsibility) to each of the concurrent impacts. In doing so, each impact should be reviewed individually to determine cause. One of three cases will exist: the multiple impacts will be caused by one party, the impacts will be split between two parties, or, in the case of multi-prime contracts, the impacts will result from more than two parties [Wickwire et al 2003]. In the case of multiple delays by one party, the responsibility lies with that party for a duration covering each day in which at least one of the impacts occurred (i.e., overlapping impacts by one party are not counted twice). In the case two party involvement in the impacts, sometimes called an 'interactive concurrent impact', the period of concurrency is shared responsibility (discussed further below), while any impacts exceeding the concurrent period are the full responsibility of the causing party. The same principle would apply in a multi-prime situation.

Classifying Impacts

The final step is to take the individual classifications of the impacts comprising the concurrent delay(s) to determine the overall classification as excusable or non-excusable, and compensable or non-compensable. Case history suggests that the court decided classification of this conglomeration of impacts may not hold to hard and fast rules, depending on the circumstances behind the delays. In other words, experts disagree on strict adherence to the following results:

Classification of Individual Impacts

	Excusable	Non-Excusable
Compensable	A Time, Money	B N/A
Non-Compensable	C Time, No Money	D No Time, No Money

Concurrent Impact Equations

Excusable / Compensable (A)	+	Excusable / Compensable (A)	=	Excusable / Compensable (A)
Excusable / Compensable (A)	+	Excusable / Non-Compensable (C)	=	Excusable / Non-Compensable (C)
Excusable / Compensable (A)	+	Non-Excusable / Non-Compensable (D)	=	Excusable / Non-Compensable (C)

&

Excusable / Compensable (A)	**+**	**Non-Excusable / Non-Compensable (D)**	**=**	**Non-Excusable / Compensable (B)**	**#**
Excusable / Non-Compensable (C)	**+**	**Non-Excusable / Non-Compensable (D)**	**=**	**Non-Excusable / Non-Compensable (D)**	
Non-Excusable / Non-Compensable (D)	**+**	**Non-Excusable / Non-Compensable (D)**	**=**	**Non-Excusable / Non-Compensable (D)**	

& - Concurrent impacts are tightly connected and apportionment of cause is unreasonable

- Responsibility % for concurrent impacts can be reasonably assigned

Figure 1.6 – Classifications of Impacts

The general consensus is that if two concurrent impacts exist, one being an excusable / compensable Owner impact, and the other being a non-excusable / non-compensable Contractor impact, then neither party is entitled to compensation (either extended overhead for the Contractor or liquidated damages for the Owner), and the result is an excusable / non-compensable impact (time extension) [Wickwire et al 2003]. However, some recent court cases indicate that if the individual impacts can be separated and segregated, and responsibility apportioned to each party, then such a pair of concurrent delays could result in a non-excusable / compensable delay [Bartholomew 2002]. In other words, the Contractor could receive extended overhead charges, and the Owner could collect liquidated damages. Furthermore, another school of thought exists that suggests that as long as an impact is out of the Owner's control or responsibility in some point, then the consequences of the impact all belong to the Contractor. In other words, an impact only becomes compensable in the absence of a non-compensable impact, meaning the concurrent excusable / compensable and non-excusable / non-compensable impacts would result in a net non-excusable / non-compensable impact [Eiserer 2002]. However, the most common practice is to allow no damages for either party. Figure 1.6 identifies the commonly accepted results of mixed classifications of concurrent delays. It must be noted, however, that professionals in the industry do not uniformly agree on these results, and case history can be found to support other positions.

Chapter 2 – Impact Documentation

Sufficient project documentation is well agreed to be an invaluable prerequisite to successful Schedule Impact Analysis [Bartholomew 2002]. Absent proper documentation, jointly agreed-upon impact resolution is a difficult task, and questions about impacts can quickly deteriorate into disputes. This chapter will detail standard documentation that should be kept during normal progression of construction, as well as special documentation to be enacted once an impact is identified, training the reader to recognize the difference between sufficient and insufficient levels of documentation and listing steps to ensure that a particular impact is properly documented.

2.1 Importance to Impact Analysis

At this point, it is instructive to identify the true definition of documentation in order to understand its importance to impact analysis. True documentation includes all physical records created by eye-witnesses to an event or operation contemporaneous to (or shortly thereafter) the event or operation [Bartholomew 2002]. Therefore, records or summaries created after the fact, by persons not directly present observing the event and/or for the purpose of capturing or reciting past events is not true documentation. Case history suggests that this retrospective information is far less credible than what is actually created at the time of the event.

Therefore, since the most reliable documentation cannot be 'recreated', it is imperative that proper records be kept as a standard course of action, and specifically when an impact is identified. When impacts do occur, the litmus test for adequate documentation is if an unrelated third party can completely recreate the event solely from the records kept during the time of the event, painting a complete and unbiased view of what occurred. The most solidly reliable records have the following characteristics [Bartholomew 2002]:

- Created by person(s) that are actually present for the event and in a position to know the details of what happened
- Recorded at, or shortly after the event
- Recognized as a standard type of record produced from that type of activity (as opposed to a specially created form developed solely to demonstrate a particular impact as a part of claim resolution)

Apart from photographs, videos or tape recordings, proper documentation must be written to be effective. Therefore, a culture of putting everything in writing is advantageous. As mentioned previously, reliable documentation as described above should be kept whether an impact has been identified or not. Usually the identification process is fairly simple, as the Contractor is required to notify the Department within a short timeframe after becoming aware of an impact (to be discussed in a later section). However,

the process of monitoring project events and the documentation produced from these events to look for impacts is key to early mitigation.

Several warning signs exist that can be used to alert the project staff of possible impacts [Wickwire et al 2003]. The first sign is in the amount of dollars expended, versus the planned schedule. Wide variances could mean an impact has occurred, and the analyst should review the project conditions to determine if there has been any change from the plan conditions. Second, a review of the actual sequence of activities can reveal an impact. The cause of any changes to the plan should be confirmed; it may be a random or intentional effort to deviate from the plan, or a changed condition may have forced a departure from the plan. Finally, activity duration is a third indicator. If durations have changed on specific items, the analyst must research the cause – be it Contractor inefficiencies, instances of risk events occurring, or Owner interference and change. In cases of Owner impacts, the Contractor is likely to identify and serve notice; however, in cases of Contractor impact, there is far less motivation for the Contractor to alert the Owner, and these events can slip by without due attention. Careful review of project documentation in an ongoing basis can prevent this, and help provide explanation of current project status for the next impact that is formally noted.

2.2 Standard Documentation

Maintaining a standard set of documentation on every project is the most important step to assuring any impacts are properly recorded. If the routine level of documentation is sufficient to recreate the events of the project, then impacts will inherently be captured. The next section will describe additional steps to take when an impact is identified, while this section will lay the ground work for assuring basic information is covered.

2.2.1 Baseline Schedule

The baseline schedule, also known as the 'As-Planned Schedule', and its accompanying identification of the Contractor's intended plan to complete the work, is the first crucial piece of documentation that must be in place. For the purposes of this technical report, the term baseline schedule will also be meant to include the schedule narrative and any other documentation identifying scope, means and methods, planned sequence, production rates, assumptions, restraints, budget or other planning information. As discussed in Section 1.4 in the overview of the 2 x 2 Matrix for Impact Analysis, the baseline conditions as represented in the schedule provide a measuring stick against which to compare all future interruptions and changes, and represent the starting point of any impact analysis [Wickwire et al 2003]. Without a reasonable and accurate baseline, the true deviation of an impact is extremely difficult to confidently assess.

A separate training module has been developed by Robert A. Griffith, P.E., Bristol District Area Construction Engineer, to train the analyst in the review of baseline CPM schedule submittals. However,

a set of basic principle characteristics of all baseline schedules will be discussed here. In addition to the basic required information, the baseline information should incorporate and be governed by:

- A contemporaneous manifestation of the plans and intentions of the Contractor at the time the project is bid. To be a true baseline schedule, the original understanding from the contract documents must be represented. Furthermore, the Contractor must actually intend to build the project according to this plan. Closely related to this…
- Completed as early in the project as possible. Most scheduling specifications allow a time limit for submittal that extends into the execution of the plan; however, no as-built knowledge or actual conditions should be included. Any impacts that have occurred to that date should not be included until the first schedule update.
- Includes the entire scope of the work required by the Contract documents.
- Carefully reviewed for realistic sequence, logic and durations. On one hand, grossly unrealistic or flawed logic or durations in the planned schedule is often revised or thrown out in litigation when an impact is disputed, but on the other, the Owner's acceptance does create a 'presumption of correctness' [Wickwire et al 2003].
- Involves major subcontractors in the development, showing dependencies between subs and the prime contractor.
- Clearly identifies Owner responsibilities and dates.
- Accounts for reasonable restraints, limitations, risks and other requirements of the Contract.

The baseline schedule is a powerful management tool for both parties to the Contract. If both parties are committed to using the schedule, and relatively quickly produce an accepted plan, the negative affects of impacts can be limited. Each party must clearly understand the expected responsibilities, rights, methods, and procedures for the schedule, which should be set forth by an unambiguous scheduling specification [Wickwire et al 2003].

Often, the Owner is hesitant to accept or approve a CPM schedule for liability reasons. It is important to understand the ramifications of acceptance. Firstly, acceptance does not limit the Contractor's means and methods, and does not remove the Contractor's responsibility and liability for implementing its plan within the specified time limit. Acceptance does, however, suggest that the submittal meets all contract requirements per the specifications. Also, it suggests that the schedule provides sufficient detail to monitor progress, evaluate impacts to justify or refute a change/delay claim, and explore mitigation of impacts [Clough et al 2000]. For further information, Dr. John Hildreth, Virginia Tech Senior Research Associate and member of the Partnership, has written a technical article entitled "A Review of the Operational and Contract Administration Implications of Schedule Response" which addresses the implications of various responses to schedule submittals [Hildreth 2006].

Problems with accepting the baseline schedule do not always lie with the Owner. Wickwire et al [2003] suggest that the most common problems with a baseline schedule include:

- Submission within the specified time limit
- Number and detail of activities (too few or too many)
- Unbalanced level of detail in the activities
- Excessive or unrealistic durations
- Schedule logic issues, including lead and lag time in relationships
- Resource leveling that improperly creates additional critical or near-critical paths
- Insufficient resources assigned to the project
- Abuse of float
- Inadequate durations for Owner activities
- Multiple major portions of work occurring simultaneously, usually at the end of the project
- Repeated rejections of the schedule submitted
- Disagreements over the right of the Contractor to finish early

It is extremely important that no matter how many disagreements there are over the baseline schedule, that the parties not give up and abandon the schedule. The analyst must ensure that a quality baseline schedule is produced and agreed upon as the starting point for all remaining management and analysis of the project.

2.2.2 Maintaining the Project Schedule

Once the baseline schedule is set, the next crucial documentation needed is a properly maintained Schedule of Record (SOR). The SOR is the current version of the schedule that has been accepted for use. Proper maintenance of the schedule means updating the schedule at least once a month to reflect accurate as-built information, including impacts experienced, and revising the schedule as a result of any major sequencing or means & methods changes. As a note, a schedule is updated when the actual progress and/or logic is inputted into the schedule up to a certain data date, with possible minor changes to activity logic. A small impact that is discrete and does not impact the logic relationships of the subsequent activities and only adds an activity or two to the schedule can be considered a schedule update. A schedule revision occurs when major logic or duration revisions occur, multiple activities are added, or an impact is inserted that adds many activities and/or changes the logic of the subsequent work.

This method of keeping the schedule in a continuously updated state represents a departure from the frequently observed status of schedules on Department projects – most often a baseline is submitted and accepted, but is updated or revised only when a major impact occurs that completely alters the schedule. Normally, in this system, the schedule is so far from realistically representing the project at that point that it is no longer relevant as a tool for managing construction. At the very least, there are usually enough other previous impacts that have occurred since the last update that using the schedule to determine the impact of the current event is very difficult. The maintenance approach is proactive rather than reactive, and is the basis for valid contemporaneous schedule impact analysis.

Change on construction projects is inevitable; updates that reflect these changes allow the schedule to remain relevant for management planning by detailing the physical progress on the project, updating logical revisions due to re-sequencing and reaction to project dynamics, and by identifying the impacts of change and interruptions on the project [Wickwire et al 2003]. In fact, the concept of updating is geared towards problem identification. Good schedule maintenance means that the SOR is:

- A realistic plan to complete the project at any given time
- Corrected to reflect actual sequence, dates and durations to that point in the project, and clearly reflects reasons for the deviations between the baseline plan and actual
- Free from logic manipulation. Is free from, or limited in, lead and lag relationships, and does not mask Contractor impacts.
- An accurate representation of the Contractor's plan to complete future work
- A record of all out-of-sequence work to date
- Carefully reviewed for any changes in logic or duration
- Inclusive of major subcontractors in the development, showing dependencies between subs and the prime contractor.

If the schedule update or revision exists in part to demonstrate recovery due to a Contractor responsible impact, then it should clearly show what actions or changes will be made to recover time. To verify these assertions, the production rates and accomplishments on site to date should be used to back up the recovery plans set forth [Wickwire et al 2003]. Updates that are not realistic or do not adequately explain changes diminish the credibility of the actual or realistic changes made, and should not be accepted. The clear link between the baseline schedule and regularly and timely submitted schedule updates and revisions is critical in the impact analysis process [Clough et al 2000].

Further detailed training in the reviewing of CPM schedule updates and revisions is provided in the training module *'Reviewing Construction Schedule Update Submittals and Assessing Progress'* for projects with CPM schedules, by Shimelis A. Meskellie, MENG, MSCE, Hampton Roads District Senior Construction Engineer. This module should be taken as a prerequisite to the information in this technical report.

2.2.3 Other Standard Documentation

If the baseline schedule and the associated updates and revisions are critical for reporting impacts to the project, the canon of other standard, daily documentation used to record the events to input information into the schedule are just as important. The extent of this documentation necessary on a given project is that level for which every aspect of project administration is captured on a daily basis. The list of common forms of documentation is extensive; as such, it is highly recommended that a systematic and uniform document control system be implemented. A reasonably extensive list is found in

Appendix B. In general, the types of reports can be broken down into the following categories [Wickwire et al 2003]:

1. **Daily Reports (Diaries):** Includes a complete and comprehensive review of each day's activities and events. A guideline for information to include in daily diaries is found in **Appendix C**.
2. **Meeting Minutes:** Minutes should include attendance, major items discussed, agreements, disagreements, pending items, action items, and issues discussed
3. **Progress Charts & Reports:** All forms of reports and charts for representing the status and condition of the project and its features, updated regularly
4. **Weekly Reports:** A weekly report of work achieved on the project, including work completed, work in progress, upcoming work in the next month, progress photos, pending changes and status of disputes
5. **Weather Records:** Includes a regular compilation of the daily weather reports included in the daily diary (see daily diary guidelines)
6. **Photographs, Videos, other Audio/Visual Records:** Photos, videos and other audio/visual recordings of the project should be taken on a daily or weekly basis, particularly in areas of change or dispute
7. **Procurement Records/Delivery Tickets:** All items procured as a result of the work on the project should be kept, including delivery tickets and invoices, quotes, and equipment
8. **Test Reports and Records:** Full documentation of the location, type and result of all tests taken as part of the work to verify compliance or measure payment
9. **Change Orders:** All information related to a change order, including the correspondence and other documentation leading up to the change order, and all information used to negotiate, analyze and approve the change order
10. **Submittals & Shop Drawings:** All items submitted for review and approval, the response, and any re-submittals. A submittal log is crucial to tracking the progress of these reviews. It is recommended that the analyst uses a submittal log to track submittals electronically.
11. **Correspondence:** All letters, e-mails and other correspondence. It is recommended that the analyst uses a correspondence log to track correspondence electronically. Types of correspondence include [Bartholomew 2002]:
    a. Letters of transmittal and submittal
    b. Letters of notice or instruction
    c. Letter requesting or disputing instructions or letters of protest
    d. Confirmations and letters of response
12. **Memoranda:** Both internal and external memoranda
13. **Cost Records:** Cost and financial records, including planned and actual earnings, overruns experienced and expected, and total anticipated costs

14. **Contract Drawings and Specifications:** The contract documents are a key form of documentation
15. **Computations and Sketches:** Measurement, calculations and sketches used to determine as-built condition or verify payment quantities
16. **Logs and Lists:** All forms of logs and lists used to record and track items on the project
17. **Other Contemporaneous Analyses and Records:** Any other analysis or record that is kept for the purpose of capturing the scope of the project is considered documentation. Examples of recommended additional analyses and records includes:
    a. As-built records, included a day-for-day as-built schedule. Several possible formats exist. Use one that captures all necessary daily information.
    b. Issues Book to compile and record the history and progress of all issues on the project
    c. Safety Records to organize all safety violations or concerns experienced on the project

This information must be carefully kept and monitored on all construction projects, regardless of whether an impact has been identified or not. The analyst should periodically visit the job site and verify that the project staff is recording this information regularly and in a manner that is retrievable.

2.3 Impact Documentation Steps

The guidelines suggested in the previous section will place the analyst in an excellent position to resolve the impact. However, certain steps should be followed once an impact is identified. Following these steps will help ensure that all necessary information is present and the processes recommended in the rest of this manual can be carried out.

2.3.1 Notice

In the normal course of impact discovery, the Contractor's field personnel inform, usually verbally, the Owner's field personnel of the event. Occasionally the impact will be communicated by e-mail or brief letter immediately after discovery. The first step in response is to make a quick evaluation of the impact to determine what immediate effect the impact is currently having on the ongoing work, and if there are means of resequencing or reordering work to eliminate or limit the impact while further investigations and decisions are being made. Crews can often be moved short distances with very little or no disruption in productivity. Along with this immediate response, the occurrence of the event should be broadcast to the project stakeholders, particularly the decision makers who will play a role in resolving the impact. This notification will allow for expedited decision making once all necessary information is gathered.

Following the initial immediate revelation, formal notice should follow very quickly. Formal notice is extremely important, as it is normally a specified requirement within a certain timeframe of the discovery of an impact, and failure to meet that timeframe can waive the Contractor's right to damages resulting from that impact. The reason behind this requirement, as stated in RBS Section 105.16,

Submission and Disposition of Claims, is that *"early or prior knowledge by the Department of an existing or impending claim for damages could alter the plans, scheduling, or other action of the Department or result in mitigation or elimination of the effect of the act objected to by the Contractor"*. One of the Owner's rights in most contracts, and in all VDOT contracts, is to mitigate or in other ways lessen the severity of an impact. In addition, it allows the Owner to review the impact conditions before they are disturbed and establishes a start date for the impact [Bartholomew 2002]. The following notification deadlines are required for various impacts on VDOT projects; project specific provisions may add to or modify this list:

- Impact/Event: Words, phrases, clauses or any other portion of the proposal alleged to be ambiguous
  RBS Section: 102.04 - Examination of Site of Work and Proposal
  Notification Time Limit: 10 Days prior to bid receipt
  Consequence for Failure to Meet Time Limit: Waiver of right Contractor may have had to his own interpretation of the alleged ambiguity

- Impact/Event: Differing Site Conditions
  RBS Section: 104.03 - Differing Site Conditions
  Notification Time Limit: "Promptly", upon discovery, prior to disturbance of conditions
  Consequence for Failure to Meet Time Limit: No contract adjustment which results in a benefit to the Contractor will be allowed.

- Impact/Event: Discovery of defective survey work
  RBS Section: 105.10 - Construction Stakes, Lines, and Grades
  Notification Time Limit: "immediately provide oral and written notice"
  Consequence for Failure to Meet Time Limit: None stated

- Impact/Event: Performance of work without inspection
  RBS Section: 105.12 - Inspection of Work
  Notification Time Limit: "Reasonable notice in writing that the material was to be used or the work was to be performed"
  Consequence for Failure to Meet Time Limit: The Contractor may be ordered to remove and replace the work or material at his own expense

- Impact/Event: Acts of omission or commission by the Department or its agents allegedly causing damage, a notice of intent to file claim
  RBS Section: 105.16 – Submission and Disposition of Claims
  Notification Time Limit: At the time the damage occurs, or beginning of the work upon which the claim and subsequent action are based (must be written and before the completion of the event)
  Consequence for Failure to Meet Time Limit: Waiver to the claim for damages

- Impact/Event: Costs for securing railroad flagger or watchperson services
  RBS Section: 107.08(a) – Railway-Highway Provisions
  Notification Time Limit: Before initially starting, intermittently continuing, or discontinuing work on or over the railway right-of-way
  Consequence for Failure to Meet Time Limit: The Contractor will bear the added costs of the flagger or watchperson services

- Impact/Event: Delaying events beyond the Contractor's control for which a time extension is requested
  RBS Section: 108.09 – Determination and Extension of Contract Time Limit
  Notification Time Limit: During prosecution of the work, "timely", and no more than 60 days after the payment of the final estimate
  Consequence for Failure to Meet Time Limit: No contract adjustment will be allowed

- Impact/Event: Request for adjustment due to a suspension ordered by the Engineer
  RBS Section: 108.10 – Suspension of Work Ordered by the Engineer
  Notification Time Limit: Within 7 days of receipt of the notice to resume work
  Consequence for Failure to Meet Time Limit: No contract adjustment will be allowed

- Impact/Event: Department notice of delay, neglect, or default
  RBS Section: 108.13 – Default of Contract
  Notification Time Limit: Within 10 days of the receipt of the Department's notice
  Consequence for Failure to Meet Time Limit: The Commissioner may declare the Contractor in default at any time after this time limit

Despite these clauses, there is some case history that suggests that if failure to give the notice within the required time does not harm or cause an inability in any way for the Owner to investigate, mitigate and/or resolve the impact, then the waiver clause may not be enforced [Wickwire et al 2003]. In general, however, these time limits must be strictly adhered to.

Beyond a requirement for timeliness, Notice must identify the specific impact, the activities impacted, the anticipated effect of the impact, and the perceived timeframe of the impact. In this manner, an impact statement might be written as follows: The Contractor experienced **X** impact on **Y** activities and resources, with **Z** anticipated effect on those activities and resources, starting at **T** time and possibly extending for an estimated **D** duration. The key for this notice statement is that it establishes a cause and effect relationship between a change in the baseline conditions of the Contract and the actual conditions experienced in the field. The notice should also identify what actions the Contractor took upon discovery of the impact, including any mitigation actions, and what actions are planned over the course of the resolution period. Any requests for information or current uncertainties should also be stated.

2.3.2 Owner Response

Once the Owner receives such a Notice, certain steps should be followed in response from a documentation standpoint. They are:

Initial Response

First, the standard documentation should be reviewed to ensure that all necessary information has been captured, and that all of the recommended standard documentation procedures were followed during the course of the discovery and notice period. If the standard procedures were not followed and additional information is needed, it will not be as credible as true documentation, but must be gathered anyway. The Owner then normally sends an initial response to the Notice. On VDOT projects, the time limit for the acknowledgement letter, which may simply acknowledge receipt of the Notice and not provide a position, is now governed by CD 2004-1. It is normally preferred, to include an initial interpretation of the event.

To prepare for this response, all documentation surrounding the impact should be gathered and reviewed. The contract documents should be carefully examined to determine which specifications or other binding requirements apply to the situation. See Section 1.4 for further discussion on understanding and interpreting the Contract. As already discussed herein, the impact should be analyzed for identification and entitlement classification.

In addition, there may be other specified requirements for the Owner, including site investigations, decisions or directions. After all of these things are completed, the initial position should be formed and communicated to the Contractor.

Additional Information Sources

In the course of the initial review, it may become evident that the standard documentation gathered does not provide the level of detail necessary to fully understand and analyze the situation. Also, the existing documentation, though sufficiently detailed, may not be in an adequate format, such that additional analyses are necessary. The following analyses are examples of means of taking documentation and using it to assist in revealing the true extent and apportionment of impacts. It is outside of the scope of this manual to go into detail on any of these methods; rather, it is intended to expose the analyst to their value and general use.

Productivity Analysis: In periods of impact, particularly in a disruption type impact, productivity of work is often affected. The objective in a productivity analysis is to determine the Contractor's productivity during an impacted period, and compare it to some baseline work for which there was no impact. If one subtracts the non-impacted rate from the actual rate during the impact (absent other impacts), the extra time that is due can be calculated. This type of analysis is sometimes called a **measured mile analysis** [Bartholomew 2002]. In an ideal situation, the analyst can look to a period of actual work on the current contract for work that is very similar in every aspect to the impacted work. This actual productivity can be considered a typical production rate for this work, and compared to the production rate during the

impacted time period. In this way, the added duration due to the impact can be determined (as well as cost impacts). To be considered comparable, the work must have very similar site conditions (same topography, same constitution of soil and rock, same time of year, etc) and use very similar resources (same type and number of crew and equipment).

Frequently, however, comparable work to the work impacted has not occurred on the project to that point in the project. In this case, other baselines for productivity can be measured against; however, all are less reliable and contain flaws. As such, analysis with anything other than actual production of very similar non-impacted work should only be used for comparison sake, to confirm reality of another means of analysis. These other productivity comparisons include:

- Productivity shown in the baseline schedule. The problem with using the baseline schedule is that it is completely theoretical, and the Contractor has not proven that it can achieve the implied productivity shown by this schedule. Achieving this productivity requires a certain resource level (discussed in the next section), an accurate assessment of field conditions at the time of the bid, and an accurate understanding of what a Contractor's particular crew is able to achieve. Any of these estimations could be incorrect, leading to a false indication (either positive or negative) of the effect of the impact.
- Productivity of the same Contractor on a different project. It may be possible to find comparable work that the particular Contractor in question performed on other projects, and obtain a production rate from that work. A reasonable level of accuracy may be determined if the site conditions are very similar and the resources used are equally similar. Finding a sample operation with this similarity may be very difficult, however.
- Productivity of another Contractor in a similar situation on another project. If a truly comparable operation can be located, this may provide reasonably accurate data. However, each Contractor is able to achieve a different production rate, and there is no guarantee that the two in comparison would produce the same output, even given the same input.
- Theoretical production of another Contractor on a generic project. This comparison is likely to be the farthest off. However use a Means manual or other production database to get an order-of-magnitude type number to compare against the impacted productivity.

A sample productivity comparison is found in **Appendix D**. This particular situation involved an impact to an excavation item. At the time of the impact, several hundred thousand cubic meters of material had already been hauled. The hauling conditions experienced at the time of the impact saw hauls of vastly different distances, hauls carrying material that was all soil and hauls that included entirely fractured rock (and blending of the two), and hauls that utilized different types of equipment. To perform an accurate comparison between the impacted and un-impacted excavation, only hauls that included the exact same parameters were compared. The ensuing settlement that resulted from the use of this

analysis saved the Department nearly a half million dollars (with no time extension) from the Contractor's initial request, reducing it by nearly 90%.

Resource Analysis: Resources are directly tied to productivity. Without proper resources, the Contractor will usually be unable to achieve its planned productivity. Therefore, prior to performing a productivity analysis, it can be beneficial to determine if the number and type of resources are the problem. This analysis is a simple exercise with a resource loaded schedule. However, whereas most Department schedules are not resource loaded, this analysis may be difficult and a reason to push for a resource loaded schedule specification.

Apart from comparing planned and actual resources, the analyst can also determine if an impact affected the use of resources on a project. Resources can play a role in impacts in the following ways:

- Number and type of resources vary based on the phase of the project, tending to increase during the beginning phases, peak, and then diminish as the project completes or enters subcontracted portions of the project. An impact that pushes a piece of work into a phase of the project where the resources are not available could result in a greater impact.
- Likewise, number and availability of resources changes seasonally. Most contractors do not have the resources available during the winter that they do during the summer.
- Resources are not as effective if moved frequently or are not assigned the right job. Too few or too many crew members on one operation affect productivity; likewise, equipment that is too big can be as ineffective as equipment that is too small for an operation.
- The Contractor does not have unlimited resource levels, and therefore cannot necessarily pursue impacted work just because it is available. Resource leveling can drastically affect apparent float on the schedule, and the effect of resource availability must be taken into consideration when quantifying the time impact of an event. Specifics of resource leveling are beyond the scope of this manual; however, an article by Professor John W. Fondahl of Stanford University entitled "The Development of the Construction Engineer: Past Progress and Future Problems" is recommended to demonstrate the effect resource leveling can have on the project schedule.

Force Account Records: Force account records are kept specifically when the Department and Contractor cannot agree on a price or are unable to define the scope of the work. However, the keeping of force account-type records is an excellent method to determine the actual costs of any impacted situation. In cases where a complex cost analysis is necessary, or the specific amount of time devoted to a particular activity or impact is desired, then keeping these type of records (even when a force account is not the method of payment) is recommended. Details on the keeping of these type records are found in RBS Section 109.05 – Extra and Force Account Work.

Day-for-Day As-Built of Impact: A Day-for-Day As-Built records the occurrence of work on each activity on a given day. As such, it provides more information than is shown on a CPM update, which only

identifies the start and completion of an activity. This added dimension of information can be useful during complex impacts to identify trends in work and show why certain portions of an impact may or may not be included in a time extension, such as if the Contractor ceases working on the impact to concentrate on other unrelated activities.

On some projects, it is suggested that the day-for-day as-built be considered part of standard documentation. In this case, prosecution of work during an impact can be compared with that during non-impacted periods to show characteristics such as a history of the Contractor's normal work schedule, habits of jumping from one work activity to another without completing the first, or typical impacts due to weather. Complex projects, or projects with greater risk for impacts may be good candidates to set up such a system.

Impact Resolution

Once the Owner's information is collected and its position determined, the final step is to receive notice from the Contractor of the total actual effect of the impact. Current VDOT specifications allow the Contractor until up to 60 days after the processing of final payment to submit the actual impact information (RBS Section 108.09 – Determination and Extension of Contract Time Limit). The ramifications of this limit is that an impact on a large job that occurs early in the project can lay unresolved for a period of years, leading to two observations: 1) it is extremely crucial to have full and extensive documentation to detail the events of an impact after memories have faded, since current VDOT specifications do not require resolution in a more timely fashion, and 2) because the specifications do not require the contemporaneous resolution that is promoted throughout this manual, the project team must foster the relationship with the Contractor and sell the benefits of such resolution.

Despite the lack of a strong specification in this case, the analyst should look for specific documentation to mark the resolution of the impact event, at whatever point during the project the issue is pursued. The first is a letter from the Contractor, which should state the following:

- The date the event causing impact actually ended and normal operations resumed
- A detailed record of the actual impacts to time and money
- What actions the Contractor took to mitigate the impact
- What Owner actions the Contractor is requesting (work order, simple direction, etc..)
- A schedule update or revision showing the impact of the event on the schedule

The Owner is then able to take this full revelation of an alleged impact and determine if it matches the impact assessed by its own documentation and special analyses. The analyst should check the impacts as represented by the Notice and compare it to the alleged full impact. From this point, final entitlement can be discussed and a resolution negotiated. The most successful situations will occur, however, when individual impacts can be discretely addressed and resolved using the documentation produced as described in this chapter.

Chapter 3 – Techniques for Schedule Impact Analysis

The previous two chapters have covered the identification and documentation of an impacting event. Chapter 3 will discuss the processes for quantifying the effect of the impact on the CPM schedule by exposing the reader to a broad range of methods used throughout the industry, and then identifying the preferred method for schedule impact analysis selected by the Partnership. Prior to performing the actual quantification of the impact on the schedule, the steps enumerated thus far should be followed.

3.1 Survey of Methods

Over the course of resolving untold numbers of construction disputes, numerous methods for quantifying the effects of impacts have been developed. The following section will discuss the most widely experienced of these methods, giving a brief overview of the process, as well as the advantages and disadvantages of each. It is not the intent of this section to provide instruction sufficient to fully utilize these methods, but rather to recognize them and understand how they work. Each method uses a different mechanism to determine to what extent (if any) the project schedule has been impacted. The eight different models covered by this section include:

1. Global Impact Approach
2. Net Impact Approach
3. Adjusted As-Planned CPM Approach
4. Adjusted As-Built CPM Approach
5. Collapsed As-Built (But-for) Schedule Approach
6. Impacted Updated CPM (Veterans Administration) Approach
7. Modification Impact Analysis (U.S. Army Corps of Engineers') Approach
8. Time/Schedule Impact Analysis Approach [Bramble et al. 1990]

Of these methods, Methods 2 through 5 are considered *retrospective* techniques; in other words, these techniques are used well after an impact has occurred and completed, usually at the end of the project, and is performed by looking back over the scope of the impact. The final three are considered *contemporaneous* techniques, meaning that they are utilized at the time of the impact (or immediately afterwards) to determine the effect of the impacting event and provide real-time resolution to the issue. These techniques can in some cases be used in after-the-fact analyses, provided that a good baseline schedule exists and the schedule has been regularly updated by recreating updates. As has been stated previously in this manual, the contemporaneous methods are favored over the retrospective methods to provide quick, equitable and final resolution to each discrete impacting event, utilizing maximum relevance with minimum hindsight.

In addition, methods 1 through 3 solely utilize the as-planned schedule via what is considered the 'what-if' method. [Stumpf 2000] These methods basically add impacts to an as-planned schedule to demonstrate what effect events had on the Contractor's original plan. Analysis based solely on the as-planned schedule is considered to be flawed, if not outright rejected. The first two techniques, which do not even fully rely on the CPM Schedule, are in the category of rejected methods. Further discussion on the individual methods will elaborate these claims and concerns. The final five methods utilize an as-built approach, with actual start and finish dates, and eliminate or reduce the reliance on the as-planned schedule. As-Built methods are preferred over as-planned methods because the as-planned methods do not measure the effect of actual performance, raise questions about the adequacy of the as-planned schedule, and require analyzing all impacts at once as opposed to discretely reviewing individual impact events. [Bubshait and Cunningham 1998] Figure 3.1 shows the methods by their classifications.

	Based On:	
	As-Planned Schedule	**As-Built Schedule**
Retrospective Techniques	***Using the As-Planned Schedule After the Delay to Determine Impacts***	***Using the As-Built Schedule After the Delay to Determine Impacts***
	Adjusted As-Planned *After the fact, inserting delays into the as-planned to quantify global impact.* ***Impacted Updated (Veteran's Administration)*** *After the fact, inserting delays into an updated as-planned to quantify impact.*	***Adjusted As-Built*** *After the fact, insert delays into as-built to show "critical path" and quantify global impact.* ***Collapsed As-Built (But-for)*** *After the fact, delays are subtracted from as-built to quantify global impact.*
Contemporaneous Techniques	***Using the As-Planned Schedule at the Time of the Delay to Determine Impacts***	***Using the As-Built Schedule at the Time of the Delay to Determine Impacts***
	Impacted Updated (Veteran's Administration) *At the time of delay, inserting delays into an updated as-planned to quantify impact.*	***Modification Impact Analysis (USACE)*** *At time of modification, schedule is updated and delay inserted to quantify singular impact.* ***Time Impact Analysis*** *Recreate time of modification. Using updated schedule, insert delay and quantify singular impact.*

Figure 3.1: Schedule Impact Analysis Techniques Comparison

The net and global approaches are not included because they do not necessarily rely on either as-planned or as-built schedules. To promote further understanding of these basic differences between contemporaneous and retrospective methods, and between as-planned and as-built methods, the following example is given. This example, and the ensuing discussion, is adapted from a technical report

by Frank Arcuri and Dr. John Hildreth of Virginia Tech for the Partnership, titled 'The Principles of Schedule Impact Analysis'. [Arcuri and Hildreth 2006]

Consider the following train schedule example that analyzes a train's expected and actual arrival time (Figure 3.2). A planned (as-planned, baseline) train schedule is issued in January 2005 based on the train company's initial plan and understanding of consumer demand and resource capabilities. After utilizing the schedule for a year, they evaluate actual data about consumer demand, available resources and actual budget conditions, and the result is a revised train schedule, issued in January 2006. Trains begin following this schedule, some arriving on time, and some arriving late. For example, Passenger A attempts to ride the train during the month of June 2006, but the train arrives late (actual train arrival). In January 2007, after receiving numerous complaints about late arrives of trains, the train company reviews the performance of its train arrivals based on the schedule. Therefore, an updated (as-built) train schedule is developed which reflects the actual train arrivals from January 2005 through January 2007.

If this scenario is now compared to various impact analysis methods, the train company's January 2007 examination of the impact of the June 2006 late train arrival is an example of the retrospective techniques. The Adjusted As-Planned and Net Impact approaches compare the late arrival of the June 2006 train to the original planned train schedule, released in January 2005. According to this first schedule, it is clear that the train was late; however, an analysis of this sort is highly irrelevant because the train in June 2006 was not scheduled to be on time based on the January 2005 schedule. In addition to the irrelevancy of the schedule, perception of the event looking back as it occurred is not as accurate as if it were analyzed at the time of the event (in this simple case, the variance is extremely small).

Upon considering the Adjusted As-Built and Collapsed As-Built (But-for) techniques to review the late train in June 2006, both of these methods also use a retrospective vision of the event. Both of these methods, however, use the revised January 2006 schedule as the baseline for measuring the arrival time of the train. Like the previous two methods identified, these methods also perform the analysis during the January 2007 train company review. The result is an updated 'as-built' train schedule that has the actual late arrival dates, such as the one mentioned in June 2006.

To consider the contemporaneous techniques, the scenario must be changed slightly. In this case, the train company becomes more immediately concerned about the late arrival of trains, and implements a system of examining why specific trains arrived late along with the January 2006 train schedule revision. As a result, when the June 2006 train is recognized to be late, the company performs an analysis to determine why this was the case. The first example of a contemporaneous approach, the Impacted Updated (Veterans Administration) approach, succeeds in analyzing the late arrival of the train, at the time of the event. However, the technique does not require periodic revisions to the schedule, or modifications to reflect the "as-built" schedule to date. The result is the use of the original January 2005 planned schedule as means for analyzing if the train is late. It is possible if, say, a train arrived late in February 2006, that this event would also be analyzed in June 2006, because this method does not require updates and analysis for each delaying event at the time of the event.

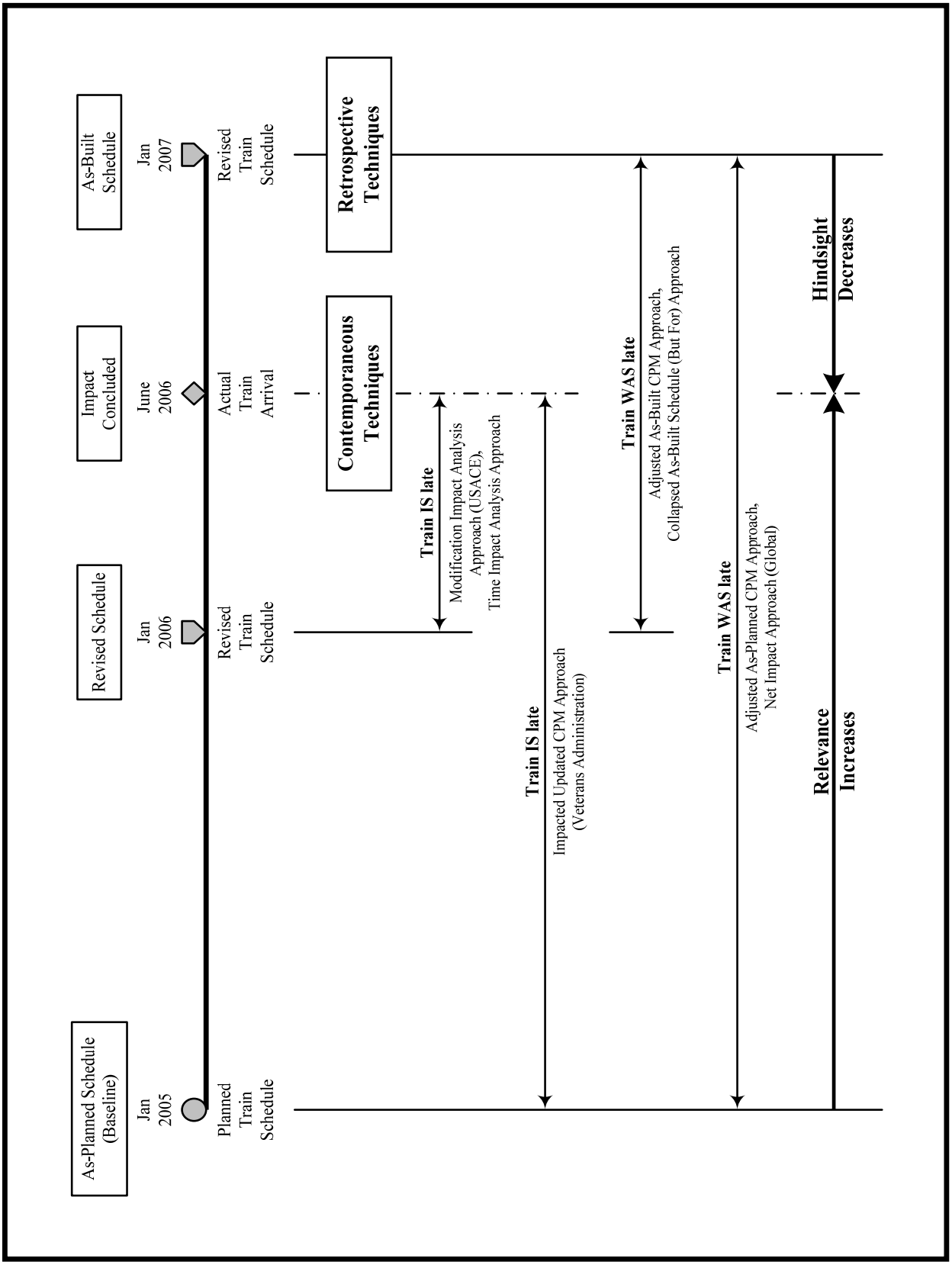


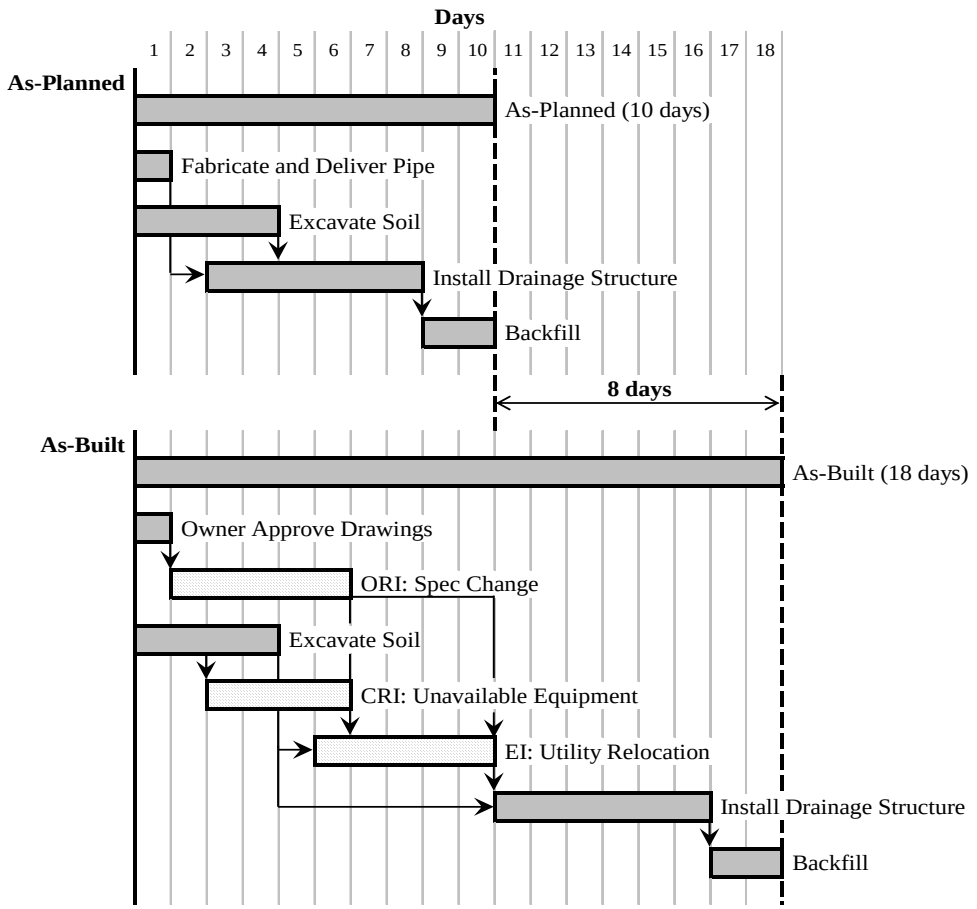
Figure 3.2: Train Schedule Example – Impact Analysis Techniques

The Modification Impact Analysis (U.S. ACE) and Time/Schedule Impact Analysis approaches are contemporaneous techniques that analyze the actual train arrival in June 2006. Both techniques utilize the January 2006 revised train schedule, using the most updated, relevant information. Although the Time Impact Analysis approach is performed in January 2007, it determines the status of the train schedule in June 2006, as well as the actual impact of the event at that time. As shown by the figure, when compared to the previous approaches, the Modification Impact Analysis and Time Impact Analysis approaches analyze the actual train arrival in June 2006 with the most relevant schedule, all while minimizing hindsight. These final two methods give the most accurate analysis of when and why the train actually arrived late in June 2006, compared to the most recently scheduled time of arrival. The train company that desires the most accurate, useful and timely information to attempt to correct is problems with late trains will select these methods to perform its analysis.

From this point, the specific schedule methods will be discussed in further detail, using the common sample fragnet of activities shown in Figure 3.4 below to demonstrate the effect of each method on quantification. In these scenarios, the impacts experienced have been classified as an Owner Responsible Impact (ORI), a Contractor Responsible Impact (CRI), and an Excusable (non-compensable) Impact (EI). Figure 3.3 explains these impacts in greater detail. Note that impact analysis techniques have been given various names by industry. In cases where more than one name has been given to a particular methodology, the variant names have been included where possible.

Owner Responsible Impact (ORI)	During pipe fabrication, following approval of the shop drawings, the Owner revises the specifications for the pipe, increasing fabrication time for the pipe and delaying delivery. The result is a 5-day delay to fabrication and delivery of the pipe.
Contractor Responsible Impact (CRI)	Two days after excavation has started, when installation of the drainage structure should start, the contractor does not have the proper equipment on site required to install the drainage structure. An extra 4 days will be needed to get the equipment.
Excusable Impact (EI)	On the fifth day of construction, a utility line is discovered within the limits of the pipe. The utility company requires 5 days to relocate the line.

Figure 3.3: Drainage Structure Example Delays



Activity	Duration	As-Planned		As-Built	
		Start	Finish	Start	Finish
Owner Approve Drawings	1	1	1	1	1
Excavate Soil	4	1	4	1	4
Install Drainage Structure	6	3	8	11	16
Backfill	2	9	10	17	18
ORI: Spec Change (Late Mat'l Delivery)	5	-	-	2	6
CRI: Unavailable Equipment	4	-	-	3	6
EI: Utility Relocation	5	-	-	6	10

Figure 3.4: Drainage Structure Example Bar Chart and Impacts

3.1.1 Retrospective Methods

The Global Impact, Net Impact, Adjusted As-Built CPM and Collapsed As-Built CPM (But-For) approaches will be reviewed in this section.

Global Impact Approach

The Global Impact method, sometimes called the Total Time Analysis, involves adding up all impacts which the claimant is not accountable for on a bar chart, end-to-end, regardless of concurrency or criticality. The total impact to the project is calculated as the sum of the durations of **all** impacting events. Using the drainage structure example, Figure 3.5 shows the global impact approach method. The as-built duration is completed in 18 days, 8 days later than the as-planned duration. In making the claim for time extension, the claimant is accounting only for excusable and owner-responsible impacts. These impacts are plotted on the bar chart, showing the start, finish, and duration of each impact. Summing the durations of these impacts results in a request for a total time extension of 10 days.

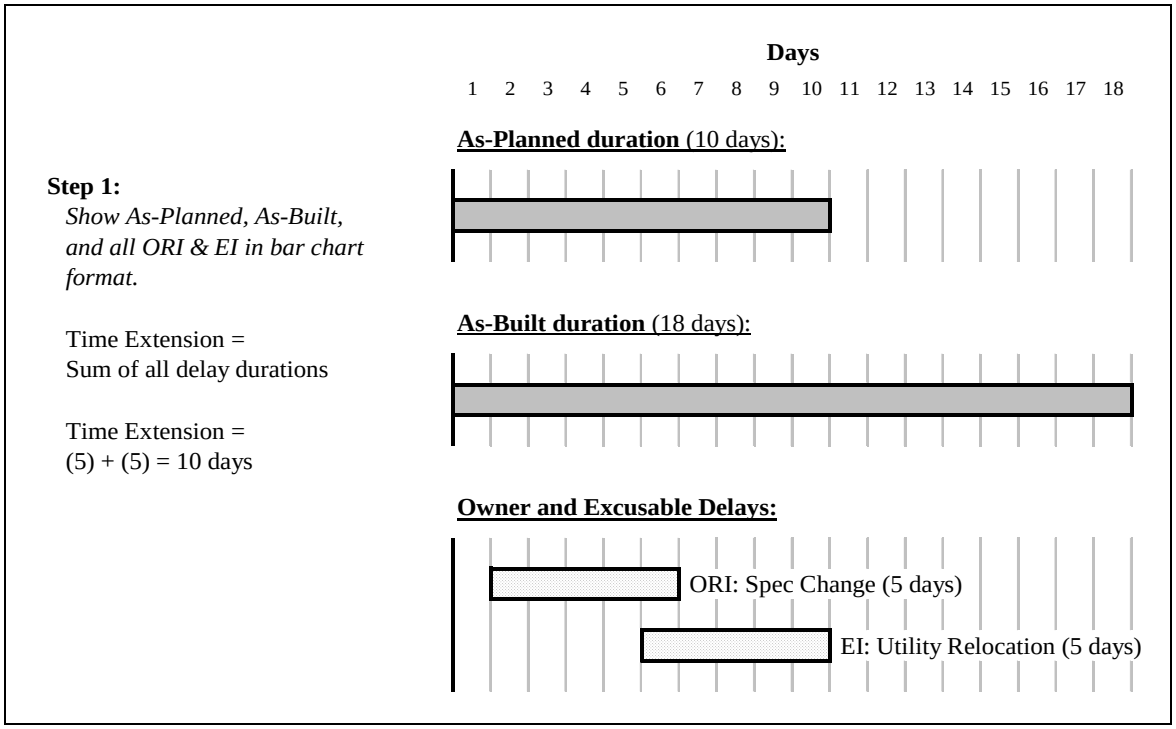


Figure 3.5: Global Impact Approach

The concurrency between the Owner Responsible Impact and the Excusable Impact is ignored, and the delays are simply summed. As a result, this method often results in extensions well beyond the actual project completion [Bramble et al. 1990]. An additional fault in this method is that there is no attempt to analyze sequence of construction and how each individual delay affected the project completion. As a result, this method is almost universally rejected as an acceptable method for determining impacts on projects.

Net Impact Approach

The net impact approach attempts to account for the global impact approach's failure to assess concurrency by depicting the net effect of all claimed delays. In this method, all impacts, including those

of the contractor, are plotted on a bar chart, similarly as done in the global impact approach (Figure 3.6). However, there is no real attempt at an analysis, and it is argued that the total impact to the project is justified for extension since there were impacts to the project and an impact to the schedule was experienced.

The figure below shows all three delays. The widespread number of impacts leads the claimant to argue that the combined effect of these impacts is the net delay on the entire project, regardless of the actual durations. Application of the net impact approach will most likely be used when there are a large number of impacting events. Although the start, finish, and duration of each delay are noted, this information is not actually used to calculate extension. The contractor's request for time extension will be the difference between the as-planned duration and the as-built duration. In the example below, this duration is calculated to be 8 days.

Although the claimant has not double-counted concurrent impacts, the individual impact of any specific event is not calculated against a critical path. The total impact of all delays is assumed to have a net effect on project completion. Without network analysis, such a method is nearly impossible to compute [Bramble et al. 1990]. The Net Impact Approach fails to take into account any project logic, the main component of CPM scheduling, and is therefore not a CPM-based technique for impact analysis.

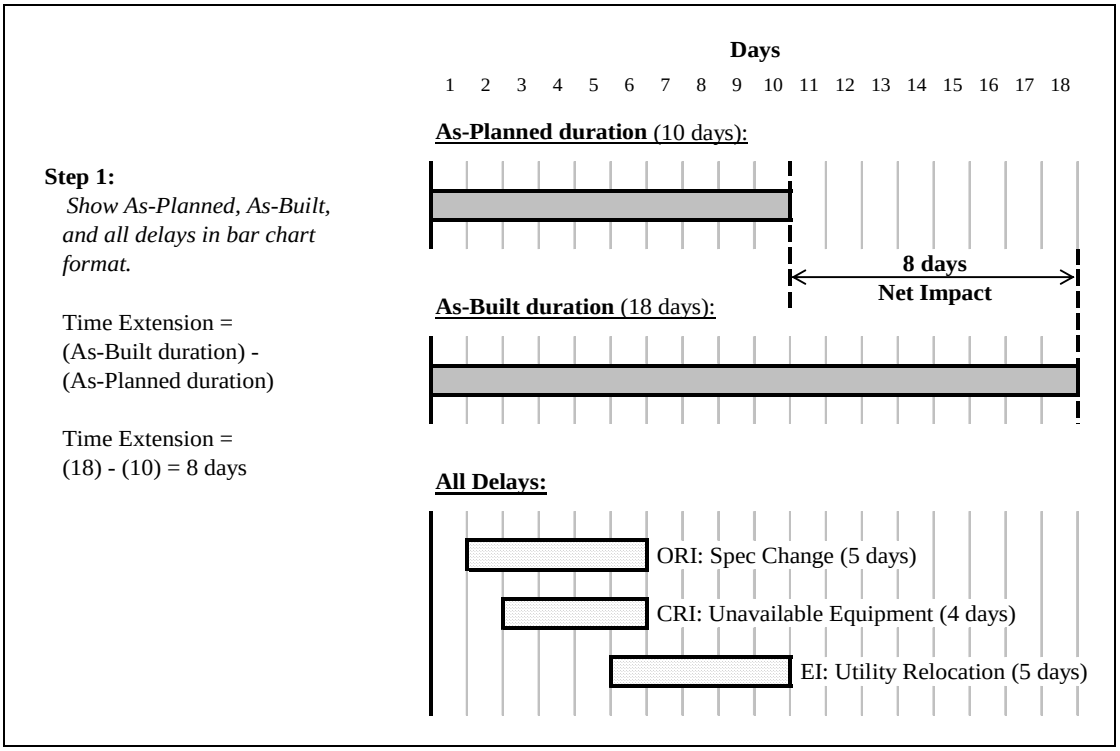


Figure 3.6: Net Impact Approach

Adjusted As-Planned CPM Schedule Approach

The Adjusted As-Planned CPM Approach, sometimes called the Impacted As-Planned Approach, represents an improvement over the first two techniques in that it utilizes a CPM network in schedule impact analysis. Schedule impacts are measured by inserting all contractor responsible impacts into the original baseline schedule, resulting in an adjusted planned duration for the project. These impacting events are depicted as activities and spliced into the schedule. Actual progress and historical work activity data are ignored in this method. As this approach is usually performed retrospectively, the adjusted planned completion duration is then subtracted from the as-built completion duration to produce a time extension.

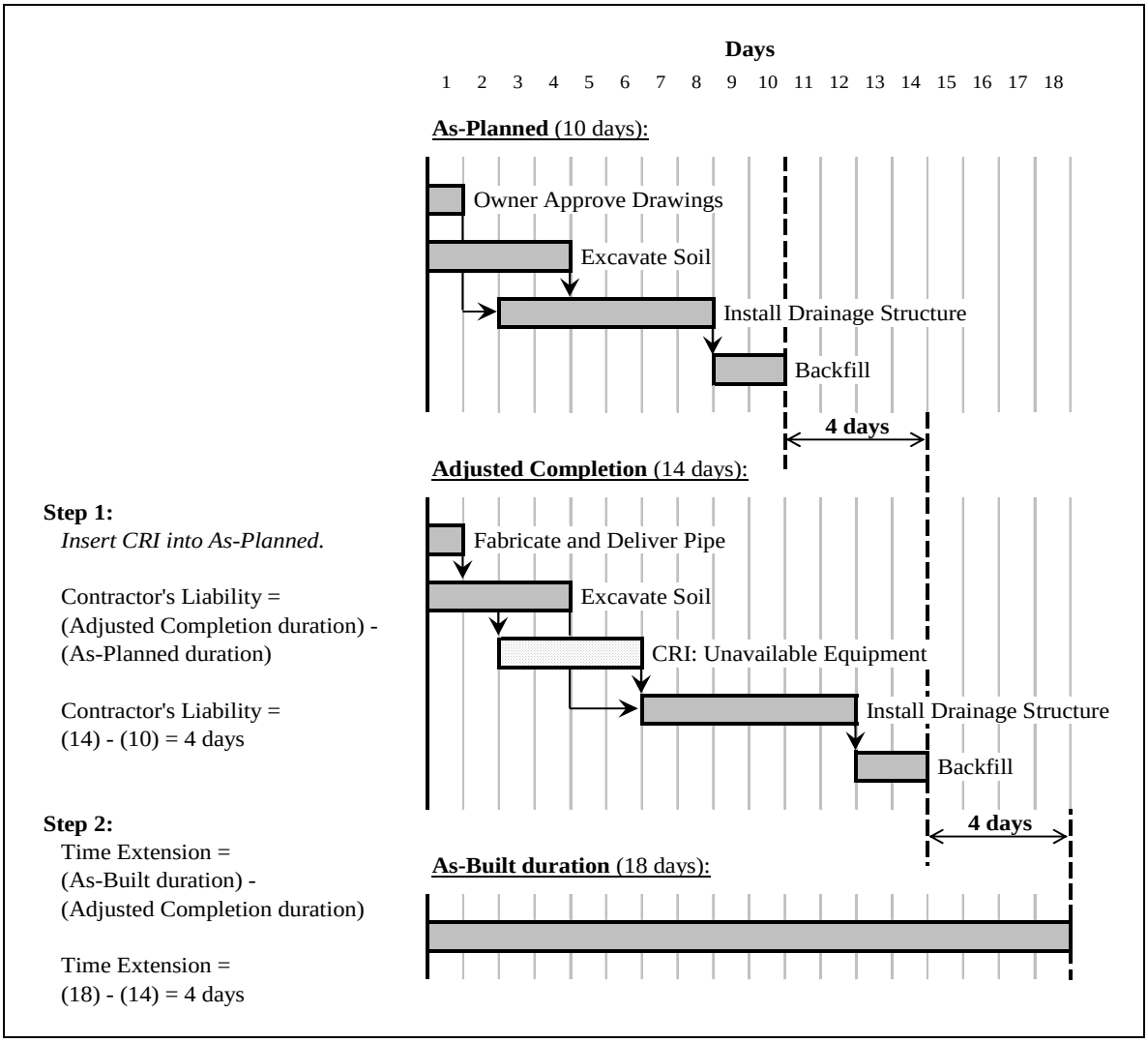


Figure 3.7: Adjusted As-Planned CPM Approach

In the example shown in Figure 3.7, the lone contractor responsible impact of 4 days is inserted into the as-planned CPM schedule, resulting in an adjusted completion duration of 14 days. The adjusted completion is then subtracted from the as-built duration to determine the amount of time extension

warranted to the contractor, which in this case is 4 days. The theory is that all impacts to the completion not identified as the responsibility of the contractor must belong to the owner.

The downfall with this method is that it ignores the actual construction progress and utilizes a theoretical schedule. It is possible that the original plan was unworkable or unrealistic, or that it was never followed. Furthermore, delays may have changed the critical path on an incremental basis [Bramble et al. 1990]. This method is very much like the Net Impact Approach in that it globally assigns all of the impacts to the as-planned schedule, with the exception that it does recognize some impacts by the claiming party (though the full impact of these events is not usually captured) and does not have as its basis a request for all time between the planned duration and the actual completion. Using the train example, without representation of changes in the schedule, relying on a very outdated train schedule is useless when looking back to determine if the train was late at some prior moment in time.

Adjusted As-Built CPM Schedule Approach

Similar to the Adjusted As-Planned CPM Schedule approach, the Adjusted As-Built CPM Schedule globally plots all impacts on an as-built schedule (instead of an as-planned schedule). Because actual dates are used, this approach tends to account for more of the actual contractor responsible impacts than the Adjusted As-Planned method does. Activities linked in a network with restraints form an as-built schedule for the entire project, with impacting events shown as distinct activities. The critical path is determined only twice – once in the as-planned analysis and again at the end of the project in the adjusted as-built analysis. The difference results in the requested time extension.

As shown in Figure 3.8, an as-built CPM network is developed by inserting owner responsible impacts and excusable impacts into the as-planned schedules, along with logical constraints. Rather than simply comparing the adjusted completion to the as-built completion date, this method shows a "critical path." In the example, subtracting the adjusted as-planned completion duration (Figure 3.7) from the as-built CPM network yields a time extension of 4 days. It is noted that the Contractor could represent the schedule in such a way that the drainage structure installation (and thus the lack of proper equipment) from Figure 3.7 was not on the critical path, and thus the total impact of the ORI and the EI would be 8 days instead of 4 days.

The calculation of the critical path is somewhat manufactured, since it is a one-time, after-the-fact calculation, rather than a contemporaneous analysis of the impact of each delay, at the time of the delay. CPM scheduling is intended to be a forward-looking technique used to predict the end of the job, not a method to establish the past; "CPM Schedule" and "as-built" are contradictory terms. Another disadvantage is that the as-built critical path can be misrepresented to demonstrate a path with a greater degree of owner responsible impacts on the critical path. Most importantly, no thorough effort is made to determine the individual impact of each delay on project completion [Bramble et al. 1990].

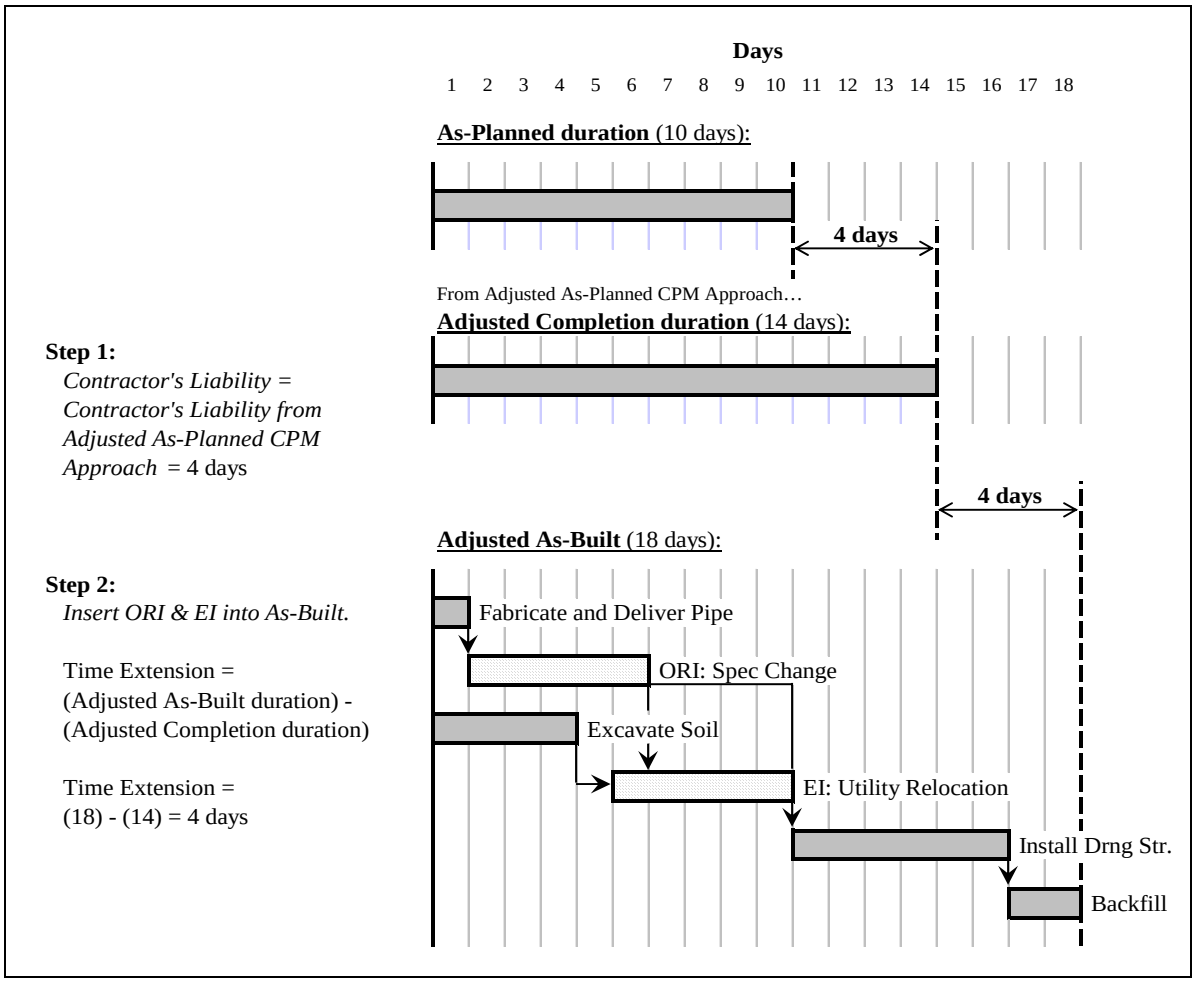


Figure 3.8: Adjusted As-Built CPM Approach

Collapsed As-Built (But-For) Schedule Method

The Collapsed As-Built Schedule impact approach utilizes the "But-For" technique, which essentially says "but-for the impacts the other party is responsible for, the claiming party would have completed on this date". The Owner responsible and excusable impacts are removed from the as-built schedule, "collapsing" the schedule into a theoretical as-built containing only Contractor responsible impacts, and demonstrating "but-for" the owner and excusable delays, the project would have been completed in a certain fashion. The technique is performed in multiple steps (Figure 3.9).

1. Once construction is complete, develop an as-built CPM schedule. Remove Owner responsible impacts from the as-built CPM schedule. The remaining duration represents what 'would have been' but-for the owner's impacts, and the difference represents a compensable time extension.

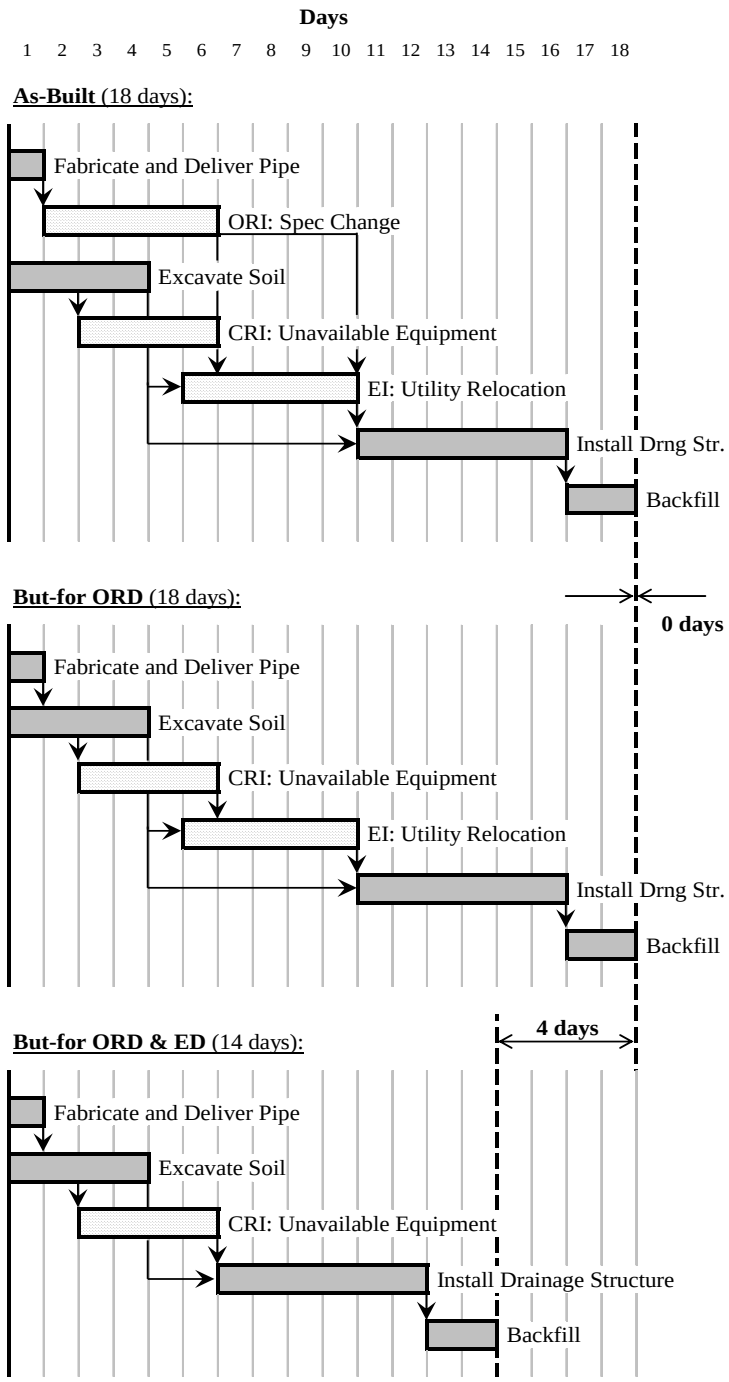
2. Remove excusable impacts from the schedule. The resulting schedule is what would have been had it not been for Owner and excusable impacts. The difference between this and the

previous schedule is the excusable non-compensable delay – justification for a time extension only.

3. Using the formula shown in the figure and below, quantify the impact of the contractor by solving for "Contractor's Liability." Tally results from all steps.

Original Duration +	Contractor Liability +	Owner Liability +	Excusable =	As-Built
(As-Planned)	(Liquidated Damages)	(Delay Damages)	Impacts	Duration

In the example situation, the removal of the Owner responsible impacts results in no change to the completion date because of the concurrent Contractor responsible impact. In the second step, the excusable impact is removed, and the completion date collapses by 4 days. This duration would be proposed for an excusable time extension. Finally, the remaining variable is the Contractor responsible impacts, which, after subtracting the previous result, comes to 4 days.



Step 1:
Remove ORI from As-Built.

Owner's Liability =
(As-Built duration) -
(But-for ORI duration)

Owner's Liability =
(18) - (18) = 0 days
Time Extension

Step 2:
Remove EI from But-for ORI.

Time Extension =
(But-for ORI & EI duration) -
(But-for ORI duration)

Time Extension =
(18) - (14) = 4 days

Step 3:
Apportion Contractor's Liability:

(As-Planned) + (Contractor's Liability) + (Owner's Liability) + (Time Extension) = (As-Built)
10 + (Contractor's Liability) + 0 4 = 18

Contractor's Liability = 4 days

Figure 3.9: Collapsed As-Built Schedule (But-for) Approach

The collapsed (but-for) logic relies on the presumption of a hypothetical outcome from what the analyst says would have happened, had a portion of historical events not occurred and thereby creating a theoretical situation; cause and effect relationships of the remaining impacts and the project activities are not demonstrated [Zafar 1996]. The critical path changes based on what impacts are subtracted, thusly not representing any real situation on the project. Frequently, this method will not fully represent the impacts of all parties [Stumpf 2000]. In addition, construction scheduling should reflect the schedule in light of current situations and cumulative events, not a retrospective subtraction of events performed on a one time basis, usually at the end of the project [Wickwire et al. 2003].

It is noted that a recent Modified But-For Method has been developed that seeks to improve on the stand But-For analysis by: 1) better representing interactions among concurrent critical impacts, 2) better representing the effects of activity disruptions, and 3) considering the viewpoints of all parties in a more unbiased manner [Mbabazi 2005]. It is outside the scope of this manual to explore this modified method more completely.

3.1.2 Contemporaneous Methods

Largely because of the problems with the retrospective analyses, contemporaneous methods were developed. The Impacted Updated As-Planned CPM (U.S. Veterans Administration), Modified As-Built (U.S. Army Corps of Engineers), and Time Impact Analysis will be covered in this section. The Modified As-Built method is also sometimes called the Modification Impacted Analysis method, and is sometimes considered to be essentially the same method as Time Impact Analysis [Bubshait 1998]. However, for the purposes of this review, the two methods will be kept distinct.

<u>Impacted Updated As-Planned CPM Method (Veterans Administration)</u>

Another approach to schedule impact analysis is the Impacted Updated As-Planned CPM method, used by the Veterans Administration. The original project schedule, as updated to reflect actual progress to a certain point in time, is used to measure the impact. The analysis will take place often during the course of construction rather than after the project is complete, thus making this method a contemporaneous approach. However, if the update information exists in sufficient detail to create schedule updates, the technique may be applied after project completion (essentially retrospectively). Thus, this method appears in both boxes in Figure 3.1.

Each impacting non-Contractor responsible event is analyzed to define where it should be inserted into the currently updated and approved network schedule, as shown by Figure 3.10. Impacts to the planned dates of successive activities caused by the impact are determined by comparing the schedules before and after the changes have been incorporated. The effect that an impact has on the CPM schedule is determined by a comparison of the schedules before and after the impacting events are incorporated into the CPM network; only if the project completion is extended is the contractor is entitled to a time extension [Veterans Administration 1989]. In the event of concurrent impacts, a single window

period covering all overlapping impacting events is used, rather than making separate calculations for each impact event.

The example in Figure 3.10 consists of concurrently impacting events, an ORI and EI, which are inserted into the most recently approve schedule, the original as-planned schedule updated through Day 1. The result is an adjusted completion of 18 days, 8 days longer than the as-planned; therefore, 8 days will be granted as a time extension. This method is not used to quantify days for delay damages, only to calculate time extension [Bramble et al. 1990].

This approach analyzes all impacts that have occurred since the last update at one time, assuming that the project schedule, as updated and approved, is correct. It does not determine whether actual construction in the field differs from the approved schedule. This method also fails to properly use the CPM approach in a contemporaneous manner by updating after each delay.

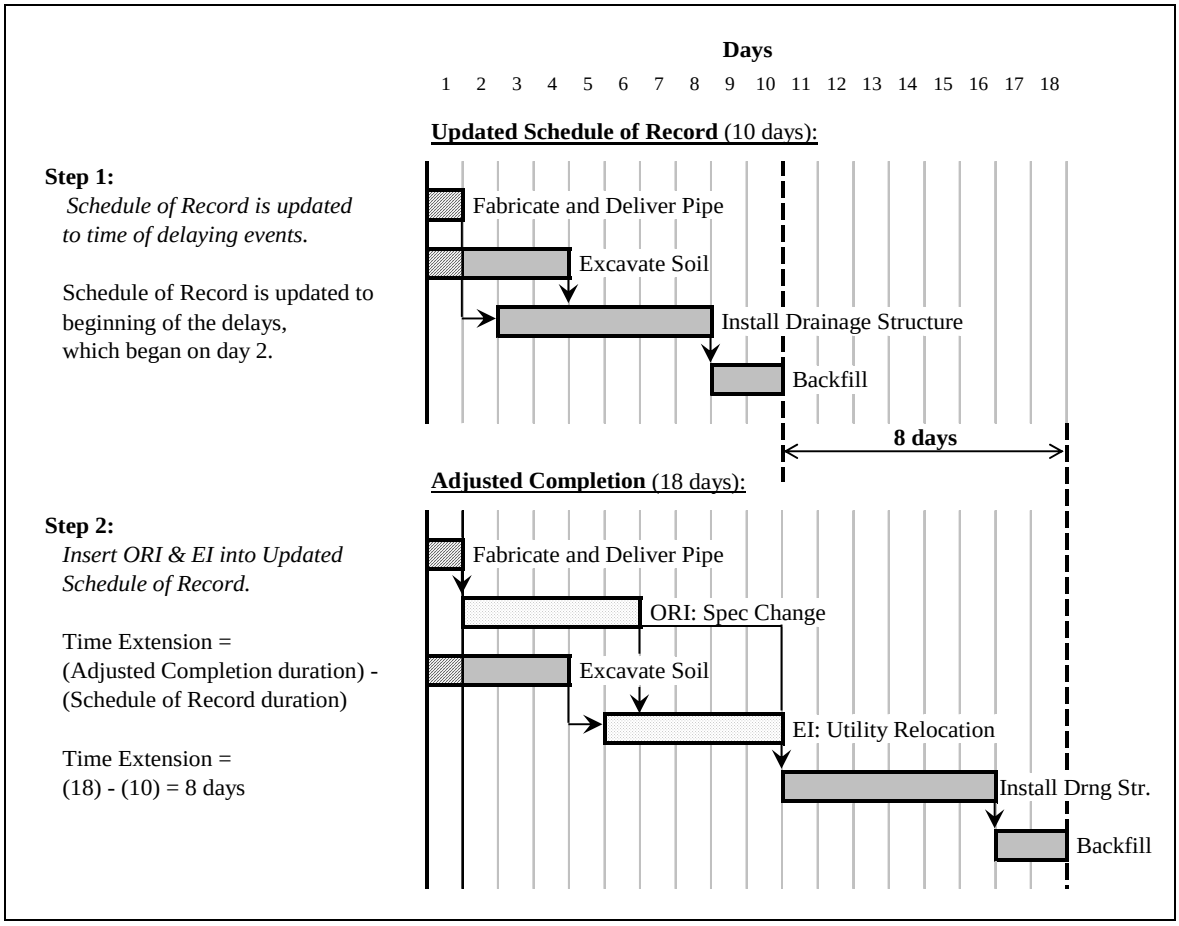


Figure 3.10: Impacted Updated As-Planned CPM (Veterans Administration) Approach

Modified As-Built (U.S. Army Corps of Engineers)

The Modified As-Built Method, called the Modification Impact Analysis by its developer, the U.S. Army Corps of Engineers, is a form of Contemporary Period Analysis (CPA) or 'Window' Analysis that

takes snapshots of the project between updates to determine impacts to the schedule. This method requires a reasonable as-planned schedule, revised as necessary, with frequent status updates and updates with each new impact. The U.S. Army Corps of Engineers' *Modification Impact Evaluation Guide* lays out the basic steps for this form of impact analysis:

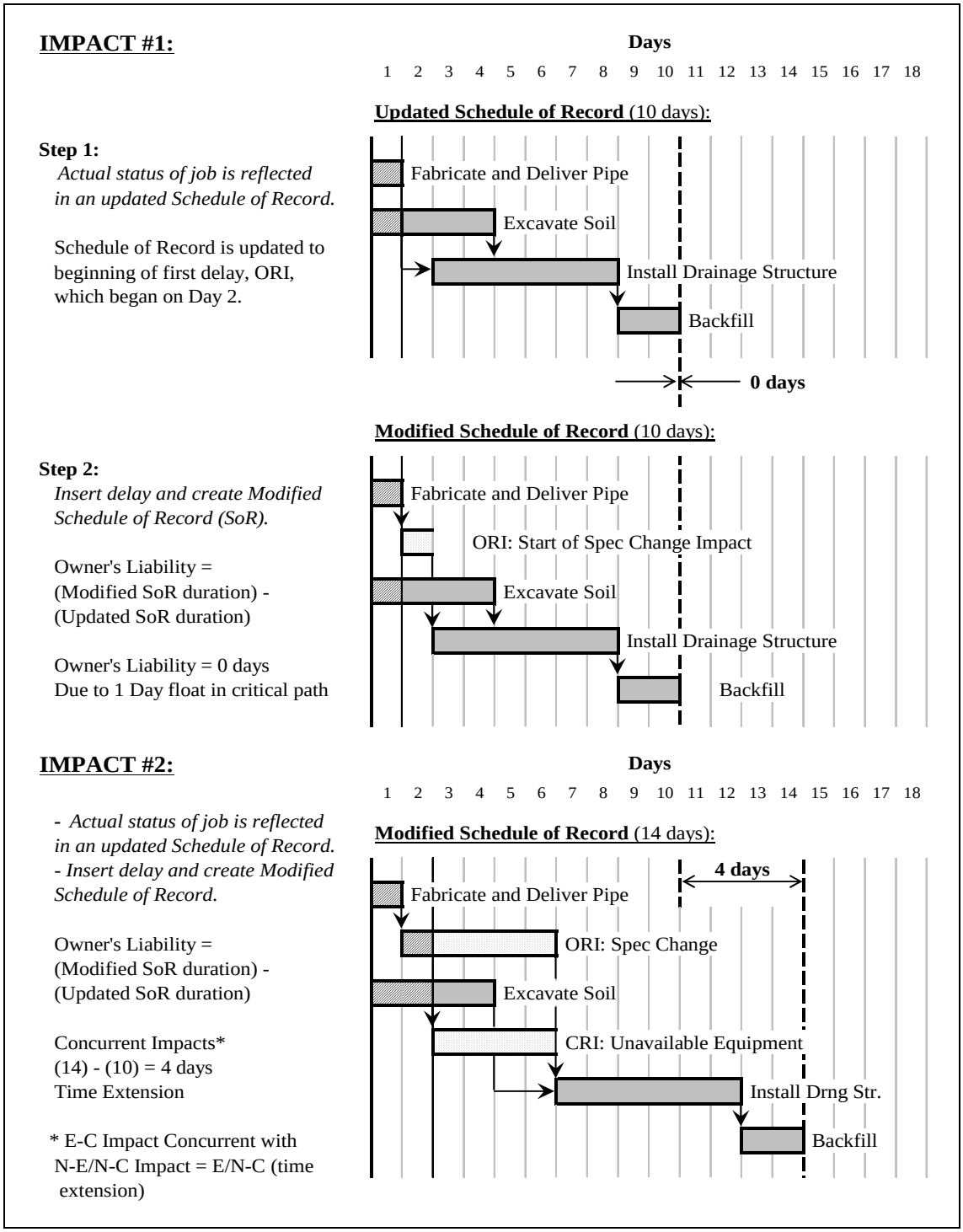


Figure 3.11: Modification Impact Analysis (U.S. ACE) Approach (Impacts #1 and #2)

Step 1: The impact analyst determines the actual status of the job when each Owner responsible or excusable impact occurs, without influence from the Contractor's formal project schedule. This process eliminates situations where the Contractor's 'working' plan may differ from the as-planned schedule, and capture effects of plan modifications.

Step 2: The effects of modifications or impact events are evaluated to determine how the schedule is impacted as a result of these events. New activities may be created if all or part of the work does not fit into an existing activity, or if an impact has occurred.

Step 3: The schedule as revised is used for new calculations to determine the new critical path and project completion date. From this new completion date, time extensions and/or delay damages can be granted.

Figure 3.11 evaluates the drainage structure example using the modification impact analysis method. Analysis of Impact #1, the owner's specification change, begins with an updated as-built schedule at the start of the ORI (Day 2). The ORI is then inserted into the schedule, making the proper modifications in the network to accommodate the change. Because the ORI has one day of float, it does not immediately delay completion. Impact #2, the 4 days impacted of unavailable equipment, starts on Day 3 and lasts through Day 6. Because it is fully concurrent with the ORI, resulting in a Excusable/Compensable impact concurrent with a Non-Excusable/ Non-Compensable impact, the result is a 4-Day time extension (Excusable/Non-Compensable). See Section 1.4.5 of this manual for further discussion on evaluating concurrent impacts.

The Schedule is then updated to the start of Impact #3, the excusable utility relocation impact (Figure 3.12). Based on the project of a 5-day impact, the schedule extends 4 days to 18 days. The first day of this impact (Day 6) is concurrent with an ORI and a CRI. The result of this concurrency is a non-compensable time extension (which was already granted as a result of the previous window analysis). The four remaining days of the impact then result in a non-compensable time extension, the result of an excusable impact. Finally, an update is performed at the end of the impacts that confirms that the net result of the impacts is an 8-day delay to project completion, and justifies granting an 8-day time extension.

This method requires the most effort, and in most cases, results in the most accurate conclusions. Particular to this method is that a schedule revision is required for each modification, ensuring that the project status is known and future changes predicted at the time of each possible impacting event. Adjustments to the schedule and impact analysis shall be performed at or near the time of the impact (both before the impact and afterwards), not at the completion of the project. As with the other methods, if there are no modifications or owner responsible impacts, then the contractor is solely responsible for late completion and is not warranted a time extension [Bramble et al. 1990].

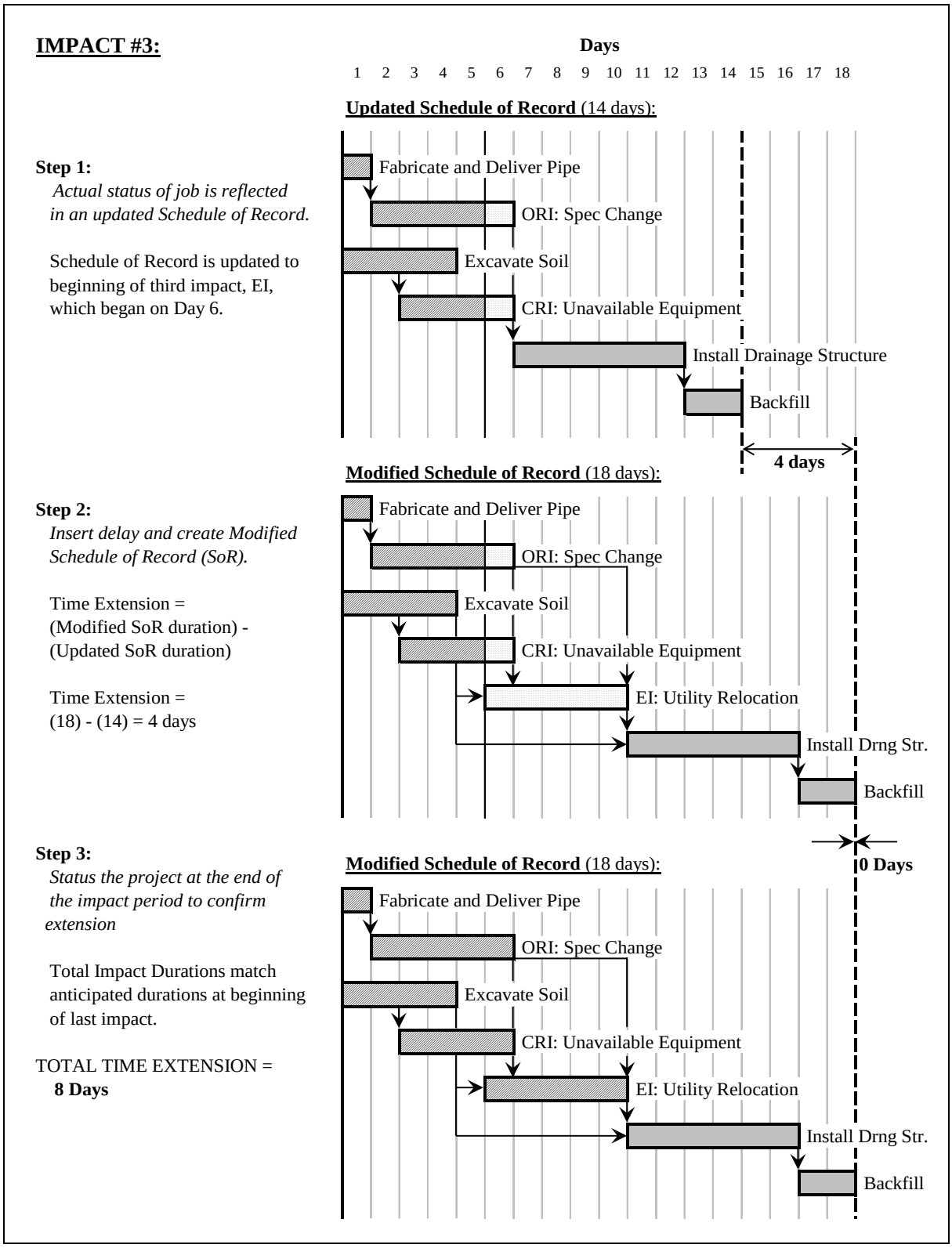


Figure 3.12: Modification Impact Analysis (U.S. ACE) Approach (Impact #3)

Time Impact Analysis

Like the Modification Impact Analysis, the Time Impact Analysis method is the most comprehensive technique, incorporating the actual project history into a dynamic plan. Using

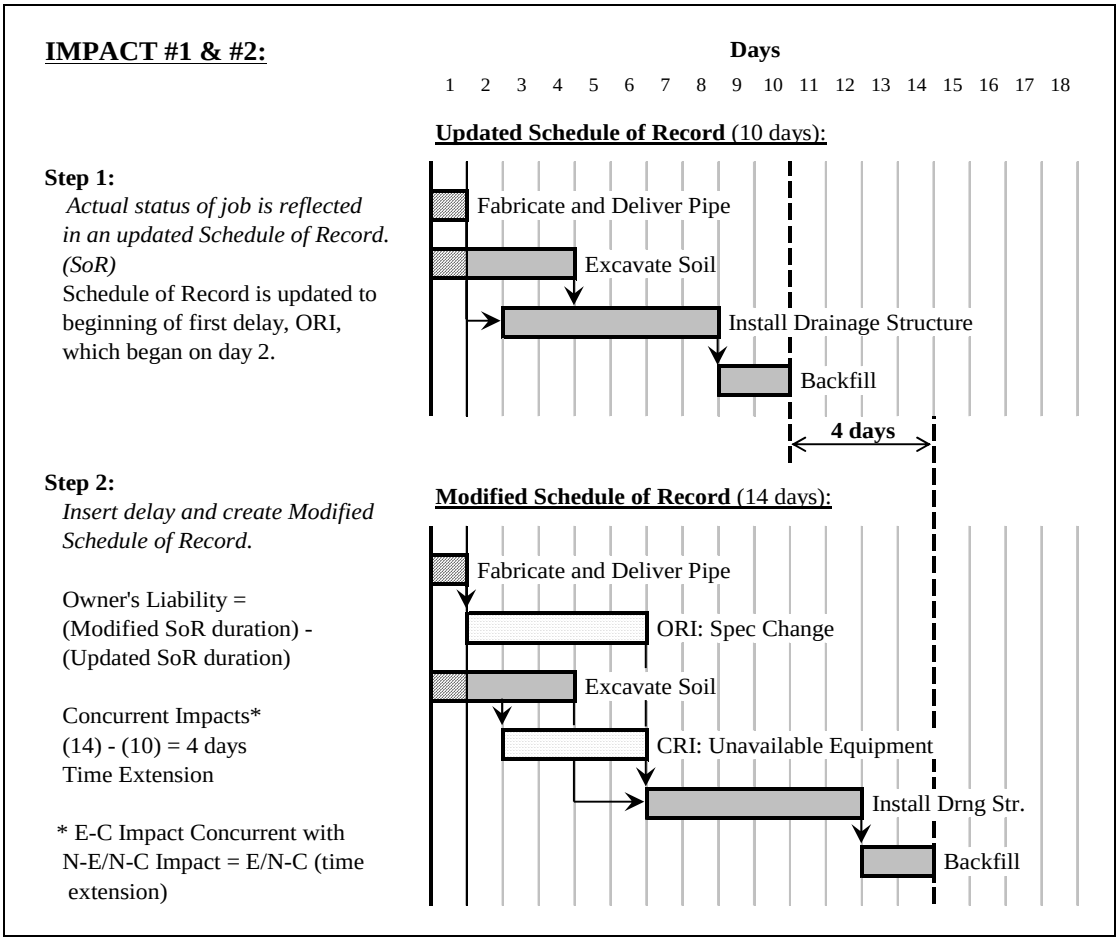


Figure 3.13: Time Impact Analysis Approach (Impact #1 and #2)

Time Impact Analysis, impacts to the schedule result in the isolation and quantification of each event. To do so, a "picture" of the CPM network is taken when the event occurs, followed by inserting the change into the network; as such, this method is also considered a Contemporary Period Analysis (CPA) or 'Window' Method. All variations that may occur in the schedule – such shifting of the critical path, consumption of float, or addition of new links between activities – are analyzed to determine the effect of the event on the schedule as a whole. Any additional or revised activities will be reflected in the as-built schedule.

In the example above, Figure 3.13, Impact #1 is the owner's specification change to the pipe (ORI) and Impact #2 is the unavailable equipment (CRI). The schedule is updated to the beginning of the first impact, Day 1, the impact is spliced into the CPM network, and the adjusted completion duration is determined to be 14 days. Both impacts are known about because this method is performed after the

impact period is complete, instead of forecasting the full impact in advance. As explained in the previous section, these concurrent impacts result in a Non-Compensable time extension. The difference from the previous method is the schedule need not be updated prior to the start of each impact, only at some reasonably recent time.

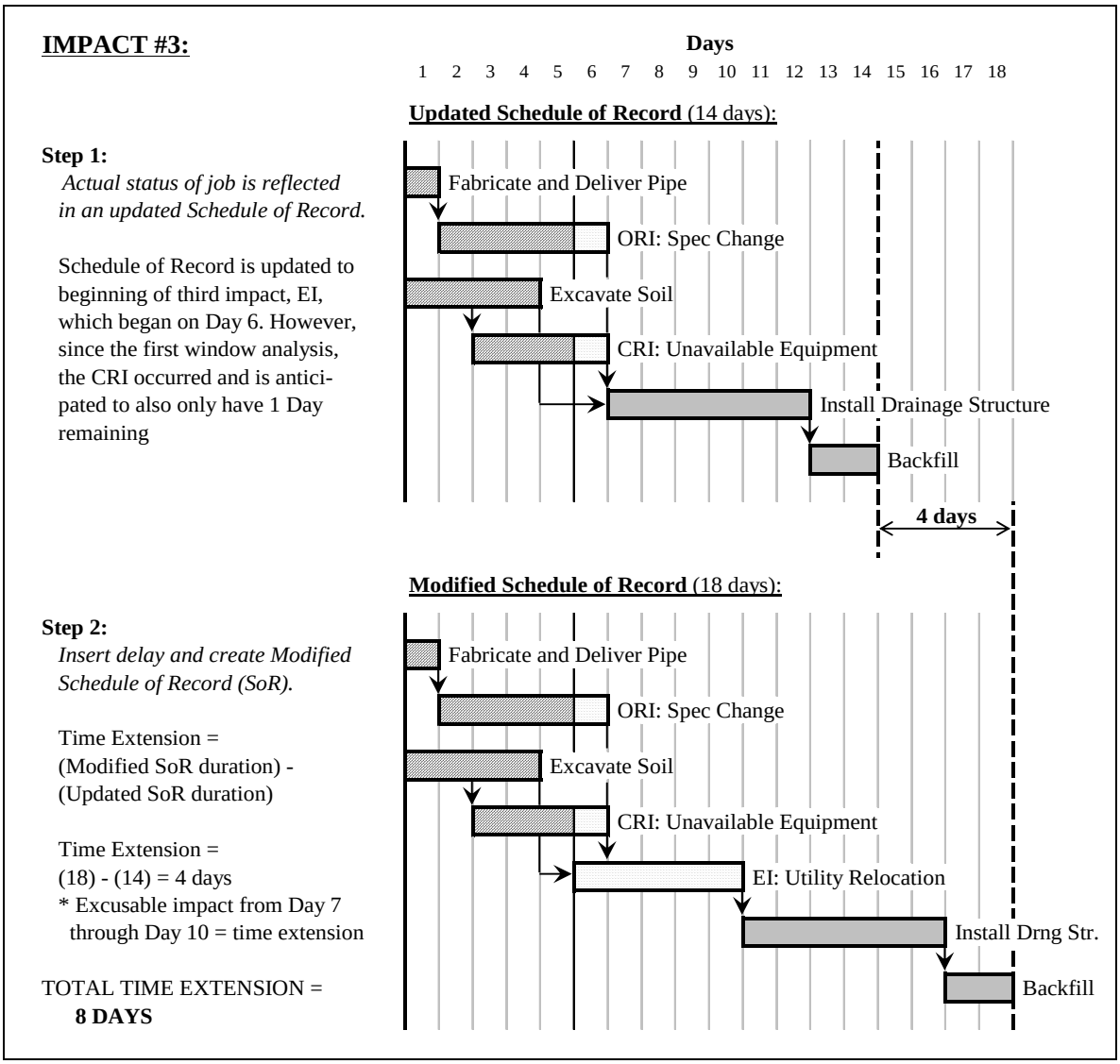


Figure 3.14: Time Impact Analysis Approach (Impact #3)

On Day 6, the excusable utility relocation impact (Impact #3) begins, and extends the completion date of Day 18 (Figure 3.14). Because Impact #3 is an excusable impact, a Non-compensable time extension is granted. The net result of the impacts is 8 days of time extension.

The goal of the systematic Time Impact Analysis approach is to give full consideration to the actual effect of events individually *and* acting together, and to evaluate the effect of ongoing impacts. It examines the evolution of the critical path and the impact of the events in question on that path [Bramble

et al. 1990]. Like the Modification Impact Analysis, the Time Impact Analysis approach is often the most time-consuming impact analysis method; however, it can be very accurate, has the potential to be the least controversial and most analytical, and can be equitable to all parties [Stumpf 2000]. This approach differs from the previous method in that an update is not required immediately prior to the start of each impact, assuming no major changes have occurred since the last update. In addition, this method is performed immediately after the impacts have concluded (and is, therefore, contemporaneous), rather than forecasting ahead.

3.1.3 Comparison of Methods

Figure 3.15 tabulates the results of each schedule impact analysis technique as applied to the drainage structure example. The actual project completed 8 days later than scheduled, yet time extensions ranged from 4 to 8 to 10 days. This discrepancy in contractor-awarded time extension is a product of the varying applications of CPM schedule, as-planned versus as-built schedules as the bases of the analysis, and retrospective versus contemporaneous techniques.

Time Impact Analysis Technique	Time Extension	Owner's Liability	Contractor's Liability
Global Impact	10	*	*
Net Impact	8	*	*
Adjusted As-Planned	4	*	4
Adjusted As-Built	4	*	4
Collapsed As-Built (But-for)	4	0	4
Impacted Updated (Vet. Admin)	8	*	*
Modification Impact (U.S. ACE)	8	0	*
Time Impact Analysis	8	0	0

* this method does not assess this damage

Figure 3.15: Results of Impact Analysis Techniques for Drainage Structure Example

The trends found in the results when comparing the different techniques against one another for this particular example are not necessarily indicative of standard variances obtained when applying these techniques. Disregarding the Global Impact and Net Impact techniques for their failure to apply CPM schedules, the remaining six techniques determine time extensions via:

(As-Planned) + (Time Extension) + (Contractor's Liability) = (As-Built)

The difference between the as-built and as-planned in the sample problem is 8 days, which is the same as the sum of the time extensions and contractor's liability for each technique (with the exception of Global Impact). The following table compares and contrasts the methods just discussed, summarizing the advantages and disadvantages of each method.

	Method	Basis	Summary of Approach	Advantages	Disadvantages
Retrospective Techniques	**Global Impact**	Not a CPM Method (Σ Delays)	Add up all impacts claimant not responsible for and add end to end (regardless of concurrency or criticality) to calculate an extension	Quick, simple	Universally rejected by industry; fails to consider delays of all parties; ignores concurrencies & critical path; is not actually a CPM method for calculating impacts
	Net Impact	As-Built Schedule / None (ΔAB – ΔAP)	Inserts all claimed impacts into bar chart and assert that the total effect of all impacts equals the differences between the as-planned completion and the as-built completion.	Quick, simple; corrects problem of double counting concurrent impacts from the Global Approach	Universally rejected. Not based on the CPM schedule, no real acknowledgement of own impacts, no real identification of how individual impacts affect the schedule
	Adjusted As-Planned CPM	As-Planned Schedule (What-if) ΔAB – (ΔAP+CRI)	Inserts impact onto the original as-planned CPM schedule. The difference between the as-built duration and this 'adjusted' as-planned is the requested extension. What would have happened without other party's impacts.	Uses a CPM network to determine cumulative effects of all impacts.	As-planned schedule may be outdated, unrealistic, or never followed. Does not relate to actual activities on the project. Schedule produced is theoretical. Global assessment of all impacts, not individual.
	Adjusted As-Built CPM	As-Built Schedule ΔAB – (ΔAB + CRI)	Global approach like Adjusted As-Planned inserts impacts into as-built schedule. Time extension is difference between as-built duration with Owner impacts and adjusted as-planned duration above.	Based on a CPM schedule and uses some as-built information to determine cumulative affect of all impacts.	One-time, after the fact calculation of critical path debatable; claiming party impacts easily hidden or manipulated; impacts of individual events not assessed.
	Collapsed As-Built (But-For) Schedule	As-Built Schedule (But-For) ΔAB – (ΔAB – ORI)	Insert all impacts into the as-built schedule. Remove Owner impacts to determine compensable duration; remove excusable impacts for non-compensable time extension; remaining duration past completion date is Contractor responsible.	Identifies delays by all parties on as-built schedule; does not depend on the as-planned schedule being accurate	As-built critical path hard to determine; problems with concurrent delays; removing owner delays can result in unrealistic, theoretical schedule; retrospective and performed on one time basis.
Contemporaneous Techniques	**Impacted Updated CPM (Veterans Administration)**	As-Planned Schedule (Cont. Period Analysis) (Impacted Plan – Prior Plan)	Contemporaneous method can be used retrospectively by adding impact activities to the approved updated planned schedule (not the original as-planned schedule). All impacts since the last update are evaluated. Time extensions are granted at each update based on the impact of the events on the remaining schedule.	CPM Schedule method is Contemporaneous in nature; impacts addressed more frequently, if not individually; current approved schedule is used; can be used retrospectively if the schedule has been updated regularly and sufficient project records exist.	Assumes the updated and approved schedule is correct; does not determine whether actual field conditions differ from approved schedule; effects of multiple impacts often calculated at once; updates not necessarily recent to impacts.
	Modification Impact Analysis (U.S. Army Corps of Engineers)	As-Built Schedule (Contemp. Period Analysis) (Window Start Update – Window End Update)	Takes updated approved schedule and confirms actual status of job in the field. Inserts impact activities into the CPM schedule network, and then calculates a new critical path and project duration. Any impact to the completion date during the 'window' or period of analysis is then reviewed for time extension	Contemporaneous CPM Schedule method uses actual job status as basis of comparing effects of impacts; schedule is updated regularly and impacts addressed individually as to their effects on project duration; no time extension is granted unless completion date changes. Very accurate with potential for little controversy	Requires good project schedule & significant schedule maintenance required – time consuming.
	Time Impact Analysis	As-Built Schedule (Contemp. Period Analysis) (Impacted Update – Prev. Update)	Very similar to the Modification Impact Analysis, updating the schedule frequently, and analyzing windows of time to determine schedule impacts. A contemporaneous approach performed after the impacts are complete. As a result, schedule updates do not necessarily occur immediately prior to the start of each impact, as long as not major changes have occurred.	Very similar advantages to the previous method. Can be less time consuming than the Modification Impact Analysis.	Requires good project schedule & significant schedule maintenance required – time consuming. Schedule may not be updated to point immediately prior to an impact, meaning that other, less visible impacts may be included in the window unintentionally. Does not forecast impacts, as it is performed after the impact is complete.

3.2 Preferred Method for Impact Analysis

The preceding section discussed several techniques used in industry to perform an impact analysis, and the theory behind their use. The following section will identify the preferred methods for performing a schedule impact analysis on VDOT projects as identified by the VDOT – Virginia Tech Partnership for Project Scheduling.

As has been stated previously, the Partnership favors a contemporaneous as-built method similar to the Contemporaneous Period Analyses, or 'Window' Analyses discussed in the last section. The contemporaneous nature of the review, whether performed during or immediately after the impact, limits the bias created by hindsight, while using the most current updated schedule maximizes the relevance of the analysis. The goal of the analysis is to determine a reasonable time extension to be granted for any excusable impacts that have occurred on the project [Finke 1997].

At the stage of the review, the analyst should have already answered the entitlement question (discussed in Chapter 1 of this manual), and determined that the impact is at least excusable/non-compensable, if not excusable/compensable. As such, in this section, the word 'excusable' will be used without reference to whether the impact is compensable or not, only that a time extension is justified. Either determination warrants an impact analysis to quantify what (if any) time extension is due. If the impact is determined to be non-excusable, yet the Contractor contends that it is excusable, the analyst is advised to perform the impact analysis in the event that the Department later determines that the impact was in fact excusable; this step will ensure that a contemporaneous review occurs and the impact of the event is quantified even if the entitlement discussion continues for a significant period after the actual impact occurred. There should be a clear goal, however, to resolve all entitlement issues as quickly as possible.

3.2.1 Detailed Review of Method

The basis of the preferred method, as with any Contemporaneous Period Analysis (CPA), is a well planned and accurately represented as-planned schedule, revised with significant changes in the plan as the project progresses and regularly updated with the current status of the project activities. The planned schedule for the remainder of the work, as identified in the current schedule (Schedule of Record), is a dynamic document that changes with each update. The view of the as-planed schedule as a static document is a major downfalls of several of the other impact analysis techniques [Finke 1997]

In short, the impact analysis will be performed by taking a schedule updated as closely as possible to the start of an impact with verified project status, estimating the duration of the impact and inserting it (with appropriate logical ties) into the schedule, and then either 1) using this estimate as the basis for the time extension, or 2) monitoring the actual progress of the impact over a window of time, usually the duration of the impact, and inserting the actual duration of the impact into the project schedule

to quantify the impact on the project completion date. These steps will now be discussed in greater detail.

STEPS

Step 1: Ensure an Accurate and Current Planned Schedule Exists

The first step of schedule impact analysis occurs prior to any actual impacts, and may actually be considered a pre-requisite to SIA. The analyst must ensure that a reasonable original as-planned schedule is developed and accepted for use on the project. Chapter 2.2 discusses this process in more detail. Future impacts to individual activities will, in essence, be compared against the durations and logic relationships set forth in this schedule, so it is of utmost importance that the schedule represents a clear and comprehensive plan that is carefully reviewed by the Department. Most CPM schedules developed for the Department are not resource loaded; therefore the acceptance process should include a thorough discussion on planned resources to be utilized to accomplish the activities shown. Errors in the as-planned schedule (either due to incorrect production estimations, improper scheduling logic, failure to include the full scope of work, etc..) can be overcome during the analysis phase, but lead to a more difficult analysis.

The second part of this first step, which also must be performed whether an impact has occurred or not, involves revising the plan at any point during the project during which the plan for sequencing the future work changes.

The final part of the first step is to regularly update the schedule. As discussed in Chapter 2.2, the minimum recommended timeframe between updates is one month. Current Department standard scheduling specifications do not require any level of maintenance beyond whatever updates the Engineer deems necessary or the Contractor wishes; however, future specifications will make monthly updating a requirement. In effect, each monthly update becomes a window analysis of any changes that happen over the last month of the project. Updates can be created after the fact, but doing so introduces bias into the schedule and the accuracy depends on the quality of the project documentation.

Step 2: Status the Schedule to a Point Immediately Before the Impact

Step 2 occurs immediately after an impact has been identified. This step may be optional based on how recently the project has been updated prior to the start of the impact. Unlike the Army Corps of Engineers approach, an updated schedule including all activity up through the day before the impact may not be necessary, but the analyst must take great care in determining whether to use the last update or to status the schedule. An update performed a few days or even a few weeks previously may be used, but care must be taken to ensure that other impacts, particularly Contractor Responsible Impacts, have not occurred in the interim. If the Contractor has not met its production goals, then the corresponding

slippage in the schedule could be attributed to the excusable impact identified for analysis. Therefore, it is recommended, if possible, to update the schedule to the evening prior to the impact start.

Step 3: Determine Whether a 'Pre' or 'Post' Impact Analysis will be the Basis for Time Extension

Once the project has been updated in Step 2, and the analyst must decide between two methods to base the time extension calculation on. The time extension, if any, will be determined by inserting an activity into the current schedule that represents the impact and observing the effect on the completion date. However, this duration can be derived by forecasting/estimating the length of the impact at the start of the event, and formally agreeing to it perhaps before work even begins, or, it can be measured once the impact is complete and the as-built duration of the impact is known (see Figure 3.16).

The process of forecasting the impact means that the Contractor will formally accept a certain extension of time, and therefore accept all remaining risks (barring further ORI's) in completing the changed/additional work in that period. This method would typically be used when there is a defined change in scope (such as a work order for added or deducted work), or when an impact has a fixed duration. Such an impact must have the following characteristics:

- A relatively certain impact duration
- The impact can be inserted into the CPM Schedule in a reasonable and logically sound manner, with proper relationships
- The Contractor's attempts to mitigate the impact are modeled in the schedule, and
- The analysis is submitted to the Department immediately after the impact is known, and well before the impact is complete (preferably before the changed work has started) [Lehmann 2001].

The observed advantages of this method are: the Contractor is motivated to complete the work in the most efficient manner possible within the agreed upon timeframe; the allocation of risk for completing the work on time mirrors the system of the original Contract (timeframe accepted by both parties prior to stating work); the method is consistent with firm fixed time/price agreement used by the Department in its contracts; the Contractor maintains the burden of proving the time (and price) required to perform the work is fair and reasonable. Also, it encourages the regular maintenance of the project schedule and effectively ensures that the remaining projected plan and completion information is kept current [Wickwire 2003]. In addition to the advantages of using this method, particularly in a work order situation, it fits Department policy to address time ***and*** money on the same work order before the work actually begins. Therefore, if it is reasonable for the Contractor to identify the full scope, including the major risks involved with the added work, this method should be used. The one obvious disadvantage is that the extension granted may or may not correlate to the actual duration of the impact.

If the scope of the changed work is indeterminate, or the duration of the impact is not possible to reasonably forecast, then the second method must be used. In this case, the impact will be tracked and

the as-built dates of the impact recorded and entered into the schedule. The resulting impacts on the completion date will determine the time extension allowed. This method is normally required on ORI's where work is delayed (such as a late shop drawing review), or disrupted. There are also some instances of added work, such as force account work, where the scope is undefined when the work begins.

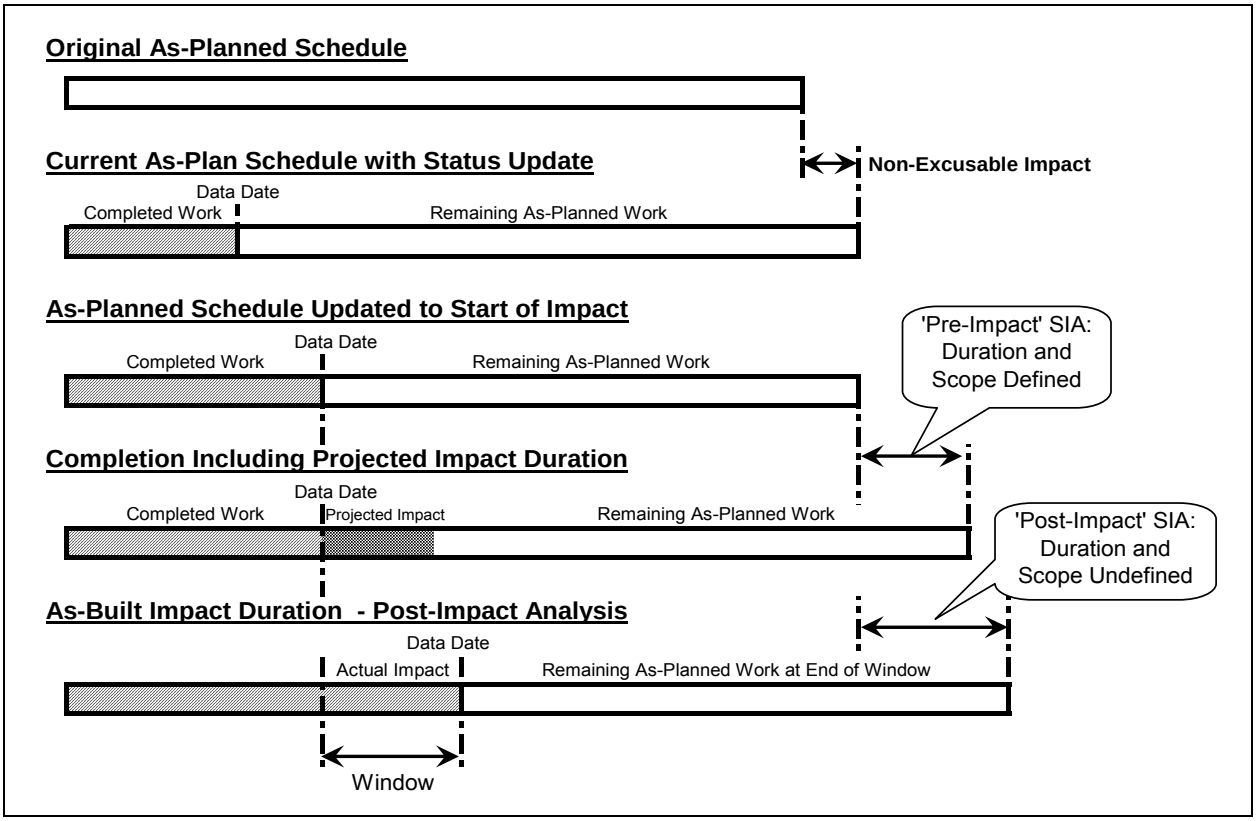


Figure 3.16: Pre-Impact versus Post-Impact SIA Methods

The first advantage of this 'post-impact' method is that the actual duration of the impact and effect on the project schedule is recorded. As long as this analysis is performed immediately after the completion of the impact, the analysis remains a contemporary method and the bias of hindsight is not introduced. Furthermore, post-impact analysis allows the freedom to account for potential concurrent impacts (that may start after the start of the first impact). The disadvantages are that the Contractor has less motivation to work as efficiently as possible and the risk for the work remains with the Department. In addition, failure to grant a time extension immediately after an impact is recognized may effectively force the Contractor into *constructive acceleration*, as the responsible Contractor accelerates to make up the lost time to avoid liquidated damages imposed in the event the extension is not granted. In the case of a traditional work order, this would also necessitate splitting up the time and money into two work orders, which is against policy. The constructive acceleration concern can be addressed by a letter from the Department acknowledging the Contractor's entitlement in the excusable impact, and stating clearly

that a time extension will be granted once the impact is complete and the full scope of the change is known based on these Schedule Impact Analysis techniques.

It is noted that even in situations where post-impact analysis is selected, it is often advantageous to forecast the possible effects of the impact on the project schedule. For instance, forecasting the duration of an impact on a non-critical path can help the analyst know when the impact will become critical, and thereby give a deadline for resolution. This process can also be used in the process of searching for methods of mitigating the impact.

Step 4: Tracking During the Impact

If the post-impact impact analysis is chosen, the event should be tracked during its resolution. The Contractor has the implied responsibility to mitigate the impact, both before and during its occurrence [Bartholomew 2002]. Therefore, the analyst should ensure that the Contractor is actively pursuing resolution in the most efficient manner during any time that will be considered for time extension. Although not able to direct means and methods, the analyst can suggest possible mitigation efforts. It is possible to mitigate part or all of an impact to a project. Figure 3.17 demonstrates what such a recovery might look like. It is noted that although the impact of the event on the schedule has been fully mitigated, the Contractor may still have incurred additional costs. In addition to honest pursuit of resolution and mitigation, the analyst is also looking to see if other impacts are occurring, or if the current impact is affecting activities other than those already identified as being impacted. Finally, daily tracking during an impact allows the analyst to see when a non-critical impact becomes critical and begins delaying the project completion date.

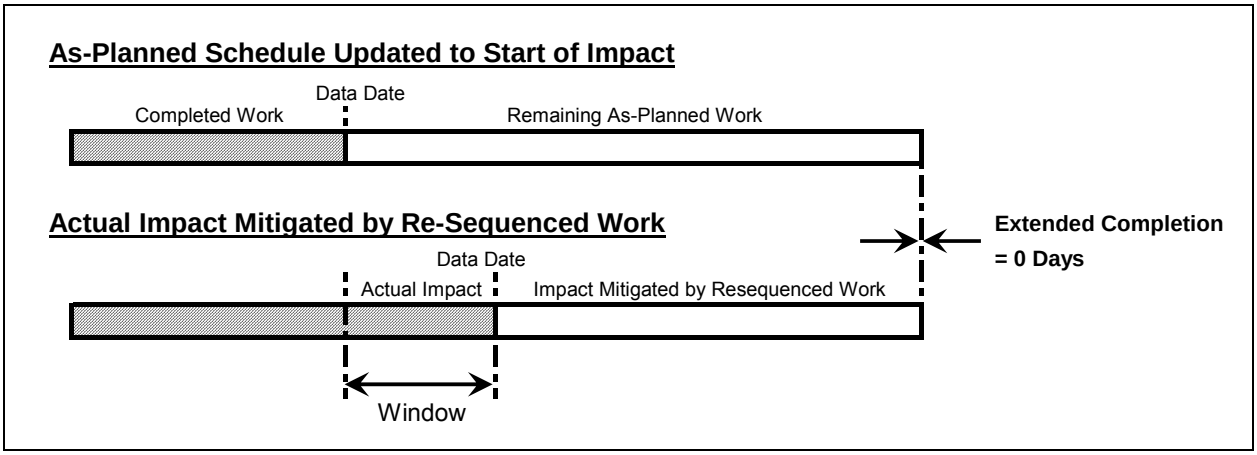


Figure 3.17: Post-Impact SIA Where Impact is Mitigated

Step 5: Determine Schedule Impact and Quantify Extension

Assuming that the post-impact analysis is selected, the analyst tracks the impact until resolution. At this point, the event can be inserted into the CPM schedule as an activity, the project schedule

updated, and the effect on the completion date quantified. The first part of this step is to determine the actual start and actual completion dates of the impact activity. As discussed in Chapter 2, the Contractor's concurrence with these dates is crucial in achieving resolution. The start of the impact is usually simple enough to agree on; however, there is frequently debate over the concluding date of the impact. In this matter, communication and documentation are keys.

Once the durations are obtained, the analyst must update the schedule to the end of the selected window. By updating the schedule first, the analyst can determine if other events have affected the project completion date apart from the noted impact. Next, add the impact activity(ies) into the schedule. Usually, the end of the window corresponds with the completion of the impact. In cases where the impact delays or suspends the start of an operation, the impact activity should be inserted prior to the activity representing that operation, and all the logically related predecessors tied in to the impact. For example, a late shop drawing review delays the start of the 'fabricate/deliver' and/or 'install' activities, and so an activity called 'Late Shop Drawing Review' or 'Shop Drawing Review Delay' would be inserted into the schedule.

In situations where an event delays the completion of an activity, the impact activity should be placed afterwards, and all the logical successor activities tied into the impact activity. An example of this situation is added work. The increased or changed scope occurs after the originally planned work, but must be completed prior to pursuing the next activity. Finally, if an impact occurs in the middle of an activity that delays, disrupts or suspends the work, then it is recommended that the activity be split, and an impact activity inserted in the middle. In this case, the impact activity has the first portion of the original activity as a predecessor and the remainder as a successor. Figure 3.18 demonstrates how each of these scenarios would appear.

The activity number assigned to the impact event should correlate to the activity impacted. Most programs will allow alphanumeric Activity ID's; as such, add the tag 'IMP' or 'DEL' to the same activity number as the operation impacted. If an impact splits an activity, add the tags 'A' and 'B' to the original activity. Figure 3.18 demonstrates this numbering system.

It is noted that occasionally an impact may only affect an activity for part the impact's duration. In these cases, the analyst must be careful to either split up the impact into an activity that affects the follow-on critical activity(ies), and an activity that does not, or use negative lags in the successor relationship to only extend the completion by the duration of critical delay.

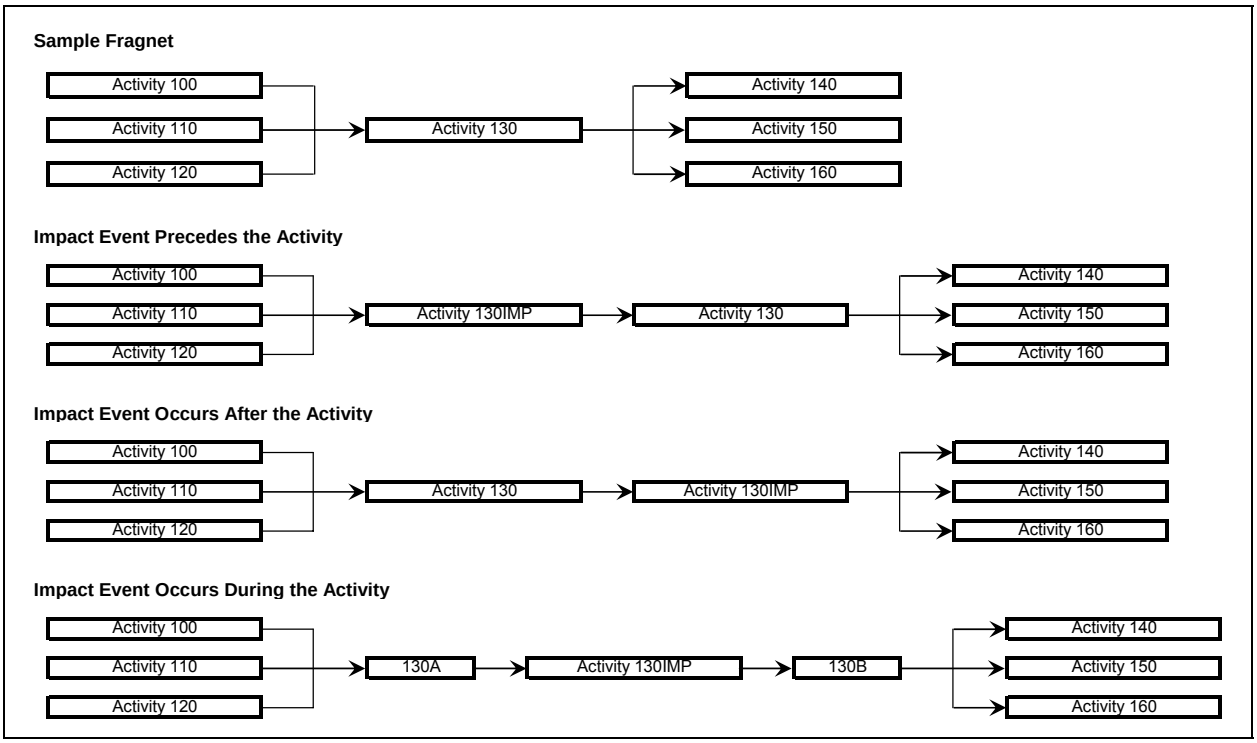


Figure 3.18: Inserting Impact Activities into the Schedule

Example Problem

A sample problem will now be examined to demonstrate the application of these steps.

Step 1: Ensure an Accurate and Current Planned Schedule Exists

The first step is to ensure an accurate as-planned schedule. Assume the following as-planned fragnet taken from the sample Wide River Bridge project discussed previously in the manual (Figure 3.19). The work included represents the completion of Span G of the rehabilitated old bridge, which involves removing the old span superstructure, columns, and abutment, rehabilitating the existing arch, and reinstalling the columns, abutment and superstructure. For the purposes of the example, assume that the start and completion date of the fragnet represent the start (4/29/2002) and completion date (9/11/2002) of the project.

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish
8100	Start Span G	0	0	29APR02	
8110	Remove Parapet - Span G	5d	5d	29APR02	03MAY02
8120	Remove Deck - Span G	15d	15d	06MAY02	24MAY02
8130	Remove Existing Abut B & Wingwalls	8d	8d	28MAY02	06JUN02
8140	Build Abut B & Wingwalls	20d	20d	07JUN02	05JUL02
8150	Place Falsework for Deck -Span G	15d	15d	28MAY02	17JUN02
8160	Remove Columns - Span G	5d	5d	18JUN02	24JUN02
8170	Repair Arch - Span G	10d	10d	25JUN02	09JUL02
8180	Place Columns - Span G	15d	15d	10JUL02	30JUL02
8190	Place Deck - Span G	15d	15d	31JUL02	20AUG02
8200	Groove Bridge Deck - Old Bridge	5d	5d	21AUG02	27AUG02
8210	Install Parapet - Span G	15d	15d	21AUG02	11SEP02
8220	Complete Span G	0	0		11SEP02

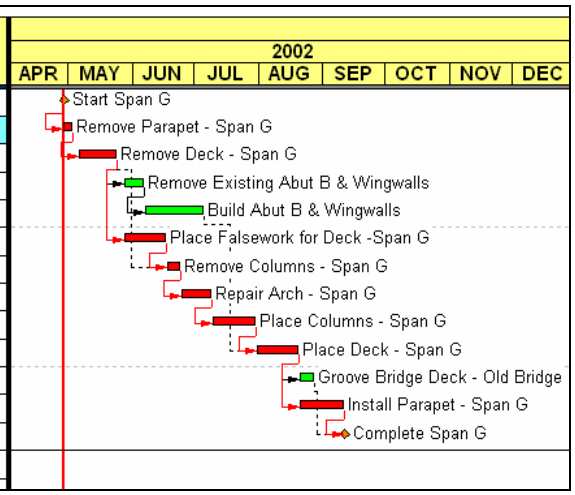


Figure 3.19: Original As-Planned Schedule for Span G

Following the approval of the as-planned schedule, the schedule must be revised if major changes in the plan occur. Figure 3.20 shows Revision 1 to the as-planned fragnet introduced above.

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float
8100	Start Span G	0	0	29APR02		0
8110	Remove Parapet - Span G	5d	5d	29APR02	03MAY02	0
8120	Remove Deck - Span G	15d	15d	06MAY02	24MAY02	0
8130	Remove Existing Abut B & Wingwalls	8d	8d	28MAY02	06JUN02	17d
8140	Build Abut B & Wingwalls	20d	20d	07JUN02	05JUL02	17d
8150	Place Falsework for Deck -Span G	15d	15d	25JUN02	16JUL02	0
8160	Remove Columns - Span G	5d	5d	28MAY02	03JUN02	0
8170	Repair Arch - Span G	10d	10d	04JUN02	17JUN02	5d
8180	Place Columns - Span G	15d	15d	04JUN02	24JUN02	0
8185	Place Transverse Beams	10d	10d	17JUL02	30JUL02	0
8190	Place Deck - Span G	15d	15d	31JUL02	20AUG02	0
8200	Groove Bridge Deck - Old Bridge	5d	5d	21AUG02	27AUG02	10d
8210	Install Parapet - Span G	15d	15d	21AUG02	11SEP02	0
8220	Complete Span G	0	0		11SEP02	0

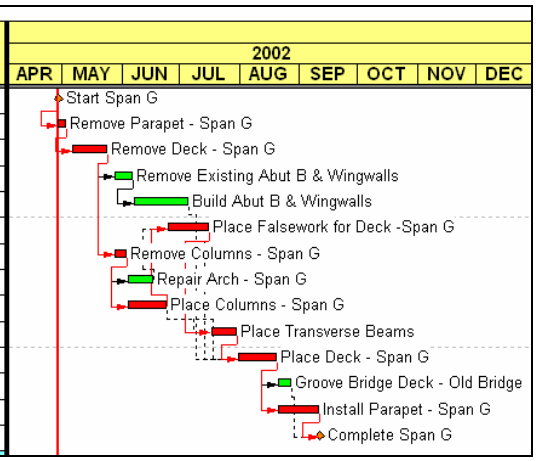


Figure 3.20: As-Planned Schedule for Span G – Revision #1

In this scenario, at some point in the project prior to Span G, the Contractor realized that there were several errors in the As-Planned Schedule, and submitted a revision with the following changes: 1) The Contractor realized that the columns must be removed and replaced prior to installing the deck falsework to avoid obstructions to the work. Logic ties were modified accordingly. 2) After performing work on the previous spans, the Contractor realized that it was most efficient to have a separate crew perform the existing arch repairs. In light of this fact and the change made in #1 above, logic ties were changed to allow this work to occur concurrently with placing the columns. 3) The original as-planned schedule neglected to include an activity for the installation of the transverse beams placed on top of the

existing arch on which the bridge deck rests. Activity 8185 was added to account for this work. Because of the changes made in #1 and #2, this added work did not impact the planned project completion.

The final 'pre-impact' step is to ensure the schedule is regularly updated with as-built project information. In Figure 3.21 below, the project has been statused to reflect activity for the first month of the project. No Owner Responsible Impacts (ORI) have been identified, yet the project is 1 day behind schedule due to the Contractor's failure to meet it's planned production in the removal of the existing bridge deck. There is no discrepancy over the cause of this slippage, and so no impact analysis is required, simply a standard update. Table 3.1 records the impact information. The data date is now June 1, 2002, and all actual progress has been entered up through this date. The Department has reviewed and verified this updated activity from project documentation.

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float
8100	Start Span G	0	0	29APR02		
8110	Remove Parapet - Span G	5d	0	29APR02	03MAY02	
8120	Remove Deck - Span G	15d	0	29APR02	28MAY02	
8130	Remove Existing Abut B & Wingwalls	8d	7d	30MAY02	10JUN02	16d
8140	Build Abut B & Wingwalls	20d	20d	11JUN02	09JUL02	16d
8150	Place Falsework for Deck -Span G	15d	15d	26JUN02	17JUL02	0
8160	Remove Columns - Span G	5d	3d	29MAY02	04JUN02	0
8170	Repair Arch - Span G	10d	10d	05JUN02	18JUN02	5d
8180	Place Columns - Span G	15d	15d	05JUN02	25JUN02	0
8185	Place Transverse Beams	10d	10d	18JUL02	31JUL02	0
8190	Place Deck - Span G	15d	15d	01AUG02	21AUG02	0
8200	Groove Bridge Deck - Old Bridge	5d	5d	22AUG02	28AUG02	10d
8210	Install Parapet - Span G	15d	15d	22AUG02	12SEP02	0
8220	Complete Span G	0	0		12SEP02	0

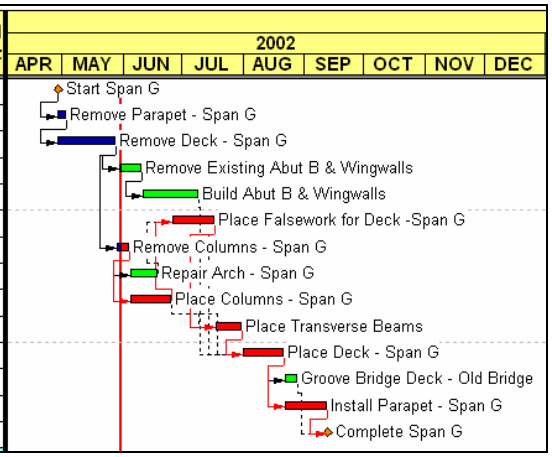


Figure 3.21: Schedule Update with Progress through June 1, 2002

Update No.	Data Date	Completion Date	Schedule Slippage	Impact Classifications		
				N-E / N-C	E / N-C	E / C
Plan	N/A	Sept. 11, 2002	N/A	-	-	-
1	June 1, 2002	Sept. 12, 2002	1	1	0	0
		Impact Totals:	**1**	**1**	**0**	**0**

Table 3.1: Update No. 1 Impact Information

Step 2: Status the Schedule to a Point Immediately Before the Impact

The next step occurs after an impact has been identified, and involves updating the schedule to a point as close as possible to the beginning of the impact. In the sample project, on the morning of June 12, 2002, the Department's Bridge Engineer was reviewing the plan calculations for the Span G columns and discovered an apparent error resulting in the under-design of the column cross sections. The

Contractor was immediately contacted and advised to stop work until the calculations could be checked more thoroughly and direction given. As a result of this impact, the analyst updated the schedule to include all activity completed through June 11th. Although there was a recent update, the analyst was concerned about progress on the Abutment B construction and on the arch repair and so completed an update (Figure 3.22). The completion date of September 12th has not changed from the previous update, shown in Figure 3.21. Table 3.2 tracks the impacts to the schedule.

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float
8100	Start Span G	0	0	29APR02		
8110	Remove Parapet - Span G	5d	0	29APR02	03MAY02	
8120	Remove Deck - Span G	15d	0	29APR02	28MAY02	
8130	Remove Existing Abut B & Wingwalls	8d	0	30MAY02	10JUN02 A	
8140	Build Abut B & Wingwalls	20d	19d	11JUN02 A	09JUL02	16d
8150	Place Falsework for Deck -Span G	15d	15d	26JUN02	17JUL02	0
8160	Remove Columns - Span G	5d	0	29MAY02	04JUN02 A	
8170	Repair Arch - Span G	10d	5d	05JUN02 A	18JUN02	5d
8180	Place Columns - Span G	15d	10d	05JUN02 A	25JUN02	0
8185	Place Transverse Beams	10d	10d	18JUL02	31JUL02	0
8190	Place Deck - Span G	15d	15d	01AUG02	21AUG02	0
8200	Groove Bridge Deck - Old Bridge	5d	5d	22AUG02	28AUG02	10d
8210	Install Parapet - Span G	15d	15d	22AUG02	12SEP02	0
8220	Complete Span G	0	0		12SEP02	0

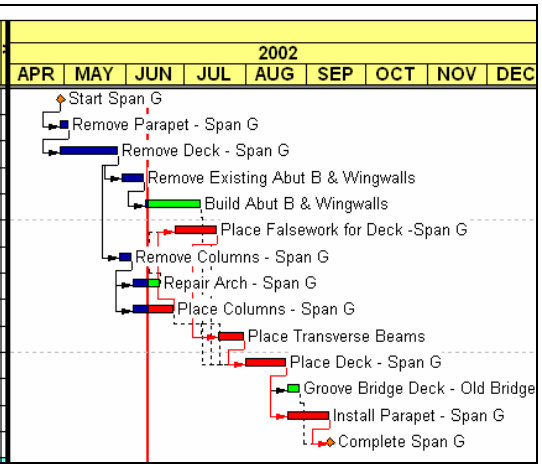


Figure 3.22: Pre-Impact Update with Progress through June 11, 2002

Update No.	Data Date	Completion Date	Schedule Slippage	Impact Classifications		
				N-E / N-C	E / N-C	E / C
Plan	N/A	Sept. 11, 2002	N/A	-	-	-
1	June 1, 2002	Sept. 12, 2002	1	1	0	0
2	June 12, 2002	Sept. 12, 2002	0	0	0	0
		Impact Totals:	**1**	**1**	**0**	**0**

Table 3.2: Update No. 2 Impact Information

Step 3: Determine 'Pre' or 'Post' Impact Analysis as the Basis for Time Extension

Subsequently, the analyst determines whether to base the time extension on an estimated duration of the impact (pre-impact), or on as-built information on the actual duration of the impact (post-impact). In the case of the sample scenario discussed in this section, it is not known how long the additional structural review of the column design will take. Therefore, it is not realistic to estimate the duration of the suspended work, and the post-impact analysis will be selected. However, if the response in the analysis is to increase the column size, thereby reducing production and increasing the time to complete the work (as well as increase the total cost of the work), then a pre-impact analysis would be

performed immediately after this decision was made. The work order generated would cover the time used in making the decision (using the knowledge of the actual duration of suspended work) as well as the estimated additional time to perform the work (plus any associated costs).

Step 4: Tracking During the Impact

The next step is to track the impact while it is ongoing. In the sample problem, the analyst would track location and activity of the crew(s) affected by the column delay. If the crew was able to relocate to the next span and perform critical work, or to assist the second crew and start early on the falsework for Span G, then the impact of the event has been mitigated and this critical time reduction should be taken into account when considering the window to use for the time extension analysis (window selection discussed later in this section).

Step 5: Determine Schedule Impact and Quantify Extension

Now the analyst determines the actual effect on the schedule of a certain impact or impacts. In the sample problem, the suspension of the work on the columns lasts seven calendar days, from June 12, 2002 through June 18, 2002. The response from the review instructs the Contractor to increase the column cross section by 30%. All future columns are to be installed at the new dimensions, while columns completed to date are to be retrofitted. The Contractor responds on June 20th, with a price for the work, and estimates an extra 4 working days to perform the work. The analyst performs the analysis in two steps.

First, as shown in Figure 3.23, the schedule is updated through June 18th, with the as-built dates of all work inserted (minus the impact activity at this point). During this procedure, it was observed that both Activity 8140, Build Abut. B & Wingwalls, and Activity 8170, Repair Arch – Span G, did not perform as planned. Activity 8140 slipped from an anticipated completion of July 9th to an anticipated completion of July 11th. Activity 8170 slipped from an anticipated completion of July 18th to an anticipated completion of July 21st. If either of these activities would have become critical in the absence of the column delay, then there are concurrent critical impacts. The column impact is an excusable/compensable impact, while the production problems are non-excusable/non-compensable impacts. The net result of this type of concurrency would be an excusable/non-compensable impact (see Section 1.4 for further discussion), which would not affect the time extension granted, but would remove entitlement to Contractor damages for the concurrency period.

To perform this check, the schedule is updated to June 19, 2002. For an accurate comparison, the 'Place Column' activity is adjusted so that its pre-impact planned completion date of June 25th remains the same. All other activities are updated with actual progress. As is seen in Figure 3.23, the delay to completing these activities did not make them critical, with 14 days and 2 days of float, respectively. The completion date remains unchanged. Therefore, there is no critical concurrent impact, and the column impact activity can now be added.

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float
8100	Start Span G	0	0	29 APR 02 A		
8110	Remove Parapet - Span G	5d	0	29 APR 02 A	03 MAY 02 A	
8120	Remove Deck - Span G	15d	0	29 APR 02 A	28 MAY 02 A	
8130	Remove Existing Abut B & Wingwalls	8d	0	30 MAY 02 A	10 JUN 02 A	
8140	Build Abut B & Wingwalls	20d	16d	11 JUN 02 A	11 JUL 02	14d
8150	Place Falsework for Deck -Span G	15d	15d	26 JUN 02	17 JUL 02	0
8160	Remove Columns - Span G	5d	0	29 MAY 02 A	04 JUN 02 A	
8170	Repair Arch - Span G	10d	3d	05 JUN 02 A	21 JUN 02	2d
8180	Place Columns - Span G	15d	5d	05 JUN 02 A	25 JUN 02	0
8185	Place Transverse Beams	10d	10d	18 JUL 02	31 JUL 02	0
8190	Place Deck - Span G	15d	15d	01 AUG 02	21 AUG 02	0
8200	Groove Bridge Deck - Old Bridge	5d	5d	22 AUG 02	28 AUG 02	10d
8210	Install Parapet - Span G	15d	15d	22 AUG 02	12 SEP 02	0
8220	Complete Span G	0	0		12 SEP 02	0

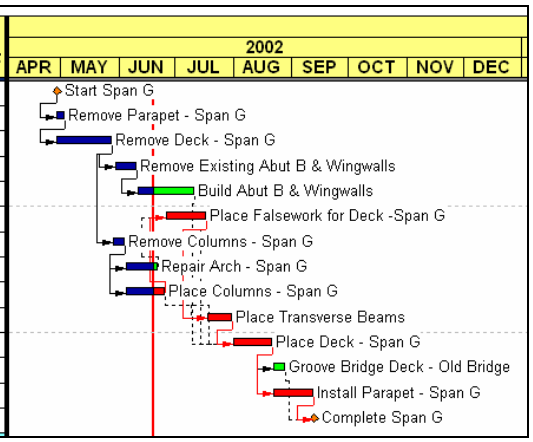


Figure 3.23: Check for Concurrent Critical Activities

Consequently, the analyst now inserts the as-built impact information for the column impact. Because the activity had already started when the impact occurred, Activity 8180 is split into two activities and the impact activity is placed in the middle (Figure 3.24). Second, the analyst inserts Activity 8180WO, (Place Column – W.O. for Retrofit & Change), an impact activity of 4 days to immediately succeed the 'Place Columns' activity. This action completes the analysis and projects the final impact of the event. The schedule completion date becomes September 25, 2002, extended from the current completion date of September 12, 2002 (Figure 3.25). Note that the original completion date of September 11, 2002 is **not** used for this comparison, as the Contractor's own production delays resulted in this original schedule slippage. The updated completion date is compared against the most recent schedule update (shown previously in Figure 3.19), resulting in the proposed 13 day time extension. In this way, both a post-impact (work suspension) and a pre-impact (added work) analysis are used to determine the appropriate time extension for this event. Table 3.3 provides the impact summary to date.

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float
8100	Start Span G	0	0	29 APR 02 A		
8110	Remove Parapet - Span G	5d	0	29 APR 02 A	03 MAY 02 A	
8120	Remove Deck - Span G	15d	0	29 APR 02 A	28 MAY 02 A	
8130	Remove Existing Abut B & Wingwalls	8d	0	30 MAY 02 A	10 JUN 02 A	
8140	Build Abut B & Wingwalls	20d	16d	11 JUN 02 A	11 JUL 02	19d
8150	Place Falsework for Deck -Span G	15d	15d	03 JUL 02	24 JUL 02	0
8160	Remove Columns - Span G	5d	0	29 MAY 02 A	04 JUN 02 A	
8170	Repair Arch - Span G	10d	3d	05 JUN 02 A	21 JUN 02	7d
8185	Place Transverse Beams	10d	10d	25 JUL 02	07 AUG 02	0
8190	Place Deck - Span G	15d	15d	08 AUG 02	28 AUG 02	0
8200	Groove Bridge Deck - Old Bridge	5d	5d	29 AUG 02	05 SEP 02	10d
8210	Install Parapet - Span G	15d	15d	29 AUG 02	19 SEP 02	0
8220	Complete Span G	0	0		19 SEP 02	0
8180A	Place Columns - Span G (Start)	15d	0	05 JUN 02 A	11 JUN 02 A	
8180B	Place Columns - Span G (Complete)	10d	10d	19 JUN 02	02 JUL 02	0
8180DEL	Place Column - Suspension of Work	7d	0	12 JUN 02 A	18 JUN 02 A	

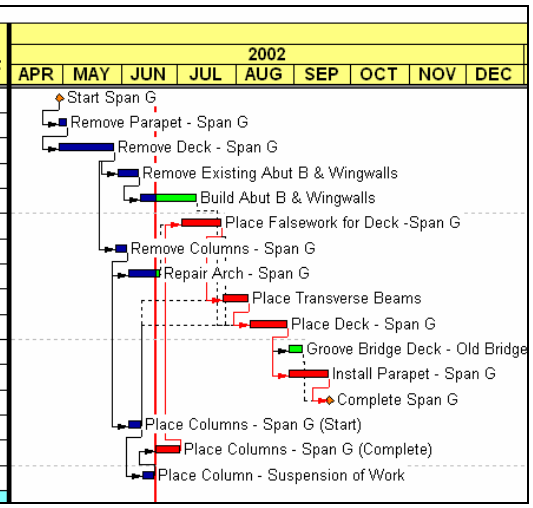


Figure 3.24: As-Built Column Impact Information Inserted Into Schedule

Act ID	Description	Orig Dur	Rem Dur	Early Start	Early Finish	Total Float
8100	Start Span G	0	0	29 APR 02 A		
8110	Remove Parapet - Span G	5d	0	29 APR 02 A	03 MAY 02 A	
8120	Remove Deck - Span G	15d	0	29 APR 02 A	28 MAY 02 A	
8130	Remove Existing Abut B & Wingwalls	8d	0	30 MAY 02 A	10 JUN 02 A	
8140	Build Abut B & Wingwalls	20d	16d	11 JUN 02 A	11 JUL 02	23d
8150	Place Falsework for Deck -Span G	15d	15d	10 JUL 02	30 JUL 02	0
8160	Remove Columns - Span G	5d	0	29 MAY 02 A	04 JUN 02 A	
8170	Repair Arch - Span G	10d	3d	05 JUN 02 A	21 JUN 02	11d
8185	Place Transverse Beams	10d	10d	31 JUL 02	13 AUG 02	0
8190	Place Deck - Span G	15d	15d	14 AUG 02	04 SEP 02	0
8200	Groove Bridge Deck - Old Bridge	5d	5d	05 SEP 02	11 SEP 02	10d
8210	Install Parapet - Span G	15d	15d	05 SEP 02	25 SEP 02	0
8220	Complete Span G	0	0		25 SEP 02	0
8180A	Place Columns - Span G (Start)	15d	0	05 JUN 02 A	11 JUN 02 A	
8180B	Place Columns - Span G (Complete)	10d	10d	19 JUN 02	02 JUL 02	0
8180DEL	Place Column - Suspension of Work	7d	0	12 JUN 02 A	18 JUN 02 A	
8180WO	Place Column - W.O. for Retrofit &	4d	4d	03 JUL 02	09 JUL 02	0

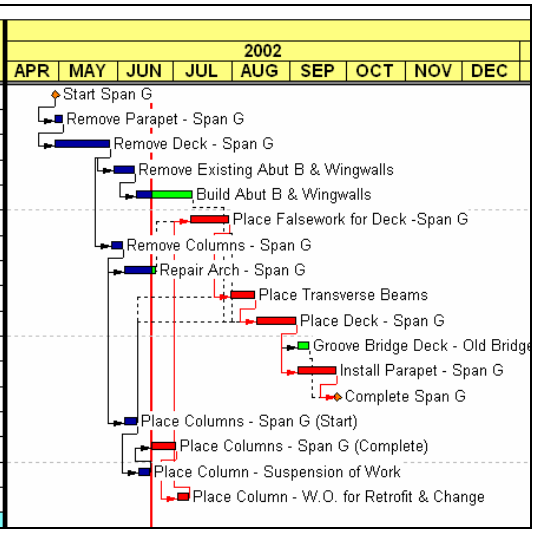


Figure 3.25: Projected Work Order Impact Activity Added for Final Adjusted Completion Date

Update No.	Data Date	Completion Date	Schedule Slippage	Impact Classifications		
				N-E / N-C	E / N-C	E / C
Plan	N/A	Sept. 11, 2002	N/A	-	-	-
1	June 1, 2002	Sept. 12, 2002	1	1	0	0
2	June 12, 2002	Sept. 12, 2002	0	0	0	0
3	June 19, 2002	Sept. 25, 2002	13	0	0	13
		Impact Totals:	**14**	**1**	**0**	**13**

Table 3.3: Update No. 3 Impact Information

Reaching Resolution

The impact analysis has now resulted in a quantified impact to the project schedule, identifying 13 days of excusable delay in the case of the sample project. Two basic choices exist in resolving the matter: 1) grant a time extension for the full 13 days, or 2) pay the contractor to accelerate work to achieve the original completion date. Some combination of these two options may also be selected. The Department normally selects the former and grants a time extension; however, the acceleration option should not be overlooked. In cases of critical projects that have a high impact on the traveling public, and/or otherwise have high administration and carrying expenses, the cost to accelerate may be achieved at a far lower cost than to extend the project. Therefore, exploring this option is recommended.

A second resolution issue worth noting is that impacts do not always result in extending the project completion date. Change can occur that reduces the total amount of work, and therefore

decreases the total time to complete the work. In the same way that the Department has a responsibility to grant a time extension in cases of excusable impacts, the Department has the same responsibility decrease the project time limit if the impact analysis reveals this.

3.2.2 Application Issues

Section 3.2.1 presented a detailed review of a standard impact analysis, which can be used for most situations. However, there are numerous analysis issues that arise during the application of this method that warrant further discussion. The following topics are aimed to resolve special case issues that may be experienced during the analysis.

Errors in As-Planned Durations

Whereas the impact analysis is generally based on the as-built duration of an impacted activity versus the as-planned duration of that activity, the accuracy of the as-planned duration becomes important. For clear-cut impacts that can be clearly identified in terms of total duration, errors in the as-planned are less important because the extension is made solely on the duration of the impact. However, in cases of modified or disrupted work where the discrete impact is difficult to separate from the rest of the planned work and the post-impact analysis is used due to uncertain scope or duration, an as-planned duration that is too short to begin with can inadvertently be included in the excusable delay calculation.

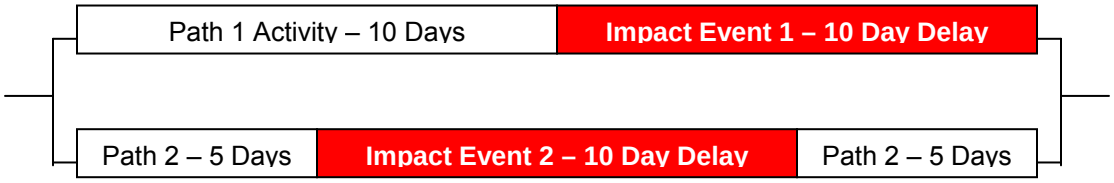
This potential over-extension of time leads to two observations. First, a reasonable, logical and well-reviewed as-planned schedule is critical. Since most Department CPM schedules are not resource loaded, the function of the Narrative and Scheduling Meeting is even more crucial to determine the full scope of the Contractor's plan. Second, this threat stresses the importance of full and complete documentation, especially surrounding all impacts. Detailed documentation will provide the best resource for determining the actual impacts to the project schedule. If there is a question about the as-built duration, a measured mile analysis (see Section 2.3.2 and **Appendix D**) can help determine the contractor's actual production rates and durations are, which can then be compared against what production is achieved during the impact.

For instance, suppose in the sample problem of Section 3.2.1 that it is decided that the duration of the extra work needed for the column retrofit and dimension change (Activity 8180WO) cannot be accurately separated from the planned work itself, and therefore a post-impact analysis is selected. After the completion of placing the columns, the analyst notes that the Contractor required 25 working days to complete the activity, including impact. The planned duration was 15 working days. Records and other documentation do not indicate that the impacted work really required 10 extra working days. The analyst can use the documentation to support what is felt to be the actual time extension, as it is less than the as-built duration of the activity. Furthermore, the analyst can use the actual durations compared to the planned durations on other identical spans of the bridge to support the case that the as-planned duration was too short.

Concurrent Impacts and Window Selection

Concurrent impacts are discussed in Section 1.4.5 of this manual. In cases of post-impact analysis, an issue can arise concerning the selection of the 'window' to use in cases of critical concurrent impacts. With single impacts occurring on a sole critical path, the window is selected to surround the dates of the actual impact as closely as possible. In cases of disruptions, the window may be selected to include the entire activity, and not simply the first and last disruption.

However, a challenge in window selection occurs when concurrent critical impacts occur, particularly since the start and completion of those impacts will rarely coincide – such as the following situation:



A 10-Day concurrent impact has occurred on a project with this dual critical path. Some methods, such as the Army Corps of Engineers technique, would suggest performing window analyses between Days 5 and 10, Days 10 and 15, and Days 15 and 20. This process, however would give 10 days of impact responsibility to the genesis of Impact Event 2, and none to the party responsible for Impact Event 1. In this case, the window should ideally be set from Day 5 through Day 20. Assuming both parties are responsible for one of the delays, the analysis would determine 10 days of concurrent delay. Entitlement would then be determined based on the table in Figure 1.4. If the event durations were not equal, as shown above, while both paths were critical, then the project has been delayed by the amount of the shorter duration. This shorter duration is also the length of the concurrent critical impact.

Usually, however, multiple impacts occurring on parallel paths are not the same duration, or are not critical for their entire duration, such as is shown below:

In this scenario, Impact Event 2 is not critical between Days 5 and 10. The Path 2 impact is non-critical until its float is consumed. Event 2 is concurrently critical with Event 1 between Days 10 and 15, and Event 1 is solely critical between Days 15 and 20. A changing critical path must be tracked and the windows selected accordingly. In these two scenarios, logic used in the But-For technique is useful in determining how to select the windows. In the first scenario, but-for either of the impacts, the other would

still cause a 10-day delay. Therefore, they are fully concurrent and the window should incorporate both impacts. In the second scenario, but-for the second impact event, the first event would have caused a 10-day delay. But-for Event #1, Event #2 would have cause a 5-day delay. Therefore, the critical concurrency only runs for 5 days, and the window can either fully cover both impacts or be split at the point where Event #2 is no longer critical.

Recovery

As has been stated previously, the Contractor has the responsibility to attempt to mitigate and recover when a schedule impact has occurred. Impact recovery can happen via various means, namely: improved production rates, fewer weather impacts than expected, or accelerating or re-sequencing the work [Lehmann 2001]. Typically, there is little that the Owner can do to influence recovery. As such, recovery normally occurs when Contractor actions mitigate an ORI or CRI. If the time extension (and compensation) is agreed upon prior to the work, then the Contractor recovers time at its own cost (financially) and benefit (in time savings).

If the recovery occurs during an impact for which the post-impact technique will be used, then the Owner will share in the time savings, but will likely be responsible for any additional costs. The completion date should not be extended past what is shown on the updated schedule if recovery does occur. If the Contractor is recovering its own impact, then the hastened completion date will act to reduce responsibility for liquidated damages. If the Owner is in some way able to bring about recovery to the schedule, such as by reduced work or modifications to a requirement or specification, then the completion date should be adjusted back as appropriate.

Float Ownership and Management

Float is the amount of time that an activity can be impacted before it becomes critical and begins delaying project completion. Float is a very important issue in impact analysis, as impacts on non-critical paths use up float up until the point they become critical. In general, float is considered a project resource that may be used by whichever party needs it. However, float is an important aspect to the Contractor's flexibility in responding to changes and other risks, and ability to achieve the most efficient use of resources on the project [Householder and Rutland 1990]. Contractors will occasionally claim entitlement for Owner usage of float, raising the importance of Owner exposure to the implications of using float. A recommended article on float management is entitled 'Who Owns Float?" by Jerry Householder and Hulan Rutland, printed in the Journal of Construction Engineering and Management.

Schedule 'Games'

The CPM Schedule can be manipulated to produce different desired results. The concept of the Schedule Impact Analysis is to eliminate all games in order to produce a fair and equitable resolution to impact events that may occur on the project. Nonetheless, it is important for the analyst to understand

some of the potential traps that a CPM submission, usually during the As-Planned submission, may contain which can later damage the resolution process or leave the Owner at greater risk and liability. James Zack in his article entitled “Schedule ‘Games’ People Play, and Some Suggested ‘Remedies’”, printed in the Journal of Management in Engineering, discusses some typical ‘games’ that can be played with the schedule and some suggested remedies to these games [Zack 1992]. This article is suggested ready for further understanding on the subject.

Chapter 4 – Summarization and Reporting of Results

A crucial and often incompletely accomplished task in the impact analysis process is the summarization and reporting of the analysis results. Without this output, the numerous pieces of documentation gathered, methods used, interpretations made, conclusions drawn from the entire contemporaneous picture of the particular issue may be lost over time, or at least require additional time and effort to recreate. The following section will discuss the summarization of the analysis, and identify methods of organizing the report for the specific audience for which it is intended.

4.1 Summarizing the Analysis

The following discusses the general reporting information that should be compiled and summarized regardless of the intended audience of the report (i.e., contractor, internal parties or FHWA). The basic goal should be to take all of the documentation and information generated as a result of the impact and produce a summary that explains the situation and ties all of the various pieces of information together. The summary should describe the cause of the impact, the results of the impact, the methods by which the cause(s) and effect(s) were analyzed, the results of this analysis, and the conclusions drawn by the analyst. The report, consistent with the entire impact analysis, should be a comprehensive and non-prejudiced review of all information surrounding an impact, and an exercise in communicating the key elements of the much broader and in-depth analysis.

The specific information included should very much follow the outline of this manual, including:

- Thoroughly identify the impact, including an explanation for why Schedule Impact Analysis was used (as it relates to the potential for an excusable or compensable impact), as well as the type, cause/responsibility and classification of the impact. In the classification, include a detailed review of associated specifications and the associated rights, responsibilities and risks they assign, as well as how these specifications were interpreted in light of the actual impact. Note any particular manifestations of intent or case history rules relied upon. Summarize the process of utilizing the 2x2 Matrix for Impact Analysis and the classification result. As a part of this identification, summarize the development of the issue, the attempts to resolve and mitigate the issue, and the basis of the position held in the identification.
- Include all pertinent documentation, as defined in Chapter 2. Summarize or attach the documentation; list documentation in a chronology to obtain an overview of the entire impact. The documentation presented should not be one-sided, but represent all positions held on the issue. Incorporate the baseline, revised (if applicable) and updated CPM schedules. In doing so,

it is often helpful to use summary charts or fragnets (pieces of the schedule) that indicate major activities or phases, milestones, and/or activities directly related to the impact. Such summary presentations often communicate the intended information more effectively than a detailed network. [Wickwire et al. 2003] Accompanying the overall time report produced from the schedule analysis, report on the analysis defined in Section 3.2 of this manual for reviewing the Contractor's time extension request. Clearly identify any errors or fallacies in the request, or improper methods of updating the schedule.

- Special analyses or graphics. As discussed in Chapter 2, special analyses or graphics used to combine, correlate or represent data or other documentation that assist in identifying the cause and effect relationship of the impact can greatly enhance the analysis. For example, depending on the particular situation, consider the use of manpower and production curves, as well as charts depicting out of sequence work.
- Conclusions reached. The final piece of the document, and perhaps the most important, is the compilation of the previous portions to present a clear understanding of the conclusion reached. The conclusions should fairly represent and respond to the positions held by all associated parties, and note the specific points of disagreement and/or specific differences in specification interpretation. Note contractor response to the impact: what steps were taken to mitigate the impact, and the diligence and steps in which resolution was pursued.

4.2 Report Organization

Preparing a report that will lead to successful resolution of an impact requires the analyst to be part communicator, part tactician, and part salesman, with the largest part by far being that of communicator. [Wickwire et al 2003] The analyst will likely be preparing the results summary for a variety of different audiences, which will namely include: intra-agency reports to the District Administrator or Central Office Scheduling and Contracts Division, either in the contemporaneous resolution phase or the claim phase; inter-agency reports, such as during discussions with the Federal Highway Administration (FHWA) concerning participation; or, external reports, such as those used with the Contractor during negotiated resolutions. In addition to the general recommendations above, the following will discuss specific recommendations for each of the aforementioned parties.

4.2.1 Intra-Agency Reporting

Intra-agency reporting involves preparing a summary for the decision makers within the agency, whether that be for resolution at the time of the impact, or at some later stage (such as during the claims process). These parties require an executive summary-type report that provides sufficient information to fully understand the issue(s) at hand and intelligently negotiate with the Contractor, but will lose its

usefulness if it is over-detailed. This information, in concert with the general guidelines noted above, can be presented using the following headings:

- **The Claim/Issue:** A statement identifying the project, the claim or issue, and the specific time and compensation requested.
- **Summary:** A brief description of the origin of the claim, the major issues or disagreements and a general chronology of major events in the impact.
- **Detailed Explanation:** An in-detail review of all major facts and dates that occurred between the time of prevailing baseline conditions and the current point in time, in which some perceived change to the baseline conditions has occurred. This section will likely include exhibits identifying key documentation, and may include a documentation chronology. In addition, identify what efforts have been made to date to reach resolution.
- **Baseline Contract:** Defines the baseline contract language and conditions, as well as the interpretation of this specification language and conditions in relation to the impact under consideration.
- **Review of Original Contractor Position:** Reviews the Contractor's original position on the impact and interpretation of the contract documents at the time of the impact given the information submitted contemporaneously. Further identifies the Department's interpretation of the contract documents. If there is a range of possible interpretations, these should all be presented, as well as the resulting affect assuming each interpretation. The review of the Contractor's position should be as impartial as possible, and if the impact, or a portion of the impact, is found to be caused by or the responsibility of the Owner, then this position should be clearly stated. Additionally, the full scope of the impact known at the time should be compared against what the Contractor has submitted to that point.
- **Review of Additional Information Submitted (Current Position):** Often as the Contractor further analyzes the impact, additional information is submitted or discussed. The report should be prepared to discuss how any additional information submitted affects the Department's position as stated in the previous section. The Department's own analysis may lead to revised recommendations from the original stance as well.
- **Recommendations:** A clear and concise quantification and apportionment of the impacts on the basis of the information from the preceding analysis. The Department may feel that the evidence leads very strongly to a certain position, and should state so. However, it is also recommended that other award levels be considered if a different interpretation is considered. If the Contractor's position is fully accepted, is the compensation level claimed justifiable? Especially during the

claim phase, the analyst should provide a range of possible solutions to allow the internal parties know the potential liability and allow some justifiable latitude to negotiate if necessary.

These guidelines will assist in the preparation of an internal report. See **Appendix E** for a sample report prepared by the Responsible Charge for the District Administrator and Scheduling and Contract Division in response to a Contractor Claim.

4.2.2 Inter-Agency Reporting – FHWA Participation

Often, the analyst may be called upon to report on an impact to an outside party, such as a separate government agency or municipality. Specifically, with the increasing dependence on federal funds to build and maintain road and bridge projects, the FHWA is an increasing presence in the approval of changes to the contract on federally participating projects. Whereas failure to obtain participation from FHWA on a time extension or work order granted to resolve an impact results in addition funds being removed from the State construction budget, the importance of fully considering and communicating with this administration has become even more evident.

As such, the analyst must understand the principles of reporting changes and other impacts to the FHWA Area Engineer, and involving him in the resolution phase. Notification should occur at each of the following points during impact resolution:

- At the occurrence of the impact
- With each correspondence that relates directly to the impact or any change that may occur as a result of the impact (by copy)
- At the onset of internal negotiation discussions. At the minimum, the impact should be discussed with the Area Engineer and concurrence sought with the proposed resolution prior to offering to the Contractor. Specific participation percentages should be fully agreed upon prior to generating a work order for the Contractor to sign.
- Due to FOIA regulations, the Area Engineer **should not** be copied on the privileged and confidential report to the DA or Central Office on official claims. However, enough communication should have already occurred with the Area Engineer at this point that he is fully informed of the Department's position.

The more information is regularly and fully communicated to the Area Engineer, the more quickly and completely can he participate in the Department's proposed resolution. There are, however, multiple impacts that FHWA will not participate in. **Appendix F** contains the Code of Federal Regulations (CFR) Title 23 Part 635: Construction and Maintenance, relating to granting time extensions and additional compensation on VDOT projects (23 CFR 635.120), as well as information on processes for other impacts such as claims awards (23 CFR 635.124), terminations (23 CFR 635.125), and force accounts

(23 CFR 635.201). In addition, **Appendix G** contains excerpts from FHWA's ***Contract Administration Core Curriculum Participant's Manual and Reference Guide 2005***, which, in Section III.B, gives guidance in how the FHWA will interpret its CFR's in each situation. In concert, these documents indicate that the FHWA will participate in conditions where:

- A detailed analysis is prepared that justifies the proposed award
- The impact in question is not a non-participating operation or the result of an action that the FHWA does not participate in
- The FHWA was consulted and concurred in the proposed course of action
- All appropriate courses of action had been considered, and
- The Department pursued the case diligently and in a professional manner

Conversely, the analyst can expect that the FHWA will not participate in the following situations:

- In cases where the Department fails to follow its own specifications. Frequent examples include time extensions for weather, non-specified material escalations or adjustments, utility or other third-party conflicts, or other extension not supported by the specifications.
- A detailed and justifiable analysis has not been performed that verifies the costs and time extension granted, or does not show that the event actually impacted the critical path, and therefore, the completion date. In addition, if the impact is considered participating, but the time determination utilizes production rates or resources that are not reasonable for the work being performed, participation can be reduced. Partial participation may also occur if the FHWA determines that the Contractor could have further mitigated the impact, or that the time extension includes non-participating portions (such as weather).
- In cases of obvious or negligent plan error that should have been corrected during the design phase.
- Routine or recurring maintenance, such as snow or graffiti removal, litter pick-up, mowing, vegetation control or routine repair. FHWA may participate in maintenance that is cost effective, such as bridge repair in certain situations.
- If it has been determined that the Department employees, officers, or agents acted with gross negligence, or participated in intentional acts or omissions, fraud, or other acts not consistent with the usual State practices in project design, plan preparation, contract administration, or other activities which gave rise to the claim.
- In cases where consequential or punitive damages, anticipated profit, or any award or payment of attorney's fees is paid by the State to an opposing party in litigation.

To clarify and ensure the maximum participation, the FHWA should be contacted as early and as often as possible, and the same general reporting information provided

4.2.3 External Reporting

The third set of reporting that occurs with each impact analysis is to the Contractor, and has resolution as its goal. Though reporting to the contractor is similar to the other reports mentioned thus far in that the facts surrounding the event, the method of analysis, the results of the analysis, and the quantification and apportionment conclusions from those results should be presented, additional considerations should play into the result. The response to the contractor must be fair and impartial, and convince the contractor that the Department has made effort to fully understand its position and has made a reasonable interpretation of the contract documents. Certain parts of the response were covered in Section 2.3.2 of this manual. Additional, such a report should have the following characteristics:

- An effort to achieve a complete and final resolution that does not leave any part of the impact unaddressed or left for future analysis.
- Consider the positions of all parties from a factual, unemotional standpoint. Demonstrates an understanding of the Contractor's position and clearly states what the perceived issues surrounding the impact are from both parties. Clearly identifies where the points of disagreement lie, quantification of the discrepancy, and why the difference in opinion exists (differing specification interpretation, differing records of actual conditions, etc.).
- In cases where the Department agrees that an Owner responsible impact has occurred, it should openly state this and award the Contractor whatever impacts are reasonably due.
- May contain negotiation offers to attempt to settle disputes. Often initial negotiations are performed verbally in face-to-face meetings, and the agreements are then put into writing. If a negotiated settlement has been reached, the report should contain the terms.
- Prompt. The report should comply with the timeframes identified in CD 2004-1, RBS Section 105.16 - Submission and Disposition of Claims, and other specifications identifying timeframes.
- Identify a schedule for decision-making to reach resolution, as well as an action item list allowing all parties to understand what their responsibilities are for moving the impact towards resolution. Statements should define who will act how and by when.
- Preserves the working relationship. As stated at the beginning of the manual, a major benefits and goal of contemporaneous resolution of issues is the maintaining of the working relationship on the construction site. The report should be written accordingly.

With these concepts in mind, an effective report can be written to the Contractor summarizing the results of the impact analysis.

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Appendices

Appendix A Rights, Responsibilities and Risks in VDOT Specification Section 100

Appendix B Standard Project Documentation

Appendix C Guidelines for Creating Daily Diaries

Appendix D Loss of Productivity / Measured Mile

Appendix E Sample Report to the District Administrator on an Impact

Appendix F Code of Federal Regulations Title 23 Part 635: Construction & Maintenance

Appendix G FHWA Manual for Interpretation & Guidelines for Using the Federal Regulations

Appendix A: Rights, Responsibilities and Risks in VDOT Specification Section 100

Section 100 Responsibilities, Rights, and Risks			
Section	Title	Type	Responsibility, Right or Risk Identified
Contractor Responsibilities			
102.01	Prequalification of Bidders	Contr. Respons.	Prequalify with the Department prior to bidding
102.04	Examination of Site of Work and Proposal	Contr. Respons.	Review site and all contract drawings prior to bidding and fully understand conditions to be encountered in performing the work.
102.04	Examination of Site of Work and Proposal	Contr. Respons.	Review site and all contract drawings prior to bidding and fully understand subsurface conditions to be encountered in performing the work.
102.04	Examination of Site of Work and Proposal	Contr. Respons.	Bring any ambiguous information in the proposal to the attention of the Engineer
102.05	Preparation of Bid	Contr. Respons.	Prepare bid on proposal form, in specified format
102.05	Preparation of Bid	Contr. Respons.	Submit a bid price for at least one design option when multiple options are shown
102.07	Proposal Guaranty	Contr. Respons.	Provide a proposal guarantee for projects > $100k
103.05	Requirements of Contract Bond	Contr. Respons.	Furnish performance and payment bonds within 15 days for projects > $100k
103.06	Contract Documents	Contr. Respons.	Executed Contract submitted by Contractor must include the: Contract, Contract bonds, Progress schedule, liability insurance and other items
103.06	Progress Schedule	Contr. Respons.	Must submit a progress schedule as specified within 30 days after the date specified in the NTP, and prior to the first estimate or payment withheld
103.06	Progress Schedule	Contr. Respons.	Execute the plan shown on the progress schedule unless conditions change
103.06	Progress Schedule	Contr. Respons.	Submit a revised progress schedule if conditions change
103.06	Progress Schedule	Contr. Respons.	Meet with the Engineer every 30 days to discuss planned dates for planned work in the next 30 days
103.06	Liability Insurance	Contr. Respons.	Contractor must provide at own expense throughout the Contract liability insurance as specified.
104.02	Alteration of Quantities or Character of Work	Contr. Respons.	Make any changes to the work required by the Engineer

104.03	Differing Site Conditions	Contr. Respons.	Notify the other party of Subsurface or latent physical conditions encountered at the site that are materially different from the contract indication as soon as discovered.
104.03	Differing Site Conditions	Contr. Respons.	No contract adjustment will be allowed unless written notice is provided
104.04	Maintenance During Construction	Contr. Respons.	Contractor shall maintain work from beginning of construction to final acceptance. Must maintain the previous course or subgrade during all construction operations. Keep portion of the project being used by the public suitable for travel & free from irregularities and obstructions
104.04	Maintenance During Construction	Contr. Respons.	During suspensions, Contractor shall open such portions to traffic as agreed to by Contractor and Engineer
104.04	Maintenance During Construction	Contr. Respons.	Provide Certified Flaggers in sufficient number
104.04	Maintenance During Construction	Contr. Respons.	Unless otherwise approved, maintain 2-way traffic
104.04	Maintenance During Construction	Contr. Respons.	Contractor pay all costs for electrical service and repair and maintenance of the traffic signals for one-way traffic control
104.04	Maintenance During Construction	Contr. Respons.	Maintain connections and public/private entrances reasonably smoothly and have continuous access
104.04	Maintenance During Construction	Contr. Respons.	Follow Engineer directions to stabilize or surface connections or entrances. No additional cost unless included as a pay item
104.04	Maintenance During Construction	Contr. Respons.	Machine the rough grade to a uniform slope from the top edge of the existing pavement to the ditchline when grading more than one day's surfacing at a time
104.04	Maintenance During Construction	Contr. Respons.	Contractor construct, maintain, and remove temporary structures and approaches necessary for use by traffic at no extra cost unless specified.
104.04	Maintenance During Construction	Contr. Respons.	Must select haul routes that minimize disturbance to the community. Will furnish haul route plan to the Engineer for review.
104.05	Removing and Disposing of Structures	Contr. Respons.	Shall remove and dispose of or store, as directed by Engineer, fences, buildings, structures, or encumbrances within construction limits unless included as a separate pay item. Also relocate, protect, store and reinstall traffic signs at no extra cost, unless stated

104.05	Removing and Disposing of Structures	Contr. Respons.	Maintain access to newspaper and mail boxes when relocation necessary, and set in final locations prior to acceptance; cost included in other items
104.06	Cleanup	Contr. Respons.	Contractor must clean up all debris and trash from construction operations continuously throughout the work. Completely clean the highway, borrow pits, quarries, disposal areas, storage areas and all ground occupied by the Contractor in connection with the work before acceptance
104.06	Cleanup	Contr. Respons.	Remove all equipment from the R/W and adjacent property within 30 days after final acceptance
105.02	Plans and Working Drawings	Contr. Respons.	Shall furnish working drawings as required in specified manner, number and format. Falswork supporting bridge superstructure shall be certified by a Professional Engineer
105.02	Plans and Working Drawings	Contr. Respons.	Costs of working drawings responsibility of the Contractor
105.03	Conformity with Plans and Specifications	Contr. Respons.	Values for materials to be used in the work shall be in close conformity with the specified values in the Contract
105.04	Furnishing and Erecting Precast Structures	Contr. Respons.	Requests for approval to use precast structures signed by Profession Engineer with certain requirements
105.05	Coordination of Contract Documents	Contr. Respons.	The Cotnractor shall not take advantage or any apparent error or omission in the plans or specifications, but shall immediately notify the Engineer
105.06	Cooperation of Contractor	Contr. Respons.	Will keep set of plans, specs and contract documents on the project at all times, except for maintenance projects and other specified projects
105.06	Cooperation of Contractor	Contr. Respons.	Contractor will have competent superintendent on site at all times with specified capabilities and authorities
105.07	Cooperation with Regard to Utilities	Contr. Respons.	Shall coordinate project construction with planned utilitiy adjustments and take all necessary precautions to prevent disturbance of the utility facilities. Notify Engineer of any failing of utility owners to cooperate with adjustments
105.07	Cooperation with Regard to Utilities	Contr. Respons.	Perform contract utility work in a manner that will cause the least inconvenience to the utility owner and those being served by the utility. Utilities shall be properly protected by the Contractor to prevent disturbance or damage. If existing utility requiring adjustment is located, Contractor shall not interfere with relocation and protect facility.

105.07	Cooperation with Regard to Utilities	Contr. Respons.	Prior to bid, contact known tuility onwers to determine the extent of the existing, adjusted or new utility facilities. Cost for additional work included in the bid
105.07	Cooperation with Regard to Utilities	Contr. Respons.	Conduct negotiations with utility owners and pay all costs for temporary or permanent adjustments for Contractor benefit
105.07	Cooperation with Regard to Utilities	Contr. Respons.	Responsible for presenting documentation substantiating costs in case of severe utility delay
105.08	Cooperation Among Contractors	Contr. Respons.	The Contractor shall not impede the work or limit access to other contractors working on, near or within the existing contract.
105.08	Cooperation Among Contractors	Contr. Respons.	Contractors working on the same project shall cooperate with each other.
105.08	Cooperation Among Contractors	Contr. Respons.	When working with other contractors, shall establish a written joint schedule of operations based on limitations of individual contracts, submitted within 30 days of award date of latest contract. Plan shall be signed and be binding for each contractor. Modifications must be signed and will be binding
105.08	Cooperation Among Contractors	Contr. Respons.	Assumes all responsibility for any of his work not completed because of the presence or operation of other contractors
105.10	Construction Stakes, Lines and Grades	Contr. Respons.	All surveying necessary outside the listed work, is the responsibility of the Contractor personnel who are experienced in highway construction
105.10	Construction Stakes, Lines and Grades	Contr. Respons.	Shall: preserve Department furnished controls and references; provide additoinal surveying as necessary, furnish to the Engineer a copy of all alignment established by the Contractor
105.10	Construction Stakes, Lines and Grades	Contr. Respons.	If original DTM's or cross sections differ from field conditions, the Contractor is responsible for proving to the Engineer
105.10	Construction Stakes, Lines and Grades	Contr. Respons.	Contractor shall: stake box culverts or culverts with openings larger than 48", stake all bridges, set points for right-of-way monuments, and submit all information to the Engineer, and request payment for construction surveying in writing
105.12	Inspection of Work	Contr. Respons.	Contractor shall keep the Engineer informed of planned operations per 103.06(e)

105.12	Inspection of Work	Contr. Respons.	If work performed without an inspector, cost to remove and replace the work or material done at Contractor expense, unless reasonalbe notice in writing was given prior to the operation
105.12	Inspection of Work	Contr. Respons.	If error or defective work found, the cost and time of correcting such work responsibility of the Contractor
105.13	Removal of Unacceptable and Unauthorized Work	Contr. Respons.	The Contractor is responsible for removing/correcting unacceptable work immediately at its own expense
105.14	Size and Weight Limitations	Contr. Respons.	Contractor shall comply with legal size and weight limitations in hauling unless covered by permit for public roads open or closed to traffic. Contractor will pay for any damage for roads closed to traffic
105.15	Acceptance	Contr. Respons.	The Contractor must request a final acceptance inspection in writing
105.15	Acceptance	Contr. Respons.	Any deficiencies found in the final inspection must be corrected prior to final acceptance, and will notify Contractor within 5 days
105.16	Submission and Disposition of Claims	Contr. Respons.	Notify the Engineer in writing describing any act of omission or commission by the Department or it agents that allegedly caused damage to the Contractor and the nature of the claimed damage
105.16	Submission and Disposition of Claims	Contr. Respons.	Immediately take written exception to any order from the Engineer that the Contractor feels will cause damage.
105.16	Submission and Disposition of Claims	Contr. Respons.	Failure to submit written notice of intent to file claim shall be conclusive waiver to such claim for damages by the Contractor.
105.16	Submission and Disposition of Claims	Contr. Respons.	Shall furnish Engineer with itemized list of materials, equipment and labor for which additional compensation will be claimed, and shall afford the Engineer every facility for keeping an actual cost record of the work. Will compare records and come into agreement at the end of each day
106.01	Source of Supply and Quality Requirements	Contr. Respons.	Contractor shall regulate his supplies so that there will be a sufficient quantity of tested material on hand at all times to prevent delay of work
106.01	Source of Supply and Quality Requirements	Contr. Respons.	Contractor must submit a Source of Materials within the time limits and according to the requirements specified. Failed tests will result in the requirement for a new source
106.01	Source of Supply and Quality Requirements	Contr. Respons.	When optional materials are included in the Contract, the Contractor shall advise the Engineer in writing of the specific materials selected.

106.01	Source of Supply and Quality Requirements	Contr. Respons.	Contractor shall give equipment and material guaranties or warranties. Will also provide an inservice operation guaranty for at least 6 months after final acceptance for all mechanical and electrical equipment and related components.
106.02	Material Inspection	Contr. Respons.	Contractor shall advise Engineer at least 2 weeks prior to the delivery of any material from a commercial source, and provide the Engineer with a copy of all invoices.
Contractor Rights			
102.10	Withdrawal of Bid	Contractor Right	A bidder can withdraw a bid if done at least one hour before bid opening, or by filling out a Conditional Withdrawal form
103.02	Award of Contract	Contractor Right	Can withdraw bid without penalty if the State does not award the project within 60 days of bid opening
103.05	Requirements of Contract Bond	Contractor Right	Request to have bond reduced during the establishment period on projects with plantings
104.02	Alteration of Quantities or Character of Work	Contractor Right	Contractor can request an adjustment, excluding anticipated profit, for the extra/changed work required by the Engineer
104.02	Alteration of Quantities or Character of Work	Contractor Right	The Contractor may submit a written Value Engineering Proposal and equally share the net savings to the Department
104.04	Maintenance During Construction	Contractor Right	After permanent structures in place, temporary structures to carry traffic become property of the Contractor
105.02	Plans and Working Drawings	Contractor Right	May authorize the fabricator in writing to act for him in matters relating to tworking drawings
105.03	Conformity with Plans and Specifications	Contractor Right	Contractor may deviate from the values by the specified tolerances
105.04	Furnishing and Erecting Precast Structures	Contractor Right	Precast units for standard drainage units and minor structures will be allowed. Can replace the precast unit with a cast-in-place unit at own expense
105.08	Cooperation Among Contractors	Contractor Right	Seek extension of time when failure to gain access to the work is not due to any fault or negligence of the Contractor
105.09	Holidays	Contractor Right	The Contractor has the right to request to work on Sundays and the holidays noted
105.15	Acceptance	Contractor Right	If portion of work complete, Contractor may ask the Enginer to make final inspection of such work

105.16	Submission and Disposition of Claims	Contractor Right	Within 60 days after the payment of the final estimate, the Contractor may submit a claim to the Department setting forth the facts upon which the claim is based
105.16	Submission and Disposition of Claims	Contractor Right	If the Contractor is not satisfied with the response of the Construction Engineer, he may notify in writing within 30 days of the Department's letter and request a meeting with the Commissioner.
106.01	Source of Supply and Quality Requirements	Contractor Right	Contractor may select any of the options for pipe type provide for by the Contract
Contractor Risks			
102.01	Prequalification of Bidders	Contractor Risk	Liability for joint venture bidding will be split equally unless otherwise specified
102.03	Interpretation of Quantities in Proposal	Contractor Risk	Quantities in the proposal are approximate only, and are subject to actual field conditions and change.
102.04	Examination of Site of Work and Proposal	Contractor Risk	Failure to account for what may become an ‘obvious’ condition of the work prior to bidding
102.04	Examination of Site of Work and Proposal	Contractor Risk	Subsurface data represented in the logs and contract documents may not be accurate – bidder must make own interpretation
102.04	Examination of Site of Work and Proposal	Contractor Risk	Failure to bring any ambiguity in contract documents to Department’s attention waives right to Contractor’s own interpretation of ambiguity
103.06	Progress Schedule	Contractor Risk	Department's review and acceptance does not relieve the Contractor of responsibility to complete the work within the time limit
103.08	Railure to Furnish Bonds or Certificate of Insurance	Contractor Risk	Failure to furnish bonds or insurance within 15 days could mean loss of award - will be found in Default
104.02	Alteration of Quantities or Character of Work	Contractor Risk	Will be required to perform any changes that the Engineer makes
104.04	Maintenance During Construction	Contractor Risk	Contractor shall bear all costs of performing maintenance work before final acceptance
104.06	Cleanup	Contractor Risk	Contractor must clean up all debris and trash from construction operations continuously throughout the work. Completely clean the highway, borrow pits, quarries, disposal areas, storage areas and all ground occupied by the Contractor in connection with the work before acceptance
105.02	Plans and Working Drawings	Contractor Risk	If working drawings not returned in specified time limit, no additional compensation will be allowed, other than extension of time

105.07	Cooperation with Regard to Utilities	Contractor Risk	New locations of utilities will not normally be shown on the plans. Some utilities may remain or be adjusted within the construction limits simultaneously with project construction operations
105.07	Cooperation with Regard to Utilities	Contractor Risk	Department not responsible for any claims for additional compesnation form Contractor resutling from delays, incovnenience, or damage sustained by him attributable to interference by utility appurtenances, or the operaiton of moving the same, other than a consideration of an extension of time
105.08	Cooperation Among Contractors	Contractor Risk	Each contractor shall assume all liability, financial or otherwise, in connection with his Contract and shall save the State harmless from any and all damages and claims that may arise.
105.08	Cooperation Among Contractors	Contractor Risk	Except for extension of time, Department no responsible for any inconvenience, delay, or loss experienced by a Contractor as a result of his failure to gain access to the work at the time contemplated.
105.08	Cooperation Among Contractors	Contractor Risk	The Department will not assume any responsibility for acts, failures, or omissions of one contractor that delay the work of another except as provided by the specifications.
105.10	Construction Stakes, Lines and Grades	Contractor Risk	Contractor will bear all cost to correct all deficiencies resulting from defective survey work
105.10	Construction Stakes, Lines and Grades	Contractor Risk	Earthwork payment made based on original location DTM or cross sections unless the DTM or sections differ from existing conditions
105.12	Inspection of Work	Contractor Risk	If portions of work uncovered at Engineer request are unacceptable, the uncovering, removing and replacing and making good will be paid for by the Contractor
Owner Responsibilities			
102.02	Content of Proposal	Owner Respons.	Upon request, will furnish a proposal to any interested party
102.12	Public Opening of Bids	Owner Respons.	Bids must be opened and read publicly at the time specified as the Bid Opening
103.02	Award of Contract	Owner Respons.	Contract will be awarded to the lowest responsive bidder without discrimination
103.02	Award of Contract	Owner Respons.	The award date will not be later than midnight on the 60th day after the opening of bids
103.04	Return of Proposal Guaranty	Owner Respons.	Must return all proposal guarantees immediately, except for 2 lowest bidders - within 5 days

103.06	Progress Schedule	Owner Respons.	Coordinate and hold a conference to discuss the plan of operations
104.02	Alteration of Quantities or Character of Work	Owner Respons.	Compensate the Contractor, excluding anticipated profits, for changes made at Engineer's directino
104.02	Alteration of Quantities or Character of Work	Owner Respons.	The Owner must review a VEP submitted by the Contractor in the same manner as prescribed for any other proposal leading to a work order
104.03	Differing Site Conditions	Owner Respons.	Notify the other party of Subsurface or latent physical conditions encountered at the site that are materially different from the contract indication as soon as discovered.
104.03	Differing Site Conditions	Owner Respons.	Investigate the differing site condition once identified. If a DSC is determined to have occurred, the State will compensate for the cost and extra time resulting from the change. Owner must notify the Contractor of the determination
104.04	Maintenance During Construction	Owner Respons.	Where deemed appropriate by the Department, the Department will install traffic signals to control one-way traffic
105.01	Authority of Engineer	Owner Respons.	Engineer will answer all questions that may arise as to the quantity, quality, and acceptability of materials furnished and work performed, rate of progress, interpretation of plans and specifications, acceptable fulfillment of the Contract by the Contractor, disputes and rights between contractors, and compensation.
105.02	Plans and Working Drawings	Owner Respons.	Provide a plan of sufficient detail necessary to give a comprehensive understanding of the work specified
105.02	Plans and Working Drawings	Owner Respons.	The owner will review and return working drawings with 30 days, or 45 days if another entity is involved in the review
105.05	Coordination of Contract Documents	Owner Respons.	The Engineer will make corrections and interpretations as necessary when errors or omissions are discovered.
105.06	Cooperation of Contractor	Owner Respons.	Owner will provide specified number of plans, specs, and revisions to Contractor
105.07	Cooperation with Regard to Utilities	Owner Respons.	Existing utilities at the design stage will be indicated on the plans. Department will make preliminary arrangements for adjusting utilities prior to construction
105.08	Cooperation Among Contractors	Owner Respons.	Engineer must review and approve joint plan of operations between multiple contractors, and must take part in the conference

105.08	Cooperation Among Contractors	Owner Respons.	If contractors cannot agree to a joint schedule of operations, must review individual plans of operation and prepare a schedule that will be binding on each contractor
105.10	Construction Stakes, Lines and Grades	Owner Respons.	Will respond to Contractor notice of survey discrepancy, and provide direction on how to proceed
105.12	Inspection of Work	Owner Respons.	Engineer will meet with Contractor prior to operations to establish which operations shall be performed in presence of inspector.
105.12	Inspection of Work	Owner Respons.	If portions of work uncovered at Engineer request are acceptable, the uncovering, removing and replacing and making good will be paid for
105.13	Removal of Unacceptable and Unauthorized Work	Owner Respons.	If granted uthorization to perform destructive sampling, Engineer must approve the method and location of each test prior to beginning, and testing must be done in presence of the Engineer
105.15	Acceptance	Owner Respons.	If all work is complete following Contractor request for final inspection, the Owner will make final acceptance
105.15	Acceptance	Owner Respons.	After any corrections are made following the final inspection, additional inspections will be made for acceptance, and will notify Contractor within 5 days.
105.16	Submission and Disposition of Claims	Owner Respons.	Must meet with the Contractor daily to agree with records at the end of each day
105.16	Submission and Disposition of Claims	Owner Respons.	Within 90 days from receipt of the claim, the Department will investigate the claim and notify the Contractor by mail of its decisions. This may be extended 30 days by mutual agreement
105.16	Submission and Disposition of Claims	Owner Respons.	The Commissioner will schedule a meeting with a dissatisfied Contractor within 30 days (or within 60 days if necessary) to discuss. The Commissioner must respond within 45 days after the meeting, which may be extended to 75 if mutually agreeable.
Owner Rights			
102.01	Prequalification of Bidders	Owner Right	Prequalify all prospective bidders
102.01	Prequalification of Bidders	Owner Right	Impose sanctions on bidders failing to comply with this section
102.06	Irregular Bids	Owner Right	Can throw out bids if they appear irregular, per guidelines specified

102.07	Proposal Guaranty	Owner Right	Require a proposal guarantee for projects > $100k
102.08	Disqualification of Bidder	Owner Right	Can disqualify a bidder for any of the specified reasons
102.09	Delivery of Bid	Owner Right	Can refuse to open a bid if not delivered in time
102.11	Combination or Condition Proposals	Owner Right	The Department can award projects separately or in combination as it pleases
102.13	Material Guaranty	Owner Right	Can require a complete statement of materials to be used on the project before awarding the project
102.14	Use of Debarred Suppliers	Owner Right	Will reject material from any debarred suppliers
103.01	Consideration of Bids	Owner Right	Can reject any or all bids, waive technicalities, advertise for new bids, or proceed to do the work if in the best interest of the State
103.03	Cancellation of Award	Owner Right	Board may cancel the award of any contract at any time before execution without liability
103.05	Requirements of Contract Bond	Owner Right	Require performance and payment bonds within 15 days for projects > $100k
103.05	Requirements of Contract Bond	Owner Right	Reject unqualified bidders (as specified) for projects <$100k
103.06	Progress Schedule	Owner Right	Review the Contractor's progress schedule
103.06	Progress Schedule	Owner Right	Contractor delays in submitting progress schedule will not result in a time extension or additional compensation
103.08	Railure to Furnish Bonds or Certificate of Insurance	Owner Right	Failure to furnish bonds or insurance within 15 days gives right to cancel award
104.02	Alteration of Quantities or Character of Work	Owner Right	Right to make changes in quantities and alterations in the work at any time.
104.02	Alteration of Quantities or Character of Work	Owner Right	Determine what additional compensation is fair and equitable for extra/changed work, including performing the work under Force Account
104.02	Alteration of Quantities or Character of Work	Owner Right	The Owner may include any conditions it feels is necessary for approval in the VEP prior to approving
104.02	Alteration of Quantities or Character of Work	Owner Right	The Engineer is the sole judge of the acceptability of a VEP. The Owner has no obligation to consider or approve any VEP
104.02	Alteration of Quantities or Character of Work	Owner Right	The Owner can use all or part of an accepted VEP without obligation or compensation of any kind to the Contractor

104.03	Differing Site Conditions	Owner Right	No contract adjustment will be allowed unless written notice is provided, or for any effects caused on unchanged work
104.04	Maintenance During Construction	Owner Right	Direct Contractor to stabilize or surface connections or entrances. No additional cost unless included as a pay item
104.04	Maintenance During Construction	Owner Right	If Contractor fails to maintain roadway, Owner can perform maintenance with own forces and charge Contractor
104.04	Maintenance During Construction	Owner Right	Review and approve Contractor's haul route plan, or select alternate haul routes or impose restrictions to minimize the impact to local residents
104.06	Cleanup	Owner Right	Department has right to require clean, neat and orderly work site
105.01	Authority of Engineer	Owner Right	Has the authority to suspend the work wholly or in part for safety reasons, for Contractor failure to carry out the provisions of the Contract, for periods of unsuitable weather or other condition unsuitable for prosecution of the work
105.02	Plans and Working Drawings	Owner Right	Owner has the right to require certain information on the working drawing submittals
105.02	Plans and Working Drawings	Owner Right	If working drawings require more than 2 revisions, the Onwer can charge the Contractor for reviews
105.03	Conformity with Plans and Specifications	Owner Right	Engineer may authorize less than complete conformity in material values
105.04	Furnishing and Erecting Precast Structures	Owner Right	Use of precast units is permissive only. Engineer may approve modifications to the units
105.07	Cooperation with Regard to Utilities	Owner Right	If utility delay of such magnitude that it significantly increases Contractor's cost, the Engineer may consider additional compensation for actual costs - at the sole discretion of the Engineer, and nothing requires acceptance
105.08	Cooperation Among Contractors	Owner Right	Owner may contract or approve concurrent contracts for performing other work on, near or within the area of the project work in the existing contract.
105.08	Cooperation Among Contractors	Owner Right	Engineer shall act as referee in case of disputing contractors working on same site, and his decisions are binding on all parties
105.08	Cooperation Among Contractors	Owner Right	Engineer may allow modifications to joint plan of operations schedule when benefit to the contractors and Department will result.
105.09	Holidays	Owner Right	Engineer has right to grant or deny permission to work on the noted holidays or Sundays

105.10	Construction Stakes, Lines and Grades	Owner Right	Engineer approves electronic submissions of Contractor survey information if submitted in that format
105.10	Construction Stakes, Lines and Grades	Owner Right	Engineer verifies any differences in original DTM's or cross sections submitted by the Contractor
105.11	Authority and Duties of Inspector	Owner Right	Inspectors authorized to inspect all work and materials, reject defective work and materials, suspend work imporperly performed (with Engineer concurrence); may not wiave provisions, make changes in the plans, accept the project, approve any operation or item, or act as a Contractor's foreman.
105.11	Authority and Duties of Inspector	Owner Right	Engineer may delegate authority to the Inspector
105.12	Inspection of Work	Owner Right	May inspect all stages, materials and details of the work. Engineer shall have access to all parts of the work, and be provided such information and assistnace by the Contractor as are required to make a complete and detailed inspection (including machines and plant equipment)
105.12	Inspection of Work	Owner Right	Upon Engineer request, Contractor shall remove/uncover portions of finished work at any time before final acceptance.
105.13	Removal of Unacceptable and Unauthorized Work	Owner Right	Work performed contrary to the instructions of the Engineer or beyond the lines shown or designated by the Engineer will be removed or replaced at the Contractor's expense
105.13	Removal of Unacceptable and Unauthorized Work	Owner Right	If Contractor fails to comply with Engineer order, will have authority to cause unacceptable/unauthorized work to be removed and replaced and to deduct the cost from money due the Contractor
105.15	Acceptance	Owner Right	Upon Contractor request, the Engineer may make partial final acceptance if all work in that portion is complete and is in the interest of the public
105.16	Submission and Disposition of Claims	Owner Right	If the Contractor's claim cantains data furnished by the Contractor that cannot be verified by theDepartment's records, the data shall be subject to a complete audit by the Department if it is to be used as a basis for payment
105.16	Submission and Disposition of Claims	Owner Right	The Commissioner has the authority to negotiate a settlement to the claim if it is valid according to the provisions in Section 2.1-127 of the Code of Virginia
106.01	Source of Supply and Quality Requirements	Owner Right	At the option of the Engineer, materials may be approved at the source of supply.

Owner Risks			
104.02	Alteration of Quantities or Character of Work	Owner Risk	The Owner will bear the reasonable costs of reviewing the Contractor's VEP
104.03	Differing Site Conditions	Owner Risk	Owner responsible for paying for any actual differing site conditions encountered
105.15	Acceptance	Owner Risk	If Engineer accepts a unit or portion of the work, and it is damaged for reasons beyond the control of the Contractor, then any necessary repairs will be paid for by the Department

Appendix B: Standard Project Documentation

Documentation kept on a daily basis:

- Daily Diaries
- Daily Reports
- Progress Photographs
- Test Reports
- Purchase Orders
- Delivery Tickets and Invoices
- Weather Data
- Requests for Information
- Cross Sections and Other Records of Work Performed
- Payment Measurements
- Sketches and Calculations
- Logs for recording project information

Documentation kept on a weekly or semi-regular basis:

- Schedules and Updates
- Weekly Reports
- General Correspondence
- Memoranda for Record
- Payroll Records
- Job Cost Reports
- Equipment Utilization Records
- Change Order Information
- Shop Drawings
- Payment Transactions
- Letters of Transmittal or Submittal
- Notice of Intents to File Claim, Acceleration, or Differing Site Conditions
- Request for Time Extension
- Letters disputing instructions or interpretations, or proceeding under protest
- Confirmations of Instructions or Agreements
- Meeting Minutes
- Force Account Time and Material Records

Documentation occurring once or on an irregular basis:

- The Contract and Contract Documents
- Change Orders and Proposed Change Orders
- Cost Estimates
- Labor Wage Agreements
- Contractual Notices

Appendix C: Guidelines for Creating Daily Diaries

Wickwire et al [2003] recommends the following guidelines for creating daily reports and diaries to maximize their value in impact analysis:

1. Brief and specific information about each work activity that occurred on the project, including the Contractor performing the work, crew size, equipment used, materials received and used, and location. Specifically note if it is the beginning or end of an activity
2. Note any field checks of measurements, dimensions or specifications
3. Types of equipment used, specifically noting idle equipment and reasons for idle equipment
4. Verbal or written instructions given to the Contractor
5. Changes in the scope of the work, both the instruction to do so and the actual performance
6. Meetings, conversations, phone calls, and e-mails on specific issues, problems or field conditions
7. Discovery of problems on on-going problems, especially when any work is occurring surrounding the problem
8. Weather conditions, including temperature, precipitation, and any affects of past weather. Recording should occur twice a day.
9. Significant milestones reached
10. Materials or equipment delivered to the site
11. Passing and failing inspections, corrective actions advised and initiated
12. On-site testing by others
13. Visitors to the job site
14. Notices of non-conforming materials or work and the resulting actions
15. Safety meetings, communications, and violations
16. Any accidents that occur on site
17. Quantities of work put in place, complete and paid or otherwise
18. Other remarks concerning performance and control of construction activities
19. Follow up on previous deficient activities and the corrective actions taken
20. Contractor and subcontractor manpower and other resources

Appendix D: Loss of Productivity / Measured Mile Examples

VDOT Project
Summary of Daily Hauling Production Rates By Vehicle

Haulpak 210M (50 Ton Dump Truck)					
		Production Rate Per Drill Pattern (Per Day)			Average Production Rate
Hauling Location	Total Hauled	7' x 7'	10' x 10'	12' x 12'	
Hauling from Subdrill Issue Areas					
Relocated Railroad Cut to Disposal Site 'D'	36,919 Cu. M.	N/A	604.2 Cu. M.	680.2 Cu. M.	677.2 Cu. M.
	(Quantity Represented):		(8,733.6 Cu. M.)	(28,185.6 Cu. M.)	(Represents 36,919 Cu. M.)
Relocated Railroad Cut to Route 29 Business Fill	105,504 Cu. M.	887.2 Cu. M.	671.6 Cu. M.	641.1 Cu. M.	680.9 Cu. M.
	(Quantity Represented):	(21,292.8 Cu. M.)	(41,721.6 Cu. M.)	(42,489.6 Cu. M.)	(Represents 105,504 Cu. M.)
Hauling from Non-Subdrill Issue Areas					
Wideville Bypass Cut to Disposal Site 'D'	32,122 Cu. M.				740.9 Cu. M.
Ramp B/Loop B Cut to Route 29 Bus./Disp Site D	26,278 Cu. M.				688.1 Cu. M.

Potential Production Impact

Measured Mile Analysis

NOTE: 'Measured Mile' comparison references the Wideville Bypass Cut to Waste in Disposal Site 'D'. Sub-drill depth in this area was whatever the Contractor elected. Ramp B/Loop B cut to Disposal Site 'D' haul noted above would also be a reasonable comparison.

Haulpak 210M Production Rates:

Relocated Railroad Cut (10' x 10' drill pattern)	671.6 Cu. M.	Per Vehicle Per Day
Relocated Railroad Cut (12' x 12' drill pattern)	641.1 Cu. M.	Per Vehicle Per Day
Route 29 Bypass Cut to Disposal Site 'D'	740.9 Cu. M.	Per Vehicle Per Day

	10' x 10' pattern	12' x 12' pattern	
Decreased Production:	9.36%	13.48%	10'x10' Pattern: (740.9 - 671.6)/740.9 = 9.36% 12'x12' Pattern: (740.9 - 641.1)/740.9 = 13.48%
Total Rock Blasted in Each Area			
Based on Contractor Load Counts	55,395 Cu. M.	102,214 Cu. M.	* total quantity from load counts includes overburden material
Added Cost Due to Lost Production:			
Based on Contractor Load Counts	$12,964.36	$34,445.96	

Total Potential Impact:	**$47,410.32**

Notes and Considerations:

* Contractor claimed that 261,364 Cu. M. of material was affected by this issue. However, this number includes overburden, subdrill and slope material that was not removed (or not rock). Totals shown above are from Contractor's load counts and generally concur with the total quantity of rock determined using the drilling logs to locate actual rock elevations and compute a rock volume from the plan cross sections.

VDOT Project
3' Sub-Drill Issue
Quantity of Rock Impacted

	STATION	Top of Rock Elev.	Subgrade Elev.	Length	3' Rock Area	3' Rock Volume	Total Rock Area	Total Rock Volume
12' x 12' Drill Pattern	2442+20	204.300	204.532		2.40		2.40	
				20.0 m		227.0		272.0
	2442+40	204.900	204.788		20.30		24.80	
				20.0 m		406.0		924.0
	2442+60	207.950	205.043		20.30		67.60	
				20.0 m		406.0		2416.0
	2442+80	211.000	205.305		20.30		174.00	
				20.0 m		406.0		4024.0
	2443+00	212.890	205.860		20.30		228.40	
				20.0 m		406.0		4474.0
	2443+20	212.400	205.916		20.30		219.00	
				20.0 m		406.0		4926.0
	2443+40	214.110	206.171		20.30		273.60	
				20.0 m		406.0		5940.0
	2443+60	215.720	206.427		20.30		320.40	
				20.0 m		406.0		6216.0
	2443+80	215.710	206.682		20.30		301.20	
				20.0 m		406.0		6196.0
	2444+00	216.310	206.938		20.30		318.40	
				20.0 m		406.0		5336.0
	2444+20	215.826	207.193		20.30		215.20	
				20.0 m		406.0		4768.0
	2444+40	214.880	207.449		20.30		261.60	
				20.0 m		406.0		4992.0
	2444+60	214.658	207.704		20.30		237.60	
				20.0 m		406.0		4796.0
	2444+80	214.969	207.960		20.30		242.00	
				20.0 m		406.0		4696.0
	2445+00	216.150	208.215		20.30		227.60	
				20.0 m		406.0		4792.0
	2445+20	216.540	208.471		20.30		251.60	
				20.0 m		406.0		4740.0
	2445+40	216.150	208.726		20.30		222.40	
				20.0 m		406.0		3860.0
	2445+60	214.040	208.982		20.30		163.60	
					3' Depth 12'x12' Pattern	**6,723**	**Total Rock 12'x12' Pattern**	**73,368**
10' x 10' Drill Pattern	2445+60	214.040	208.982		20.30		163.60	
				20.0 m		406.0		2840.0
	2445+80	213.540	209.237		20.30		120.40	
				20.0 m		406.0		2332.0
	2446+00	213.440	209.493		20.30		112.80	
				20.0 m		406.0		1600.0
	2446+20	211.620	209.748		20.30		47.20	
				20.0 m		359.0		628.0
	2446+40	210.490	210.004		15.60		15.60	
				20.0 m		359.0		732.0
	2446+60	212.670	210.259		20.30		57.60	
				20.0 m		406.0		1124.0
	2446+80	213.890	210.515		20.30		54.80	
				20.0 m		406.0		1764.0
	2447+00	215.090	210.770		20.30		121.60	
				20.0 m		406.0		2864.0
	2447+20	216.200	211.026		20.30		164.80	
				20.0 m		406.0		2740.0
	2447+40	215.150	211.281		20.30		109.20	
				20.0 m		406.0		2496.0
	2447+60	216.100	211.537		20.30		140.40	
				20.0 m		406.0		2508.0
	2447+80	215.260	211.792		20.30		110.40	
				20.0 m		406.0		2352.0
	2448+00	216.340	212.048		20.30		124.80	
				20.0 m		406.0		2292.0
	2448+20	215.990	212.303		20.30		104.40	
					3' Depth 10'x10' Pattern	**5,184**	**Total Rock 10'x10' Pattern**	**26,272**
7' x 7' Drill Pattern	2448+20	215.990	212.303		20.30		104.40	
				20.0 m		406.0		2040.0
	2448+40	216.250	212.559		20.30		99.60	
				20.0 m		406.0		2000.0
	2448+60	216.522	212.814		20.30		100.40	
				20.0 m		406.0		1788.0
	2448+80	215.980	213.070		20.30		78.40	
				20.0 m		406.0		1552.0
	2449+00	216.200	213.325		20.30		76.80	
				20.0 m		406.0		1488.0
	2449+20	216.100	213.551		20.30		72.00	
				20.0 m		406.0		1620.0
	2449+40	217.040	213.836		20.30		90.00	
				20.0 m		406.0		2132.0
	2449+60	218.300	214.092		20.30		123.20	
				20.0 m		406.0		2240.0
	2449+80	218.000	214.347		20.30		100.80	
				20.0 m		406.0		1828.0
	2450+00	217.720	214.603		20.30		82.00	
				20.0 m		406.0		1156.0
	2450+20	216.370	214.858		20.30		33.60	
					3' Depth 7'x7' Pattern	**4,060**	**Total Rock 7'x7' Pattern**	**17,844**
					Total Rock	**15,967**	**Total Rock**	**117,484**

Appendix E: Sample Report to the District Administrator on an Impact

PRIVILEGED AND CONFIDENTIAL
Prepared at the Direction of and for
Discussion with Counsel

VDOT Project 7029-108-101, C504, B601, B602
FHWA # HPD/NH/STP-029-4(003)

Wide River Bridge Claim Analysis

Analysis of the District Responsible Charge

The Claim

New Ordeal, Inc. (NOI) filed a claim on Project 7029-108-101, C504, B601, B602 on May 25, 2005, on Day 58 after the final payment dated March 28, 2005. **(Exhibit 1)** The submission of the claim was in accordance with Specification Section 105.16, subsequent to the Notices of Intent to File Claim, J54-01 submitted on June 1, 2002. The total claimed amount is $496,869.00, derived from the following NOI issue:

Summary

NOI File J54-01: The Contract contained a bid item for Item 24278 Group II Channelizing Devices with a quantity of 500 DAY, which NOI bid at $10.00/DAY. Over the course of this 4-year project, this quantity overran by an additional 58,302 DAY (58,802 DAY total). The Department notified NOI that this quantity was in significant error on December 1, 2001, and requested a price breakdown for quantities exceeding the contract quantity of 500 days. On December 9, 2001, NOI responded, stating that it was not in a position to renegotiate the price for this item, and would evaluate their costs to determine if a price reduction is justified. The Department responded on December 17, 2002 reaffirming its position, and, after receiving no response, issued a unilateral work order (Work Order No. 3) for Group II Channelizing Devices at $0.50/DAY to cover all quantities used on the project above the contract quantity. NOI then submitted its Notice of Intent on June 1, 2002, serving notice that it would claim for payment for the difference between the Contract price of $10.00/DAY and the $0.50/DAY issued in the unilateral work order.

Total Cost Claimed: 52,302 DAY x $9.50/DAY ($10.00 Bid - $0.50 W.O.) = **$496,869.00**

Detailed Analysis

NOI File J54-01 – Group II Channelizing Devices

Detailed Reasons for the Claim: The subject project's bids were received and opened on February 20, 2001, and the project was executed on April 1, 2001. The bid documents contained a pay item for Group II Channelizing Devices, Item 24278, at a quantity of 500 DAY, and bid at a price of $10.00/DAY. As stated, the project was executed with these conditions. Being a multi-phased project, with multiple detours and traffic shifts, it was immediately recognized that this quantity, over a planned 27 month project, was in significant error (contract quantity had overrun after only 8

days of work). On December 1, 2001, the Residency notified the Contractor of this error, and requested a price reduction for all barrels used above the contract quantity to reflect the actual conditions. On December 6, 2001, NOI responded, stating it was not in a position at this time to renegotiate prices, but would evaluate costs as the project progressed to determine if a price reduction was justified. **(Exhibit 1)**

The Department responded on December 17, 2002, noting that prices are normally inversely related to quantities, and that, at that time, it was anticipated that quantities would increase from 500 DAY to at least 10,000 DAY over the course of the project. The Residency referred to Specification 105.05, which states:

"The Contractor shall not take advantage of any apparent error or omission in the plans or specifications. If the Contractor discovers an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the Contract."

The letter also referenced Specifications 102.03 and 104.02, indicating that the work had changed nature from the original intent communicated by the quantities set up in the contract.

Following this notification and further discussions at partnering meetings and informally, the Residency wrote NOI on May 22, 2002 advising the contractor that it now anticipated approximately total quantities in the range of 50,000 days, and attached a work order with a price of $0.50/DAY for all quantities over the contract quantity. The Contractor responded on June 4, 2002, stating that it did not take advantage of a known error (Spec. 105.05) and had no way of knowing the final quantity to be used. The letter questioned the Department's estimate of 50,000 days as being extremely high, and stated that the letter served as a Notice of Intent if the Department intended to pursue this change in price. The Department responded to the Notice of Intent with a letter on June 6, 2002. **(Exhibit 1)**

The Department then proceeded to issue a unilateral work order (W.O. #4) for Group II Channelizing Devices at $0.50/DAY, signed on June 4, 2002. This price was based on historical prices for this item across the district at the time, though the original documentation of the derivation of this price cannot now be located (more on this later).

The project continued under this payment basis, and eventually amassed a total quantity of 58,802 days of usage. NOI again contended this scenario in a September 20, 2005 letter responding to the transmittal of the Final Estimate, and again in its January 2, 2006 letter. Finally, the Contractor submitted its claim dated May 5, 2006 requesting compensation for the difference in the bid price and the paid unilateral work order price for 58,302 days of usage, totaling $498,869.00.

Original Contract Language/Interpretation of Specifications: As stated above, the Department maintains its right to modify the quantity per Specification 105.05, having notified the Contractor of an error in its own quantities, as quoted above. Other specifications also provide support or further information on this position:

- Special Provision Section 512 – Maintenance of Traffic **(Exhibit 2)**. On Page 192 of the contract, Section 512.04 states that "Group 2 channelizing devices, as required by the Engineer, will be measured in days and will be paid for at the contract unit price per day."

- Specification Section 102.03 – The Department accepted and paid for the original contract quantity at the original contract unit price. The Department saw fit to negotiate a revised unit price as a result of its error based on a fair price for the number of barrels actually in use.
- Specification Section 104.02 – The Specification allows the Engineer to make changes to the quantities in the original contract. The actual quantity exceeded the contract quantity by nearly 34,000%, and the contract price was 20 times the average price for this item. The nature of the work was certainly different from the communicated concept in the bid documents. The Engineer used his right to determine a fair and equitable price when a revised price (in this case due to a significant error) cannot be agreed upon.
- Specification 109.03 – Contract prices prevail 'unless modified by work order'. The price was modified by a work order in this case.
- Specification 109.04 – This specification states that the 'contractor shall accept as payment in full' payment at the original contract prices, which protects the Department from the contractor claiming for more than the contract price. It does not state that the Department will accept paying for overruns.
- The Department has the right to issue a work order at any time as the owner, and the contractor is required to do the work. The contractor does have the right not to sign the work order, but then they have to justify why the original price is valid.

Review of Original Notice of Intent Analysis and Response: The original response to the Notice was based on the specifications listed above. The District felt that this major error in quantities warranted a renegotiation of the price. If an overrun of this magnitude does not constitute a change in the nature of the work, then one questions whether any situation would qualify under this specification. The Contractor was asked to provide substantiation to its original price, that it was warranted over 58,802 days of usage, but never responded. Furthermore, in the Department's June 6, 2002 response to NOI's Notice, the contractor was advised that 'you are required to furnish the Project Inspector with an itemized list of equipment, labor, and materials for which additional compensation will be requested. . . Failure on your part to provide the Inspector with access for keeping strict accounts of actual cost will constitute a waiver of the claim, except as is substantiated by Department records". To this date, the Contractor has never provided any information to the Department showing what its actual costs were with regards to the channelizing devices. As such, the District could not recommend payment above what it believed was a price in line with the statewide averages for this item. No time impact was identified or requested as a result of this impact. The Department's position is that this change in contract price for greatly increased quantities is a risk borne by the Contractor.

Review of Additional Information Submitted in Claim: Following the submission of the Claim, further research was done on this issue. The Claim does not provide any new information that was not available during the original research. Specifically, it does not in any way justify the amount in the original bid item for the grossly overrun quantity, or provide any reason why the contractor requires this unit cost to avoid a cost impact. The District takes issue with NOI's claim that the Engineer does not have the authority to renegotiate the contract price in this situation, maintaining its original position that this is a change in the nature of the work, and that it had every right to renegotiate a price. The original research used to justify a $0.50/DAY price on the unilateral work order could not be found. However, an 18-month Bid History dated November 2004 was searched,

and should provide accurate data for most of the time period that all of the extra barrels were actually used. The average price for Item 24278 for projects in across the state (except Northern Virginia) with a somewhat comparable quantity (anything over 25,000 DAY) was found to be $0.50/DAY, matching exactly what was originally calculated **(Exhibit 3)**. By comparison, the average bid price for quantities comparable to the 500 Days in the contract for projects in the Lynchburg District was $1.16/DAY, far below the contractor's bid of $10.00/DAY. This finding supports the suggestion that the Contractor may have been taking advantage of an apparent error in the State's bid documents. The fact that the second low bidder also bid $10.00/DAY has absolutely no bearing on the fact that this bid price takes advantage of a Department error.

Although it is possible that the specifications can be interpreted in more than one way on this matter, the District has not changed its opinion that a unilateral work order was appropriate in this situation. It should also be noted that the District allowed payment for the project field office, which could have been deducted after the completion date in accordance with Specification 514.03.

This issue had no effect on time, and did not result in any idle manpower or equipment.

Recommendations:

The District continues to recommend that this Claim for the full contract amount be rejected, as we feel that there was sufficient justification and authority to issue a unilateral work order in this instance. A review of the current bid history suggests that based on statewide averages from the November 2004 bid history would support the payment of $0.50/DAY used on the unilateral work order for the barrels. **In other words, no additional compensation is recommended.**

Appendix F: Code of Federal Regulations Title 23 Part 635: Construction & Maintenance

Included in Appendix of special note to impact analysis:

23 CFR 635.102	**Definitions**
23 CFR 635.120	**Changes and extra work**
23 CFR 635.121	**Contract time and contract time extensions**
23 CFR 635.124	**Participation in contract claim awards and settlements**
23 CFR 635.125	**Termination of contract**
23 CFR 635.127	**Agreement provisions regarding overruns in contract time**
23 CFR 635	**Subpart B – Force Account Construction**

Subpart E—Interstate Maintenance Guidelines

635.501 Purpose.
635.503 Policy.
635.505 Maintenance guidelines.
635.507 Implementation.
635.509 Deficient or unsatisfactory maintenance.

AUTHORITY: 23 U.S.C. 101 (note), 109, 112, 113, 114, 116, 119, 128, and 315; 31 U.S.C. 6505; 42 U.S.C. 3334, 4601 *et seq.*; Sec. 1041 (a), Pub. L. 102–240, 105 Stat. 1914; 23 CFR 1.32; 49 CFR 1.48(b).

EDITORIAL NOTE: Nomenclature changes to part 635 appear at 67 FR 75924, Dec. 10, 2002.

Subpart A—Contract Procedures

SOURCE: 56 FR 37004, Aug. 2, 1991, unless otherwise noted.

§ 635.101 Purpose.

To prescribe policies, requirements, and procedures relating to Federal-aid highway projects, from the time of authorization to proceed to the construction stage, to the time of final acceptance by the Federal Highway Administration (FHWA).

§ 635.102 Definitions.

As used in this subpart:

Administrator means the Federal Highway Administrator.

Calendar day means each day shown on the calendar but, if another definition is set forth in the State contract specifications, that definition will apply.

Contract time means the number of workdays or calendar days specified in a contract for completion of the contract work. The term includes authorized time extensions.

Design-build project means a project to be developed using one or more design-build contracts.

Division Administrator means the chief FHWA official assigned to conduct business in a particular State. A State is as defined in 23 U.S.C. 101.

Force account means a basis of payment for the direct performance of highway construction work with payment based on the actual cost of labor, equipment, and materials furnished and consideration for overhead and profit.

Formal approval means approval in writing or the electronic transmission of such approval.

Incentive/disincentive for early completion as used in this subpart, describes a contract provision which compensates the contractor a certain amount of money for each day identified critical work is completed ahead of schedule and assesses a deduction for each day the contractor overruns the incentive/disincentive time. Its use is primarily intended for those critical projects where traffic inconvenience and delays are to be held to a minimum. The amounts are based upon estimates of such items as traffic safety, traffic maintenance, and road user delay costs.

Liquidated damages means the daily amount set forth in the contract to be deducted from the contract price to cover additional costs incurred by a State transportation department because of the contractor's failure to complete the contract work within the number of calendar days or workdays specified. The term may also mean the total of all daily amounts deducted under the terms of a particular contract.

Local public agency means any city, county, township, municipality, or other political subdivision that may be empowered to cooperate with the State transportation department in highway matters.

Major change or major extra work means a change which will significantly affect the cost of the project to the Federal Government or alter the termini, character or scope of the work.

Materially unbalanced bid means a bid which generates a reasonable doubt that award to the bidder submitting a mathematically unbalanced bid will result in the lowest ultimate cost to the Federal Government.

Mathematically unbalanced bid means a bid containing lump sum or unit bid items which do not reflect reasonable actual costs plus a reasonable proportionate share of the bidder's anticipated profit, overhead costs, and other indirect costs.

Public agency means any organization with administrative or functional responsibilities which are directly or indirectly affiliated with a governmental body of any nation, State, or local jurisdiction.

Publicly owned equipment means equipment previously purchased or otherwise acquired by the public agency involved primarily for use in its own operations.

Specialty items means work items identified in the contract which are not normally associated with highway construction and require highly specialized knowledge, abilities or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract; in general, these items are to be limited to minor components of the overall contract.

State transportation department (STD) means that department, commission, board, or official of any State charged by its laws with the responsibility for highway construction. The term ''State'' should be considered equivalent to ''State transportation department'' if the context so implies.

Workday means a calendar day during which construction operations could proceed for a major part of a shift, normally excluding Saturdays, Sundays, and State-recognized legal holidays.

[62 FR 6873, Feb. 14, 1997, as amended at 67 FR 75924, Dec. 10, 2002]

§ 635.103 Applicability.

The policies, requirements, and procedures prescribed in this subpart shall apply to all Federal-aid highway projects except for those title 23 requirements specifically discharged in an approved certification acceptance plan, in accordance with 23 U.S.C. 117.

[56 FR 37004, Aug. 2, 1991, as amended at 62 FR 6873, Feb. 14, 1997]

§ 635.104 Method of construction.

(a) Actual construction work shall be performed by contract awarded by competitive bidding; unless, as provided in § 635.104(b), the STD demonstrates to the satisfaction of the Division Administrator that some other method is more cost effective or that an emergency exists. The STD shall assure opportunity for free, open, and competitive bidding, including adequate publicity of the advertisements or calls for bids. The advertising or calling for bids and the award of contracts shall comply with the procedures and requirements set forth in §§ 635.112 and 635.114.

(b) Approval by the Division Administrator for construction by a method other than competitive bidding shall be requested by the State in accordance with subpart B of part 635 of this chapter. Before such finding is made, the STD shall determine that the organization to undertake the work is so staffed and equipped as to perform such work satisfactorily and cost effectively.

(c) In the case of a design-build project, the requirements of 23 CFR part 636 and the appropriate provisions pertaining to design-build contracting in this part will apply. However, no justification of cost effectiveness is necessary in selecting projects for the design-build delivery method.

[56 FR 37004, Aug. 2, 1991, as amended at 67 FR 75925, Dec. 10, 2002]

§ 635.105 Supervising agency.

(a) The STD has responsibility for the construction of all Federal-aid projects, and is not relieved of such responsibility by authorizing performance of the work by a local public agency or other Federal agency. The STD shall be responsible for insuring that such projects receive adequate supervision and inspection to insure that projects are completed in conformance with approved plans and specifications.

(b) Although the STD may employ a consultant to provide construction engineering services, such as inspection or survey work on a project, the STD shall provide a full-time employed State engineer to be in responsible charge of the project.

(c) When a project is located on a street or highway over which the STD does not have legal jurisdiction, or when special conditions warrant, the STD, while not relieved of overall project responsibility, may arrange for the local public agency having jurisdiction over such street or highway to perform the work with its own forces or by contract; provided the following

highway, the terminus is the first interchange outside the reservation.

(f) The advertisement or call for bids on any contract for the construction of a project located on the Federal-aid system either shall include the minimum wage rates determined by the Secretary of Labor to be prevailing on the same type of work on similar construction in the immediate locality or shall provide that such rates are set out in the bidding documents and shall further specify that such rates are a part of the contract covering the project.

§ 635.118 Payroll and weekly statements.

For all projects, copies of payrolls and statements of wages paid, filed with the State as set forth in the required contract provisions for the project, are to be retained by the STD for the time period pursuant to 49 CFR part 18 for review as needed by the Federal Highway Administration, the Department of Labor, the General Accounting Office, or other agencies.

§ 635.119 False statements.

The following notice shall be posted on each Federal-aid highway project in one or more places where it is readily available to and viewable by all personnel concerned with the project:

NOTICE TO ALL PERSONNEL ENGAGED ON FEDERAL-AID HIGHWAY PROJECTS

United States Code, title 18, section 1020, reads as follows:

Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the costs thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction of any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever, knowingly makes any false statement, false representation, false report, or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever, knowingly makes any false statement or false representation as to a material fact in any statement, certificate, or report submitted pursuant to the provisions of the Federal-aid Road Act approved July 11, 1916 (39 Stat. 355), as amended and supplemented,

Shall be fined not more than $10,000 or imprisoned not more than five years, or both.

§ 635.120 Changes and extra work.

(a) Following authorization to proceed with a project, all major changes in the plans and contract provisions and all major extra work shall have formal approval by the Division Administrator in advance of their effective dates. However, when emergency or unusual conditions justify, the Division Administrator may give tentative advance approval orally to such changes or extra work and ratify such approval with formal approval as soon thereafter as practicable.

(b) For non-major changes and non-major extra work, formal approval is necessary but such approval may be given retroactively at the discretion of the Division Administrator. The STD should establish and document with the Division Administrator's concurrence specific parameters as to what constitutes a non-major change and non-major extra work.

(c) Changes in contract time, as related to contract changes or extra work, should be submitted at the same time as the respective work change for approval by the Division Administrator.

(d) In establishing the method of payment for contract changes or extra work orders, force account procedures shall only be used when strictly necessary, such as when agreement cannot be reached with the contractor on the price of a new work item, or when the extent of work is unknown or is of such character that a price cannot be determined to a reasonable degree of accuracy. The reason or reasons for using force account procedures shall be documented.

(e) The STD shall perform and adequately document a cost analysis of each negotiated contract change or negotiated extra work order. The method and degree of the cost analysis shall be

subject to the approval of the Division Administrator.

(f) Proposed changes and extra work involved in nonparticipating operations that may affect the design or participating construction features of a project, shall be subject to review and concurrence by the Division Administrator.

§ 635.121 Contract time and contract time extensions.

(a) The STD should have adequate written procedures for the determination of contract time. These procedures should be submitted for approval to the Division Administrator within 6 months of the effective date of this Final Rule.

(b) Contract time extensions granted by a STD shall be subject to the concurrence of the Division Administrator and will be considered in determining the amount of Federal participation. Contract time extensions submitted for approval to the Division Administrator, shall be fully justified and adequately documented.

§ 635.122 Participation in progress payments.

(a) Federal funds will participate in the costs to the STD of construction accomplished as the work progresses, based on a request for reimbursement submitted by State transportation departments. When the contract provisions provide for payment for stockpiled materials, the amount of the reimbursement request upon which participation is based may include the appropriate value of approved specification materials delivered by the contractor at the project site or at another designated location in the vicinity of such construction, provided that:

(1) The material conforms with the requirements of the plans and specifications.

(2) The material is supported by a paid invoice or a receipt for delivery of materials. If supported by a receipt of delivery of materials, the contractor must furnish the paid invoice within a reasonable time after receiving payment from the STD; and

(3) The quantity of a stockpiled material eligible for Federal participation in any case shall not exceed the total estimated quantity required to complete the project. The value of the stockpiled material shall not exceed the appropriate portion of the value of the contract item or items in which such materials are to be incorporated.

(b) The materials may be stockpiled by the contractor at a location not in the vicinity of the project, if the STD determines that because of required fabrication at an off-site location, it is not feasible or practicable to stockpile the materials in the vicinity of the project.

(c) In the case of a design-build project, the STD must define its procedures for making progress payments on lump sum contracts in the Request for Proposal document.

[56 FR 37004, Aug. 2, 1991, as amended at 67 FR 75925, Dec. 10, 2002]

§ 635.123 Determination and documentation of pay quantities.

(a) The STD shall have procedures in effect which will provide adequate assurance that the quantities of completed work are determined accurately and on a uniform basis throughout the State. All such determinations and all related source documents upon which payment is based shall be made a matter of record.

(b) Initial source documents pertaining to the determination of pay quantities are among those records and documents which must be retained pursuant to 49 CFR part 18.

§ 635.124 Participation in contract claim awards and settlements.

(a) The eligibility for and extent of Federal-aid participation up to the Federal statutory share in a contract claim award made by a State to a Federal-aid contractor on the basis of an arbitration or mediation proceeding, administrative board determination, court judgment, negotiated settlement, or other contract claim settlement shall be determined on a case-by-case basis. Federal funds will participate to the extent that any contract adjustments made are supported, and have a basis in terms of the contract and applicable State law, as fairly construed. Further, the basis for the adjustment and contractor compensation shall be

in accord with prevailing principles of public contract law.

(b) The FHWA shall be made aware by the STD of the details of the claim at an early stage so that coordination of efforts can be satisfactorily accomplished. It is expected that STD's will diligently pursue the satisfactory resolution of claims within a reasonable period of time. Claims arising on projects handled on Certification Acceptance projects or on exempt non-NHS projects should be processed in accordance with the State's approved Certification Acceptance Plan or Stewardship Plan, as appropriate.

(c) When requesting Federal participation, the STD shall set forth in writing the legal and contractual basis for the claim, together with the cost data and other facts supporting the award or settlement. Federal-aid participation in such instances shall be supported by a STD audit of the actual costs incurred by the contractor unless waived by the FHWA as unwarranted. Where difficult, complex, or novel legal issues appear in the claim, such that evaluation of legal controversies is critical to consideration of the award or settlement, the STD shall include in its submission a legal opinion from its counsel setting forth the basis for determining the extent of the liability under local law, with a level of detail commensurate with the magnitude and complexity of the issues involved.

(d) In those cases where the STD receives an adverse decision in an amount more than the STD was able to support prior to the decision or settles a claim in an amount more than the STD can support, the FHWA will participate up to the appropriate Federal matching share, to the extent that it involves a Federal-aid participating portion of the contract, provided that:

(1) The FHWA was consulted and concurred in the proposed course of action;

(2) All appropriate courses of action had been considered; and

(3) The STD pursued the case diligently and in a professional manner.

(e) Federal funds will not participate:

(1) If it has been determined that STD employees, officers, or agents acted with gross negligence, or participated in intentional acts or omissions, fraud, or other acts not consistent with usual State practices in project design, plan preparation, contract administration, or other activities which gave rise to the claim;

(2) In such cost items as consequential or punitive damages, anticipated profit, or any award or payment of attorney's fees paid by a State to an opposing party in litigation; and

(3) In tort, inverse condemnation, or other claims erroneously styled as claims ''under a contract.''

(f) Payment of interest associated with a claim will be eligible for participation provided that the payment to the contractor for interest is allowable by State statute or specification and the costs are not a result of delays caused by dilatory action of the State or the contractor. The interest rates must not exceed the rate provided for by the State statute or specification.

(g) In cases where STD's affirmatively recover compensatory damages through contract claims, cross-claims, or counter claims from contractors, subcontractors, or their agents on projects on which there was Federal-aid participation, the Federal share of such recovery shall be equivalent to the Federal share of the project or projects involved. Such recovery shall be credited to the project or projects from which the claim or claims arose.

[56 FR 37004, Aug. 2, 1991, as amended at 62 FR 6873, Feb. 14, 1997]

§ 635.125 Termination of contract.

(a) All contracts exceeding $10,000 shall contain suitable provisions for termination by the State, including the manner by which the termination will be effected and the basis for settlement. In addition, such contracts shall describe conditions under which the contract may be terminated for default as well as conditions where the contract may be terminated because of circumstances beyond the control of the contractor.

(b) The STD prior to termination of a Federal-aid contract shall consult with and receive the concurrence of the Division Administrator. The extent of Federal-aid participation in contract termination costs, including final settlement, will depend upon the merits of the individual case. However, under no

circumstances shall Federal funds participate in anticipated profit on work not performed.

(c) Except as provided for in paragraph (e) of this section, normal Federal-aid plans, specifications, and estimates, advertising, and award procedures are to be followed when a STD awards the contract for completion of a terminated Federal-aid contract.

(d) When a STD awards the contract for completion of a Federal-aid contract previously terminated for default, the construction amount eligible for Federal participation on the project should not exceed whichever amount is the lesser, either:

(1) The amount representing the payments made under the original contract plus payments made under the new contract; or

(2) The amount representing what the cost would have been if the construction had been completed as contemplated by the plans and specifications under the original contract.

(e) If the surety awards a contract for completion of a defaulted Federal-aid contract or completes it by some other acceptable means, the FHWA will consider the terms of the original contract to be in effect and that the work will be completed in accordance with the approved plans and specifications included therein. No further FHWA approval or concurrence action will therefore be needed in connection with any defaulted Federal-aid contract awarded by a surety. Under this procedure, the construction amount eligible for Federal participation on the project should not exceed the amount representing what the cost would have been if the construction had been completed as contemplated by the plans and specifications under the original contract.

§ 635.126 Record of materials, supplies, and labor.

(a) The provisions in this section are required to facilitate FHWA's efforts to compile data on Federal-aid contracts for the establishment of highway construction usage factors.

(b) On all Federal-aid construction contracts of $1 million or more for projects on the National Highway System, the STD shall require the contractor:

(1) To become familiar with the list of specific materials and supplies including labor-hour and gross earning items contained in Form FHWA–47, ''Statement of Materials and Labor Used by Contractors on Highway Construction Involving Federal Funds,'' prior to the commencement of work under this contract;

(2) To maintain a record of the total cost of all materials and supplies purchased for and incorporated in the work, and also of the quantities of those specific materials and supplies listed on Form FHWA–47, and in the units shown; and

(3) To furnish, upon the completion of the contract, to the STD on Form FHWA–47 both the data required in paragraph (b)(2) of this section relative to materials and supplies and a final labor summary for all contract work indicating the total hours worked and the gross earnings.

(c) Upon receipt from the contractor, the STD shall review the Form FHWA–47 for reasonableness and promptly transmit the form to the Division Administrator in accordance with the instructions printed in the form.

[56 FR 37004, Aug. 2, 1991, as amended at 62 FR 6873, Feb. 14, 1997]

§ 635.127 Agreement provisions regarding overruns in contract time.

(a) Each State transportation department (STD) shall establish specific liquidated damages rates applicable to projects in that State. The rates may be project-specific or may be in the form of a table or schedule developed for a range of project costs and/or project types. These rates shall, as a minimum, be established to cover the estimated average daily construction engineering (CE) costs associated with the type of work encountered on the project. The amounts shall be assessed by means of deductions, for each calendar day or workday overrun in contract time, from payments otherwise due to the contractor for performance in accordance with the contract terms.

(b) The rates established shall be subject to FHWA approval either on a project-by-project basis, in the case of project-specific rates, or on a periodic

basis after initial approval where a rate table or schedule is used. In the latter case, the STD shall periodically review its cost data to ascertain if the rate table/schedule closely approximates, at a minimum, the actual average daily CE costs associated with the type and size of the projects in the State. Where rate schedules or other means are already included in the STD specifications or standard special provisions, verification by the STD that the amounts are adequate shall be submitted to the FHWA for review and approval. After initial approval by the FHWA of the rates, the STD shall review the rates at least every 2 years and provide updated rates, when necessary, for FHWA approval. If updated rates are not warranted, justification of this fact is to be sent to the FHWA for review and acceptance.

(c) The STD may, with FHWA concurrence, include additional amounts as liquidated damages in each contract to cover other anticipated costs of project related delays or inconveniences to the STD or the public. Costs resulting from winter shutdowns, retaining detours for an extended time, additional demurrage, or similar costs as well as road user delay costs may be included.

(d) In addition to the liquidated damages provisions, the STD may also include incentive/disincentive for early completion provisions in the contract. The incentive/disincentive amounts shall be shown separately from the liquidated damages amounts.

(e) Where there has been an overrun in contract time, the following principles shall apply in determining the cost of a project that is eligible for Federal-aid reimbursement:

(1) A proportional share, as used in this section, is the ratio of the final contract construction costs eligible for Federal participation to the final total contract construction costs of the project.

(2) Where CE costs are claimed as a participating item based upon actual expenses incurred or where CE costs are not claimed as a participating item, and where the liquidated damages rates cover only CE expenses, the total CE costs for the project shall be reduced by the assessed liquidated damages amounts prior to figuring any Federal pro rata share payable. If the amount of liquidated damages assessed is more than the actual CE totals for the project, a proportional share of the excess shall be deducted from the federally participating contract construction cost before determining the final Federal share.

(3) Where the STD is being reimbursed for CE costs on the basis of an approved percentage of the participating construction cost, the total contract construction amount that would be eligible for Federal participation shall be reduced by a proportional share of the total liquidated damages amounts assessed on the project.

(4) Where liquidated damages include extra anticipated non-CE costs due to contractor caused delays, the amount assessed shall be used to pay for the actual non-CE expenses incurred by the STD, and, if a Federal participating item(s) is involved, to reduce the Federal share payable for that item(s). If the amount assessed is more than the actual expenses incurred by the STD, a proportional share of the excess shall be deducted from the federally participating contract construction cost of the project before the Federal share is figured.

(f) When provisions for incentive/disincentive for early completion are used in the contract, a proportion of the increased project costs due to any incentive payments to the contractor shall be added to the federally participating contract construction cost before calculating the Federal share. When the disincentive provision is applicable, a proportion of the amount assessed the contractor shall be deducted from the federally participating contract construction cost before the Federal share calculation. Proportions are to be calculated in the same manner as set forth in paragraph (e)(1) of this section.

[52 FR 31390, Aug. 20, 1987. Redesignated at 62 FR 6872, Feb. 14, 1997]

Subpart B—Force Account Construction

§ 635.201 Purpose.

The purpose of this subpart is to prescribe procedures in accordance with 23

U.S.C. 112(b) for a State transportation department to request approval that highway construction work be performed by some method other than contract awarded by competitive bidding.

[48 FR 22912, May 23, 1983]

§ 635.202 Application.

This subpart applies to all Federal-aid and other highway construction projects financed in whole or in part with Federal funds and to be constructed by a State transportation department or a subdivision thereof in pursuant of agreements between any other State transportation department and the Federal Highway Administration (FHWA). This subpart does not apply to projects constructed under a Certification Acceptance Plan in those States where the Secretary has discharged his/her responsibility pursuant to 23 U.S.C. 117, except where employees of a political subdivision of a State are working on a project outside such political subdivision.

[48 FR 22912, May 23, 1983]

§ 635.203 Definitions.

The following definitions shall apply for the purpose of this subpart:

(a) A *State transportation department* is that department, commission, board, or official of any State charged by its laws with the responsibility for highway construction. The term *State* should be considered equivalent to *State transportation department* if the context so implies.

(b) Except as provided for as emergency repair work in § 668.105(i) and in § 635.204(b), the term *some other method* of construction as used in 23 U.S.C. 112(b) shall mean the *force account* method of construction as defined herein. In the unlikely event that circumstances are considered to justify a negotiated contract or another unusual method of construction, the policies and procedures prescribed herein for force account work will apply.

(c) The term *force account* shall mean the direct performance of highway construction work by a State transportation department, a county, a railroad, or a public utility company by use of labor, equipment, materials, and supplies furnished by them and used under their direct control.

(d) The term *county* shall mean any county, township, municipality or other political subdivision that may be empowered to cooperate with the State transportation department in highway matters.

(e) The term *cost effective* shall mean the efficient use of labor, equipment, materials and supplies to assure the lowest overall cost.

(f) For the purpose of this part, an *emergency* shall be deemed to exist when emergency repair work as provided for in § 668.105(i) is necessary or when a major element or segment of the highway system has failed and the situation is such that competitive bidding is not possible or is impractical because immediate action is necessary to:

(1) Minimize the extent of the damage,

(2) Protect remaining facilities, or

(3) Restore essential travel.

This definition of *emergency* has no applicability to the Emergency Relief Program of 23 CFR part 668.

[39 FR 35158, Sept. 30, 1974, as amended at 48 FR 22912, May 23, 1983; 52 FR 45172, Nov. 25, 1987]

§ 635.204 Determination of more cost effective method or an emergency.

(a) Congress has expressly provided that the contract method based on competitive bidding shall be used by a State transportation department or county for performance of highway work financed with the aid of Federal funds unless the State transportation department demonstrates, to the satisfaction of the Secretary, that some other method is more cost effective or that an emergency exists.

(b) When a State transportation department determines it necessary due to an emergency to undertake a federally financed highway construction project by force account or negotiated contract method, it shall submit a request to the Division Administrator identifying and describing the project, the kinds of work to be performed, the method to be used, the estimated costs, the estimated Federal Funds to be provided, and the reason or reasons that an emergency exists.

Appendix G: FHWA Manual for Interpretation and Guidelines for Using the Federal Regulations

Contains excerpts from FHWA's *Contract Administration Core Curriculum Participant's Manual and Reference Guide 2005*. Included in Appendix of special note to impact analysis:

Section III.B.4. Change Orders (Extra Work and Time Extensions)

Section III.B.5 Claims

Section III.B.6 Liquidated Damages

Section III.B.7 Suspension and Debarment

Section III.B.8 Termination of Contracts

Contract Administration Core Curriculum Participant's Manual and Reference Guide 2005

FHWA
Office of Infrastructure
Office of Program Administration
Contract Administration Group (HIPA-30)
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http://www.fhwa.dot.gov/programadmin/contracts/index.htm

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NCHRP report lists the retention rates for all 50 States. The rates at that time varied from 0 to 10%.

Retention for Subcontract Work. The US DOT's DBE regulation requires recipients to include a "prompt pay" clause in all Federally-funded contracts. Section 26.29 of the regulation requires:

- prime contractors to pay subs for satisfactory performance of their contracts no later than a specific number of days from receipt of each payment by the prime, and
- prompt return of retainage payments within a specific number of days after the subcontractor's work is satisfactorily completed.

Final Payment. By statute (23 U.S.C. 121(b)), FHWA cannot make final payment for a project until after approving the completion of it's construction. Guidance contained in the FAPG, G 6042.8, Construction Monitoring, indicates that a final inspection of the project should determine whether the actual construction conforms with the approved plans and specifications, including all approved changes. The final inspection may be an actual on-site inspection performed at or near project completion; an in-depth review of the STA's project records at or near project completion; or a finding that is based on a process review of the STA's internal project controls which demonstrates that the STA is properly exercising its internal controls. The level of effort put into the final inspection should be based on the size, complexity and importance of the project, as well as the level of previous oversight. The final inspection shall be documented on the FHWA-1446A, "Construction Inspection Report," (RCS-HHO-30-28).

The final inspection report should include any findings, items or issues that must be addressed prior to final acceptance, the agreed upon corrective measures and timetable. Any other items which must be submitted prior to final payment such as the STA's materials certification (for FHWA oversight projects); or the FHWA-47 should also be identified.

After all outstanding issues are resolved, the project's final acceptance should be documented on the FHWA-1446B, "Final Acceptance Report," (RCS-HHO-30-28), unless the Division has developed an alternate format.

Effect of Warranty Period. Currently the effect of a warranty on final payment and retention varies among the STAs. A few STAs have distributed the payment for the warranted product over the life of the warranty period. Most STAs require a warranty bond and, therefore, follow their normal procedures to make the final project payment.

4. Change Orders (Extra Work and Time Extensions)

References:

23 CFR 635.102
23 CFR 635.120

23 CFR 635.121

Applicability:

Applies to NHS projects.

Background:

Establishing a strict set of rules to govern Federal-aid policy on change orders is not practicable since applying the rules would be subject to the specific circumstances that created the need for the change order.

The construction industry recognizes that it is unrealistic to expect that a construction project could be built without deviating from the project plans. Although project designers should be diligent and exercise due care in developing the plans, they are not omniscient. There are many peculiarities (e.g., unforeseen site conditions, utility conflicts, changes in the geology, etc.) that can arise during construction and virtually every project should expect changes. Only the construction engineer is in a position to judge the adequacy of project designs and respond to needed changes.

Frequently, change orders are used to make the design a better fit for the actual field conditions. Also, a change order may result in a better product at no substantial increase in cost or time, or an equivalent product with savings in cost, time, or both. Generally, change orders are classified by purpose:

- plan changes,
- specification changes,
- change in cost (+/-), and
- change in time (+/-).

Guidance:

Federal-aid policy requires that proposed major extra work or major changes in the contract plans and provisions be formally approved in advance by the Division Administrator. However, when emergency or unusual conditions justify, the Division Administrator may give advance verbal approval and ratify such approval with formal approval, as soon as practicable. This procedure is consistent with the Federal need to preserve and protect the expenditure of Federal funds.

Non-major changes and non-major extra work also require formal approval; however, at the discretion of the Division Administrator, such approval may be given retroactively. Form FHWA-1365 (Appendix A-117) should be used to document verbal approvals; the form can then be attached to the formal change order request.

The STA, with the Division Administrator's concurrence, should establish and document specific parameters for non-major change and non-major extra work. The definition of a major change or major extra work, as included in 23 CFR 635.102, is as follows:

Major change or major extra work means a change which will significantly affect the cost of the project to the Federal government or alter the termini, character or scope of work.

Early coordination between the STA and the FHWA is essential in the review of change orders. There are four basic components that FHWA will consider during its review of change orders. These considerations are:

- Federal-aid eligibility,
- impact on the original "scope of the work,"
- basis of payment, and
- time adjustments.

Federal-aid Eligibility. Typically, if the proposed change is eligible for Federal-aid reimbursement, then full participation logically follows. However, there may be situations where only parts of the change order are eligible. Generally speaking, the FHWA is prohibited from participating in costs related to routine or recurring maintenance (snow removal, graffiti removal, litter pickup, mowing, roadside vegetation control, etc.), however, the FHWA may participate in preventive maintenance work that is shown to be cost effective (such as pavement joint repair, crack sealing, drainage clean out work, etc.). Mr. Gee's October 8, 2004 memorandum on Preventive Maintenance Eligibility provides guidance on this subject.

The FHWA is often asked to approve change orders to correct work because of a design or construction engineering error. The FHWA policy on the participation in design or construction engineering errors was established by Mr. Williams' memorandum of July 12, 1963 (Appendix A-118). In general, this policy states that each case should be considered on its own merits. Federal-aid participation in errors that may reasonably be expected to occasionally occur (despite the exercise of normal diligence) may be justified, as long as the STA's carelessness, negligence, incompetence, or under-staffing were not contributing factors.

The FHWA's policy regarding participation in consultant design errors is that the consultant should pay for the cost of the new design, but is generally not held responsible for additional construction costs resulting from such errors, as long as the errors are not a result of gross negligence or carelessness. In addition to Mr. Williams' memorandum referred to above, Mr. LaHue's memorandum of September 8, 1978 (Appendix A-119) provides additional guidance on this subject.

Impact on the Original "Scope of the Work". Typically, if the proposed change falls within the previously authorized scope of work, then FHWA participation follows.

There may be circumstances in which participation in the full scope of the change order work is precluded. For example, a change order on a pavement rehabilitation project may provide for the installation of additional edge drains at and beyond the project limits. A change of the project limits and modification of the project agreement would be needed in order for the cost of edge drains outside the project limits to be eligible. Otherwise, Federal-aid participation would be limited to the cost of edge drains up to the original project limits.

There may be other circumstances where major contract modifications are proposed which are beyond the original scope of work. In these cases, the Division Office must determine whether the additional work is a modification of the original scope or a significant change that would benefit from competitive bidding. The individual circumstances associated with the magnitude and quality of the change as well as the cumulative impact upon the whole project should be reviewed. Have the contract work elements changed? How does the additional work impact quantities and cost? Does the proposed change impact the complexity of the work? What is the cumulative impact on the project? Would the public benefit from competitive bidding rather than a negotiated change?

Basis of Payment. The STA must perform and suitably document the cost analysis for each negotiated work change order. The method and degree of analysis are the STA's decision, however, the process should be acceptable to the Division Administrator.

Force account procedures should only be used as a last resort when agreement cannot be reached on the price of a new work item, or when the extent of the work is unknown or of such character that a price cannot be determined to a reasonable degree of accuracy. A Headquarters memorandum of September 8, 1982 (Appendix A-120) contains FHWA policy on the use of force account procedures.

Time Extensions. The change order should also provide the time needed to accomplish the work. The FHWA policy states that contract time extensions granted by a STA that affect project costs or liquidated damages shall be subject to the concurrence of the Division Administrator and will be considered in determining the amount of Federal participation.

Most State standard specifications require the contractor to submit and maintain a project schedule that details the timing for construction operations from start to finish. Reasonably, this schedule should depict the planned operation by day or week and may take the form of a critical path. A trace of the critical path identifies the controlling operations. In the absence of a critical path or activity schedule, a determination of the controlling operation(s) is necessary.

If work covered by a change order affects a controlling operation, a change in the contract time may be warranted. If the controlling operation is unaffected, a change in the contract time is not warranted. In order to establish the time required to perform the work, an estimate of the time should be developed as the other components (i.e., labor, equipment, and materials) are estimated.

Occasionally, there are events that are beyond the control of either the STA or the contractor that affect the controlling operation. These should be enumerated in the STA's standard specifications and be acceptable to support an extension of contract time. Such events include the following:

- labor strikes (including job pickets),
- public protests (to the project),
- general riot,

- declaration of war,
- "acts of God," and
- traffic accidents (e.g., hazardous spills).

Events that are normally considered to be under the control of the contractor and, therefore, do not warrant a time extension include:

- shutdowns for maintenance,
- breakdowns,
- suspensions or stop work orders for violation of safety or pollution regulations,
- shutdowns for construction accidents, and
- material delays.

The FAPG (NS 23 CFR 635A) provides further guidance on materials delays. The contractor is responsible for the timely order and delivery of materials for the project. A delay in delivery of materials does not in itself generally support an extension of contract time. However, if an unusual market condition (i.e., an industry-wide strike, natural disaster, or area-wide shortage) occurs, a time extension may be in order.

Delays due to inclement weather should be expected and should generally not be the basis for a change in contract time except in extreme cases.

The FAPG (NS 23 CFR 635A) also provides guidance on the granting of time extensions due to utility, railroad, and right-of-way (ROW) clearance delays. Because of the assurances required from the STA prior to the FHWA project authorization, the FHWA policy generally does not permit participation in time extensions for such delays. Whenever the railroad or utility is permitted to adjust its facilities coincidentally with contract operations, such activities must be clearly addressed in the contract provisions. All parties should understand that any interference by the railroad or utility to the contractor's operations generally will not constitute an allowable delay. In general, an extension of contract time due to ROW delays is very unusual and is the exception rather than the rule. For FHWA approval of an extension, it must be shown that:

- the construction work was actually delayed by the ROW, railroad, or utility difficulty,
- the contractor did everything required by the contract to minimize the delay, and
- the STA was unable to exercise effective control of the situation despite its best efforts.

Occasionally, FHWA is asked to participate in time extensions or delay claims that result from State budgetary problems. In some cases, State budgetary problems may lead to the STA's inability to pay the contractor or provide adequate inspection staff. FHWA has refused to participate in the such costs based on the assurances required in 23 USC 302 that require States to be adequately staffed to carry out the Federal-aid program.

5. Claims

References:

23 CFR 635.124

Applicability:

Applies to NHS projects.

Background:

A claim can be defined as a demand for additional compensation that is formally submitted to someone in the STA outside of the normal process for change approvals. In simple terms, a continued demand for payment is termed a claim if it has been previously denied under the STA's normal procedures for change approval.

Both the STA and the contractor share in the responsibility for claims. Many claims could be avoided if reviews of the contract documents were more thorough, both in preparation of the project and in bidding the project. Problems occur most often when an STA rushes a project with incomplete or inadequate plans through the letting process. Due to public pressure, States sometimes promise to get work under construction or to open highways on some predetermined date. Similarly, shelf projects, those projects with plans that were developed several years earlier, can be especially dispute-prone because traffic patterns and other field conditions may have changed. Most States acknowledge that projects containing known errors are sometimes let for bid because the time frame does not allow for errors to be corrected. Contractors may contribute to claims through ineffective project management, scheduling practices and substandard work.

Guidance:

A comment made during the rulemaking process in 1985 was that FHWA's involvement in claims allowed "second guessing" of those who were more intimately involved in the claim award, and that FHWA should become involved earlier in order to make fair and objective decisions. FHWA agreed with that philosophy and supports uniformity and objectivity in our decision-making. Therefore, 23 CFR 635.124(b) contains a general statement about early coordination and involvement. The specific details of coordination and involvement are left to each FHWA Division Office and STA to finalize, allowing them the flexibility to work out an arrangement which accommodates the State's program. When developing coordination procedures, the STA should be cognizant that under the Freedom of Information Act, the contractor and other outside parties may obtain information in FHWA files.

A good generalization of FHWA's policy is the following statement:

> *"If the States are diligent and pursue resolution of a claim through the courts or arbitration boards (including appeals), consulting with and*

keeping FHWA fully informed throughout the process, FHWA will share in the results."

However, FHWA will determine on a case-by-case basis the Federal-aid eligibility of a contract claim awarded on the basis of an arbitration or mediation proceeding, administrative board determination, court judgment, negotiated settlement, or other contract claim settlement. Federal funds will participate to the extent that the claim can be supported by the facts and has a basis in the contract and under applicable State law. Further, the basis for the adjustment and contractor compensation should be in accord with prevailing principles of contract law (23 CFR 635.124(a)).

Similarly, for court judgments abiding with State law, the FHWA specifically reserves the right to review all matters, not just the court's decision, in the award of a claim since the claim may have been awarded under a State law which is inconsistent with Federal law.

The burden of proof to document the reasonableness of a claim remains vested in the STA. As indicated by 23 CFR 635.124(c), FHWA believes the STA is in the best position to compile and provide the information, including legal briefs where needed, to support a decision for FHWA participation in claims.

What about the influence on FHWA's participation relative to the acts of STA employees involved in contract administration and contract plan preparation matters, which subsequently give rise to claims? The FHWA will participate when the acts are reasonable and within the standards of the profession. FHWA will not participate in claim awards that arise from gross negligence, intentional acts or omissions, fraud, or other actions by an STA employee(s) which are not consistent with the usual State practices.

On December 16, 1992, FHWA addressed claims resolution for non-oversight projects. For non-Interstate NHS projects, the STA must base its determination of Federal-aid participation on the requirements of 23 CFR 635.124. For non-NHS projects, the STA may determine the level of Federal-aid participation based upon State procedures; however, the STA must comply with the allowable cost principles of OMB Circular A-87 as addressed in 49 CFR 18.22.

Interest. Federal-aid funds can participate in interest associated with a claim if three conditions are met:

- the interest must be allowable by State statute or specification,
- the interest is not the result of delays caused by dilatory action of the State or contractor, and
- the interest rate does not exceed the rate provided for by statute or specification.

Attorney's Fees. Contractors' attorney fees are not eligible for Federal participation. The basis for this determination is that there is no statutory authority for the payment of attorney fees. However, the STA's administrative costs, including attorney fees related to the defense of claims, are reimbursable. Such costs are reimbursable at the same participation rate as the related construction project.

Anticipated Profit. The FHWA does not participate in anticipated profit because this is in the realm of the contractor's risk.

NHI Course No. 134037A, "Managing Highway Contract Claims: Analysis and Avoidance": The course is targeted at FHWA, State and local personnel involved in project development, construction, and claims management.

Other sources of information on claim avoidance are the American Society of Civil Engineers which has published Avoiding and Resolving Disputes During Construction: Successful Practices and Guidance, by the Underground Technology Research Council, 1991, and Construction Contract Claims, Changes, and Dispute Resolution, by Paul Levin, 1998; the Association for the Advancement of Cost Engineering; and the *Construction Claims Monthly* which is published by Business Publishers, Inc.

Alternative Dispute Resolution

Claims and disputes cannot always be avoided. Research by the Construction Industry Institute (CII) has found that construction disputes arise from three major sources: project uncertainty, process problems and people issues. If the source of the dispute is not addressed, resolving the dispute can become increasingly difficult, resource-intensive, and will usually result in a solution which satisfies no one. Dispute resolution methods range in hostility level from negotiation up to extended litigation.

The focus of alternative dispute resolution (ADR) techniques is to allow fair-minded people to resolve their differences in a manner that emphasizes reasonableness and fairness. ADR does not mean turning responsibility for project decisions over to others (i.e., lawyers) because litigation is costly and time-consuming. ADR methods vary in the level of the assistance drawn from outside sources, and the decision-making taken away from the disputing parties.

The construction industry has developed a variety of ADR methods. As CII's research shows, the most valuable techniques are those that prevent or resolve disputes as early as possible by the individuals directly involved at the project level. Commonly used methods include negotiation, mediation, non-binding arbitration, dispute review board, mini-trial, binding arbitration, private judging, and finally, litigation.

Partnering

Technically, partnering is not an ADR method. Rather, partnering is a change in the attitude and the relationship between owner and contractor. Partnering is the creation of a relationship between the owner and contractor that promotes recognition and achievement of mutual and beneficial goals. Partnering occurs when trust, cooperation, teamwork and the successful attainment of mutual goals become the hallmarks for the relationship.

The key to making partnering work requires having a plan which is backed up by open communication, willing participants, senior management support, and up front commitment. Communication starts early in the process through a team-building session. All the key managers for the project are assembled for a workshop that focuses on team building, goal setting, identifying issues, and solving problems. The workshop is run by a facilitator who ensures that all issues are brought out into the open. Authority to solve problems must be delegated to the lowest level. A critical feature of partnering is to identify the dispute resolution process that will be used on the

project and designate key players in the process. Follow-up meetings are held at regular intervals to evaluate goals and objectives. (The FHWA's representative to the partnering workshops should have the authority to approve change orders and claims.) The cost of the partnering sessions is typically borne equally by both the owner and the contractor. Federal funds may be used to reimburse the owner for their share of the cost at the project pro rata share rate.

In 1995, AASHTO's Construction Subcommittee's Contract Administration Task Force conducted a survey of the STAs. At that time, forty-six STAs were using partnering. Despite the fact that 28 States had been using the technique for less than two years, 34 States believed that partnering had reduced claims in their States.

Other partnering references include:

- Partnering, U.S. Army Corps of Engineers, IWR Working Paper 91-ADR-P-4, March 1990;
- In Search of Partnering Excellence, CII 17-1, July 1991;
- Partnering-A Concept for Success, Associated General Contractors of America, September 1991; and
- Partnering Manual, Central Artery/Tunnel Project, January 1998.

Negotiation

Negotiation occurs when parties resolve the issues themselves, usually at the project level. However, the STA's administrative processes would also be considered as negotiation in a broad sense of the term.

Mediation

Mediation involves a neutral third party to depersonalize the dispute while facilitating its resolution, preferably in a "win-win" solution. The parties may jointly appoint a mediator or they may request that a mediator be appointed by an association such as the American Arbitration Association. The mediator provides assistance in resolving the dispute by narrowing and clarifying issues, however, the mediator does not decide the dispute. The mediator may meet with the parties individually or collectively but all information disclosed to the mediator is confidential. Mediation is normally non-binding since the mediator has no inherent power.

Mediation is a flexible method that can be adapted by the parties to fit their needs. While the American Arbitration Association has developed flexible rules of conduct, the parties should agree on the process to be used; how the mediator will be selected and paid; who has authority to make decisions for each party; and what happens if mediation does not result in a resolution. The cost to the owner of the mediation process is eligible for Federal-aid reimbursement.

Dispute Review Board

A dispute review board (DRB) requires the creation of a three member standing committee which meets on a regular basis to review and resolve all project disputes before they become formal claims. Drawing from the experts in the type of construction contained in the contract, each party will choose a member, and then those two members will jointly select the third member. The DRB members are considered to be "standing neutrals," independent of either party. The parties will split the cost of operating the DRB (the owners portion of the cost is eligible for Federal-aid reimbursement). In order to resolve issues at an early stage, DRB's typically keep abreast of construction progress. While the DRB will issue written decisions for the issues, the decisions are typically non-binding upon the parties.

Additional information about DRBs may be found in the 1996 Construction Dispute Review Board Manual authored by A. Mathews, Bob Matyas, Bob Smith and Joe Sperry. The CII has published Prevention and Resolution of Disputes Using Dispute Review Boards, CII 23-2, October 1995.

Many states have used DRBs on large bridge or tunnel projects. According to the Dispute Review Board Foundation, STA usage includes: Alaska (1 project), California (42), Colorado (4), Delaware (1), Florida (60), Hawaii (9), Maine (4), Massachusetts (47), Oregon (3), Utah (1) and Washington (54); and

The Dispute Review Board Foundation has compiled data on the success of DRBs in successfully minimizing construction litigation. The Foundation furnishes the following statistics.

Industry Sector	Through late 1998				
	No of Jobs	Value in $Billions	Disputes		
			Settled	Litigated	% Settled
Tunnels & Underground	114	$9.4	149	16	90%
Heavy Highway	285	$16.0	324	1	100%
Building, Process & Other	77	$4.8	121	0	100%
Totals	476	$30.2	594	17	97%

On the Boston Central Artery project, 47 of 123 construction contracts had DRBs representing approximately $6.8 billion in construction. These contracts ranged from $12.5 million to $419.5 million. On these contracts, 9,635 total issues were raised, however, the vast majority of these issues were resolved informally. Only 15 issues were raised to a formal DRB. To date, no issues went to litigation.

Florida DOT has used DRBs extensively for projects over $10 million. The 60 projects currently using DRBs represent approximately $1.1 billion in construction. Of the 45 disputes that have been heard as of January 1999, the contractors and FDOT have each claimed an approximately equal number of victories. The disputes have ranged in

size from relatively small claims up to $6 million. To date there has been no litigation regarding DRB recommendations.

Caltrans began requiring DRBs for all contracts greater than $10 million in January 1998. The use of DRBs for smaller contracts is optional but encouraged.

Mini-trial

Mini-trials are more formal than mediation or a DRB in that the dispute is treated as a business problem. Lawyers and experts present a summary of their "best case" to an advisory panel drawn from senior officials of the owner and the contractor with an independent neutral who provides an objective viewpoint. Typically the hearing documents and negotiation discussions are considered confidential and cannot be used in later litigation.

Pennsylvania (PennDOT) used this method to settle a construction claim on the Schuylkill Expressway project.

> PennDOT Mini-Trial Procedures
>
> Each party is represented by a principal participant with the authority to settle the dispute on behalf of the party he represents. The FHWA also has a representative with the authority to approve any settlement reached by the parties. A neutral advisor selected jointly by the parties chairs the mini-trial. The neutral advisor performs a mediation function, enforces time limitations, asks questions of witnesses and, if necessary, issues an advisory opinion on the merits of the dispute. The presentations at the mini-trial are informal with the rules and procedures stated in the agreement. The mini-trial is conducted within a specific time frame, typically no more than three days.

Arbitration

Arbitration is a method under which decisions are made by one or three arbitrators, chosen by the parties, based on fact and law. Although decisions may or may not be binding and without appeal, in almost all cases, the arbitration decision is accepted by both parties. Usually, the only cases carried on to litigation are those that involve a point of law.

Private Judging

The Construction Industry Institute has identified private judging as a middle ground between arbitration and litigation. This procedure allows the parties to state their case before a mutually accepted neutral and have the decision becoming the judgment of the appropriate trial court with the right of appeal. The referees are normally retired judges. The parties may agree to simplify and expedite the process.

Escrow of bid documents

In conjunction with dispute review boards, several states have utilized an escrow of bid document special provision on large complex contracts that have the potential for litigation. Escrow bid documents address the issue of how a contractor interpreted the contract provisions and developed the bid. Escrow bid documents properly prepared

and properly used are a great source of information for parties who want to resolve disputes on an equitable basis. The more accurate information each party has the more likely litigation can be avoided. Generally, the escrow documents remain in a depository and are not used until the state receives a notification of intention to file a claim from the contractor.

A guide specification for escrowing bid documents can be found in Section 103.08 of AASHTO's 1998 Guide Specifications for Highway Construction.

Home Office Overhead (HOO)

Home office overhead costs (HOO) are expenses that a contractor incurs for the benefit of all contracts that cannot be attributed to any individual contract. Examples of these expenses include home office estimating, personnel and administration. HOO is allocated to all of the contractor's work, usually in proportion to the value of each project to the company's' total receipts.

Any suspension of work or other delay in contract performance will disrupt or reduce the contractor's direct income from the project. However, the contractor continues to incur HOO. Two types of HOO may affect delay damage claims: unabsorbed and extended. Contract case law has developed distinct definitions for these terms. Unabsorbed HOO is the increased cost that must be borne by a contractor because delays in one project have prevented the contractor from defraying those costs over other projects, as originally intended. Extended HOO are the increased overhead costs borne by the contractor after the original completion date which are caused by project delays.

Because HOO costs are indirect costs to any given project, contractors claiming HOO as an element of a delay damage claim must establish that the claimed expenses are permissible and/or justified.

FHWA has allowed participation in HOO costs only in cases when the owner agency caused the delay during which time the HOO costs could not be charged off to earnings and the contractor was prevented from doing other work which could have been allocated HOO. Otherwise FHWA's position has been to disallow HOO when an STA's standard specification for extra work and force account work provide for full compensation at either the contract unit price, or a negotiated unit price.

Eichleay formula. The appropriateness of the Eichleay formula for calculating unabsorbed HOO costs seems to depend on the circumstances of the claim. Federal and state courts vary in their acceptance and application of the formula. There are also several other formulas in use (original contract period formula, fixed overhead formula, burden fluctuation method, comparative absorption rates, etc.); however, most contractors rely on the Eichleay formula.

6. Liquidated Damages

References:

23 CFR 635.127

Applicability:

Applies to NHS projects.

Background:

Contract time is an essential element of the contract and it is important that the work be pressed vigorously to completion. The cost to the contracting agency for the administration of the contract, including engineering, inspection, and supervision, increases as the contract time increases. Likewise, the road user costs also increase as the completion date of the contemplated facility is extended. The liquidated damages contract provision provides a mechanism for the contracting agency to recover these costs associated with the contract time overrun. The STAs are required to incorporate liquidated damages provisions into their Federal-aid contracts as a condition of the project agreement.

Most of the STAs use a liquidated damage rate schedule based on a range of contract amounts. However, some use a daily rate that is calculated specifically for the particular project.
During 1984, the OIG reviewed the assessment of liquidated damages in five of the nine FHWA regions during a 3-year period. The OIG found that the STAs were recovering only 41 percent of their total actual construction engineering costs. The actual engineering costs were $2.44 for each dollar of liquidated damages collected. As a result, the OIG determined that $15 million of Federal funds were lost annually. Part of the problem was that the FHWA regulation in force during the OIG review period contained the 1972 AASHTO schedule of liquidated damages.

In December 1984, the FHWA issued a memorandum on the OIG's review and recommended that each STA, in consultation with their Division Office, review their current rates. Subsequently in 1987, the FHWA revised its regulation (23 CFR 630.305) on assessment of liquidated damages. During development of the final rule on project agreements, the liquidated damages requirements were moved to 23 CFR 635.127.

Guidance:

Significant provisions contained in regulation 23 CFR 635.127 are:

- Each STA is required to develop and maintain its own liquidated damages rates that will cover, as a minimum, the STA's average daily construction engineering (CE) costs attributable to a contract time overrun;

- The STA rates are subject to verification and approval by the Division Administrator, and at least every two years must be reviewed and adjusted, as necessary, by the STA;

- In addition to CE costs, the STA may include the costs of project-related delays or inconveniences, to the STA or to the public, in their liquidated damages provisions. In such cases, costs recovered in excess of the actual CE costs should be deducted from the construction costs in proportion to the Federal participation on the project; and

- Incentive/disincentive amounts are to be shown separately from the liquidated damages amounts and are to be based on road user costs.

Is it acceptable to include business impact costs in liquidated damages?

No, it is not acceptable to include business impact costs. This would conflict with FHWA policy in the following areas:

- The contractor could challenge the clause on the basis that such costs are not costs to the State or the public as required by 23 CFR 635.127(c). "The STD may, with FHWA concurrence, include additional amounts as liquidated damages in each contract to cover other anticipated costs of project related delays or inconveniences to the **STD or the public**. "

- The FHWA's existing guidance on Incentive / Disincentive clauses, in Technical Advisory TA 5080.10, Section 7-a prohibits the inclusion of such costs.

- There are numerous problems and issues in providing a fair, open, transparent process for estimating business damages and losses.

- The FHWA is prohibited from re-distributing such funds without Congressional approval.

7. Suspension and Debarment

References:
49 CFR Part 29
FHWA Order 2000.2A

Applicability:

Applies to all Federal-aid construction projects.

Background:

Suspension and debarment (S/D) are discretionary administrative actions taken to protect the Federal Government by excluding persons and / or companies from participation in the Federal assistance programs. A S/D action ensures that the Federal Government does not conduct business with a person or a company who has an unsatisfactory record of integrity and business ethics. The S/D actions are administered government-wide; consequently, a person excluded by one Federal agency is excluded from doing business with any Federal agency.

Causes for debarment are listed in 49 CFR '29.800 and include:

- Conviction of or civil judgment for:

- fraud or a criminal offense in connection with a public or private agreement or transaction,
- violation of Federal or State antitrust statutes (i.e., price fixing, bid rigging, etc.),
- embezzlement, theft, forgery, bribery, falsification or destruction of records, false statements, receiving stolen property, false claims, obstruction of justice, or
- any other offense indicating a lack of business integrity or business honesty that seriously and directly affects the present responsibility of a person.

- Violation of the terms of a public agreement or transaction so serious as to affect the integrity of an agency program (i.e., willful failure to perform, a history of failure or of unsatisfactory performance, or willful violation of a statutory or regulatory provision or requirement).

- Any of the following causes:

  - a debarment by any Federal agency,
  - knowingly doing business with a debarred, suspended, ineligible, or voluntarily excluded person, in connection with a covered transaction,
  - failure to pay substantial outstanding debts, or
  - violation of a voluntary exclusion agreement or of any settlement of a debarment or suspension action.

    - Any other cause of so serious or compelling a nature that it affects the present responsibility of a person.

When circumstances warrant, suspension action will be taken to protect the Federal Government by excluding persons and / or companies proposed for debarment from participation in the Federal assistance programs while the debarment action is processed. Causes for suspension action (49 CFR § 29.700) include adequate evidence:

- that a cause for debarment exists, or

- to suspect the commission of an offense listed above. An indictment for such offenses will constitute adequate evidence for purposes of suspension actions.

Suspension / debarment actions are prospective, meaning they do not apply to existing contracts. The actions only apply to “covered” contracts within the meaning of 49 CFR 29. 200. Covered transactions include all primary transactions (i.e., any transaction between FHWA and a financial assistance recipient regardless of size, and lower tier transactions (i.e., prime contracts between STA’s and contractors or consultants, subcontracts, and contracts for material supply or vendor contracts, etc.) equal to or exceeding $25,000. Lower tier transactions, regardless of size, under which a person has critical influence or substantive control over a prime contract (auditing services,

construction inspection and quality assurance services, that might influence a contract) are also covered.

Only those persons (individuals, corporations, or subsidiaries) listed in the suspension / debarment notice are covered. If a parent company is debarred, this does not mean that subsidiary firms of the parent company are debarred.

Guidance:

FHWA will consider action against a person and / or company whenever a cause within the meaning of 49 CFR Part 29 has occurred. The FHWA will document the facts of the occurrences such that S/D actions imposed by the FHWA apply to procurement and nonprocurement programs (i.e., Federal-aid) under 49 CFR Part 29.

Processing. Every effort should be made to initiate actions within six months of knowledge of a cause. FHWA Order 2000.2A details the process for S/D actions. State and local officials should also contact the State and local agencies responsible for S/D actions to learn their procedures.
Length. Suspension actions are taken for a temporary period, pending the completion of a debarment decision. Generally, suspensions may not exceed 12 months, unless a legal proceeding is initiated which precludes lifting of the suspension. Debarment periods are generally in place for three years; however, if circumstances warrant, a larger period may be imposed. The final debarment period may be reduced commensurate with the seriousness of the cause and any mitigating evidence presented. The debarment period is measured, retroactively, from the effective date of the suspension.

Implementation. The General Services Administration maintains a government-wide list of excluded parties. This web-based system is titled "Excluded Parties List System" (GSA List). Prior to the award of all consultant and construction contracts, the FHWA Division Office should check the GSA List to determine if the prospective participant is excluded from Federal procurement and nonprocurement programs. On projects that do not require FHWA concurrence in award, this responsibility is assumed by the State.

The GSA List now contains three sections - – procurement, nonprocurement, and reciprocal. Provisions in the Federal Acquisition Streamlining Act of 1994 ensure that suspensions, debarments, and other exclusions from Government procurement and nonprocurement programs are applied reciprocally government-wide. In short, exclusion from **any** procurement or nonprocurement program initiated on or after August 25, 1995, means exclusion **all Federally** funded procurement – both direct Federal procurement and grant / Federal-aid “non-procurement”.

To ensure that the FHWA S/D actions are administered in a timely manner, the field offices are notified of FHWA S/D actions, via E-Mail, within a few days of their occurrence. In addition, a list of persons and companies suspended and debarred by the FHWA is available at http://www.fhwa.dot.gov/programadmin/contracts/actions.htm. The FHWA list includes actions taken by the FHWA only and therefore, cannot be used in lieu of the GSA List that contains all Federal S/D actions.

Participant Certification. All participants in the Federal-aid program are required to provide certifications (49 CFR 29.510) as follows:

- Each STA must certify the current eligibility status of their principals. This certification is now incorporated in the project agreement certifications;

- Prime contract bidders and consultants are required to certify as to their own current eligibility status, as well as that of their principals, as a part of each Federal-aid highway contract bid proposal and consultant agreement; and

- All lower tier participants (i.e., subcontractors, material suppliers, vendors, etc.) are also required to certify as to the current eligibility status of the company and its principals.

8. Termination of Contracts

References:

23 CFR 635.125

Applicability:

Applies to NHS projects.

Background:

Termination is an action taken by the contracting agency to cancel a contract. There may be a number of grounds to warrant termination, including termination for cause, termination for convenience, and termination for default.

Guidance:

Federal-aid contracts exceeding $10,000 must contain suitable provisions for termination by the STA. The provisions must identify the manner by which the termination will be effected and the basis for settlement.

Prior to termination of a Federal-aid contract for which the Division Administrator concurred in the award, the STA shall consult with and receive the concurrence of the Division Administrator. Federal-aid participation in a terminated contract is decided by the individual merits of the particular case. However, in no instance will FHWA participate in any allowance for anticipated profits on work not performed. For “State-approved projects”, the STA may act for FHWA in this process but it must follow the procedures in 23 CFR 635.125 for NHS projects.

If the STA awards a contract for completion of a Federal-aid contract previously terminated for default, FHWA policy limits the amount eligible for Federal participation. The amount eligible is the lesser of the original contract or the sum of the new contract plus the payments made under the original contract.

Termination for Cause or Convenience. Terminations for cause or for convenience are for circumstance beyond the contractor's control. The AASHTO lists the following conditions as grounds for termination for cause:

- executive orders of the President for war, national defense or national emergency,
- restraining orders or injunction obtained by third party action, or
- "acts of God".

Grounds for termination for convenience include circumstances for which it is in the best interest of the contracting agency to cancel the contract (e.g., construction funding has become depleted).

In terminating a contract for cause or for convenience, written notice is given to the contractor, relieving him or her from further contractual obligation. The contractor will be paid for completed work, for work necessary to preserve and protect the completed work, and for materials stockpiled for the project.

Termination for Default. Terminations for default are for circumstances that are deemed to be under the contractor's control. The AASHTO guide specifications include the following as circumstances for termination for default:

- failure to begin work under the contract within the time specified in the "Notice to Proceed,"
- failure to perform the work with sufficient workmen and equipment or sufficient materials to assure the prompt completion of the project,
- performance of the work not in conformance with the contract requirements or refusal to remove or replace rejected materials or unacceptable work,
- discontinuance of the work,
- failure to resume work which has been discontinued within a reasonable period of time after notice to resume,
- committal of any act of bankruptcy or insolvency,
- allowing any final judgment to remain unsatisfied,
- making an assignment for the benefit of creditors, or
- failure to comply with contract requirements regarding payment of minimum prevailing wages or EEO.

The STA's specifications typically require notice to the contractor and surety of default considerations by the STA. The notice gives the contractor and the surety a specified period of time, such as 10 days, to respond or to proceed with the work. If that period expires without response, the contracting agency may declare the contractor in default, and notify the contractor and surety that the contractor is in default and the contract is

void. The surety is then liable under conditions of the performance bond and must provide funds to complete the project, up to the full value of the bond. To avoid paying the bond, the surety may elect to assign another contractor to complete the work. However, if the surety is unable or unwilling to assign another contractor, the funds will be transferred to the STA.

If the surety awards a second contract, no action is required of FHWA since the surety's contract is considered an extension of the original contract. However, if the STA awards a contract to complete the work covered by a defaulted Federal-aid contract, normal Federal-aid procedures for PS&E advertising and award must be followed, and the Federal-aid funding for the project will be limited to the lesser of the original contract value, or the amount spent under the defaulted contract plus the second contract.

U.S. Department of Transportation
Federal Highway Administration

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System Preservation

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MEMORANDUM

U.S. Department of
Transportation
Federal Highway
Administration

Subject: **ACTION**: Preventive Maintenance Eligibility

Date: October 8, 2004

From: /s/ Original signed by:
King W. Gee
Associate Administrator for Infrastructure

Refer To: HIAM-20

To: Directors of Field Services
Division Administrators
Federal Lands Highway Division Engineers

Timely preventive maintenance and preservation activities are necessary to ensure proper performance of the transportation infrastructure. Experience has shown that when properly applied, preventive maintenance is a cost-effective way of extending the service life of highway facilities and therefore is eligible for Federal-aid funding. By using lower-cost system preservation methods, States can improve system conditions, minimize road construction impacts on the traveling public, and better manage their resources needed for long-term improvements such as reconstruction or expansion. Preventive maintenance offers State DOT's a way of increasing the return on their infrastructure investment.

During the 1990's, Congress incrementally broadened, through legislation, the applicability of Federal-aid funding to preventive maintenance activities. Congress' acknowledgement of preventive maintenance activities as an eligible activity on Federal-aid highways is a logical step that reinforces the importance of implementing a continuing preventive maintenance program. Each of these actions was conveyed to the field through a series of memoranda. This policy memorandum supersedes the related memoranda listed in the attachment.

The FHWA division offices have an important role in promoting system preservation and are encouraged to work closely with their State DOT counterparts to establish a program that identifies eligible preventive maintenance measures for all roadway assets on Federal-aid highways. The AASHTO defined preventive maintenance "as the planned strategy of cost effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system without increasing structural capacity." Projects that address deficiencies in the pavement structure or increase the capacity of the facility are not considered preventive maintenance and should be designed using appropriate 3R standards. Functionally, Federal-aid eligible preventive maintenance activities are those that address aging, oxidation, surface deterioration, and normal wear and tear from day-to-day performance and environmental conditions. Preventive maintenance activities extend the service life of the roadway asset or facility in a cost-effective manner.

Division offices should proactively work with their State partners to establish a preservation component, which is composed of various preventive maintenance activities and treatments. These include roadway

activities such as joint repair, seal coats, pavement patching, thin overlays, shoulder repair, restoration of drainage systems, and bridge activities such as crack sealing, joint repair, seismic retrofit, scour countermeasures, and painting. Many other activities that heretofore have been considered routine maintenance may be considered Federal-aid eligible on an area-wide or system-wide basis as preventive maintenance (i.e., extending the service life). This might include such work items as regionwide projects for periodic sign face cleaning, cleaning of drainage facilities, corrosion protection, spray-applied sealant for bridge parapets and piers, etc. These typical preventive maintenance work items are not intended to be all-inclusive but are rather a limited list of examples.

The final eligibility determination should be the result of collaboration between the division and the State DOT. This determination should be based on sound engineering judgment and economic evaluation, allowing flexibility in determining cost-effective strategies for extending the service life of existing pavements, bridges, and essential highway appurtenances on Federal-aid highways.

All preventive maintenance projects should consider appropriate ways to maintain or enhance the current level of safety and accessibility. Isolated or obvious deficiencies should always be addressed. Safety enhancements such as the installation or upgrading of guardrail and end treatments, installation or replacement of traffic signs and pavement markings, removal or shielding of roadside obstacles, mitigation of edge drop offs, the addition of paved or stabilization of unpaved shoulders, or installation of milled rumble strips should be encouraged and included in projects where they are determined to be a cost effective way to improve safety. To maintain preservation program flexibility, and in accordance with 23 U.S.C. 109(q), safety enhancements can be deferred and included within an operative safety management system or included in a future project in the STIP. In no way shall preventive maintenance type projects adversely impact the safety of the traveled way or its users.

As with any Federal-aid project, adequate warning devices for highway-rail grade crossings within the project limits or near the terminus shall be installed and functioning properly per 23 CFR 646 before opening the project to unrestricted use by traffic. For projects on the NHS, all traffic barriers shall comply with the FHWA September 29, 1994, memorandum entitled Traffic Barrier Safety Policy and Guidance, signed by E. Dean Carlson. This work can be accomplished by force account or through other existing contracts prior to final acceptance.

The FHWA supports the increased flexibility for using Federal-aid funding for cost-effective preventive maintenance. The Maintenance Quality Action Team (MQAT) is developing technical guidance on preventive maintenance activities and transportation system preservation as a whole; that technical guidance is under development and will be issued in the near future. For further information please contact Christopher Newman of the Office of Asset Management, at (202) 366-2023 or Christopher.newman@fhwa.dot.gov, or visit the Transportation System Preservation website at www.fhwa.dot.gov/preservation.

Attachment

Attachment: Memoranda Superseded by Preventive Maintenance Memorandum

- 01/27/04 Stewardship of Preservation and Maintenance
- 01/11/02 HBRRP Funds For Preventive Maintenance (23 U.S.C. 116(d))
- 10/30/98 Implementation of TEA-21 Interstate Maintenance Guidelines
- 08/19/98 Phase Construction for Safety Considerations
- 06/18/97 Transportation System Preservation
- 03/21/96 Preventive Maintenance Revision to 23 U.S.C. 116

- **10/12/93** Safety and Geometric Considerations for Interstate Maintenance Program Projects
- **06/14/93** Interstate Maintenance Program
- **07/27/92** Preventive Maintenance
- **05/21/92** 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) Implementation Interstate Maintenance Program

Preventive Maintenance Questions and Answers

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FHWA

United States Department of Transportation - Federal Highway Administration - Infrastructure

U.S. Department of Transportation
Federal Highway Administration

Program Administration

MEMORANDUM

U.S. Department of
Transportation
Federal Highway
Administration

Subject: Participation in Engineering Errors

Date: July 12, 1963

From: G.M. Williams
Director of Engineering and Operations

Reply to
Attn of:

To: Mr. August Schofer
Regional Engineer
Hagerstown, Maryland

Reference is made to your April 16 and June 27 memorandums, relative to the above-noted subject.

Your existing policy on this matter, as set forth in your April 21, 1960, memorandum to division engineers, was established with the advice of this office. This policy draws a distinction between engineering errors incorporated into the P.S.&E. approved by Public Roads and engineering errors committed by State personnel during construction operations. Federal participation in the costs of corrective work is allowed in the first instance but is denied in the second. As you indicate, our present thinking is that a more flexible policy would be appropriate in the latter instance.

In this regard, it is now considered that each such engineering error should be considered on its own merits to determine whether any corrective work is eligible for Federal participation. Where carelessness, negligence, incompetence, or understaffing on the part of the State are not contributing factors, favorable consideration may be justified for the type of errors that might occasionally occur despite the exercise of normal diligence. In all other instances Federal participation should continue to be denied. Questionable cases should be referred to this office for advance review and advice.

We believe that the foregoing will provide you with the requested information. Please advise if further comment is desired.

This page last modified on May 6, 2005

Program Administration

MEMORANDUM

U.S. Department of Transportation
Federal Highway Administration

Subject: Participation in the Cost of Corrective Work Resulting from Construction Engineering Errors

Date: September 8, 1978

From: Chief, Construction and Maintenance Division
Office of Highway Operations

Reply to Attn of: HHO-32

To: Regional Federal Highway Administrators
Regions 1-10
Regional Engineer, Region 15

There was concern expressed by State Construction Engineers at the recent American Association of State Highway and Transportation Officials (AASHTO) Construction Committee in Portland, Maine, that there were inconsistencies in applying Federal-aid participation in the cost of corrective work resulting from construction engineering errors.

Our position remains unchanged. We have long considered that cases will arise where participation may be warranted in the cost of corrective work resulting from construction engineering errors.

It would be difficult to outline in detail specific guidelines where we should or should not participate in such costs, since circumstances surrounding each case will be different. Thus, each case should evaluated individually. Broad generalities such "as all staking errors are ineligible" or "design errors are eligible - construction errors are not" should be avoided.

Where a State has exercised normal diligence in carrying out its construction engineering activities and an error does cause some increased cost, Federal-funds can be used.

Sanford P. LaHue

This page last modified on May 6, 2005

Program Administration

MEMORANDUM

U.S. Department of Transportation
Federal Highway Administration

Subject: Audit of Construction Contract Change Orders

Date: September 8, 1982

From: Director Office of Highway Operations

Reply to Attn of:

To: Regional Federal Highway Administrators
Regions 1-10
Direct Federal Program Administrator

The Office of the Inspector General has recently completed a Department wide review of construction contract change orders. In the draft report of this review, one of the findings and recommendations directly addresses the Federal Highway Administration's (FHWA) documentation and use of force account procedures. The report indicated instances where force account procedures were apparently being used as a matter of convenience. This impression was derived from the available change order documentation.

This is a reminder and a follow-up to the Inspector General's review, that contract changes should be settled primarily through negotiations. Force account type procedures should be used only when necessary and then be appropriately documented. We are not convinced that this is a growing problem, but take this opportunity to reaffirm the FHWA's commitment to providing for adequate controls in the administration of highway construction contracts.

David S. Gendell

This page last modified on May 6, 2005